AS AGREED WITH THE CIVIL SOCIETY MEETING, HERE IS A REPORT
JOINTLY PREPARED BY THE DEPARTMENT OF ENERGY AND THE ASIAN DEVELOPMENT BANK

A. Consultations Undertaken

1. The Government of the Philippines and the Asian Development Bank (ADB) have prepared this report at the request of the CTF Trust Fund Committee on consultations undertaken with civil society organizations and other stakeholders on the Philippines CTF Investment Plan update.

2. As part of other work on the ADB-funded e-trikes pilot project, since April 2011 ADB has met with a wide range of stakeholders covering broad user groups—from tricycle drivers, suppliers, manufacturers, government officials, to lawmakers—on the e-Trike project design. ADB maintains lists of participants who attended the meetings (available upon request) that include more than 200 individual attendees at these events. However, as we have acknowledged in our earlier meeting, neither ADB nor the Department of Energy consulted a recognized renewable energy group before submitting the revised country Investment Plan for the Philippines.

1. DOE's Consultation in Taguig City (18 October 2011)

3. The DOE held a consultation meeting in Taguig City attended by 16 LGUs (12 in NCR, Albay, Boracay, Cabanatuan, Davao) to present the proposed E-Trike Program wherein a minimum of 20,000 units to a maximum of 100,000 units of e-trikes will be deployed under a "Rent-to-Own" arrangement through the ADB loan facilities to LGUs. During the consultation meeting, the results of the Pilot E-Trike Study held in Mandaluyong was discussed, including the city's approach to maximize driver participation in the actual runs, while paying Php150.00 or Php300.00 boundary per day. The need for the formulation of a long-term plan on promotion and sustainability was emphasized.

DOE and LGU Officials at the consultation meeting

4. The DOE noted the concerns and recommendations of the LGUs, among them, the need to conduct test runs of the vehicle, do life-cycle study of the lithium battery, suit e-trike design to specific terrain and conditions of routes, undertake IEC for driver-beneficiaries, make attractive the cost and financial scheme, address potential default-payment of drivers which caused bankruptcy of Monte de Piedad in a previous lending program to drivers, and install related support infrastructures.

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2. Project related discussion with stakeholders since April 2011

5. Since April 2011, the Project team along with Government counterpart staff has consulted stakeholders, including national and local government units. In addition, drivers were consulted in Mandaluyong City and Malay (Aklan), two of the areas where the first units will be deployed. Beginning in July 2011, the ADB e-Trikes Project team began hosting informal industry meetings to foster communication and cooperation amongst industry players and to ensure local buy-in throughout the project preparatory process. To date, seven informal meetings have offered opportunities to encourage representatives of the local tricycle manufacturing community to ask questions about e-Trikes specifications, design and bidding processes, and to maintain open communication with the ADB team. Summaries of the stakeholder activities undertaken to date and lists of attendees are available upon request.

3. Consultation since February 2012

6. Since requests have been made for further consultations about the proposed switch from renewable energy to sustainable transport, the Department of Energy and ADB have reached out in a range of ways to a variety of stakeholders. Here is a summary of their outreach to key stakeholders since early February 2012:

(i) **Single stakeholder meetings, Manila:** In early February 2012, ADB met the Networking and Project Development Federation of Free Workers (FFW) and the Asian Labor Network on IFIs (ALNI) Philippine Chapter. ADB also had a bilateral meeting with WWF on the investment plan.

(ii) **Washington, DC meeting:** On February 9, 2012, the DOE and ADB led a telephone conference with international NGO representatives, mostly all Washington, DC, based, which was organized in consultation with the World Resources Institute (WRI), which represents developed country CSOs as an observer to the CTF Trust Fund Committee. Key NGOs monitoring energy and transport issues participated, including Overseas Development Institute (ODI), WRI, and Oxfam America. In advance of that meeting, NGOs concerned about the CTF investment plan update met and articulated their main concerns in a Briefing Note on the Philippines Clean Technology Fund Investment Plan Update. The document guided the discussions, and the meeting led to a shared understanding on many issues. Minutes of the meeting and a list of participants are available upon request.

(iii) **Planning of multi-stakeholder consultations, Manila**: On February 10, 2012, ADB facilitated discussions among key civil society stakeholders about a series of further consultations on both the shift away from renewable energy and moving forward with sustainable transport. The NGO Forum on ADB, Aksyon Klima, WWF, and the Freedom from Debt Coalition worked with ADB to design the consultations. At a follow-up February 24th meeting, in addition to the groups above, Clean Air Initiative–Asia and Partnership for Clean Air joined the planning. The groups shared their consolidated recommendations for the consultations with the DOE on March 2nd, and the group is planning to meet with the DOE on March 9th to finalize the consultation schedule and the proposed participants at each meeting.

4. Planned future consultations

7. In the near future, the DOE, with ADB's support, is planning to continue the consultation process through the following events:

- Continue bilateral meetings- at the request of concerned stakeholders, the Government of the Philippines and ADB will continue to meet any stakeholders who want to express their concerns about the consultation process or related issues.

- Multi-stakeholder consultations, Manila- Although the actual methodology of the meetings has not yet been decided, the initial discussions led to the planning of a series of six consultations along these lines:

  (i) **Consultation 1: Renewable energy in the Philippines–** The first consultation is for power sector stakeholders and for those interested in financing and the renewable energy sector. The Department of Energy (DOE) may present its case for not using CTF funds for a renewable energy project and solicits further inputs from key stakeholders. The consultation may also address other types of renewable energy that were not funded with CTF financing, such as wind, geothermal, etc.

  (ii) **Consultation 2: Other options/why e-Trikes?–** The main target group for this consultation will be policy makers, government officials, academics, and some transport stakeholders who want to participate to prepare for consultation #3. This consultation will look at the other transport options for the CTF funding such as buses and e-jeepneys, and the DOE will present data and a case for choosing e-Trikes. This consultation is putting into context and discussing with relevant government agencies and other stakeholders the decision on why e-trikes were selected and not specifically the other options for CTF funding.

  (iii) **Consultation 3: Sustainable transport in the Philippines–** Consultation #3 focuses on the full range of transport stakeholders. This consultation aims to discuss with public transport (jeepney and tricycles) operators/drivers associations on the use and potential of fleet electrification. Representatives from TODA/JODA groups from Taguig and Makati who have actual experience could join this consultation. DTI and DNR representatives could speak about the disposal issue. DOE may present its case for using CTF funding for a sustainable transport project and solicit further inputs from key stakeholders. Note that some of the topics in the agenda below will also be covered in the project level consultations. However, at Consultation #3, as the target group is transport stakeholders, the depth of conversation will differ from those of the project level consultations with civil society.

  (iv) **Consultation 4**: ***Sustainable transport and finance***– Consultation 4 is for those interested in financing and the sustainable transport sector. The DOE may present its rationale for seeking funding for the e-trike project and solicit inputs from key stakeholders. An example of the type of discussion that could take place in this consultation include asking why banks with DOTC-approved criteria for borrowing for sustainable transport, including but not limited to e-trikes, were not used for financing purposes.

(v) **Project level consultations**– assuming that the above consultations conclude with an agreement to move forward with sustainable transport and an e-Trike project, the project level consultations will cover topics agreed by ADB, DOE and key stakeholders, including those listed below. These consultations will vary in length, depending on the topic. Note that some of these topics were included in the consultation with transport stakeholders. As these consultations are for a wider audience, including civil society, academe, and others, they may address each topic at a different level.

(vi) **Concluding consultation**–At the end of the series of consultations, it was proposed to lead a wrap-up session that synthesizes all inputs and discussions. Perhaps at the end of each consultation a representative would be selected to join this wrap up meeting with the DOE and ADB and agree on steps forward.

8. While Department of Energy (DOE) will take the lead in these consultation meetings with ADB's support, the DOE plans to undertake its own consultations with additional stakeholders, including other government agencies.

B. Summary of Issues

9. Here is a summary of issues that has been raised by the consultants during various consultations.

Consultation with the NGOs: Comments Matrix

Question/Comment	Response
No government ownership, ADB "railroading" the project and corrupting energy policy formulation	• The Secretary of the Department of Energy (DOE), in his letter to CTF, has clearly stated the Government's commitment to electric transport and that the project is a priority in the context of energy security. • The Government was actively involved in the design of the e-Trike project and participated in stakeholder discussions with tricycle driver associations, local mayors and governors on the planned e-Trike program. ADB has played a dual role in the project: as technical expert and financier. • While solar power is a priority for ADB, the context in the Philippines is different due to high electricity tariffs, and private sector interest prompted by the higher tariffs and additional subsidy through feed in tariffs (which government investment could crowd out). It is DOE's policy position to currently limit subsidizing investments in solar to 50 MW for next three years to lessen its impact on average electricity price and benefit from expected sharp price reduction of solar panels in the coming few years. • On 16 February 2012, the Cabinet-level investment committee of the National Economic and Development Authority (NEDA) approved the E-

Question/Comment	Response
	Trike project together with its proposed ADB financing with CTF support, to be presented to NEDA Board—chaired by the President—for approval (expected by mid-March).
No formal consultation was done for the proposed CTF reallocation and ADB should delay the decision.	• ADB and DOE followed the same process of consultation during submission of the original Country Investment Plan in 2009. However no NEDA infrastructure committee was involved as it was simply an allocation from one project (solar) to another project (e-trike) of DOE. In preparing for the recent request for reallocation, ADB and DOE plan further consultations both in Manila (preliminary discussion on 10 February followed by wider consultation on 17 February) and Washington (9 February), and will include civil society representatives from multiple locations by video conference. We appreciate the NGO Forum on ADB's support in the planning of these consultations, to ensure they meet NGO needs. • DOE made its commitment to hold extensive consultation in its letter to CTF, stating "We are working with ADB to consult local NGOs regarding this matter and also on the details of the energy efficiency component of the revised investment plan." • A list of key stakeholders consulted by ADB since April 2011 is available upon request. • The Philippine Investment Plan is a document prepared by the Government, and the Department of Finance submitted the plan to CTF. Secretary, DOE's letter reconfirmed its commitment to fast track processing at all levels, including CTF approval. • As our work progresses, the DOE is committed to continuing consultations in the future. It will also undertake detailed consultations in each of the project areas to discuss options for old tricycle disposal and establishment of meaningful after-sales support for this technology.
CTF investment could have been used as a subsidy for the feed in tariff to reduce consumer impact.	• The original Philippine Investment Plan included about 100 MW equivalent rooftop solar project using net metering to sell excess power back to the grid. This would have reduced the average panel price though large international competitive bidding—the proposal was not for subsidizing other form of solar power
Disposal of old tricycles and safety aspects of Lithium Ion battery.	• Some earlier models of electric tricycles in the Philippines (and elsewhere) used lead acid batteries. However, all mainstream electric cars nowadays use lithium ion batteries: Nissan Leaf and Chevy Volt are prime examples. Based on global trends, ADB considers that the lithium ion battery, with longer life, higher energy density, no disposal related health hazard, and ability to fast charge, is the optimum choice. This is also the conclusion (Figure 1, page 12) of a recent IEA study[1], which concluded that although there is an inverse relationship between specific energy and specific power (*i.e.*, an increase in specific energy correlates with a decrease in specific power), lithium-ion batteries have a clear edge over other electrochemical approaches when optimized for both energy and power density. • Although due to high level of recycling, the volumes of lead dumped in

[1] International Energy Agency, Technology Roadmap: Electric and plug-in hybrid electric vehicles, June 2011.

Question/Comment	Response
	the environment is relatively less in the case of lead acid batteries, much of the recycling is done on an informal basis, in unhygienic and dangerous conditions, and resulting in serious lead poisoning of the recyclers themselves and the neighboring communities.[2] Children are more susceptible to lead poisoning than adults and may suffer permanent neurological damage; pregnant women exposed to lead can cause damage to the fetus and birth defects. • The ADB financed pilot project has introduced Lithium-Ion batteries in 20 pilot e-Trikes and these have completed more than 200,000 km since May 2011. • Recent recalling of lithium batteries in the US were not because of battery fault but to improve battery casing design. The proposed e-Trikes will include the improved battery casing. • According to the US National Highway Traffic Safety Administration (NHSTA) report,[3] an incident involving fire occurred more than three weeks after a vehicle had been crash tested on May 12, 2011. That incident, which occurred at the test facility caused no injuries, is the only case of a battery-related fire in a crash or crash test of vehicles powered by Lithium-Ion batteries, despite a number of other rigorous crash tests of the Chevy Volt separately conducted by both NHTSA and General Motors. • GM and federal safety officials believe that last year's fires were caused by coolant leaking from damaged plastic casing around the batteries after side-impact collisions. The coolant caused an electrical short, which sparked battery fires seven days to three weeks after the crash tests. No owners have reported fires after crashes. GM's design solution is to add steel to the plates protecting the batteries. The NHTSA also has crash-tested a Volt with the added steel, and have accepted GM's proposed solution. • Battery and old tricycle disposal will be addressed by the project. Battery suppliers will be responsible for collecting used batteries under the project. Options for old tricycle disposal and meaningful after sales support will be developed after consultation. The first consultation in Puerto Princesa will be in early March 2012 for the public in each area.
Current design is not suitable for a scale-up plan.	• The current 20 e-Trike design was to test battery technology and charging options. New designs will be used for the scale up project. • DOE has concluded its nationwide contest for the best e-Trike design and awarded ten winners from a total of 183 entries. ADB has recruited a professional car designer to fine-tune the top three designs from the competition, to be used by the project. Different designs will be developed for different areas. • The drivers of the 20 pilot units running since May 2011 are convinced of

[2] http://www.worstpolluted.org/projects_reports/display/65
[3] http://www.nhtsa.gov/About+NHTSA/Press+Releases/2011/Statement+of+National+Highway+Traffic+Safety+Administration+On+Possible+Fires+in+Lithium-Ion+Vehicles+Involved+in+a+Crash

Question/Comment	Response
	the benefits of the e-Trike, especially of the lithium-ion batteries, which is allowing them to fast-charge the battery in 20 minutes. The passengers are also satisfied with the performance. • Procurement will be of the whole e-Trike; unbundling of operational clusters was used only to demonstrate how new local industries may develop.
No feasibility studies and ADB financing may crowd out the private sector.	• Feasibility study will be posted (www.adb.org/etrike) after discussions with NEDA and NEDA board approval of the project. • ADB financing and a large-scale project is necessary for industry transformation. Without such project, local and retail and wholesale market for lithium-Ion batteries is unlikely to develop by itself. Currently, some private entrepreneurs are using lead acid battery in e-Trikes as lithium-Ion batteries are not locally available. • The ADB project will not crowd out private sector financing, but rather would create opportunity for newer projects as it will establish technology credibility for e-vehicles. The project will also build a local industry that may export electric vehicles across Southeast Asia and create demand for local private sector financing.

Question/Comment	Response
Role of Government Agencies in Decision Making The CSOs sought clarity on the inter-agency decision making process noting that the original investment plan was endorsed by multiple agencies in the GOP; yet this apparently did not happen for the updated plan. They also noted that there was a perception that the project was being driven by the ADB and lacked sufficient ownership by the GOP.	ADB explained that in the development of the original plan, the MDBs worked closely with the Department of Energy (DOE), Department of Finance (DOF), and the National Economic and Development Authority (NEDA), and the three agencies agreed that the $125 million in CTF financing to be administered by ADB would be earmarked for the energy sector. Since the EEEV project is fundamentally seen as an energy project, and falls within the mandate of the DOE–led Fueling Sustainable Transport Program, they were under the assumption that ownership rests with the DOE, with the DOF as the key counterpart for all MDB-financed projects. ADB and the DOE claim that this was communicated to the Department of Transport and Communication (DOTC) and the Department of Environment and Natural Resources (DENR) and that NEDA was aware of all developments. Further, since the President of the Philippines, also the chair of the Climate Change Commission (CCC), had apparently sanctioned the EEEV project, the DOE saw no need to revert to other members of the CCC. It should be noted that inter-governmental consultation is primarily the responsibility of the government.
Alternatives Considered for Inclusion in the Updated Investment Plan The CSOs sought clarity on the alternatives considered, not only in comparison with the original net metering project, but also within the range of	The RE scenario is very different now to what it was three years ago when the original rooftop solar net metering project was proposed. In 2009, the price of solar power generation was very high at $9/watt (solar prices have been declining rapidly to a global average of about $2 per watt in 2012) and intervention to support the sector was justified. The government had set a solar generation target of 100MW, and the Electric Power Reform Act bars public sector investments in generation. With the sector fully privatized, the net metering project was a good idea for achieving transformational impacts especially to reduce prices for residential and commercial.

Question/Comment	Response
sustainable transport solutions, as well as across a wider range of options in other sectors.	In the current scenario, the feed-in-tariff structure (FIT) is not yet finalized, and due to the unresolved cost issues, the government has approved only up to 50MW of solar power to be installed in the next 3 years. DOE has already received private sector interest for 300MW. Therefore, DOE do not see a role for intervention in solar generation until 2016 due to the potential to crowd out private sector activity, as well as concerns over the cost implications of increased supply of solar power (at relatively high incremental cost) to the grid. Regarding other RE options, the GOP is trying to phase in wind power, and hydro-energy has always been prominent in the Philippines grid mix. Investments in RE would hence not be transformational, and a $125 million loan combined with expected ADB co-financing of 3-4 times this amount is too large for the demand-side energy efficiency market. On the other hand, the DOTC and DOE have recently jointly recommended that there be a stronger push for alternative fuels. The Philippines is a net importer of energy to the tune of $8 billion per year and rising. So, the government has stressed the need for improving energy security by tempering fossil fuel consumption. The ADB and GOP assessed potential feasible projects based on a cost curve analyses. Meanwhile, they had also earlier started a parallel pilot e-Trike project. While they considered CNG and LPG options as alternatives, they found scaling up the e-Trike project to be the best option available in the short term. The CNG and LPG would take a longer lead time to have the infrastructure in place, including confirmation of the gas supply. Moreover, the DOE has prepared a alternative fuels roadmap for the next 20 years, and EVs are a critical component in it. The ADB and DOE are working with ADB's sustainable transport team to ensure that this project, which is part of government's broader transport sector plan, supporta institutional capacity building, regulatory rationalizing, etc. ADB will continue to work on improving the regulatory regime of the solar power sector. On February 20, separate from the consultation on the investment plan, ADB conducted a consultation with NGOs regarding the issues of open access, the FIT design and other power sector issues. It will use this ongoing process of dialogue to address concerns and arrive at a more viable cost sharing framework. This project has multiple benefits: for the drivers, this will increase daily income, for the government, it will reduce volume of oil import and improve energy security, enable optimization of the framework of a comprehensive urban transport plan, and for the users, it will reduce congestion, accidents, pollution and reduce the carbon footprint of the transport sector.

Question/Comment	Response
Potential for Emissions Reductions Concerns were raised about coal being a potential fuel source for the additional electricity consumed by e-Trikes. The CSOs referred to a UNEP Risoe Center study that suggests a switch to EVs would offer no reductions in emissions over vehicles powered by standard liquid fuels charging if the source of electricity comes from burning coal relatively inefficiently.	While very unlikely, but even if the entire additional demand for electricity is generated by coal, the project would lead to lower emissions than persisting with liquid fuel-powered tricycles due to improvements associated with technology and efficiency standards. Further, while the RE sector has a comparatively higher potential for emissions reductions, the ADB and GOP maintain that participation in that sector is not feasible for now. ADB contacted Andrew Simpson of Curtain University, the author of Figure 3.43 (page 129) of UNEP publication "Technologies for Climate Change Mitigation. In study, the author had used the typically lower efficient brown coal-fired power generation common in Victorian (Australia) with emissions intensity of 1.21 $kgCO_2$/kWh. The author highlighted that in the Australian State of New South Wales, the black coal fired stations emission intensity is about 0.89 $kgCO_2$/kWh, or about 26% lower than Victoria. The author however agreed—to earlier, ADB and GOP position—that even if the grid is 100% coal fired a normal EV without air-conditioner will be significantly better than ICE vehicles, especially in Asian cities where the average speed is about 12 k/hour. ADB will further clarify the appropriateness of its assumptions for the Philippines in the e-trike project document.
Cost Effectiveness clarification on the comparative cost effectiveness between the net metering project and the EEEV project under worst case scenarios involving coal-based electricity generation.	ADB and DOE has explained that the proposed FIT for the solar sector, if it comes through, will be \$0.45/KWh, almost double the domestic tariff rate and which rivals Japan for the highest tariff in Asia, and they expect it to be fully passed through to consumers. Thus, even if the net metering project is more cost-effective in terms of GHG reductions, an intervention on solar is not a viable option at present. Further, they estimate that with a small battery of 3kWh, the bulk of the EVs will be charged at home during the night, during off-peak period and will not increase the peak demand of the system. So, the additional electricity supply needed may not be as high and will significantly improve the cost effectiveness of the EEEV project.
Additional Costs and Risk Premium The CSOs raised the question of how the project would incentivize private sector investment and reduce the access to financing barrier, which many consider to be a main barrier to EEEV deployment since the additional investment costs are recovered through lower operations costs.	ADB noted that the Government has clarified that ADB's value add is not pure financing. ADB's involvement with CTF support would bring reputable safer battery manufacturer in the country and establish a retail-supply infrastructure—a pre-requisite for a locally made EV industry. Concessional financing will create the enabling environment for a local EV industry—safer reputable batteries with local support, charging infrastructure, and secondary industries. Access to finance is not a barrier; rather, there are technological, institutional and mindset barriers. The ADB and GOP believe the market can be transformed if technology can be brought in and, based on the interest expressed by a consortium of international manufacturers, the Philippines could become a hub for EV exports to the rest of Asia. Overall analysis of barriers and the transformation impacts will be discussed in details in the project documents,

Question/Comment	Response
What other options have been considered as alternatives to electric vehicles (e.g., CNG, LPG)?	All options have been and continue to be considered: CNG and LPG must be imported; switching from gasoline to these fuels results in minimal GHG reductions and does not enhance energy security. Switching from diesel to CNG may achieve 20% GHG reduction in best case scenario, but the energy efficiency gain would still be lower than that achieved via EEEVs. CNG and LPG may be practical for cars, light trucks, and heavy-duty vehicles, but these fuels do not present an opportunity for conversion of motorcycles and e-Trikes, which are at the bottom of the public transport pyramid.

ADB

Project Number: 43207
June 2012

Proposed Loans, Grant and Administration of Loan and Grant

Republic of the Philippines: Market Transformation through Introduction of Energy Efficient Electric Vehicles Project

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Asian Development Bank

CURRENCY EQUIVALENTS
(as of 6 June 2012)

Currency Unit	–	Peso (₱)
₱1.00	=	$0.0230
$1.00	=	₱43.53

ABBREVIATIONS

ADB	–	Asian Development Bank
ASR	–	Assessment, Strategy and Roadmap
BOI	–	Board of Investments
CDM	–	Clean Development Mechanism
CER	–	certified emissions reduction
CO_2	–	carbon dioxide
CTF	–	Clean Technology Fund
DOE	–	Department of Energy
EIRR	–	economic internal rate of return
EV	–	electric vehicle
FIRR	–	financial internal rate of return
ICE	–	internal combustion engine
ICB	–	international competitive bidding
LGU	–	local government unit
Li-Ion	–	Lithium Ion
LIBOR	–	London interbank offered rate
Meralco	–	Manila Electric Company
NCB	–	national competitive bidding
PMU	–	project management unit
TODA	–	Tricycle Operators and Drivers Association

WEIGHTS AND MEASURES

GWh (gigawatt-hour)	–	1,000 megawatt-hours
kg (kilogram)	–	1,000 grams
kWh (kilowatt-hour)	–	1,000 watt-hours
mg (milligram)	–	0.001 gram
mm (millimeter)	–	0.001 meter
MW (megawatt)	–	1,000 kilowatts
MWh (megawatt-hour)	–	1,000 kilowatt-hours

NOTES

(i) The fiscal year (FY) of the Government of and its agencies ends on 31 December.

(ii) In this report, "$" refers to US dollars.

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CONTENTS

PROJECT AT A GLANCE

1. Project Name: Market Transformation through Introduction of Energy Efficient Electric Vehicles
2. Project Number: 43207-013

3. Country: Philippines **4. Department/Division:** Southeast Asia Department/Energy Division

5. Sector Classification:

Sectors	Primary	Subsectors
Energy	√	Energy efficiency and conservation
Transport		Transport management and policies

6.Thematic Classification:

Themes	Primary	Subthemes
Economic growth	√	
Environmental sustainability		
Capacity development		

6a. Climate Change Impact:

Mitigation	High

6b. Gender Mainstreaming:

Effective gender mainstreaming (EGM)	
Gender equity theme (GEN)	
No gender elements (NGE)	
Some gender benefits (SGB)	√

7. Targeting Classification:

General Intervention	Targeted Intervention: Geographic dimensions of inclusive growth	Targeted Intervention: Millennium development goals	Targeted Intervention: Income poverty at household level
√			

8. Location Impact:

Rural	Medium
Urban	High
National	Low
Regional	

9. Project Risk Categorization: High

10. Safeguard Categorization:

Environment	**C**
Involuntary resettlement	**C**
Indigenous peoples	**C**

11. ADB Financing:

Sovereign/Nonsovereign	**Modality**	**Source**	**Amount** ($ million)
Sovereign	Project loan	Ordinary capital resources	300.0
Total			**300.0**

12. Cofinancing:

Financier	**Category**	**Amount** ($ million)	**Administration Type**
Clean Technology Fund	Official-Grant	5.0	Full
Clean Technology Fund	Official-Loan	100.0	Full
Total		**105.0**	

13. Counterpart Financing:

Source	**Amount** ($ million)
Government	99.0
Others	
Total	**99.0**

14. Aid Effectiveness: Not Applicable

I. THE PROPOSAL

1. This is a report and recommendation on (i) a proposed loan, (ii) proposed administration of a loan to be provided by the Clean Technology Fund, and (iii) proposed administration of a grant to be provided by the Clean Technology Fund to Republic of the Philippines for the Market Transformation through Introduction of Energy Efficient Electric Vehicles Project.[1]

II. THE PROJECT

A. Rationale

2. Electric vehicles or e-vehicle represent a new technology with the promise to transform the way energy is used by today's internal combustion engine (ICE) vehicles. For net energy importing countries, such as the Philippines, electric vehicles can dramatically reduce the country's oil dependency, and improve long-term energy security. They are efficient, generate no harmful air and noise pollution and can be powered by indigenous renewable energy.

3. Countries around the world are introducing e-vehicles to reduce energy security concerns: for example, the government of Israel has created generous policy incentives to support its commitment to 100% electric vehicles by 2020; the United States Government provides rebates of up to $7,500 per vehicle and have a target of one million electric cars by 2015. The International Energy Agency's Technology Roadmap[2], recently announced the pro-active policies of the 17 countries—including the UK, Australia, Ireland, Japan, Singapore—that will support sales and deployment of seven million electric vehicles by 2020.

4. Accounting for the total energy consumed from well to wheel[3], e-vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared to ICE vehicles because: (i) no electricity is used while stranded in traffic jams (except air conditioning), (ii) energy losses in electric motors are about 5%-15%, compared with 70%-80% losses in the engines of ICE vehicles, and (iii) transmission and distribution of electricity is more efficient and cost effective than transportation of liquid fuels to the end user.

5. The Philippines is in the forefront of developing local e-vehicle industry—e-Trikes, e-Jeepneys, and e-Buses. Since 2009, e-vehicle enthusiasts have undertaken a number of small isolated initiatives, and the Government plans to fast track the process using electric tricycles or e-Trikes as a priority. In April of 2011, ADB introduced[4], as a pilot, 20 locally made electric tricycles (e-Trikes) powered by imported Lithium-ion batteries in the City of Mandaluyong. Promising technical results has prompted the Government to scale-up the pilot program[5] and use an early-adopter opportunity to establish a sustainable local e-vehicle industry. This initiative has also attracted a number of reputable global battery and car manufacturers in the country, who considers the local market as the launching pad for a potential export market for these $4,000 to $5,000 e-Trikes to neighboring countries in southeast and south Asia.

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[1] The design and monitoring framework is in Appendix 1.
[2] Technology Roadmap: Electric and plug-in hybrid electric vehicles, International Energy Agency, June 2011. Available at http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf
[3] Energy consumed and green house gases (GHGs) emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle, details available at: http://web.mit.edu/evt/summary_wtw.pdf
[4] Financed by RETA 6441: Efficiency Improvement and Connectivity Strengthening in Southeast Asia. Manila.
[5] Prepared by *Technical Assistance to the Republic of the Philippines for Mitigation of Climate Change through Increased Energy Efficiency and the Use of Clean Energy*. Manila. (TA 7754-PHI), ADB. 2010.

6. The Government plans to transform the nascent e-Trike industry to an industry with at least three large local e-vehicle manufacturer. Large reputable global electric car (and battery) manufacturers are focused on bringing in the early adopter's family car (Nissan Leaf, Chevy Volt and Toyota Prius) with price tag of about $45,000 for markets in Europe, the United States, and Australia. The Philippine vision is to transform the "base of the pyramid", the tricycles, through technology leapfrogging. The combination of Lithium-ion battery technology and professionally designed e-Trikes to international standards will establish higher safety, environmental and efficiency principles. The proposed electric vehicle policy[6] also directly supports electric vehicle related businesses and will provide tax-exemption on imported electric vehicles for nine years.

7. Use of Lithium-ion battery will also reduce the risk of re-introduction of Lead into the transport sector. Excessive use of e-bikes and e-Trikes with Lead Acid batteries and improper disposal prompted authorities in the Peoples Republic of China to crackdown[7] the industry. Philippines faces the risk of large import volume of substandard tricycles with poor quality Lead acid batteries reintroducing Lead in the environment. This may add to existing concerns on illegal smelting[8] of Lead. Detailed discussions on are in the supplementary document 24.

8. For this transformation, the Government has sought support from the Clean Technology Fund (CTF), which have resources amounting to more than $4 billion pledged by major donors such as Australia, France, Germany, Japan, Spain, Sweden, the United Kingdom, and the United States. In December 2009, the Trust Fund Committee for the CTF endorsed the Philippine Country Investment Plan (CIP)[9], which the Government updated and submitted for approval in June 2012 to use CTF funds to buy down the cost of transforming the energy use by the tricycles. A detailed discussion on emissions reduction is in supplementary document 23.

9. In 2010, the Philippines spent about $10 billion[10] (a 39% increase from 2009) on oil import or about $27 million a day, of which 80% was for the transportation sector. The average cost of import was about $80 per barrel and, on an average, between 30 to 40 days worth of inventory was in the system—key concerns on energy security. Preliminary modeling shows that a 7% electric vehicle penetration by 2015 and 15% by 2030, can reduce fuel imports by approximately 6% in 2015, 13% in 2020, and more than 40% by 2030 with more reductions in greenhouse gas emissions and air pollution.

10. The National Framework Strategy on Climate Change[11] 2010-2022, recognizes a low-carbon path in the transport sector as an essential element and promotes models to improve the transport sector's efficiency, as part of its strategic priority. The proposed Project is consistent with Department of Energy's Fueling Sustainable Transport Program (supplementary document 15) and the Alternative Fuel Vehicles Incentives Act of 2011. The promotion of new technology and energy efficient transportation solutions is part of the core lending strategy of the Assessment Strategy and Roadmap for the Philippine energy sector, and the program is in the Country Operations Business Plan[12],2012-2014).

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[6] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid and Other Alternative Fuel Vehicles Incentives Act of 2011. Available in the list of supplementary documents in Appendix 2.

[7] Recently, government closed down 583 lead-acid battery manufacturing plants because of improper disposal of hazardous waste and poor technical standard. http://www.zhb.gov.cn/zhxx/hjyw/201108/t20110802_215645.htm

[8] Philippines Department of Environment and Natural Resources recently ordered a nationwide campaign against illegal smelting of lead acid batteries. http://www.gov.ph/2011/09/01/denr-orders-crackdown-on-illegal-used-lead-acid-battery-recycling-plants-in-region-3/

[9] Published in December 2009, available at: http://www.dotc.gov.ph/Philippines%20CTF%20CIP%20Nov%209.pdf.

[10] Source: Department of Energy, available at: http://www.doe.gov.ph/DO/Report2010.htm

[11] The National Framework Strategy on Climate Change 2010-2022 available at: http://climate.gov.ph

[12] ADB, Manila, September 2011, available at http://www.adb.org/sites/default/files/cobp-phi-2012-2014.pdf

B. Impact and Outcome

11. The impact of the proposed Project is sustainable energy use by the transport sector, and the outcome is the transformation of the tricycle industry through large-scale adoption of locally made energy efficient e-Trikes.

C. Outputs

12. The proposed Project has five outputs: (i) complete e-Trike units delivered to Local Government Units (LGUs) accompanied by a standard 3-year warranty; (ii) Lithium-ion battery supply chain with associated support services established; (iii) solar charging stations pilot in selected areas; (iv) material recovery from ICE tricycles and used batteries; and (v) successful communication, social mobilization and technology transfer.

13. **Output 1: E-Trike units.** The Project will deliver 100,000 complete e-Trike units to selected cities (para. 22) and areas to replace existing ICE tricycles. The supply contract will include a standard warranty on mechanical and technical performance of the e-Trikes. The risk of technical defects and poor performance of batteries during this guaranteed performance period (at least 3 years or 2,000 charges) will be borne by the battery manufacturer. All e-Trikes will be clearly marked with a "battery supplied by" (similar to "Intel Inside" in computers) label to make consumer aware of the brand and obligations of the suppliers under the project.

14. **Output 2: Battery supply chain.** The Project will initiate creation of Lithium-ion battery supply chain in the Philippines by creating an initial substantial[13] market. The transformation objective is to attract reputable international suppliers, who have supplied at least one large global vehicle brand[14].

15. **Output 3: Solar charging stations.** The Project will establish (i) on a pilot basis, 5 off-grid solar charging stations—200 kW each—either as a cluster or stand alone, (ii) certain number of grid-connected charging stations. The solar charging stations will be sufficient to support the electricity needs of 1,000 e-Trikes. Most of this off-grid charging stations will be in the two island locations—Boracay and Puerto Princessa. For other areas, certain number of grid-connected charging stations will be included to reduce the "range anxiety" of drivers. Existing electric utilities will also be encouraged to establish charging stations as commercial operation.

16. **Output 4. Material recovery from ICE tricycles and used batteries.** The Project will collect old ICE tricycles (both the side-car and the motorcycle), following the requirements of United National Framework Convention on Climate Change (UNFCCC). Used batteries (Lead Acid from ICE tricycles and Lithium Ion from e-Trikes) will also be recovered.

17. **Output 5. Communication, social mobilization and technology transfer.** All stakeholders will be educated about the project—its benefits, technical parameters, costs and market potential of e-Trikes. This includes specific training of the drivers on use and maintenance of e-Trikes and technical training to other stakeholders to develop local human resources to support local industry development.

[13] By April 2012, Nissan sold about 11,000 electric cars (Nissan Leaf) in the US which required about 264 MWh of Lithium ion batteries—the 100,000 e-trike will need at least 300 MWh of Lithium ion batteries.
[14] Table 5A: Manufacturers of EVs/PHEVs and partnering battery manufacturers, Electric and plug-in hybrid electric vehicles, Technology Roadmap, International Energy Agency, Updated June 2011

D. Investment and Financing Plans

18. The Project is estimated to cost $504 million (Table 1). ADB will provide $300 million from its ordinary capital resources, with a 15-year term, including a grace period of 5 years, an interest rate determined in accordance with ADB's London Interbank Offered Rate (LIBOR)-based lending facility[15], and a commitment charge of 0.15% per annum, and such other terms and conditions set forth in the draft loan and project agreements. Based on these loan terms and repayment method, the average loan maturity is 11 years and there is no maturity premium payable to ADB. The CTF will co-finance the Project with a grant of $5 million ($1 million for capacity building and $4 million for a solar charging pilot) and a loan of $100 million, with a 40-year term, including a grace period of 10 years, a management fee of 0.10%, 2% principal payment (year 11-20), 4% principal payment (year 21-40) and an interest charge of 0.25% of disbursed and outstanding credit balance. ADB will administer the CTF funds. CTF funds will be used to blend with ADB's investment and to fill the investment gap. ADB will finance the financial charges during constriction for both ADB and CTF loans. The Project will likely receive payments (about $20 million) for carbon credits after the Project is implemented. The Government will finance the remaining $99 million, including taxes and contingency amounts for the e-Trikes.

Table 1: Project Investment Plan[a]
($ million)

Item	Total
A. Base Cost[b]	
1. E-trike components	
a. Lithium Ion battery	118.80
b. Body and other parts	211.20
c. Motors	37.84
2. Supporting infrastructure	
a. Charging stations	0.48
b. Battery recycling	2.30
c. Old tricycles disposal/recycling	2.64
d. Communication, social mobilization and admin support	0.87
e. Solar charging station pilot	4.00
3. Consulting Support	-
a. Technology Transfer and Local Industry Support	0.87
b. Implementation Consultant	0.87
Sub-Total (A)	**379.86**
B. Contigencies[c]	
1. Physical	44.38
2. Price	14.07
Sub-Total (B)	**58.45**
C. Taxes	**51.25**
D. Financial Charges During Construction[d]	**14.44**
Total	**504.00**

[a] Includes taxes and duties, government's contribution will be as tax exemption.
[b] In mid-2011 prices.
[c] Physical contingencies (11.6% for foreign and 12.6% for local base costs). Price contingencies at projected using the differential between international inflation rate and inflation rate on local currency costs.
[d] Includes interest during construction and commitment charges. Interest during construction for ADB loan(s) has been computed at the 5-year London interbank offered rate fixed swap rate plus a spread of 0.4%. Commitment charges for an ADB loan are 0.15% per year to be charged on the undisbursed loan amount. ADB loan may finance local transportation and insurance costs. This covers interests accrued from both ADB and CTF loans.

Source: ADB Estimates.

[15] Government's choice to borrow under LIBOR-based lending was its own independent decision.

Table 2: Financing Plan

Source	Amount ($ million)	Share of Total (%)
Asian Development Bank	300.00	59.53%
Clean Technology Fund (loan)	100.00	19.84%
Clean Technology Fund (grant)	5.00	0.99%
Government	99.00	19.64%
Total	504.00	**100.00**

Source: Asian Development Bank estimates.

E. Implementation Arrangements

19. As the Executing Agency, DOE will be responsible for the overall implementation, technical supervision and execution of the Project. It will oversee and coordinate the implementation, monitoring and evaluation of the program; execute contract of sale agreements with the local government units to ensure effective implementation; and establish and oversee the Project Management Unit. DOE, as the EA, will lead in all project procurement activities including management of the supply and service contracts of various suppliers.

20. Landbank will pay the Bureau of Treasury of DOF the amount disbursed by ADB under the loan for the supply e-Trikes. Landbank will recover this amount from the LGU, which will repay Landbank the amount paid to the Bureau of Treasury. LGUs will allot the e-trikes to the drivers and charge a single-digit interest rate over the cost of the e-trikes from the supplier. This project will cover the cost of operation of the independent E-Trike office, which will act as a Project Implementation Unit. The drivers will repay this amount through daily payments (below 200 Pesos) over a 5-year period. The E-Trike office at a LGU may involve a private agency (or an NGO) for collection of the daily payment (boundary) from the drivers and use the collected fund to repay the Landbank loan.

21. To avoid the establishment of a national monopoly for the supply of e-Trikes, it is proposed that at least three vehicle manufacturers/assemblers will selected through International Competitive Bidding for the supply and support of the vehicles in the Philippines in accordance with ADB’s Procurement Guidelines (2010, as amended from time to time). The project will be organized into two phases: (i) a development phase, during which certain geographic supply packages will be procured to allow new operators to gain a foothold, plus allow the project to address any initial implementation issues, and (ii) a wider scale-up phase. The industry development phase is planned to be 24 to 30 months long, and a mid-term review will conclude this phase. The mid-term review will finalize the cities to be included in Phase II. Initial industry development phase will procure 20,000 e-Trikes, and the remaining 80,000 units will be manufactured and distributed over the remaining period of 30 to 36 months.

22. The following criteria were used for selecting cities: (i) the LGU leadership’s commitment and interest in e-Trikes including own previous initiatives; (ii) commitment to set up public electric charging infrastructure; (iii) large number of existing ICE tricycles in the area; and (iv) the electricity supply and demand situation. Accordingly, the following sixteen areas were chosen for the industry development phase: Antipolo, Boracay, Cabanatuan, Caloocan, City of Manila, Dagupan City, Davao, Lipa City, Los Banos, Makati City, Mandaluyong City, Paranaque City, Puerto Princesa City, Quezon City, Sta Cruz, and Tarlac City.

23. The project will replace existing tricycles (ICE motorcycles with a side car) in the following order of priority: two stroke tricycles, tricycles that a driver owns, and older tricycles. ADB and the DOE will approve the selection criteria for each area—areas where the number of single stroke tricycles are less, drivers may be selected by a public lottery among the applicants. DOE and ADB will select a neutral party or a participating NGO to conduct public lotteries.

24. The overall implementation schedule is conservative, taking into account the nascent state of the industry. The implementation arrangements are summarized in Table 3 and are described in detail in the Project Administration Manual, [16] which also include details on the selection process and selection criteria of the drivers.

Table 3: Implementation Arrangements

Aspects	**Arrangements**		
Implementation period	October 2012 – September 2017 (60 months)		
Estimated completion date	September 2017		
Management			
(i) Oversight body	Project Steering Committee headed by Secretary of DOE(Chair). National Economic and Development Authority (NEDA), Department of Transportation and Communication (DOTC) and Department of Environment and Natural Resources (DENR) as Members		
(ii) Executing agency	Department of Energy. DOE will establish a PMU to be responsible for: overall management and supervision of project implementation.		
(iii) Key implementing agencies	Local Government Units (LGUs) involved. First procurement package includes Puerto Princesa, Boracay, Mandaluyong City and Cabanatuan City.		
(iv) Implementation unit	LGU will create an E-Trike Office (PIU) which will be responsible for the implementation and monitoring of the Project at the ground level.		
Procurement: Industry Development Phase	International competitive bidding with domestic preference	Procurement of assembled vehicles with associated warranty and support services	$ 110.64 million
Procurement: Scale Up Phase	International competitive bidding with domestic preference	Procurement of assembled vehicles with associated warranty and support services	$ 216.25 million
Consulting services	Quality-and-Cost-Based Selection (QCBS) and Quality-Based Selection(QBS)	119 person-months (Project Implementation Consultant)	$ 1 million
	Single- source selection (Individual Consultants)	36 person-months (Technology transfer and Local industry Support, Communications)	$ 1 million
Advance Contracting	Advance procurement of 5,000 e-Trikes for Boracay (500 units), Cabanatuan (1,500), Mandaluyong (1000), Paranaque (1,000), and Puerto Princessa (1,500 units) in 2012		
Disbursement	Direct Payment for procurement packages. Separate Imprest Account for CTF and ADB for administration and other categories. The ADB loan and CTF loan grant proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2007, as amended from time to time).		

[16] Project Administration Manual (accessible from the list of linked documents in Appendix 2).

III. DUE DILIGENCE

A. Technical Assessment

25. According to the Massachusetts Institute of Technology (MIT)[17], more efficient battery technologies are providing a cleaner alternative to pollution-emitting internal combustion engines. In many cases, conventional motorcycles emit more pollution than even large SUVs because they are not equipped with equivalent emissions-control technology. An electric motorcycles can immediately eliminate tailpipe emissions, can dramatically reduce a city's overall pollution rate. GHG emissions could be negligible, as these e-vehicles can be be powered with renewable energy, especially solar.

26. The United States Department of Energy views Lithium-ion battery technology as one of the most promising new battery options, due to its high energy and power densities and its potential to last the lifetime of the vehicle[18]. In 2008, MIT's Electric Vehicle Team designed eMoto[19] and found that use of Lithium-ion batteries could reduce the weight of an electric vehicle battery pack by up to 76% (from 93 kg to 23 kg). The lighter vehicles with a longer battery life proved to be more cost efficient and were able to travel farther and accelerate faster than models using heavier battery technology. ADB's pilot project compared e-Trikes with different options: the Lithium-ion batteries (38 kg) were 72% lighter than the Lead acid (140 kg).

27. The 20 e-Trikes pilot project used different battery size and charging options: 10 e-Trikes with 3 kWh batteries for fast (20 minutes) charging in public stations, and the 10 e-Trikes with 6 kWh batteries with on board chargers for home charging (6 hours). The pilot concluded that: (i) Lithium-ion batteries are the sustainable battery choice; (ii) properly designed e-Trikes are capable of meeting the variable range, speed, and terrain considerations in the Philippines; (iii) fast charging is possible and can be locally designed and built; (iv) due to sophisticated battery and charging technologies, the drivers and LGUs will not be able to manage the risk of a faulty battery; and (v) the fuel savings are significant and are sufficient to support a rent-to-buy e-Trike scheme for the drivers. This e-Trikes financed by this project will use Lithium ion batteries.

B. Sustainability

28. Local support infrastructure and technical capacity is an essential pre-requisite for the Project. In 2008, one Manila city bought 200 e-Trikes (with lead acid batteries), unfortunately, only less than 10 are still operating. Apart from the main problem of lack of cash to replace Lead Acid batteries within 12 to 15 months, lack of ongoing technical support contributed to this failure. The lesson from the Mandaluyong pilot is similar: to make e-Trike initiative sustainable an essential pre-requisite will be a vibrant local industry that will provide, among others, skilled technicians, repair and support services, insurances, charging stations, and spare parts.

29. The project will transform the risk allocation: the owner of e-Trikes will not absorb the risks associated with this new technology, the battery manufacturers are best placed to manage the risk of poor performing batteries. By backing off the risk of unreliable batteries through the supply chain, via the vehicle supplier, the risk will be allocated to the battery maker.

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[17] The Technology Review, published by MIT, 2007, available at: http://www.technologyreview.com/energy/19069/.
[18] Center for Transportation Research Argonne National Laboratory, operated by The University of Chicago, for the United States Department of Energy. Available at: http://www.transportation.anl.gov/pdfs/TA/149.pdf
[19] An electric motorcycle that demonstrated low cost electric vehicle, available at: http://web.mit.edu/evt/emoto.html.

C. Financial Analysis

30. Broadly, typical tricycle driver uses approximately $5[20] worth (5 liters) of gasoline to drive 100 km per day but can save about $4 per day by switching to an electric tricycle, which consumes 5 kWh of power costing $1[21]. With large-scale adoption, these individual savings could accumulate to a significant national savings of over $4 billion per year. Replacement of 100,000 gasoline tricycles with electric tricycles at a cost of $450 million, for example, can generate about $175 million each year from avoided fuel imports. Detail financial analysis was carried out in real terms using 2011 prices, that examined the aggregate costs and incremental benefits measured by the revenue from drivers or users.

D. Economic Analysis

31. The Project's economic analysis is based on incremental cost and benefit streams associated with the Project component, whose economic performance is evaluated by comparing with- and without-Project scenarios. Benefits are derived mainly from the fuel savings or avoided costs from the importation of fuel and income from the boundary payments of drivers/users. The overall economic internal rate of return exceeds the economic hurdle of 12%. This indicates that the Project, from the perspective of the Government, is economically viable.

E. Governance

32. ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the Government. The specific policy requirements and supplementary measures are described in the Project Administration Manual.[22] To ensure transparency and good governance, DOE will publicly disclose on its website information on how loan proceeds are being used. For each procurement contract, LBP and DOE will disclose (i) the list of participating bidders; (ii) the name of the winning bidder; (iii) basic details on bidding procedures adopted; (iv) the amount of the contract awarded; (v) a list of goods and services purchased; and (vi) the intended and actual utilization of loan proceeds under each contract being awarded. ADB will organize special training for LBP, DOE and PMU staff covering all aspects of Project implementation and ADB procedures, including procedures for implementation, procurement, use of consultants, disbursement, reporting, monitoring, and prevention of fraud and corruption.

F. Poverty, Social and Gender

33. With an e-Trike the drivers will receive a higher daily take-home pay. In Davao, 92% drivers were renters, and about 80% were married with about three dependents and 70% had secondary degree. In Boracay, about 40% drivers are owners. The fuel cost savings of ₱200 per day will greatly benefit the driver community and is the basis for the rent-to-own scheme. The Project will not displace or negatively impact on the livelihood of tricycle drivers or families. Since fabrication and assembly could be largely domestic, the Project could create a net employment gain of around 10,000 jobs by 2015. The Project is not expected to have a significant effect on the existing oil-fuelled local tricycle assembly industry in the short term.

[20] Tricycles in Boracay, with its hilly terrain and heavy traffic uses about 6 liters ($8.20) to drive about 30 km per day.
[21] Assuming cost of power of 20 cents /kWh in the Philippines, one of the highest in the region.
[22] Project Administration Manual (accessible from the list of linked documents in Appendix 2)

34. The pilot e-Trike design has incorporated women's needs with better seating arrangements. Female passengers will be consulted on the design and safety aspects of proposed e-Trike models, especially for metro-Manila, ADB women personnel will be used as a focus group. As this is a replacement program, the scope for female drivers will be limited. ADB will target that at least 30% of charging station jobs to be filled by women (only during day-time shifts). Female workers will also be trained to inspect the e-Trikes for basic safety issues (road-worthiness, for example) and collection of e-Trike data on every charge. The health and safety benefits of the new design will be significant for the population, especially children.

G. Safeguards

35. The Project is categorized as C for environment, involuntary resettlement and indigenous people. The e-Trikes will have no tail-pipe emissions and no engine noise. Because of classified as category C, no separate environmental assessment will be required, although environmental implications need to be reviewed. According to ADB's publication on electric bikes[23], lead pollution is an inherent problem with electric vehicles and electric bikes with Lead acid batteries will increase the overall pollution rates than the ICE motorcycles. The Lithium-ion batteries are not an environmental hazard[24] and are classified by the U.S. federal government as non-hazardous waste[25] and are safe for disposal in the normal municipal waste stream.

H. Special Features

36. The proposed Project aims to create an internationally competitive local e-vehicle industry using latest battery and charging options including solar charging. The Project will ensure ongoing competition where possible to prevent market inefficiencies, and "regulate" where necessary with the ultimate aim that sufficient competition exists across the entire value of the e-Trike industry. The Project will be cofinanced with CTF resources.

1. Clean Development Mechanism (CDM)

37. The Project is likely to be registered under CDM of the Kyoto Protocol. Considering large amount of renewable energy component of the Philippines electricity grid, and the inherent efficient of the electric motors, the emission from the e-Trikes would be significantly less than the fossil fuel consumption of the gasoline driven tricycles i.e. the baseline scenario. Potential for emission reduction per electric tricycle distributed and operational is likely to be approx. 3.8 tCO_2e.[26] The project would apply for registration under the CDM, and if registered, the project would generate certified emission reductions. Income from these carbon credits will be an important source of revenue for the project and promotion of such programs by the DOE. DOE has submitted the project design documents[27] to UNFCCC.

I. Risks and Mitigating Measures

38. Major risks and mitigating measures are summarized in Table 4 and described in detail in the risk assessment and risk management plan.[28]

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[23] ADB. 2009. *Electric Bikes in the People's Republic of China: Impact on the Environment and Prospects for Growth.* Manila (available in the list of supplementary documents in Appendix 2).
[24] http://www.ehso.com/ehshome/batteries.php
[25] http://www.epa.gov/osw/hazard/wastetypes/universal/batteries.htm
[26] Assumptions: 80km/day; 15km/liter on gasoline tricycle; emission factor of baseline vehicle=146.93 gCO_2/km.
[27] Available at: http://cdm.unfccc.int/UserManagement/FileStorage/3KY4J2IW70AZPTX9MS6VGU1QORNE8F
[28] Risk Assessment and Risk Management Plan (accessible from the list of linked documents in Appendix 2).

Table 4: Summary of Risks and Mitigating Measures

Risks	Mitigating Measures
Poor quality e-Trikes underscoring technology credibility and project viability.	Pre-qualified bidders will be asked to competitively supply professionally designed e-trike units. Tight quality control measures will be applied at all levels. Minimum warranty and support will be guaranteed by the suppliers.
Poorer batteries selected through international bidding under the project	Strict minimum technical standards and commercial qualification criteria will ensure only reputable international manufacturers products are incorporated into the vehicles
Excess financing cost because of multiple intermediaries.	ADB worked closely with the government to ensure the drivers pay single-digit interest rates.
Inadequate e-Trike demand discouraging new investment	Extensive communication and public awareness campaign will ensure, drivers, users and policy makers understand key benefits.
Inadequate capacity of local industry to meet demand	Procurement will be phased to ensure a ramp up period for early adoption and new investments.

Source: Staff Analysis

IV. ASSURANCES

39. The Government has assured ADB that implementation of the Project shall conform to all applicable ADB policies including those concerning anticorruption measures, safeguards, gender, procurement, consulting services, and disbursement as described in detail in the Project Administration Manual and loan documents.

40. The Government has agreed with ADB on certain covenants for the Project, which are set forth in the loan agreements and grant agreement.

V. RECOMMENDATION

41. This is a recommendation for

(i) the loan of $300 million to Republic of the Philippines for the Market Transformation through Introduction of Energy Efficient Electric Vehicles Project from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's London Interbank Offered Rate (LIBOR)-based lending facility; for a term of 15 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan agreement presented to the Board;

(ii) the administration by ADB of a loan not exceeding the equivalent of $100 million to the Republic of the Philippines for the Market Transformation through Introduction of Energy Efficient Electric Vehicles Project to be provided by the Clean Technology Fund; and

(iii) the administration by ADB of a grant not exceeding the equivalent of $5 million to the Republic of the Philippines for the Market Transformation through Introduction of Energy Efficient Electric Vehicles Project to be provided by the Clean Technology Fund.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
Impact Sustainable energy use by transport sector	 Fuel used by the transport sector is reduced by at least 2.8% (based on 20 million Barrels per year consumption in 2010) or an equivalent of 89.2 million Liters of gasoline per year. Pollution in selected cities reduced by at least 20% (from the baseline measurement under the project)	 Data published by the Department of Energy	**Assumption** Sufficient renewable energy investment in the power sector across the country Public transport use pattern will not be altered significantly by introduction of cheap (electric) fuel **Risks** Uncontrolled growth of electric vehicle across the country Cheaper and poorer quality electric vehicle flooding the market
Outcome Tricycle industry transformation through large scale adoption of locally made energy efficient e-Trikes	 At least 5 companies are established that are registered by the Board of Investment as new industries At least two retailers distributing (and assembling) Lithium-Ion and others high energy density batteries locally At least 50% of the conversions outside the project boundary using Lithium Ion batteries	 Data published by the LGUs collected by project implementation consultants Published reports by the Department of Energy and Board of Investment Market survey during the mid-term review	**Assumptions** Locally made e-Trike will meet its expected design life Enough local technical expertise is available to support the local industry **Risks** Oil price will not drop significantly from its current high level Significant increase of electricity price and power shortage in specific region Local e-Trike business becomes unviable because of cheaper imports
Outputs Complete e-Trike units delivered to LGUs with at least standard 3-year warranty Battery supply chain including support infrastructure created	 At least 17,000 e-Trikes operating by December 2013, and 50,000 by 2014, and 100,000 by 2015 At least three internationally reputable battery companies established active presence in the Philippines by 2014 from none in 2011	 Project Reports TRU Reports Industry commission and Board of Investment Reports Report from Securities and Exchange Commissions	**Assumptions** Project will transform local industry and will be able to attract overseas investors to partner with local businesses enabling technology transfer and employment generation Government commitment to electric tricycle will continue and government will resolve registration and franchise issue across the country Drivers and passengers

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
Solar and other charging stations available in selected areas to meet the public charging needs	At least 2 reputable motor suppliers by 2012 oive solar charging stations of 200 kW each will be established. At least 500 locally assembled charging stations are installed in selected project areas At least 30% operators of public charging stations will be women (only during daytime shift)		acceptance of e-Trike will continue Project will be able to attract reputable Lithium-ion battery manufacturer/supplier in the Philippines Local manufacturing will be able to meet the project demand **Risks** Financing cost increases because of involving multiple layers of intermediaries
Material recovery from ICE tricycles and used batteries: a. Lithium Battery Recycling b. Body Disposal	Battery recycled options studied and pilot operating Old tricycles are collected and disposed of as per UNFCC's requirements and local environmental rules		Resistance of businesses using current technology Inadequate capacity of industry to meet local demand Stakeholder acceptance of rent to own e-Trike
Communication, Social Mobilization and Technology Transfer	Consumers are aware of benefits of electric vehicles (3 workshops) and at least six companies selling in Metro-Manila with service support by December 2012		Accident and unforeseen event undermining e-Trike technology

Activities with Milestones	Inputs
Output 1: Complete e-Trike units delivered to LGUs with standard 3-year warranty 1.1 Signing of Memorandum of Agreement between DOE, Lang Bank, and LGU (intermittent per LGU) (01/09/2012 – 30/09/2012) 1.2 Finalize prequalification and bidding documents for goods package (01/06/2012 – 30/06/2012) 1.3 Conduct prequalification and bidding documents for goods package (30/06/2012 –30/9/2012) 1.4 Conduct procurement activity from advertisement, bid submission, bid evaluation to contract award (intermittent 8 packages, 01/08/2012 – 30/03/2016) 1.5 Delivery and distribution of e-Trikes to LGUs (for drivers) and signing of supply and maintenance agreement between supplier and LGU (31/03/2013 – 31/12/2016) 1.6 **Output 2: Battery supply chain including support infrastructure created** 2.1 Conduct procurement activity and signing of supply and maintenance agreement between suppliers and LGUs (for drivers) (01/08/2012 – 30/03/2016) 2.2 Identify and establish a service center per LGU (1/3/2012-29/3/2013)	**Inputs** ADB $ 300 CTF (loan) $ 100 CTF (grant) $ 5 Government $ 99

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
Output 3: Solar and other charging stations available in selected areas to meet the public charging needs 3.1 Identify electricity provider for each area (01/01/2012-31/05/2014) 3.2 Signing of memorandum of agreement between electricity provider, LGU and DOE (01/01/2012-31/09/2012) 3.3 Finalize technical specifications for charging stations per LGU (01/01/2012-31/09/2012) 3.4 Conduct procurement activity from advertisement, bid submission, bid evaluation to contract award, turnkey package for Solar Charging stations in Boracay and Puerto Princesa (01/07/2012 - 31/12/2012) 3.5 Installation of solar charging stations (01/01/2013 – 31/05/2013) **Output 4: Material Recovery from ICE Tricycles and used batteries** 4.1 Finalize material recovery plan for batteries and old tricycles (01/04/2012 – 31/08/2012) 4.2 Allocate budget for each LGU and designate area for collection and disposal (01/07/2012 – 31/12/2015) 4.3 Develop database of old tricycles in each LGU (01/01/2012 – 31/12/2016) **Output 5: Communication, Social Mobilization and Technology Transfer** 5.1 Conduct project implementation general training on project management unit, identified LGUs, other related agencies and establish technical working group to prepare material recovery plan (intermittent, 01/01/2013 – 31/05/2016) 5.2 Prepare and implement general information, education, and communication plan for each LGU (01/012013 – 31/05/2015) 5.3 Undertake training and workshop on e-Trike technical operations and maintenance (O&M) (01/01/2013 – 31/08/2016)			

ADB = Asian Development Bank, CTF = Clean Technology Fund, DOE = Department of Energy, LGU = Local Government Unit

Source: ADB Project Team.

THE **BRICS** REPORT

New Delhi
BRICS
2012

THE **BRICS** REPORT

A Study of Brazil, Russia, India, China, and South Africa with special focus on synergies and complementarities

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This report is written by experts and scholars from BRICS countries with the support of BRICS governments. It aims to promote pragmatic economic cooperation among BRICS countries.
The data from international institutions and individual country sources have been used in this report for comparability reasons, which may not be fully consistent with government statistics, and hence shall not be deemed as officially approved.

Contents

Tables

Preface

The acronym BRIC stands for Brazil, Russia, India, and China. The term was coined by the Chief Economist of Goldman Sachs, in 2001, in a paper titled 'Building Better Global Economic BRICs', which looked at the growth prospects of the four largest emerging economies that are culturally and geographically disparate. The main finding was that the BRICs would play an increasingly important role in the global economy. The projections were revised in later publications, as the BRIC economies fared better than expected.

This study expands the original terms of reference to include South Africa because of its growing significance in the global economy. The new acronym is, therefore, BRICS and it symbolizes the collective economic power of Brazil, Russia, India, China, and South Africa. Together the BRICS account for more than 40 per cent of the global population, nearly 30 per cent of the land mass, and a share in world GDP (in PPP terms) that increased from 16 per cent in 2000 to nearly 25 per cent in 2010 and is expected to rise significantly in the near future.

This study, which is supported by the ministries of finance and the central banks of the BRICS, focuses on synergies and complementarities between the economies, highlighting their role as growth drivers of the world economy. The emphasis is on best practices, areas of cooperation, and strengthening economic links so that the BRICS could collectively play a more central role in the 'new normal' of the post-crisis global economy.

This is also perhaps the most opportune time for forging closer links, given that the world economy is in a state of flux and a rebalancing is taking place towards the emerging economies. Their pivotal role in the global recovery has already catapulted the BRICS into the leadership role, which needs further cementing through greater interface among economies.

The study, which is in five parts, is in the nature of a forward-looking report that seeks to reinforce and strengthen the position of BRICS in the global economy. Chapter 1 of the study provides an overview of the BRICS, their financial, government, and regulatory framework, and their share in the global economy. Chapter 2 examines the impact of the global crisis, the resilience of the BRICS economies, their use of fiscal and monetary stimuli, the process of recovery, and their contribution to global growth. Chapter 3 looks at the best practices in the BRICS and the lessons they hold for each other and the world economy. Chapter 4 looks at the challenges that the BRICS are likely to face in moving to a higher growth path. Chapter 5 explores areas of cooperation among the BRICS including initiatives that could propel the BRICS and the world economy to a higher growth trajectory.

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Executive Summary

This study, which is supported by the ministries of finance and the central banks of the BRICS, focuses on synergies and complementarities between the economies, highlighting their role as growth drivers of the world economy. The emphasis is on best practices, areas of cooperation, and strengthening economic links so that the BRICS could collectively play a more central role in the 'new normal' of the post-crisis global economy. The study is divided into five chapters.

I. Overview of BRICS

Chapter 1 of the study provides an overview of the BRICS, their financial, government, and regulatory framework, and their share in the global economy. Together, the BRICS account for more than 40 per cent of the global population, nearly 30 per cent of the land mass, and a share in world GDP (in PPP terms) that increased from 16 per cent in 2000 to nearly 25 per cent in 2010, and is expected to rise significantly in the near future. If one compares the GDP in

PPP terms for 2010, four economies figure among the G-20 top ten, with China, India, Russia, Brazil, and South Africa in 2nd, 4th, 6th, 8th, and 26th place, respectively. In terms of contribution to growth of PPP-adjusted global GDP of the world, these five economies accounted for 55 per cent during 2000–8, and their contribution is expected to rise in the coming years. However, as per the criterion of GDP at market prices, among the members of the G-20, China holds the 2nd position while Brazil, India, Russia, and South Africa hold the 7th, 9th, 11th, and 19th positions, respectively.

II. Impact of the Financial Crisis on BRICS

Chapter 2 examines the impact of the global crisis, the resilience of the BRICS economies, their use of fiscal and monetary stimuli, the process of recovery, and their contribution to global growth. The recent global financial crisis that engulfed almost all economies marked a painful adjustment at the macro level coupled with micro-level distortions and incentives created by past policy actions. The crisis spread to the BRICS through four channels—trade, finance, commodity, and confidence. The slump in export demand and tighter trade credit caused a deceleration in aggregate demand. The global financial crisis inflicted significant loss in output in all the BRICS economies. However, real GDP growth in India and China remained impressive even though they also witnessed some moderation due to weakening global demand. The crisis also exposed the structural weakness of the global financial and real sectors. The reversal of capital flows led to equity market losses and currency depreciations, resulting in lower external credit flows. The banking sectors of the BRICS economies performed relatively well.

The BRICS, however, recovered swiftly with the support of domestic demand. Still, the recovery is yet to be made compatible with the fiscal consolidation process. Besides the current recovery process, there are specific lessons for the BRICS economies from the recent crisis. These lessons include (i) recognizing the invalidation of the decoupling hypothesis, (ii) allowing domestic demand to serve as a durable source of growth, (iii) instituting financial sector reforms, (iv) monitoring and managing speculative capital flows, (v) creating fiscal policy space on a sustainable basis as a central feature of their reform agenda, and (vi) focusing on infrastructure development and employment generation.

III. Best Practices

Chapter 3 looks at the best practices and institutions within the BRICS economies that have made significant differences to these economies and contributed to their high growth rates. Many of these practices and institutions have relevance within the BRICS bloc for enhancing cooperation and creating synergies, so that the BRICS collectively could grow faster.

Major showcase areas for Brazil include agricultural research, which has transformed the country into a major exporter, the use of bio-fuel for road transport, and the emergence of Embraer as a high-technology aircraft manufacturer. In the social sphere, conditional cash transfers that target poverty and the success of the anti-AIDS policy provide useful lessons. A regulatory framework that helped Brazil withstand the shock of the global crisis, including the regulation of capital flows, and the issuance of domestic currency-denominated international bonds, which transfer currency risk to investors, are other successful practices that have been highlighted.

Russia's major achievements include reforms during 1999–2009 that promoted economic growth, lowered inflation, and led to a dramatic fall in the number of people living below the poverty line. Specific achievements include setting up of the Oil Stabilisation Fund that was successful during the crisis, budgetary reforms through the devolution of decision-making powers, and the introduction of a flat personal income tax rate of 13 per cent that ensured improvement in compliance.

The main showcase institution for India is private entrepreneurship which has been instrumental in achieving 8–9 per cent annual growth of the economy in recent years. Private initiative has been responsible for the excellence achieved in the information technology sector and the innovative streak that has led to improvization and production of low-cost goods for the Indian mass market. Besides, the calibrated approach to capital account convertibility and the External Commercial Borrowing Policy have helped insulate the economy against surges and reversals of debt flows and maintained the external debt at sustainable levels. The Right to Information Act is increasing the transparency and accountability of government operations and the Mahatma Gandhi National Rural Employment Guarantee Scheme is a major step towards making growth inclusive.

The best practices and institutions of China are those that have helped ensure progress in terms of sustaining its rapid economic growth, enhancing its overall national strength, and improving the living standards of its people. It also includes the success in making the historic transition from a highly centralized planned economy to a robust socialist market economy, and from a closed and semi-closed country to one that is open to the outside world. Specific areas are FDI attraction and utilization, and infrastructure financing, among others.

The Chinese globalization model has also been different, in that foreign direct investment was encouraged. The sub-national governments (cities/provinces) have been successful in attracting foreign investment by providing improved infrastructure and a favourable regulatory environment. China also has experience in financial macro-management. The reform and development of China's banking industry and financial market is an important driver for rapid and sustainable growth.

South Africa has a long record of responsible macroeconomic management, which has helped to promote the development of a deep and liquid bond market and reduced external vulnerability. South Africa has strong institutions and a highly developed, well-regulated banking sector that escaped the worst effects of the financial crisis. With the most developed industrial and financial capabilities on the African continent, South Africa's role in the integration of policies, markets, finance, and infrastructure is vital to Africa's economic development and realization of the continent's potential as a growth pole in the global economy. Outwardly oriented South African companies are among the largest sources of FDI in Africa and the country's development financing institutions are playing an increasing role in the funding of regional infrastructure investment.

IV. Major Challenges

Chapter 4 looks at the challenges that the BRICS could face in moving to a higher growth path. Since the macroeconomic parameters and features of development vary within BRICS economies, the challenges they face to make their growth process sustainable also vary. For instance, in Brazil macroeconomic stabilization is a key precondition for successful reforms and sustainable growth. The challenges that the Brazilian economy face are as follows: (i) its tradeable goods sector is small when compared to other EMEs like China; (ii) saving and investment rates have to increase as in other BRICS economies like China and India; (iii) improvements are required in public sector management; and (iv) it also needs to enhance the depth of the financial sector as well as improve long-term financing structures for the private sector.

In the case of Russia, the key challenges are accelerating the implementation of structural reforms, particularly in inefficient and undercapitalized natural monopolies, and strengthening the investment climate.

For India, the major challenges are (i) making the growth process more inclusive, (ii) improving physical infrastructure, (iii) developing the agriculture sector, and (iv) enhancing delivery of essential public services, such as education and health, to large parts of the population.

Similarly for China, policy changes are needed to address both domestic and external challenges. The policy challenge for China is to sustain rapid and stable economic growth, driven by both exports and domestic demand in a more balanced way. To facilitate restructuring of the economy, financial sector reforms are needed to improve the intermediation of China's large private savings. The government also needs to raise social spending in the areas of education, healthcare, and pensions, which will serve to reduce precautionary saving and boost consumption over time. There is also a need to improve the investment structure, advance reforms in the healthcare, pension, and education systems, and provide more support to rural areas and less-developed regions.

The key challenge for South Africa is to achieve higher levels of inclusive growth that raise employment and reduce inequality. Low domestic savings, currency volatility, inadequate investment in productive sectors of the economy, skill shortages, and ensuring efficient government services delivery are other challenges. Policies proposed in the New Growth Path constitute the key means to address these challenges through a developmental state that places employment at the centre of the fight against inequality. Within a prudently managed macroeconomic framework, the government is prioritizing policy measures focused on the expansion of infrastructure networks, skills development, interventions to raise youth employment, industrial policy that promotes higher value added exports, the development of rural economies, small enterprise promotion, green economy initiatives, and regional integration.

One common challenge that BRICS economies face is the need for institutional development without which sustainable growth cannot be ensured. In a post-global crisis world largely shaped by financial instability and weak growth in the major economies, the BRICS countries have a remarkable opportunity to coordinate their economic policies and diplomatic strategies not only to enhance their position as a grouping in the international economic and financial system, but also to be a stabilization factor for the world economy as a whole. BRICS should increasingly harmonize and coordinate their policies with a view to sustaining their growth momentum and capacity to weather global turbulence. The benefit of cooperating among themselves is immense for the BRICS as well as for the global economy. A strategic agenda for forging closer links among the BRICS, as outlined in this joint report, may contribute to consolidating and expanding their roles in global affairs.

V. BRICS Cooperation

Chapter 5 lists exsting areas of cooperation among the BRICS, and explores new areas of cooperation including initiatives that could increase growth and development in BRICS countries and worldwide. In the BRICS economies, there exist huge opportunities to extend economic growth and development to the next level. In this regard, there is possibility to further increase cooperation among the BRICS to gain competitive advantages. It is important to note that all the proposals laid out in this chapter might contribute to promote synergetic relationships among the BRICS economies. However, implementation of these may require further deliberations and their political and technical feasibility is yet to be determined in greater detail. The new areas of cooperation listed below should be seen basically as exploratory items to be included in further discussions and in the agenda of future meetings of the BRICS leaders, ministers, and other policymakers. The focus areas suggested are as follows:

(i) Intra-BRICS Trade and Investment Cooperation
(ii) Cooperation in Infrastructure Financing
(iii) Industrial Development and Cooperation
(iv) Cooperation in Transportation
(v) Cooperation in Food Security
(vi) Cooperation in Technical Education
(vii) Cooperation in Financial Market Development

(viii) Cooperation in Research and Development
(ix) Cooperation in the Area of Culture and Tourism
(x) Cooperation in International Issues
(xi) Cooperation in Energy Security
(xii) Cooperation to Build Effecitve Institutions
(xiii) International Development Bank for Fostering South–South Investment

To conclude, even though the BRICS have pursued different paths of growth with different macroeconomic parameters and varied institutional strengths, the world seems to be optimistic about their emergence based on their respective durable comparative advantages. The growing role of the BRICS is confirmed by the rapid recovery of these economies from the global financial crisis, which demonstrates that optimal global economic policymaking cannot be undertaken without including the BRICS economies at the highest level.

1 Overview of BRICS

Basic Information on BRICS Countries

In the past few decades, some large economies such as Brazil, Russia, India, China, and South Africa (BRICS) have acquired a vital role in the world economy as producers of goods and services, receivers of capital, and as potential consumer markets. The BRICS economies have been identified as some of the fastest growing countries and the engines of the global recovery process, which underscores the changed role of these economies. Even in the G-20 countries' forum, BRICS are playing a formidable role in shaping macroeconomic policy after the recent financial crisis. At present, these five countries encompass over 40 per cent of the world's population and account for nearly 25 per cent of total global GDP in terms of PPP. If one compares the GDP in PPP terms, four economies figure among the top ten, with China, India, Russia, Brazil, and South Africa in 2nd, 4th, 6th, 8th, and 26th places, respectively (Table 1.1). In terms of contribution to growth of PPP-adjusted global GDP of the world, these five economies accounted for 55 per cent during

Table 1.1 Overview of BRICS, 2010

	GDP in PPP (in US$ billion)		GDP (US$ billion)		Share in World GDP (in per cent)		Per Capita GDP (US$)	
	Rank in World	GDP	1990	2010	1990	2010	1990	2010
1	2	3	4	5	6	7	8	9
Brazil	8	2,172	508	2,090	3.3	2.9	3,464	10,816
Russia	6	2,223	–	1,465	–	3.0	–	10,437
India	4	4,060	326	1,538	3.1	5.4	378	1,265
China	2	10,086	390	5,878	3.9	13.6	341	4,382
South Africa	26	524	112	357	0.9	0.7	5,456	7,158

Source: IMF database.
Note: – Not available.

2000–8, and their contribution is expected to rise in the coming years.

The BRICS comprise a huge land share of the world (Table 1.2) and, as a result, own vast natural resources. China, which has a land area of about 9.6 million sq. km, is the third-largest country in land size, after only Russia and Canada. Russia accounts for around 20 per cent of the world's oil and gas reserves, while China has about 12 per cent of the world's mineral resources. In terms of agricultural land, Russia has 121.5 million hectares of arable land. Brazil covers 47 per cent of South America and is the fifth-largest country in the world (8.5 million sq km), surpassed only by Russia, Canada, China, and the United States of America.

Each of the BRICS countries has multiple and different attributes and thus each has a huge potential to develop. Brazil is extremely rich in resources such as coffee, soybeans, sugar cane, iron ore, and crude oil, with around 60 million hectares of arable land (just 7 per cent of its land area) but with an agricultural area of 31.2 per cent of the total land area. Russia is noted for its massive deposits of oil, natural gas, and minerals. India is a strong service provider with a rising manufacturing base, while China is seen as the manufacturing workshop of the world with a highly skilled workforce and relatively low wage costs. South Africa is the 26th largest economy in the world, with a GDP of US$ 357 billion. It is a medium-sized country with a total land area of slightly more than 1.2 million sq. km and around 12 per cent arable land area. It is the world's largest producer of platinum and chromium and holds the world's largest known reserves of manganese, platinum group metals, chromium, vanadium, and alumino-silicates. South Africa generates 45 per cent of Africa's electricity and the South African power supplier provides the 4th cheapest electricity in the world.

Table 1.2 Land Use in BRICS, 2008

Country	Land Area (1,000 ha)	Arable Land (1,000 ha)	Area Harvested for Cereals (1,000 ha)	Production of Cereals (1,000 tonne)	Irrigated Land (1,000 ha)	Irrigated Land (per cent of arable land)
1	2	3	4	5	6	7
Brazil	845,942	61,000	20,220	71,288	4,500	6.6
Russia	1,637,687	121,649	41,716	95,079	4,346	3.5
China	932,749	108,642	88,593	483,680	64,141	52.3
India	297,319	158,145	99,880	246,774	62,286	36.8
South Africa	121,447	14,500	3,319	14,586	1,498	9.7
World	**13,003,469**	**1,380,515**	**708,495**	**2,489,302**	**306,247**	**21.1**

Source: *FAO Statistical Year Book*, 2010.

Economic Growth

It is widely perceived that over the next few decades the growth generated by the largest developing countries, particularly the BRICS, could become a much more significant force in the world economy. Among the BRICS, India and Brazil are relatively more domestic demand-driven economies. As a group, they witnessed faster economic recovery from the 2008 financial crisis than advanced and other emerging market economies (EMEs). Although they have strong external linkages, they have nonetheless undergone significant rebalancing of their economies towards their domestic sectors in the post-crisis period. According to an estimate by Goldman Sachs, the four original BRIC countries are expected to represent 47 per cent of global GDP by 2050, which would dramatically change the list of the world's 10 largest economies. An important change that we may expect over the medium to long term is that the top 10 countries in terms of GDP may be different from the top 10 countries in terms of per capita GDP.

The inherent strength of the BRICS emanates from strong domestic demand-based economies in the case of India and Brazil and the significant outward linkages of China and Russia. South Africa benefits from its large resource base and proximity to untapped growth potential of the African continent.

Among the BRICS, China, followed by India, are the fastest-growing economies in the current decade. Between 1978 and 2009, the Chinese economy grew at an average annual rate of 9.9 percent, which is much higher than the world average for the period. The growth performance of Russia and Brazil also improved significantly after the financial crises of the 1990s.

The sustained economic reforms and improved macroeconomic fundamentals along with a buoyant macroeconomic environment contributed to the improved growth performance of the BRICS in the current decade (Table 1.3).

The strong growth performance of the BRICS is attributed to strong macroeconomic fundamentals, as reflected by the high savings and investment rates, even though Brazil and South Africa still have room to increase these rates. South Africa's investment ratio has increased strongly over the past decade as government and public corporations have stepped up infrastructure investment, but overall investment is constrained by low savings.

Among the BRICS, China has the highest saving and investment rates followed by India. High savings have also helped reduce the contribution of net exports to GDP in the case of China and India. As a result, high investment-led growth was largely financed by domestic savings (Table 1.4).

The salient features of the BRICS economies are their large geographical dimensions and size of population. It is widely perceived that all the BRICS markets have great potential for establishing the most stabilising of forces, that is, a prosperous middle class. This middle-income group in each country is growing at varying rates but the future direction is clear, that is, the middle class will both broaden and deepen, providing a solid base for the growth and development of the economies.

Linkages between Agriculture, Industry, and Services Sectors

The output structures in the BRICS economies have changed significantly when compared to previous decades. The declining share

Table 1.3 Growth Rate of Gross Domestic Product

(per cent)

	1991–2002	2002	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9
BRICS								
Brazil	2.6	2.7	3.2	4.0	6.1	5.2	–0.6	7.5P
Russia	–	4.7	6.4	8.2	8.5	5.2	–7.8	4.0P
India	5.7	4.6	9.2	9.8	9.4	7.3	5.7	10.4
China	10.3	9.1	10.4	11.6	13.0	9.6	8.7	10.3
South Africa	2.1	3.7	5.3	5.6	5.8	3.7	–1.7	2.8
Advanced Economies	2.8	1.7	2.7	3	2.8	0.5	–3.2	3.0
Euro Area	2.1	0.9	1.7	3	2.8	0.6	–4.1	1.7
USA	3.5	1.8	3.1	2.7	2.1	0.4	–2.4	2.8
World	**3.2**	**2.9**	**4.5**	**5.1**	**5.2**	**3.0**	**–0.6**	**5.0**

Source: *World Economic Outlook*, IMF (2011).
Note: P: Projection; – Not available.

Table 1.4 Gross Domestic Investment and Savings

(per cent to GDP)

Country		1990	1995	2000	2006	2007	2008	2009	2010
1		2	3	4	5	6	7	8	9
Brazil	Investment	20.2	18	18.3	16.8	18.3	20.7	16.5	19.3
	Saving	21.4	16.5	16.5	19.7	18.8	18.4	16.1	17.0
Russia	Investment	–	25.4	18.7	21.4	24.1	26.2	22.7	19.8
	Saving	–	28.8	38.7	34.1	33.2	34.9	33	24.7
India	Investment	24.2	26.6	24.2	36	37.6	35.6	34.5	37.9
	Saving	22.7	25.4	23.2	32.9	33.5	30.2	29.8	34.7
China	Investment	36.1	41.9	35.1	43.6	41.7	42.5	44.8	48.8
	Saving	39.6	44.1	37.5	51.3	50.5	50.2	54.2	54.0
South Africa	Investment	–	18.2	15.9	19.7	21.3	22.0	19.4	21.7
	Saving	19.1	16.5	15.8	14.4	14.1	14.9	15.4	20.0

Source: World Bank Database.

Note: – Not available.

of agriculture in their respective GDPs has been a common trend over the years. While there has been considerable stability in agricultural growth in Brazil and Russia during 2000–5 compared to earlier decades, agricultural performance in India and China has shown greater volatility. However, Russia has experienced a decline in share of agriculture from 7.6 per cent in 1995 to 4.9 per cent in 2008, while Brazil's share remained relatively stable between 1995 and 2008 (Table 1.5). Another common trend is the rising share of services in BRICS country GDPs since 1990. In China, industry continues to dominate in GDP at around 42.8 per cent in 2008 (around 35.5 per cent in 1990), while the share of services has increased from 38.5 per cent in 1990 to 45.7 per cent in 2008.

Agri-business plays a central role in Brazil's economic development, engaging 35 per cent of its workforce and contributing to almost 42 per cent of its export dollars. Brazilian agriculture has undergone dramatic changes in the past few decades. From a net importer of food grains until the 1970s, Brazil has emerged as the major net exporter of food products. A similar trend is witnessed in the case of India, where the Green Revolution and developments in biotechnology helped the country become self-reliant in food production. With increasing global demand for food and scarcity of arable land in the world, agronomic conditions will enable Brazil to continue its growth and become a larger supplier of agricultural commodities to nations around the world. In China, especially since 1991 with the introduction of the socialist market economy system, many changes in urban areas were ushered in. The share of primary industry rapidly went down, while that of the secondary and tertiary industries increased. In Russia, there are measures to implement the National Project in agro-industrial complex. Among the BRICS, South Africa has the smallest share of agriculture in GDP, at around

Table 1.5 Sectoral Share in GDP

(percentage to GDP)

Country	Sectors	1990	1995	2000	2005	2008	2009
1	2	3	4	5	6	7	8
Brazil	Agriculture	10.1	5.8	5.6	5.7	5.9	6.1
	Industry	29.9	22.0	27.7	29.3	27.9	25.4
	Services	60.0	72.2	66.7	65.0	66.2	68.5
Russia	Agriculture	–	7.6	6.7	5.4	4.9	4.7
	Industry	–	27.9	31.4	32.9	29.7	32.9
	Services	–	64.6	62.0	61.6	65.6	62.4
India	Agriculture	30.0	26.8	23.2	18.9	19.0	17.1
	Industry	22.3	23.2	20.7	21.0	21.0	28.2
	Services	47.7	50.0	56.1	60.0	60.0	54.6
China	Agriculture	26.0	19.7	15.2	12.2	11.6	11.0
	Industry	35.5	40.6	40.7	42.2	42.8	48.0
	Services	38.5	39.7	44.1	45.6	45.7	41.1
South Africa	Agriculture	4.6	3.9	3.3	2.7	3.2	3.0
	Industry	40.1	34.8	31.8	31.2	32.5	31.1
	Services	55.3	61.3	64.9	66.2	64.3	65.8

Source: United Nations System of National Accounts.

Note: – Not available.

3 per cent and its services sector accounts for more than 60 per cent of the total GDP.

In terms of the World Economic Forum ranking on global competitiveness, China ranks 27 (out of 139 countries) in 2010–11, while the rest of the BRICS economies are placed at 51 (India), 54 (South Africa), 58 (Brazil), and 63 (Russia), respectively. The better rank of China can be attributed to its large market size (2), macroeconomic environment (4), and innovation (26). The ranks of various indicators of competitiveness suggest that the BRICS have strong and deep markets, which is also evident in the case of South Africa (Table 1.6).

Education, Inequality, Demographic Trends, and Other Social Indicators

The demographic dividend that BRICS economies enjoy, in comparison with rapidly aging societies and longer life-expectancies in advanced countries, is likely to benefit the group in the future. The share of the urban population is rising and the child-dependency ratio is falling, pointing to a rising share of the working age population. The increasing labour force shows the huge demand-and-supply potential in the BRICS economies (Table 1.7).

Though these economies are better placed demographically than advanced countries, a decline in the working age population is expected to take place at a faster pace in some of the BRICS countries. At present, the population in the age group of 0 to 14 years is the highest in India (32.1 per cent), followed by Brazil (27.9 per cent), China (21.4 per cent), and Russia (15.3 per cent). It is expected that the average age of the population in India will decline, before it begins to

Table 1.6 Rank on Global Competitiveness Index (GCI), 2010–11

Country	Global Competitive Index	Infrastructure	Macroeconomic Environment	Higher Education and Training	Market Size	Business Sophistication	Innovation
1	2	3	4	5	6	7	8
Brazil	58	62	111	58	10	31	42
Russia	63	47	79	50	8	101	57
India	51	86	73	85	4	44	39
China	27	50	4	60	2	41	26
South Africa	54	63	43	75	25	38	44

Source: *Global Competitiveness Report 2010–11*, World Economic Forum.

Table 1.7 Population and Demographic Profile of BRICS

Country	Total Population (million)		Urban Population (per cent of total)		Dependency Ratio		Total Fertility Rate (births per woman)	
	1990	2010	1990	2010	1990	2010	1990–5	2005–10
1	2	3	4	5	6	7	8	9
Brazil	149.6	195.4	73.9	86.5	65.9	47.9	2.6	1.7
Russia	148.1	140.4	73.4	73.2	49.4	38.7	1.6	1.5
India	862.2	1214.5	25.6	30.0	71.5	55.6	3.9	2.5
China	1142.1	1354.1	26.4	47.0	51.2	39.1	2.0	1.8
South Africa	36.7	50.5	52.0	61.7	72.7	53.6	3.3	2.4

Source: *Human Development Report*, UNDP.

Note: Data for 1990 in the case of Russia has been taken from *HDR* 2010.

rise after 25 years. According to projections by the United Nations, the median age in India will cross 30 only by 2025 and will remain at around 35 until 2040. In 2020, the average Indian will be only 29 years old, compared with the average age of 37 years in China and the US, 45 years in Western Europe and 48 years in Japan.

As projected, China's population would peak at around 1.5 billion in the beginning of 2030s and decline slowly afterwards. According to government estimates, the population of India is expected to increase from 1,029 million to 1,400 million during the period 2001–26, which is an increase of 36 per cent in 25 years at the rate of 1.2 per cent annually.

According to 2010 data, India has an urbanization rate of less than 30 per cent, and China's a little more than 40 per cent, while Russia's and Brazil's rates are 73 and 85 per cent, respectively. In the case of South Africa, about 61.7 per cent of the population lives in urban areas. Judging from these data, it is evident that China and India still have much room for urbanization, which will become an engine for their future growth. South Africa's fertility rate has declined over the past decade due to rapid urbanization and the high prevalence of HIV/AIDS.

The BRICS economies have to work together to improve living conditions for their populations and the quality of social services. Various social sector indicators suggest that there is a large scope for improvement in all the BRICS economies (Table 1.8). Among the BRICS, the Russian Federation ranks highest (71st out of 169 countries) in terms of the Human Development Index (HDI, 2010), while South Africa (129th) and India (134th) are ranked the lowest. South Africa has fairly high adult literacy rates (per cent of population 15 years and older) for both males (88.9 per cent) and females (87.2 per cent) (HDI, average for 1999–2007).

Table 1.8 Social Sector Indicators, 2007

	Brazil	Russia	India	China	SA
1	2	3	4	5	6
Human Development Index (HDI, 2007)					
HDI Rank	75	71	134	92	129
Adult Literacy (per cent of 15 yrs and above during 1999–2007)					
Male	89.8	99.7	76.9	96.5	88.9
Female	90.2	99.4	54.5	90	87.2
Child-related Indicators					
Gross Enrolment Ratio (2007)	87.2	81.9	68.7	61.0	76.8
Children under Age 0–5 yrs (during 2000–6)	6	3	46	7	12
Population below Income					
National Poverty Line	21.5	19.6	28.6	2.8	–
Population not Using Improved Water Supply (2006)	9	3	11	12	7
Life Expectancy (yrs)					
Male	68.6	59.9	62.0	71.3	53.2
Female	75.9	72.9	64.9	74.7	49.8
Inequality Measures					
Richest 10 per cent to Poorest 10 per cent	40.6	11	8.6	13.2	35.1
Gini Index	55.0	37.5	36.8	41.5	57.8

Source: UNDP, *Human Development Report*, 2010.
Note: – Not available.

Better quality healthcare provision has reduced infant mortality in Brazil (from 47 per 1,000 live births in 1990 to 22.5 in 2009), contributing to an improvement in the well-being of the Brazilian population, which is somewhat witnessed in Russia as well.

Fiscal Sector

As a result of the 2007–9 crisis, fiscal stability in many countries deteriorated. Most countries encountered rising fiscal deficits and public debts and, therefore, had to implement fiscal consolidation. Fiscal consolidation was the main point on the agenda of the G-20 Summit in Toronto, June 2010. G-20 leaders agreed to implement responsible economic policies, eliminate fiscal deficits resulting from stimulus programmes, and prevent the escalation of growth in public debt. In particular, it was decided to reduce the fiscal deficit twofold in three years.

BRICS economies have different political systems. Therefore, the political environments under which reforms are initiated and implemented are quite distinct. For instance, China has a socialist democratic political system. India is a federal republic that has a democratic set-up with a parliamentary system similar to England; India is also the world's largest voting republic, with participatory multi-party democracy. The politics of Russia and Brazil take place within the framework of a federal presidential republic. South Africa has been a constitutional multi-party democracy since the end of Apartheid in 1994. In all the BRICS countries, governments have played a significant role in the growth and development process.

In early 2000, the BRICS initiated fiscal consolidation measures. In addition to putting in place the Fiscal Responsibility Law

(FRL), Brazilian authorities are committed to maintaining primary surplus targets stipulated in the draft Budget Guidelines Law every year. Similarly, in India, the fiscal position of the central government underwent consolidation in terms of targeted reduction in fiscal deficit indicators under the Fiscal Responsibility and Budget Management (FRBM) Act. In the same manner, Chinese authorities showed their commitment to reform the budget process. In the late 1990s, South Africa took steps to improve the transparency of budgeting by publishing medium-term expenditure estimates over a three-year horizon. This coincided with a period of debt consolidation to reduce interest payments and reforms to improve the efficiency of tax collection.

Russia has taken a number of steps to achieve this goal. Already in the Law on Federal Budget for 2011–13, a substantial reduction in deficit (resulting, in part, from the fall in public spending/GDP ratio) was envisaged. The deficit was to decline from 5.9 per cent of GDP in 2009 to 3.6 per cent of GDP on 2011 and, further to 2.9 per cent of GDP in 2013. In practice, actual market conditions helped significantly improve fiscal balance forecasts. The Law on Federal Budget for 2012–14 envisages reduction in deficit to 1.6 per cent of GDP in 2013 and 0.7 per cent of GDP in 2014. Fiscal consolidation also featured prominently in the Budget Address of the President, which required elimination of federal budget deficit by 2015.

Apart from reducing the deficit, a number of other important measures were taken in Russia to achieve medium- and long-term budget stability. In particular, it was decided to re-expand the Reserve Fund and to re-introduce fiscal rules (which were cancelled during the crisis) in 2015; the latter will be modified taking into account the crisis experience.

Already at the end of 2011, a substantial part of fiscal oil and gas revenues will be transferred to the Reserve Fund, which was significantly depleted during the crisis when it was the main source of financing the government's stimulus programme. In fact, most of the extra revenues (as compared to the original Law on Budget) resulting from the favourable external conditions will be transferred there; only a small part has been used to increase expenditures. Expansion of the Reserve Fund is also planned for 2012–14.

Currently, in Russia, there is an active discussion (in the framework of expert groups on the update of '2020 Strategy') of new budgetary rules to be implemented in the near future. These rules will likely put upper bounds on federal public expenditures depending on the external parameters and contribute to the medium- and long-term fiscal stability.

In contrast to China, India, and Brazil, Russia being an oil-surplus economy has a surplus in general government accounts, driven mainly by a sharp rise in oil prices in recent years. India's fiscal deficit was the highest even before the emergence of the global financial crisis (Table 1.9).

Table 1.9 Fiscal Deficit of General Government

(percentage of GDP)

Country	1998	2000	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8
Brazil	–6.5	–3.84	–3.5	–2.36	–1.4	–3.1	–2.9
Russia	–8.0	3.3	8.3	6.8	4.9	–6.3	–3.6
India	–7.8	–9.3	–5.3	–4.0	–8.0	–10.0	–9.4
China	–2.8	–3.3	–0.7	0.9	–0.4	–3.1	–2.6
South Africa	–	–1.5	0.8	1.4	–0.5	–5.2	–5.8

Source: IMF Database.
Note: – Not available.

In some BRICs economies, the global economic slowdown has impacted on fiscal consolidation targets negatively. During 2008 and 2009, the fiscal position of all the BRICS economies worsened mainly due to countercyclical expansionary fiscal measures to augment domestic demand. Even Russia, which had mostly managed its fiscal surplus in the recent past, saw a deterioration in the fiscal situation during 2009. Despite large fiscal expansionary measures in 2009, Brazil and China maintained better fiscal balance among the BRICS (Table 1.10).

High and rising levels of gross debt imply significant risks for the economy as demonstrated by the recent European debt crisis. In the long run, persistently high levels of public debt make economies more vulnerable to adverse shocks, reduce their long-run growth potential, and endanger the prospects for monetary stability. Among the BRICS, India and Brazil have the largest gross debt-to-GDP ratio at around 69 per cent and 66 per cent of GDP, respectively, in 2010 (Table 1.11).

Looking ahead, with the current level of unemployment and fragile macroeconomic environment, fiscal consolidation in the years to come will be a challenge for the BRICS (Table 1.12). In the case of India, Brazil, and South Africa, in view of the gap in terms of socio-economic performance and widespread deprivation, carrying out required government fiscal consolidation is a major challenge. On balance, the consolidation of economic recovery in the BRICS, along with global economic recovery, would be crucial for moving towards fiscal consolidation.

The planned composition of fiscal adjustment during 2010–15 differs among the BRICS economies. From the broad announcements made so far, it appears that India intends to rely on revenue measures, while Russia and South Africa foresee greater reliance on a

Table 1.10 Fiscal Balance of General Government

(percentage of GDP)

Year	Brazil		Russia		India		China		South Africa	
	Revenue	Expenditure	Revenue	Expenditure	Revenue	Expenditure	Revenue	Expenditure	Revenue	Expenditure
1	2	3	4	4	5	6	7	8	9	10
1998	27.8	42.3	34.6	42.5	16.1	23.9	12.1	14.9	–	–
2000	30.4	35.3	36.2	32.8	16.6	26.0	13.8	17.1	26.3	27.9
2001	31.3	37.2	36.9	33.7	16.6	26.1	15.1	17.9	27.4	27.8
2002	31.9	39.5	37.0	36.3	17.1	26.4	15.9	18.9	26.4	27.5
2003	31.4	39.2	36.4	34.9	17.5	26.1	16.2	18.6	26.6	29.0
2004	32.2	37.6	36.6	31.7	18.2	25.4	16.6	18.1	28.1	29.9
2005	33.4	39.2	41.0	32.8	18.4	24.8	17.2	18.6	30.1	29.9
2006	33.4	39.4	39.5	31.1	19.4	24.7	18.2	18.9	31.6	30.4
2007	33.9	38.3	39.9	33.1	21.0	25.0	19.8	18.9	31.8	30.5
2008	34.1	38.0	38.6	34.3	19.7	27.2	19.7	20.0	30.7	30.9
2009	33.1	39.3	34.3	40.5	18.9	28.5	20.0	23.0	27.3	32.4
2010	37.4	40.3	35.3	38.9	17.5	26.5	20.4	22.9	27.5	33.3

Source: IMF Database.
Note: – Not available.

Table 1.11 Gross Debt of General Government

(percentage of GDP)

	1998	2000	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8
Brazil	–	66.7	66.7	65.2	64.1	68.9	66.1
Russia	–	59.9	9.0	8.5	7.8	10.9	9.9
India	65.4	71.4	76	72.9	72.6	74.2	69.2
China	11.4	16.4	16.5	19.8	16.8	18.6	17.7
South Africa	–	42.0	31.4	27.4	26.7	30.1	35.7

Source: IMF Database.
Note: – Not available.

Table 1.12 Fiscal Consolidation Policy

Country	Medium-term Fiscal Target
Brazil	Fiscal consolidation is being carried out. The R$ 50 billion budget cut announced in March 2011 by the government derives from a review on net revenues, as well as cuts in expenses. Mandatory spending will be reduced by R$ 15.8 billion, whereas discretionary spending will be cut by R$ 34.3 billion during 2011. In order to make the former feasible, the government has adopted a set of measures regarding payroll and hiring, unemployment and social benefits, as well as grants and subsidies. Public investment remains low by international standards but is expected to increase substantially under the Growth Acceleration Programme (PAC).
Russia	Reflecting a gradual unwinding of the anti-crisis package, in 2010 the general government deficit was projected to improve by 3 per cent of GDP. Beyond 2010, the authorities' 2010–12 federal government budget implies a steady decline in the non-oil balance by about 1–2 per cent of GDP a year to 9.5 per cent of GDP by 2012, mainly through lower spending on public administration and low-priority infrastructure projects, but also higher social security contributions. Over the longer term, the authorities plan to reduce the non-oil deficit to their sustainable target of 4.7 per cent of GDP by 2013.

(*Contd*)

Table 1.12 (*Contd*)

Country	Medium-term Fiscal Target
India	Gradual fiscal consolidation is envisaged by reducing the central government fiscal deficit to 3 per cent of GDP by 2013–14. The planned reduction would be mainly revenue-driven, from higher growth and from measures to simplify the tax code, raise voluntary compliance, and reduce exemptions.
China	The fiscal stimulus package is temporary with an explicit timeline through 2010. It was decided that China would continue with its proactive fiscal policy in 2011.
South Africa	South Africa will continue to manage public finances in a countercyclical manner to support long-run fiscal sustainability. The narrowing of the consolidated government balance will continue over the medium-term expenditure framework. This will be done through a moderation in the growth of expenditure and a recovery in revenue in line with the economic cycle. The public sector will continue to support large-scale infrastructure projects to address transportation, water, and energy sector bottlenecks. Social income grants provide a safety net for the poor, while initiatives to support job creation will be intensified. The ratio of debt to GDP is expected to stabilize in 2015–16 before declining.

combination of revenue and expenditure management (Table 1.13). On the other hand, Brazil, which comes under the category of medium and low need of fiscal adjustment, has yet to lay out detailed plans. It was decided that China would continue its proactive fiscal policy to maintain economic growth and curb price rise in 2011.

Once the growth process has recovered, the BRICS economies need to revert to a path of fiscal consolidation. As a result, demand should emanate from private sources, given the widespread rollback of large fiscal deficits. The most urgent challenge is to put in place credible fiscal consolidation plans to achieve sustainable fiscal

Table 1.13 Composition of Fiscal Adjustment Plans

Fiscal Adjustment Need	Mostly Revenue	Revenue and Expenditure	Mostly Expenditure	Detailed Plans in Preparation
HIGH (> 6 per cent)	India			
MEDIUM (3– 6 per cent)				China & South Africa
LOW (< 3 per cent)		Russia		Brazil

Source: *World Economic and Financial Survey*, IMF, May 2010.

positions before the end of the next decade. These would have to include reforms of the rapidly growing social spending programmes and entitlements and broadening of tax bases. The timing and sequencing of exit from monetary and fiscal stimulus in emerging economies will vary according to country circumstances.

Monetary Policy Framework

The BRICS economies operate under varied monetary policy frameworks (Table 1.14). Brazil and South Africa have inflation targeting regimes, while China, India, and Russia operate under different frameworks.

The Central Bank of Brazil's (BCB) Monetary Policy Committee (COPOM) was created on 20 June 1996, and assigned the responsibility of setting the stance of monetary policy and the short-term interest rate. The aim in creating COPOM was to enhance monetary policy transparency and confer regularity to the monetary policy decision-making process. Brazil implemented a formal inflation-

Table 1.14 Monetary Frameworks in BRICS

Country	Monetary Policy Framework	Key Monetary Policy Tools	Objectives
Brazil	Inflation targeting	Interest rate (Selic rate): Interest rate on overnight interbank loans collateralized on federal debt instruments	Inflation: Point target of 4.5 per cent with tolerance range of 2 percentage points for headline CPI
Russia	No single target indicator - Inflation (CPI) target for 3-year period - Managed floating exchange rate regime	OMOs and standing facilities; reserve requirements	To ensure stability of national currency
India	Multiple Indicators Approach	Key policy rate: Repo/reverse repo rate and reserve requirements, CRR and SLR	Maintain price stability, financial stability, and ensure appropriate flow of credit to productive sectors
China	Multiple Indicators Approach	Reserve requirement ratio, central bank base interest rate, rediscounting, central bank relending, open market operation, and other policy instruments specified by the State Council	Maintain the stability of the value of the currency and thereby promote economic growth
South Africa	Inflation targeting	Key policy rate: Repurchase rate	Inflation target range for headline CPI of 3–6 per cent combined with financial stability objective

targeting framework for monetary policy in June 1999. Under this regime, COPOM's monetary policy decisions have as their main objective the achievement of the inflation targets set by the National Monetary Council (CMN). If inflation breaches the target set by the CMN, the Governor of the Central Bank is required to write an open letter to the Minister of Finance explaining the reasons for missing the target, as well as measures required to bring inflation back to the target, and the period over which these measures are expected to take effect.

In Brazil the central bank's main policy instrument is the overnight, inter-bank interest rate, called the Over-Selic rate. The target for the Over-Selic rate is set at regular meetings of the BCB's Monetary Policy Committee (COPOM). The Open Market Operations Department (Demab) is responsible for carrying out open market operations to keep the Over-Selic rate as close as possible to the target established by COPOM.

Since 2006, eight regular meetings of COPOM have been held, with each lasting for two days. Eight days after each meeting, the Committee releases the meeting minutes on the Central Bank's website and to the press through the Central Bank's press officer. At the end of each quarter (March, June, September, December), COPOM publishes the Central Bank's *Inflation Report*, which provides detailed information on economic conditions, as well as COPOM's inflation projections from its most recent meeting.

Monetary policy, conducted by the Bank of Russia, is designed to maintain financial stability and create conditions conducive to sustainable economic growth. In the 2000s, Russia's monetary policy was geared at containing inflation and smoothing fluctuations of the nominal exchange rate. In the past few years the scaling down of interventions in the domestic foreign exchange market, the increased flexibility of the exchange rate, and the gradual winding up of anti-crisis measures stimulated the role of interest rate policy in reducing inflation. The principal objective of monetary policy over the next three years is to reduce inflation to an annual rate of 5 per cent.

At present monetary policy instruments used by the Bank of Russia are open market operations, standing facilities, and reserve requirements. The Bank of Russia influences interest rates through its open market operations and standing facilities: the upper limit of the interest rate corridor is the fixed rate on overnight refinancing operations (REPO and lombard loans) and the lower limit is the fixed overnight deposit rate.

The Bank of Russia has been implementing its exchange rate policy in the context of the managed floating regime, aimed at mitigating the effect of external shocks on the Russian economy. The operational benchmark of the exchange rate policy is the rouble value of the bi-currency basket, currently consisting of 0.45 euro and 0.55 US dollar. The Bank of Russia uses the floating operational intra-day band of fluctuations in the value of the bi-currency basket.

As the monetary authority of the country, the Reserve Bank of India (RBI) formulates, implements, and monitors monetary policy with the objective of maintaining price stability and ensuring adequate flow of credit to productive sectors. Monetary policy in India evolved with increasing current and capital account liberalization, liberalization of the financial sector, changing patterns of credit requirements of the real sector, and rapid changes in the world economic scenario. The operating procedure of monetary policy in terms of targets and instruments, therefore, saw substantial changes.

The twin objectives of monetary policy, that is, maintaining price stability and ensuring availability of adequate credit to productive sectors of the economy to support growth, have remained unchanged, though their relative emphasis varied depending on the circumstances. In line with this, in recent years, a preference emerged for a soft and flexible interest rate environment within the framework of macroeconomic stability. The use of broad money as an intermediate target has been de-emphasised, but the growth in broad money (M3) continues to be used as an important indicator of monetary policy. A multiple-indicators approach was adopted in 1998–9, wherein interest rates or rates of return in different markets (that is, money, capital, and government securities markets) along with high frequency data on currency, credit extended by banks and financial institutions, fiscal position, trade, capital flows, inflation rate, exchange rate, refinancing and transactions in foreign exchange are juxtaposed with output data to draw policy perspectives.

With the increasing market orientation of the financial structure and deregulation of the operations of commercial banks, the RBI has restructured its armoury of instruments with direct instruments gradually giving way to indirect ones. The thrust of monetary policy in recent years has been to develop an array of instruments to transmit liquidity and interest rate signals in the short term in a more flexible and bi-directional manner. A Liquidity Adjustment Facility (LAF) was introduced in June 2000 to modulate short-term liquidity and signal short-term interest rates. The LAF operates through repo and reverse repo auctions, thereby setting a corridor for the short-term interest rate consistent with policy objectives. The RBI is able to modulate the large market borrowing programme by combining strategic devolvement/private placement of government securities with active open market operations.

In China, the objective of the monetary policy is to maintain the stability of the value of the currency and thereby promote economic growth. The monetary policy instruments applied by the People's

Bank of China (PBC) include the reserve requirement ratio, central bank base interest rate, rediscounting, central bank lending, open market operations, and other policy instruments specified by the State Council.

The Monetary Policy Committee in China plays an important role in macroeconomic management and in the formulation and adjustment of monetary policy. The responsibilities, composition, and working procedures of the Committee are prescribed by the State Council. The rules of the Committee stipulate that it is a consultative body responsible for the formulation of monetary policy by the PBC; its responsibilities are to advise on the formulation and adjustment of monetary policy and policy targets for a certain period, application of monetary policy instruments and major monetary policy measures, and coordination between monetary policy and other macroeconomic policies. The Committee plays its advisory role based on comprehensive research on macroeconomic situations and the macro targets set by the government. The Committee performs its functions through regular quarterly meetings. An ad hoc meeting is held in case it is proposed by the Chairman or endorsed by more than one-third of the members of the Monetary Policy Committee.

The mandate of the South African Reserve Bank (SARB) is defined in the Constitution of the Republic of South Africa as 'the protection of the value of the currency in the interest of balanced and sustainable economic growth in the Republic'. Deriving from this constitutional mandate, the Bank regards its primary goal in the South African economic system as 'the achievement and maintenance of price stability'. Inflation targeting was adopted as a framework for monetary policy in February 2000 with the aim of achieving and maintaining headline CPI inflation within a range of 3–6 per cent on a continuous basis.

The government sets the inflation target in consultation with the Reserve Bank. The monetary policy committee (MPC) meets at least six times per year. Decisions are announced immediately after the meeting at a televised press conference and the MPC statement is published on SARB's website. The minutes are not published, but the bi-annual *Monetary Policy Review* discusses factors influencing inflation and risks to the outlook. SARB engages directly with the public twice a year at Monetary Policy Forums that are held in major centres around the country. In addition, the Governor of SARB appears before the Parliament's Portfolio Committee on Finance at least three times a year.

The SARB implements inflation targeting in a flexible and forward-looking manner taking cognisance of external shocks to the economy, as well as other factors such as changes in the output gap and domestic imbalances. Financial stability is also an important objective of SARB.

SARB has also focused on maintaining and improving its domestic market operations. Liquidity in the domestic and international interbank markets is carefully monitored. Although contingency plans were put in place and communicated to the banking counterparties, it was not necessary to provide any additional or special liquidity to domestic banks beyond the normal daily operations during the global financial crisis and subsequent recession.

The MPC takes cognisance of movements in the exchange rate and their potential impact on inflation in determining policy rates. However, the rand is a freely floating exchange rate and SARB does not try to influence the level of the currency. Interventions, if any, are aimed at smoothing out excessive currency volatility in the short term through open-market operations. Over the past few years, reserve accumulation has been necessary to reduce South Africa's external vulnerability in the face of a rising current account deficit.

Price Situation

Over the past few years, large fluctuations in the prices of industrial and agricultural commodities combined with volatile exchange rates have increased the volatility of inflation in BRICS economies, particularly India, China, and South Africa (Table 1.15). Among the BRICS, Russia, Brazil, and South Africa received the direct positive impact of high commodity prices, while they acted as constraints on growth for China and India. In the second half of 2010, central banks grappled with the balancing act of anchoring high inflation along with managing fragile economic growth.

Table 1.15 Inflation: Average Consumer Prices

(per cent change)

Country	2000	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8
Brazil	7.1	6.9	4.2	3.6	5.7	4.9	5.0
Russia	20.8	12.7	9.7	9.0	14.1	11.7	6.9
India	4.0	4.2	6.2	6.4	8.3	10.9	13.2
China	0.4	1.8	1.5	4.8	5.9	–0.7	3.3
South Africa	5.4	3.4	4.7	7.1	11.5	7.1	4.3

Source: IMF.

External Sector

Global integration of most of the emerging market economies, in general, and the BRICS in particular, gained momentum in the

1990s, mainly on account of the structural adjustments adopted by these economies. The financial sector developments in these economies enhanced trade and capital flows along with increased technology transfers and mobility of labour. Increased global integration is highly visible in terms of the openness of the BRICS economies through higher share in global trade and other financial flows, which enhanced the growth potentials of these economies (Table 1.16). Integration changed the course of development of the BRICS economies through active management of their external liabilities and assets across segments. This resulted in minimizing external sector vulnerabilities, which helped the BRICS economies withstand the recent global financial crisis and its aftershocks.

Merchandise Trade and Invisible Flows

The share of the BRICS in global trade continued to grow at a rapid pace. Their share in world exports increased substantially over the past decade mostly through broad-based diversification, both in commodities and regions of trade, while imports witnessed a sharp rise that was driven by increased investment and consumption demand led by the increasing purchasing power of these economies (Table 1.17).

BRICS EXPORTS

All the BRICS economies maintained persistent trends of rising share of exports in GDP, reflecting the structural transitions witnessed by these economies in exploring avenues for exports based on comparative advantage and supported by productivity gains (Table 1.18).

Table 1.16 Global Integration of BRICS Economies

	Share in World Trade		Trade Openness		Current Account Balance (per cent of GDP)		Forex Reserves (per cent of GDP)		External Debt (US$ billion)		Debt Service Ratio	
Country	1990	2010	1990	2010	1990	2010	1990	2010	1990	2009	1990	2009
1	2	3	4	5	6	7	8	9	10	11	12	13
Brazil	0.8	1.2	6.9	11.2	0.8	–2.3	1.5	13.7	119.7	276.9	22.5	23.4
Russia	–	2.3	–	30.3	–	4.9	0.0	30.4	–	381.3	4.4	17.7
India	0.5	1.8	6.9	21.7	–1.2	–3.2	0.5	18.0	85.7	237.7	34.9	5.9
China	1.6	9.2	17.4	29.5	1.3	5.2	7.6	48.8	55.3	428.4	11.7	2.9
South Africa	0.6	0.5	24.3	27.9	1.4	–2.8	0.9	10.7	23.3	42.1	–	9.3

Source: IMF, UNCTAD, and World Bank.

Note: – Not available.

Table 1.17 BRICS Share of Global Trade

(per cent)

	1990	1995	2000	2005	2008	2009	2010
BRICS	3.6	6.0	7.0	11.2	13.6	13.7	15.0
Brazil	0.8	0.8	0.8	1.0	1.1	1.1	1.2
Russia	–	1.5	1.4	2.1	2.6	2.2	2.3
India	0.5	0.6	0.7	1.2	1.5	1.6	1.8
China	1.6	2.6	3.5	6.4	7.9	8.3	9.2
South Africa	0.6	0.5	0.5	0.5	0.5	0.5	0.5

Source: UNCTAD.
Note: – Not available.

Table 1.18 BRICS Exports of Goods and Services

(per cent of GDP)

Country	1990	1995	2000	2005	2008	2009	2010
Brazil	6.9	6.8	10.1	15.1	13.8	11.3	11.2
Russia	–	29.8	44.3	35.2	31.5	28.2	30.3
India	6.9	10.2	12.3	18.8	23.7	20.1	21.7
China	17.4	23.1	23.3	37.1	34.9	26.7	29.5
South Africa	24.3	22.8	27.8	27.4	35.9	27.7	27.9

Source: UNCTAD.
Note: – Not available.

The composition of BRICS exports changed drastically over the past two decades due to structural changes across the sectors of these economies during the period. Though the BRICS are still known for exports of natural resources, these economies moved from being exporters of primary products to exporters of manufactured products. Likewise, their export destinations have undergone dramatic changes in response to globalization and liberalization which, in turn, helped the BRICS increase their share in global trade (Table 1.19).

Table 1.19 BRICS Share in World Exports

	1990	1995	2000	2005	2008	2009	2010
BRICS	3.9	6.5	7.5	12.2	14.8	15.1	16.3
Brazil	0.9	0.9	0.9	1.1	1.2	1.2	1.3
Russia	–	1.6	1.6	2.3	2.9	2.4	2.6
India	0.5	0.6	0.7	0.9	1.2	1.3	1.4
China	1.8	2.9	3.9	7.3	8.9	9.6	10.4
South Africa	0.7	0.6	0.5	0.5	0.5	0.5	0.6

Source: UNCTAD.
Note: – Not available.

Despite the fact that all the BRICS economies having significant human capital endowments, the difference in their resource endowments are reflected in their export baskets. For instance, manufactures account for 93.6 per cent of total merchandise exports from China in contrast to 66.0 and 51.8 per cent from India and South Africa, respectively, while it is 38.0 per cent of Brazilian exports and 21.1 per cent of Russian exports. Russia's export basket is dominated by fuel and mining exports (nearly 70 per cent), while agriculture products, fuel, and mining products account for nearly 60 per cent of exports from Brazil. South Africa's emergence has coincided with the rise of other emerging markets in Africa. The demand for South Africa's manufactured commodities (nearly 51.8 per cent) have boosted the countries exports and, subsequently, economic growth (Table 1.20).

Structural developments across sectors in BRICS economies during the past two decades are more visible in technological developments, which may also be responsible for the changes in the composition and destination of BRICS exports. This is revealed by the share of high-technology goods in the export baskets, which have registered an increasing trend (Table 1.21).

Table 1.20 BRICS Exports Profile, 2009

Country	Merchandise Exports (US$ billion)	Share in World Total Exports	Share by Commodity			Share by Destination				
			Agri-cultural Products	Fuels and Mining Products	Manu-factures					
1	2	3	4	5	6	7	8	9	10	11
Brazil	153.0	1.2	37.7	21.3	38.0	EU (22.3)	China (13.2)	US (10.3)	Argentina (8.4)	Japan (2.8)
Russia*	303.4	2.5	6.9	69.0	21.1	EU (52.7)	Belarus (5.5)	China (5.5)	Turkey (5.4)	Ukraine (4.6)
India	164.9	1.3	10.2	20.6	66.0	EU (20.5)	UAE (14.4)	US (10.8)	China (5.9)	HK, China (4.0)
China	1,201.6	9.6	3.4	2.9	93.6	EU (19.7)	US (18.4)	HK (13.8)	Japan (8.1)	Rep. Korea (4.5)
South Africa	61.7	0.5	10.7	34.8	51.8	EU (26.5)	China (10.5)	US (9.0)	Japan (7.6)	Switzerland (4.2)

Source: WTO.
Note: * National accounts data.

Table 1.21 High-technology Exports (per cent of Manufacturing Exports)

Country	1990	1995	2000	2005	2007	2008	2009
1	2	3	4	5	6	7	8
Brazil	7.1	4.8	18.6	12.8	11.9	12.0	13.9
China	–	–	17.2	8.1	6.9	6.5	9.3
India	2.4	4.3	4.8	4.7	5.3	5.7	8.6
Russia	–	10.5	18.6	30.6	29.7	28.7	31.0
South Africa	–	5.7	7.0	6.6	5.7	5.2	5.6

Source: World Bank Database.
Note: – Not available.

Increased technology-intensive investments and a higher supply of human resources propelled growth in the services sector, which, in turn, led to higher productivity in the BRICS economies. Among the exports of invisibles, the share of services exhibited significant improvement in almost all the BRICS economies (Table 1.22).

Table 1.22 BRICS Share of World Exports of Services

(per cent)

	1990	1995	2000	2005	2008	2009	2010
BRICS	2.1	3.8	4.7	7.0	8.8	8.7	9.8
Brazil	0.5	0.5	0.6	0.6	0.8	0.8	0.9
Russia	–	0.9	0.6	1.0	1.3	1.2	1.2
India	0.6	0.6	1.1	2.0	2.7	2.6	3.1
China	0.7	1.6	2.0	2.9	3.7	3.7	4.2
South Africa	0.4	0.4	0.3	0.4	0.3	0.3	0.4

Source: UNCTAD.
Note: – Not available.

BRICS IMPORTS

As fast-growing economies, the import demand from these economies now plays a catalytic role in the global growth process. The diversification in the composition of exports from primary to manufactured products, mostly in the form of value additions, requires large imports (Table 1.23).

Table 1.23 Imports of Goods and Services

(per cent of GDP)

Country	1990	1995	2000	2005	2008	2009	2010
1	2	3	4	5	6	7	8
Brazil	5.6	8.2	11.0	10.8	13.0	10.6	11.4
Russia	–	26.7	23.7	21.7	22.3	20.9	22.1
India	8.5	11.5	13.9	22.1	30.5	25.0	26.4
China	13.7	20.2	20.3	30.6	26.5	21.7	24.9
South Africa	18.6	22.8	25.3	28.9	38.3	29.4	24.9
BRICS: Share in World Imports							
BRICS	3.3	6.1	6.2	10.0	12.5	13.3	14.8
Brazil	0.6	1.0	0.9	0.7	1.1	1.1	1.3
Russia	–	1.3	0.7	1.3	2.0	1.7	1.8
India	0.7	0.7	0.8	1.3	2.0	2.0	2.1
China	1.5	2.5	3.4	6.1	6.9	8.0	9.1
South Africa	0.5	0.6	0.5	0.6	0.6	0.6	0.5

Source: UNCTAD.
Note: – Not available.

The major chunk of BRICS economies' import basket consists of capital goods, indicating the process of large-scale industrialization in these economies which is also reflected in their changed composition of commodity exports (Table 1.24).

The BRICS' imports of services have also grown, reflecting the increasingly broad-based nature of growth achieved by these economies over the past decades. As in the case of demand for commodity imports, large-scale industrialization and the increased emphasis on

Table 1.24 BRICS Imports Profile, 2009

Country	Merchandise Imports (US$ billion)	Share in World Total Imports	Share by Commodity			Share by Origin				
			Agri-cultural Products	Fuels and Mining Products	Manu-factures					
1	2	3	4	5	6	7	8	9	10	11
Brazil	133.7	1.1	6.4	17.6	75.9	EU (22.9)	US (15.8)	China (12.5)	Argentina (8.8)	Japan (4.2)
Russia	191.8	1.5	15.2	3.8	79.8	EU (45.9)	China (13.4)	US (5.4)	Ukraine (5.3)	Japan (4.2)
India	257.2	2.0	5.6	37.6	46.6	EU (14.4)	China (11.5)	UAE (7.4)	US (6.0)	Saudi Arabia (5.4)
China	1,005.9	7.9	7.6	24.9	67.1	Japan (13.0)	EU (12.7)	Rep. of Korea (10.2)	HK, China (8.6)	Taipei, Chinese (8.5)
South Africa	73.2	0.6	7.4	23.3	68.3	EU (32.2)	China (13.1)	US (7.8)	Saudi Arabia (5.0)	Japan (4.9)

Source: WTO.

exports encouraged a high demand for services. Besides, the improved living standards of the middle class of these economies have driven the import demand of services to a greater extent (Table 1.25).

Table 1.25 BRICS Share of World Imports of Services

	1990	1995	2000	2005	2008	2009	2010
BRICS	2.5	6.0	6.1	8.4	10.5	11.0	12.5
Brazil	0.9	1.1	1.1	1.0	1.3	1.4	1.8
Russia	–	1.6	1.1	1.6	2.0	1.9	2.0
India	0.7	0.8	1.2	1.9	2.4	2.5	3.1
China	0.5	2.0	2.3	3.4	4.3	4.8	5.1
South Africa	0.4	0.5	0.4	0.5	0.5	0.4	0.5

Source: UNCTAD.
Note: – Not available.

TRADE LINKAGES: INCREASING SOUTH-TO-SOUTH TRADE

Despite a significant rise in the share of exports among intra-BRICS economies, there is scope for increased trade among these countries, which underlines the need to increase the South-to-South trade matrix. India and China are some of the largest consumers in the world, particularly of oil and other raw materials, while Russia, Brazil, and South Africa are some of the largest suppliers of metal, oil, and other natural resources. Hence, there is a need to identify further economic linkages among these countries through trade and investment promotion channels (Table 1.26).

PRIVATE TRANSFERS

Remittance flows to developing countries reached US$ 316 billion in 2009, which is a decline of 6 per cent from the US$ 336 billion recorded in 2008, reflecting the effect of the global financial crisis

Table 1.26 Export Linkages of BRICS

(US$ billion)

Exports from Russia	Brazil	China	India	South Africa	Advanced Economies	Euro Area
1990	–	–	–	–	–	–
2000	0.6	5.2	1.1	0.03	60.6	34.1
2009	1.4	16.1	4.8	0.2	138.1	92.3
Exports from India	Brazil	China	Russia	South Africa	Advanced Economies	Euro Area
1990	0.0	0.0	–	0.0	11.1	3.0
2000	0.3	0.8	0.9	0.3	27.4	7.6
2009	2.2	10.2	0.9	1.9	79.0	26.3
Exports from China	Brazil	India	Russia	South Africa	Advanced Economies	Euro Area
1990	0.1	0.2	–	0.0	52.0	5.1
2000	1.2	1.6	2.2	1.0	208.3	30.6
2009	15.9	29.7	17.5	7.4	858.5	174.4
Exports from Brazil	China	India	Russia	South Africa	Advanced Economies	Euro Area
1990	0.4	0.2	–	0.2	22.9	8.1
2000	1.1	0.38	0.4	0.3	34.6	13.0
2009	21.0	3.4	25	1.3	65.1	28.5
Exports from South Africa	China	India	Russia	Brazil	Advanced Economies	Euro Area
1990	–	–	–	–	–	–
2000	0.3	0.4	0.03	0.2	15.7	6.2
2009	5.6	2.0	0.2	0.4	30.9	10.7

Source: *Directory of Trade Statistics*, IMF.
Note: – Not available.

on remittances. The contribution of private transfers in the BRICS also varies widely among member countries. India and China remain as the top two recipients of global remittances in 2009, with US$ 49 billion and US$ 48 billion, respectively. For India, with an increasing current account deficit, remittances play a cushioning role. Russia tops the list of emerging market economies in terms of money transfer outflows; calculated on the basis of balance of payments data, the value of remittances from Russia in 2009 stood at US$ 19 billion, or 7 per cent of the world's total remittances. Unlike other private capital flows, remittances maintained a consistent increasing trend at least in the cases of India and China, while it showed a declining trend in Russia and Brazil (Table 1.27).

Table 1.27 BRICS Share in Global Remittance Inflows

(per cent)

	1990	1995	2000	2005	2007	2008	2009	Remittances to GDP Ratio
Brazil	0.8	3.3	1.2	1.3	1.1	1.1	1.0	0.3
Russia	0.0	2.5	1.0	1.1	1.2	1.4	1.3	0.4
India	3.5	6.1	9.8	8.1	9.7	11.3	11.9	3.9
China	0.3	0.9	4.0	8.8	10.1	10.9	11.5	1.0
South Africa	0.2	0.1	0.3	0.2	0.2	0.2	0.2	0.3

Source: World Bank.

CURRENT ACCOUNT

The performance of the BRICS on the external front, as reflected in the current account, varied widely over the years as well as among the countries. China experienced an increase in its current account surplus prior to the crisis that moderated thereafter, while the current account surplus of Russia has declined over time. India, South Africa, and Brazil have been running current account deficits (Table 1.28).

Table 1.28 Trade Balance and Current Account Balance

(per cent of GDP)

Country	Trade Balance*					Current Account Balance				
	1990	2000	2008	2009	2010	1990	2000	2008	2009	2010
1	2	3	4	5	6	7	8	9	10	11
BRICS										
Brazil	1.4	–0.9	0.8	0.7	–0.2	–0.7	–3.8	–1.7	–1.5	–2.3
Russia	–	20.7	9.2	7.3	8.3	0.0	18.0	6.2	4.1	4.9
India	–1.6	–1.6	–6.7	–4.9	–4.8	–2.4	–1.0	–2.0	–2.8	–3.2
China	3.7	3.1	8.3	5.0	4.6	3.1	1.7	9.6	6.0	5.2
South Africa	6.3	3.4	7.0	–5.8	–7.3	1.4	–0.1	–7.1	–4.1	–2.8
Advanced Economies										
Japan	0.9	1.8	1.2	1.1	2.1	1.5	2.6	3.2	2.8	3.6
United States	–0.9	–3.1	–3.8	–2.0	–2.6	–1.4	–4.2	–4.7	–2.7	–3.2

Source: UNCTAD and IMF.

Note: – Not available. * Goods and services.

The impact of the crisis on the current accounts of the BRICS economies also varied as reflected in terms of the reduction in current account surpluses (China and Russia), the surplus turning into a deficit (Brazil), widening of the current account deficit (India), and decline in the deficit (South Africa). On the current account, while the decline in oil prices affected Russia, the steep fall in export demand across the board impinged on all the other BRICS economies.

BRICS AND CAPITAL FLOWS

There has been a marked increase in the magnitude of net private capital flows into the BRICS economies. Global as well as emerging domestic factors contributed to an increase in capital inflows. Global factors include excess liquidity and a low interest rate regime followed in the industrialized countries along with an improvement in the risk perception towards EMEs and the urge for higher yields. This encouraged the shifting of the direction of global capital flows in favour of EMEs, complicating macroeconomic management in some cases (Table 1.29).

Table 1.29 Share of Global FDI Inflows

(per cent)

	1990	1995	2000	2005	2008	2009	2010
BRICS	2.2	13.8	5.8	11.7	16.0	16.7	17.8
Brazil	0.5	1.3	2.3	1.5	2.6	2.2	3.9
Russia	–	0.6	0.2	1.3	4.3	3.1	3.3
India	0.1	0.6	0.3	0.8	2.4	3.0	2.0
China	1.7	11.0	2.9	7.4	6.2	8.0	8.5
South Africa	0.0	0.4	0.1	0.7	0.5	0.5	0.1

Source: UNCTAD.

Within private capital flows to the BRICS, FDI witnessed a substantial increase together with the high presence of portfolio flows, especially debt flows, over the past decade. Portfolio debt flows moderated in general, while equity flows remained volatile on cues of global and domestic growth perceptions. Unlike portfolio flows, net FDI flows to the BRICS remained steady even during the recent crisis, reflecting the longer-term view on the growth potentials of the BRICS and the soundness of their financial systems (Table 1.30). Outflows of FDI from these economies also increased, taking advantage of the attractive investment opportunities abroad with a view to acquiring new technologies and natural resources.

In contrast to FDI flows, portfolio flows to developing and emerging market economies were driven by global risk factors. The liberal policy approach towards equity inflows and technological advances witnessed in the BRICS equity markets resulted in a heightened concentration of global portfolio flows (Table 1.31).

FOREIGN EXCHANGE RESERVES

All BRICS economies witnessed significant accumulation of international reserves through the past decade, barring some moderation during periods of the global financial crisis. The reserve accumulation of the BRICS can be viewed as a measure of insurance against future crises. As a result the BRICS' share in global international reserves increased remarkably during the current decade (Table 1.32).

EXTERNAL DEBT

The total external debt of the BRICS economies has increased significantly over the years. Although the volume of BRICS' external debt showed an increase, its magnitude declined in general, barring the recent crisis period, as in the case of India (Table 1.33).

Table 1.30 Cross-country Movement of FDI Flows

(US$ billion)

Country	FDI Inflows							FDI Outflows						
	1990	2000	2005	2007	2008	2009	2010	1990	2000	2005	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BRICS														
Brazil	1.0	32.8	15.1	34.6	45.1	25.9	48.4	0.6	2.3	2.5	7.1	20.5	–10.1	11.5
Russia	0.0	2.7	12.9	55.1	75.0	36.5	41.2	–	3.2	12.8	45.9	55.6	43.7	51.7
India	0.2	3.6	7.6	25.3	42.5	35.6	24.6	0.0	0.5	3.0	17.2	19.4	15.9	14.6
China	3.5	40.7	72.4	83.5	108.3	95.0	105.7	0.8	0.9	12.3	22.5	52.2	56.5	68.0
South Africa	–0.1	0.9	6.6	5.7	9.0	5.4	1.6	0.0	0.3	0.9	3.0	–3.1	1.2	0.5
Advanced Economies														
Japan	1.8	8.3	2.8	22.5	24.4	11.9	–1.3	50.8	31.6	45.8	73.5	128.0	74.7	56.3
UK	30.5	118.8	176.0	196.4	91.5	71.1	45.9	17.9	233.4	80.8	272.4	161.1	44.4	11.0
US	48.4	314.0	104.8	216.0	306.4	152.9	228.2	31.0	142.6	15.4	393.5	308.3	282.7	328.9

Source: UNCTAD.
Note: – Not available.

Table 1.31 Cross-country Movement of Portfolio Flows

(US$ billion)

Country	Portfolio Investment Inflows						Portfolio Investment Outflows					
	1990	2000	2005	2007	2008	2009	1990	2000	2005	2007	2008	2009
1	2	3	4	5	6	7	8	9	10	11	12	13
BRICS												
Brazil	0.6	8.7	6.7	48.1	–0.8	46.2	0.1	1.7	1.8	–0.3	–1.9	–4.1
Russia	–	–9.9	–0.7	15.5	–27.6	8.2	–	0.4	10.7	10.0	7.8	10.4
India	0.0	2.5	12.2	35.0	–15.0	–	0.0	0.1	0.0	–0.2	0.0	–
China	0.0	7.3	21.2	21.0	9.9	–	0.2	11.3	26.2	2.3	–32.7	–
South Africa	0.3	1.8	5.7	21.9	13.7	–7.6	13.4	0.3	3.7	3.4	6.7	1.9
Advanced Economies												
Japan	46.7	47.4	183.1	196.6	–103.0	–56.3	37.8	83.4	196.4	123.5	189.6	160.2
UK	23.8	268.1	237.0	406.7	363.9	284.0	30.0	97.2	273.4	179.6	–199.6	241.1
US	22.0	436.6	832.0	1154.7	527.7	376.6	28.8	127.9	257.5	396.0	–117.4	549.4

Source: IMF/International Financial Statistics.

Note: – Not available.

Table 1.32 BRICS and Foreign Exchange Reserves

(US$ billion)

	1990	1995	2000	2005	2008	2009	2010
BRICS	41.2	162.5	271.0	1203.6	2834.7	3374.8	3914.6
Brazil	7.7	49.9	32.5	53.3	192.9	237.4	287.1
Russia	0.0	14.9	24.8	176.5	412.7	417.8	445.0
India	2.1	18.6	38.4	132.5	248.0	266.2	276.2
China	30.2	76.0	168.9	822.5	1950.3	2417.9	2867.9
South Africa	1.2	3.0	6.4	18.8	30.8	35.5	38.4
Share in Total Global Reserves							
BRICS	4.2	10.6	13.3	27.1	37.7	39.0	40.1
Brazil	0.8	3.3	1.6	1.2	2.6	2.7	2.9
Russia	0.0	1.0	1.2	4.0	5.5	4.8	4.6
India	0.2	1.2	1.9	3.0	3.3	3.1	2.8
China	3.1	5.0	8.3	18.5	25.9	28.0	29.4
South Africa	0.1	0.2	0.3	0.4	0.4	0.4	0.4

Source: UNCTAD.

Table 1.33 External Debt Stocks, Total (DOD, current US$)

Country	1990	1995	2000	2005	2007	2008	2009
1	2	3	4	5	6	7	8
Brazil	119.7	160.5	241.5	187.5	237.6	262.1	276.9
Russia	–	121.4	160.0	229.9	368.1	402.5	381.3
India	85.7	95.2	100.2	120.2	202.8	224.7	237.7
China	55.3	118.1	145.7	284.0	373.8	378.2	428.4
South Africa	23.3	25.4	24.9	31.1	43.6	41.9	42.1
External Debt-to-GDP Ratio							
Brazil	23.6	20.8	37.6	21.1	17.2	15.8	17.3
Russia	–	38.7	61.6	30.1	28.3	24.2	31.2
India	26.3	25.9	20.9	14.8	17.6	17.8	18.7
China	14.2	16.2	12.2	12.6	10.7	8.4	8.6
South Africa	20.8	16.8	18.7	12.6	15.3	15.2	14.8

Source: World Bank, Global Development Finance, and IMF, WEO, October 2010.

Note: – Not available.

EXCHANGE RATE REGIME AND CONVERTIBILITY

The exchange rate regime and the implementation of supporting policies are critical for economic development and financial stability of countries. Due to wide differences in economic and financial environments, the BRICS economies follow different exchange rate systems in their current and capital accounts (Table 1.34).

The macroeconomic instabilities experienced by Brazil during the previous decades, particularly the vulnerabilities arising from its external sector, finally induced it to adopt inflation targeting which, in turn, required introducing a floating system of exchange rate in January 1999. Since then, the Brazilian real averaged R$ 2.26 against the USD up to 31 December 2010. The real effective exchange rate has also oscillated substantially, reacting to shifts in fundamentals such as the terms of trade, risk aversion, and underlying capital flows.

Russia's exchange rate regime has been reclassified from 'stabilized arrangement' to 'other managed arrangement', effective 1 November 2008, to reflect the managed depreciation of the Rouble and higher day-to-day exchange-rate fluctuations. The exchange system is free of restrictions on payments and transfers for current international transactions, and legislation is also free of foreign exchange restrictions on capital account transactions. The Bank of Russia implements its foreign exchange policy in the general context of monetary policy. The major objectives of the Bank of Russia's foreign exchange policy are to ensure stability of the national currency and create conditions for the dynamic development of Russia's foreign exchange market. The Bank of Russia pursues managed floating arrangement in the exchange rate policy. In 2007 Russia completed liberalization of the foreign exchange legislation regarding capital account transactions.

Table 1.34 BRICS Exchange Rate Regime

Country	Currency	Exchange Rate Structure	Current Exchange Rate System	Recent Developments in Capital Account
Brazil	Real	Unitary	Floating	Adoption of prudential measures
Russia	Russian Rouble	Unitary	Other managed arrangement, managed floating exchange rate	Easing of controls
India	Rupee	Unitary	Managed floating with no predetermined path for the exchange rate to floating	Easing of controls
China	Renminbi	Unitary	Managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies	Increasing de facto openness of the capital account
South Africa	Rand	Unitary	Floating	Easing of controls

In the case of India, given the stated policy of the RBI to contain volatility in the exchange rate without reference to any specific target or band, its net intervention operations have helped in significantly absorbing the pressure of capital flows on exchange rate volatility. In recent years, however, the exchange rate has become relatively more flexible, particularly in relation to the size of net intervention operations of the RBI.

China adopted a managed floating exchange rate regime on 1 January 1994. In July 2005, China launched the reform of the RMB exchange rate regime and moved into a managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies. The reform of the RMB exchange rate regime has moved ahead in a proactive, controllable, and gradual way to increase the role of the market in establishing the rate. Currently, the US$-RMB spot exchange rate can move intra-day 0.5 per cent from a central parity that is determined at the open of trading by a truncated weighted average of primary dealers' offer rates and is announced by the China Foreign Exchange Trading System.

South Africa has a flexible exchange rate regime, but excess capital inflows are sometimes purchased to increase the level of foreign exchange reserves and to reduce exchange rate volatility. Reserve purchases are sterilized via, *inter alia,* the issuance of debentures, repurchase transactions, and sterilization swaps. The National Treasury assists the SARB in funding sterilization operations. The SARB does not target a specific level for the Rand, but interventions may sometimes be contemplated to sterilize large capital inflows that could fuel volatility in the foreign exchange market.

Among the BRICS, South Africa accepted the obligations of Article VIII, sections 2, 3, and 4 of the International Monetary Fund's Articles of Agreement on 15 September 1973. India accepted the obligations of Article VIII of the Articles of Agreement of the IMF in 1994, followed by Russia in June 1996, China in December 1996, and Brazil in November 1999 which obliged them to remove restrictions on the transactions in their current accounts. Regarding the capital account, in accordance with the policy of inflation targeting, Brazil adopted a floating exchange rate in 1999 under conditions of almost full capital account convertibility. Russia slowly started liberalizing its capital account in the early 1990s, but it faced a serious currency crisis in 1998 under its strained fiscal circumstances and introduced a series of emergency measures, including re-intensification of capital controls and the announcement of a debt moratorium. However, the capital account restrictions in Russia have been reversing recently. China and India follow a gradual path to capital account liberalization.

Financial Market Performance

Stock Exchange

During the period 1999–2010, capital markets in the BRICS experienced fluctuations, which also varied within the group. A significant fall in equity indices was observed between the years 2000 and 2008. Within the group, Brazil and China saw more equity index fluctuations than Russia, India, and South Africa. Except for the two years mentioned, equity indices rose in all the BRICS economies (Table 1.35).

During this period, the price–earnings ratio (PE) as indicator of capital markets in the BRICS were relatively more stable in China and India compared with Brazil, Russia, and South Africa. In 2010, the PE ratios declined for all BRICS countries except India.

Table 1.35 Stock Market Performance of BRICS Countries

Country	Index				Movement (per cent change)				PE Ratio			
	1999	2005	2009	2010	1999	2005	2009	2010	1999	2005	2009	2010
Brazil	889.5	1,569.40	3,624.50	–	61.6	50	121.3	–	18.6	12.39	17	13.8
Russia	177.71	1125	1444.1	–	201.6	83.3	128.6	–	–	8.3	11.1	8.3
India	209.5	382.9	468.5	–	89.1	40.2	100.5	–	22.8	20.17	21.8	22.4
China	33.5	29.3	64.8	–	10.2	15.6	58.8	–	–	15.78	15.6	14.6
South Africa	7806	16438	24996	–	74	44	28.6	–	–	14.4	21.8	18.9

Source: Bloomberg and Morgan Stanley Capital International.
Notes: Russia: RTS Stock Exchange and shares included in RTS Index calculation base.
– Not available.

The number of companies domestically incorporated in stock exchanges in two of the BRICS economies, namely, Brazil and South Africa declined during the period 2000 to 2006 and has fluctuated in recent years. As regards Russia, the number of listed companies, which was on a rising trend, fluctuated in recent years, while China and India witnessed continuous growth in the number of listed domestic companies during most of the years of the same period (Table 1.36).

The depth of stock markets measured in terms of market capitalization to GDP in BRICS economies progressively deepened over the years. The ratio which was as low as 3.6 per cent in 1990 for Brazil, reached a high of 74 per cent in 2010. The corresponding ratios during the same period in the case of India were 12.2 per cent and 93.4 per cent, respectively. China and Russia, both of which started off with a relatively shallower base, rapidly caught up. In China, the market capitalization-to-GDP ratio in 1995 was 5.8 per cent, which jumped to 81 per cent in 2010. The corresponding ratios with respect to Russia were 4.0 per cent and 67.9 per cent, respectively. Among the BRICS, South Africa had the largest market capitalization relative to the size of GDP during 2010 (Table 1.37).

The turnover ratio as indicators of the depth of financial markets (stock markets) also deepened considerably over the period in the BRICS. The ratio jumped from a high base of 115.9 per cent in China in 1995 to 229.6 per cent in 2009. Russia with the ratio of 108.5 per cent in 2009 had a low base of only 36.9 per cent in 2000. Similarly, India which had a turnover ratio of 65.9 per cent in 1990 attained a high in turnover ratio of 119.3 per cent in 2009. Brazil and South Africa also witnessed a significant jump in the ratio during the period, that is, 23.6 per cent to 73.9 per cent during 1990 to 2009 in Brazil and 7.0 per cent to 57.3 per cent in South Africa during 1995

Table 1.36 Total Listed Domestic Companies

Country	1990	1995	2000	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10
Brazil	581	543	459	381	392	442	432	377	373
Russia	–	170	249	296	309	328	314	279	345
India	2435	5398	5937	4763	4796	4887	4921	4955	4987
China	0	323	1086	1387	1440	1530	1604	1700	2063
South Africa	732	640	616	388	401	422	425	410	407

Source: Standard & Poor's, *Emerging Stock Markets Factbook* and supplemental S&P data.

Notes: Listed domestic companies are domestically incorporated companies listed on the country's stock exchanges at the end of the year. This indicator does not include investment companies, mutual funds, or other collective investment vehicles.

– Not available.

Table 1.37 Market Capitalization of Listed Companies

(per cent of GDP)

Country	1990	1995	2000	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10
Brazil	3.6	19.2	35.1	53.8	65.3	100.3	35.7	73.2	74
Russia	0	4	15	71.8	106.6	115.6	23.9	70.5	67.9
India	12.2	35.7	32.2	68.3	89.5	46.4	53.2	85.4	93.4
China	0	5.8	48.5	34.9	91.3	178.2	61.8	100.3	81
South Africa	123	186	118	229	274	291.3	178.5	249.3	278.4

Source: Standard & Poor's, *Emerging Stock Markets Factbook* and supplemental S&P data, and World Bank and OECD GDP estimates.
Note: Market capitalization (also known as market value) is the share price times the number of shares outstanding.
Listed domestic companies are domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies does not include investment companies, mutual funds, or other collective investment vehicles.

to 2009. All BRICS countries suffered a decline in their turnover ratio in 2010 (Table 1.38).

The dividend–yield ratio as an indicator of capital markets in the BRICS declined gradually, indicating better market value in these countries over the period. The year 2008, however, witnessed the ratio rising compared with other years (Table 1.39).

Combined external financing of capital markets in the BRICS from bonds, equities and loans in absolute terms during the period 1999–2010 increased significantly. This also indicates the integration of the BRICS financial markets with world financial markets (Table 1.40).

The depth of the financial sector can also be gauged from the extent of insurance sector penetration into the economy. In the absence of population-wise distribution of insurance policies, both life and general, an alternative to measuring the depth of the sector is the volume of the sector with respect to GDP expressed in percentage terms. The ratio with respect to life insurance has been on the rise in most BRICS economies with the highest being 0.122 per cent in South Africa in 2008. However, with respect to non-life insurance, the depth remained 0.01–0.03 per cent in all BRICS countries during the period (Table 1.41).

Financial Sector

The Brazilian financial market is based on a modern and solid banking system, a state-of-the-art payment system, and reliable market infrastructure. In 2002, the Brazilian Central Bank launched the new Brazilian Payment System which allows final and irrevocable transfers on a real-time basis. The recent credit-market reforms in Brazil have

Table 1.38 Stocks Traded, Turnover Ratio

(per cent)

Country	1990	1995	2000	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10
Brazil	23.6	47.8	43.5	38.3	42.9	56.2	74.3	73.9	66.4
Russia	0	0	36.9	39	64.1	58.9	59.2	108.5	85.7
India	65.9	10.5	133.6	94.2	93.1	84	85.2	119.3	75.6
China	0	115.9	158.3	82.5	102	180.1	121.3	229.6	164.4
South Africa	–	7	34	39	48.8	55	61.6	57.3	39.6

Source: Standard & Poor's, *Emerging Stock Markets Factbook* and supplemental S&P data.
Notes: Turnover ratio is the total value of shares traded during the period divided by the average market capitalization for the period. Average market capitalization is calculated as the average of the end-of-period values for the current and the previous period.
– Not available.

Table 1.39 Equity Valuation Measures: Dividend–Yield Ratios

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Brazil	9.34	2.95	3.18	4.93	5.51	3.46	4.43	3.9	3.1	2.2	4.6	2.9	2.7
Russia	0.72	0.14	0.92	1.11	1.87	2.38	3.12	1.6	1	1.2	3.5	1.4	1.5
India	2	1.25	1.59	2.03	1.81	1.47	1.53	1.3	1	0.7	1.8	0.9	0.9
China	3.71	3.14	0.95	1.95	2.41	2.19	2.26	2.7	1.5	1.2	3.1	1.9	2.2
South Africa	–	–	2.8	3.5	3.8	3.2	2.6	2.5	2.4	2.7	4.5	2.7	2.3

Source: Data from Morgan Stanley Capital International.
Note: – Not available.

Table 1.40 Emerging Market External Financing: Total Bonds, Equities, and Loans

(in US$ million)

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Brazil	14,214	12,952	21,454	19,266	11,119	12,909	15,834	27,486	31,219	73,218	30,843	39,601	67,703
Russia	13,156	167	8,313	2,831	8,535	12,239	22,532	37,004	59,165	84,536	61,230	53,940	45,389
India	1,434	2,376	3,428	2,066	1,360	3,776	13,060	21,660	29,534	60,513	37,561	58,320	115,929
China	6,975	3,462	9,227	4,255	4,256	12,843	22,850	38,805	50,040	75,677	28,261	66,829	79,879
South Africa	–	3,423	8,699	4,647	4,058	7,837	5,413	6,266	12,701	19,904	2,816	7,980	7,460

Source: Data provided by the Bond, Equity, and Loan Database of the International Monetary Fund sourced from Capital Data.

Note: – Not available.

Table 1.41 Insurance Sector in BRICS Economies

Country	1990	1995	2000	2005	2006	2007	2008
1	2	3	4	5	6	7	8
Life Insurance Premium Volume/GDP							
Brazil	0.002	0.003	0.004	0.013	0.013	0.014	0.015
Russia	–	–	–	0.001	0.001	0.001	0.001
India	0.010	0.012	0.017	0.026	0.041	0.040	0.039
China	0.002	0.003	0.010	0.018	–	–	–
South Africa	0.077	0.110	0.146	0.108	0.130	0.126	0.122
Non-Life Insurance Premium Volume/GDP							
Brazil	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Russia	–	–	–	0.02	0.02	0.02	0.02
India	0.00	0.01	0.01	0.01	0.01	0.01	0.01
China	0.01	0.01	0.01	0.01	–	–	–
South Africa	0.02	0.03	0.03	0.03	0.03	0.03	0.03

Source: World Bank.
Note: – Not available.

contributed to a substantial rise in intermediation, paving the way for solid financial inclusion. Improvements such as the reduction of directed lending and dissemination of information can contribute to enhancing the power of monetary policy and reduce debt service (credit cost). The Central Bank of Brazil has decided to implement the Basel II framework in the Brazilian banking sector and is directly involved in formatting the Basel III framework. After the global financial crisis, all the BRICS economies are envisaged to implement the revised framework for better banking sector regulation.

In Russia, banking supervision has continued to improve and the regulatory framework is considered to be broadly adequate. Russian banks are generally well-capitalized and sufficiently provisioned. Capital adequacy ratios are at comfortable levels by international standards. Profitability in the banking system is robust and has improved, even as foreign banks have entered the market and increased competition. As of the end of November 2010, there were 225 banks with foreign investment in their authorized capital.

In India, major policy measures during the reform of the banking sector included phased reductions in statutory pre-emption like cash reserve and statutory liquidity requirements and deregulation of interest rates on deposits and lending, except for a select segment. The diversification of ownership of banking institutions is another feature which has enabled private shareholding in public sector banks through listing on the stock exchanges, arising from dilution of government ownership. Over the period, the performance of the banking sector has improved, both in terms of reducing non-performing assets (NPAs) and improvement on indicators of prudential measures. Further, at the policy level, greater emphasis has been placed on financial inclusion and improving the delivery of financial services in line with technological developments.

Since the reform and opening up of China, China's banking industry reforms have continuously deepened especially in recent years, with the banking sector's comprehensive strength, risk management capabilities, and international role gaining significance rapidly. To promote reform and improve management at the same time, shareholding commercial banks in China have continued to deepen reforms, thereby consolidating the micro-foundations of the financial system.

The South African banking sector has consistently maintained capital adequacy ratios well in excess of the required minimum. As a result, South African banks remained adequately capitalized through the crisis and the financial system did not experience any funding or liquidity problems. This is due to the fact that South African banks are well regulated, have sophisticated liquidity management systems, and limited reliance on funding in foreign currency. To further strengthen regulation to support financial stability, the government is currently focused on four main areas of reform in the banking sector: strengthening financial stability, broadening financial services for the poor, increasing competitiveness and efficiency, and promoting investor and consumer protection.

A shift is underway to a 'twin-peak' approach to regulation with the central bank being responsible for prudential regulation and the financial services regulator for market conduct regulation. Prudential regulation of the insurance sector will be strengthened through the introduction of 'Solvency Assessment and Management', an approach similar to Solvency II in Europe. In addition, regulation of the credit rating agency was introduced during 2011. A framework to facilitate moving OTC derivative trading to an exchange and the approach to oversight of shadow banking, hedge fund, and private equity industries will be reviewed.

Preparations for implementing the Basel III capital and liquidity requirements are underway, including the QIS and assessments of the availability of high-quality liquid assets and banks' ability to adhere to the required standards. A formalized framework of identifying systemically significant institutions is also being developed. Crisis management arrangements are being strengthened between the National Treasury and SARB. A review of the contingency framework has been conducted in terms of a World Bank/First Initiative project.

BANKING SECTOR PERFORMANCE

Capital-to-asset ratio as an indicator of the performance of BRICS witnessed a gradual fall over the period, indicating an expansion in banking activities. Years like 2005 and 2009, however, witnessed a rise in the ratio (an improvement in financial stability, deleverage, increase in risk aversion), indicating contraction in banking activities (Table 1.42).

Capital-to-risk weighted assets as an indicator of the soundness of banks has risen considerably in BRICS economies though there were years when it fell marginally in some of the countries. Following the global crisis, there has not been any significant fall in the ratio, indicating that the banking sectors in these countries are sound and well capitalized. A similar pattern is reflected in the NPAs of banks in the BRICS, which have been gradually declining over the period as a percentage of total loans.

As regards banks' provisions for NPAs, such provisions were kept much in excess of the total non-performing loans in Brazil and China. However, provisions as a percentage of non-performing loans have been increasing in all BRICS countries during the period.

The profitability of banks in terms of both return on assets and return on equity has also been rising gradually in most BRICS economies notwithstanding fluctuations in the ratios over the years (Table 1.43).

The Brazilian banking system consists of state-owned, foreign, and private domestic banks. There are, however, differences in the asset structures of the various banking segments. In Brazil, most financial institutions that receive demand deposits are organized under a multiple or universal bank structure, combining the commercial portfolio with at least one of the following portfolios: investment, leasing, real estate credit, or financing. According to the *Central Bank Financial Stability Report*, published in June 2010, state-owned institutions accounted for 41 per cent of the total assets, while domestic private banks held 37 per cent, and private foreign institutions

Table 1.42 Prudential Indicators of the Banking Sector in BRICS

	Bank Capital to Assets				Regulatory Capital to Risk Weighted Assets			
Country	1999	2005	2009	2010	1999	2005	2009	2010
1	2	3	4	5	6	7	8	9
Brazil	–	10.4	11.2	10.9	–	17.9	18.9	17.6
Russia	14.3	12.8	15.7	–	18.1	15	20.9	18.9
India	5.9	9.8	10.3	–	11.2	12.8	13.2	–
China	5.2	4.4	5.6	–	11.2	2.5	11.4	–
South Africa	–	7.9	6.7	–	–	12.7	14.1	14.4

Sources: National authorities; IMF staff estimates.

Note: – Not available.

Table 1.43 Bank Profitably Indicators in BRICS

(per cent)

Countries	Return on Assets				Return on Equity				Non-performing Loan / Total Loan			
	1999	2005	2009	2010	1999	2005	2009	2010	1999	2005	2009	2010
1	2	3	4	5	6	7	8	9	10	11	12	13
Brazil	–	3.2	2.4	3.2	–	30.1	22.1	29.3	–	3.5	4.2	3.1
Russia	–0.3	3.2	0.7	1.6	–4.0	24.2	4.9	10	13.4	2.6	9.5	9.5
India	5.9	0.9	1	–	–	13.3	12.3	–	14.7	5.2	2.3	–
China	5.2	0.6	0.8	–	–	15.1	15.1	–	28.5	8.6	1.6	–
South Africa	–	1.2	0.9	–	–	15.2	15.9	15.4	–	1.5	5.9	5.9

Source: *Global Financial Stability Report*, IMF.

Note: – Not available.

held 19 per cent. The remaining 2 per cent was distributed among 1,388 credit co-operatives, which are important agents for agricultural business.

Since 1994, there has been considerable concentration in the banking sector, with a significant reduction in the number of institutions. In June 2010, there were 140 banking institutions, with the five largest accounting for 70 per cent of the total assets.

State-owned banks in Brazil play a significant role in agricultural and real estate credit. Given the tough competition for market share, however, private and state-owned banks are gradually operating in the same areas, with private banks increasing their stake in real estate credit and public institutions targeting retail credit through acquisitions of smaller institutions. Finally, it is worth mentioning the important role played by BNDES, the Brazilian Development Bank, in fostering infrastructure investment via long-term credit operations.

As of end-2009, China's banking sector was composed of 3,857 banking institutions with approximately 193,000 outlets and 2,845,000 employees. The total assets and total liabilities of financial institutions in the banking sector reached RMB 78.8 trillion and RMB 74.2 trillion, respectively; the outstanding deposits of banks denominated in both domestic and foreign currencies grew to RMB 61.2 trillion; and the outstanding loans in both domestic and foreign currencies reached RMB 42.56 trillion. The outstanding non-performing loans (NPLs) of commercial banks registered RMB 497.3 billion, the NPL ratio recorded 1.58 per cent, and the coverage ratio for provisioning grew to 155 per cent. In 2009, the net profits of banking institutions after tax reached RMB 668.43 billion. In terms of market capitalization, the Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), and Bank of

China (BOC) rank as the top three global banks. The five largest commercial banks, namely, ICBC, CCB, BOC, ABC, and BOCOM, account for 50.89 per cent in total assets and 59.86 per cent of the banking sector's total after-tax net profits. Their NPL ratios registered 1.54 per cent, 1.50 per cent, 1.52 per cent, 2.91 per cent and 1.36 per cent, respectively.

Russia's financial system is dominated by banks. The Russian banking industry comprises a number of players: (i) the Central Bank of Russia (CBR); (ii) state-owned banks; (iii) large private banks, (iv) local private banks, and (v) banks controlled by foreign capital. In 2006 the majority share (90.1 per cent of total assets) of the banking system in Russia was constituted of credit institutions, with private banks accounting for a larger share in the total assets of the banking system (55.5 per cent) vis-à-vis the state-owned banks (34 per cent). Non-bank credit institutions account for only around 10 per cent of the total assets of the banking system.

One feature of the Russian market is the large number of credit organizations; as on 1 December 2010 there were 1,023 credit organizations, of which 225 have foreign participation in chartered capital. The market is also characterized by significant concentration, with the top 30 banks accounting for approximately 70 per cent of all banking assets.

Retail and corporate banking is dominated by state-controlled banks, the main ones being Sberbank and VTB. State-controlled banks taken together held more than 48 per cent of the banking sector's total assets as of December 2010. The largest private-owned banks are Alfa Bank, MDM Bank, PromSvyazBank, and UralSib. Major international banks with substantial retail and corporate banking footprint in Russia are subsidiaries of Barclays, Citibank, Raiffeisen, Société Générale, and Uni Credit.

Participation in the Russian formal financial sector remains low. An estimated 60 million people (42 per cent of the population) still have no access to financial services, such as bank savings accounts, credit, or investments in securities.

The Indian financial system is a complex network of institutions, with a variety of functions and governed by different regulations, that are dominated by public and private commercial banks. Besides commercial banks, which are the predominant intermediaries of the financial system, there are cooperative banks, development finance institutions, non-banking financial companies, insurance companies, provident funds, and mutual funds. The RBI exercises its supervisory role over the banking system encompassing commercial and cooperative banks through the powers provided under the Banking Regulation Act, 1949 and the Reserve Bank of India Act, 1934. The RBI also regulates select all-India financial institutions under the Reserve Bank of India Act, 1934. Consequent upon amendments to the RBI Act in 1997, a comprehensive regulatory framework for Non-Banking Financial Companies (NBFCs) was also introduced. In respect of state and district central cooperative banks and regional rural banks, while the RBI is the regulator, supervision is vested with the National Bank for Agriculture and Rural Development (NABARD). Insurance companies and mutual funds are regulated by the Insurance Regulatory and Development Authority (IRDA) and the Securities and Exchange Board of India (SEBI), respectively.

The banking sector in India evolved to a significant extent in response to financial sector reforms initiated as part of structural reforms encompassing trade, industry, investment, and the external sector that were launched by the central government in the early 1990s against the backdrop of a serious balance of payments problem.

Accordingly, financial sector reforms were initiated as part of overall structural reforms to impart efficiency and dynamism to the financial sector. The country's approach to reform in the banking and financial sector was guided by *Pancha Sutra* or five principles: (i) cautious sequencing of reform measures; (ii) introduction of norms that were mainly reinforcing; (iii) introduction of complementary reforms across sectors (monetary, fiscal, external, and financial); (iv) development of financial institutions; and (v) development and integration of financial markets. The evolution of the banking sector in this phase can be divided into two phases, that is, from 1991–2 to 1997–8 and from 1997–8 onwards.

The regional rural banks (RRBs) have been playing an important role in purveying rural credit. With a view to strengthening them, banks were encouraged to amalgamate state-wise the RRBs sponsored by them. In this context, the Government of India, after consulting NABARD, the concerned state governments and sponsor banks, initiated the process of amalgamating RRBs in September 2005. As a result of this initiative, 137 RRBs were amalgamated by 31 October 2006 to form 43 new RRBs (sponsored by 18 banks in 15 states). This has brought down the total number of RRBs from 196 to 102. Further amalgamation proposals are being considered by the Government of India to strengthen the rural credit sector.

South Africa's banking sector is highly concentrated with the five largest banking groups (ABSA Bank Ltd., Standard Bank of South Africa Ltd., FirstRand Bank Ltd., Nedbank Ltd., and Investec Bank Ltd.), accounting for 91.6 per cent of total bank assets at the end of 2010. The financial crisis did not have a direct impact on the South African banking system, but the economic downturn that resulted from the crisis reduced the profitability of banks.

Growth in loans and advances declined sharply at the onset of the crisis as a result of a downturn in the economy and turned negative in September 2009, only returning to positive growth in May 2010. The rate of growth has remained relatively subdued since then, and registered year-on-year growth of 2.5 per cent in December 2010.

Credit risk remains relatively high, although stable, with asset quality appearing to have reached a plateau. Through the crisis, impaired advances rose sharply as households and businesses came under increasing financial strain. Banks continued to face high levels of impaired advances loans during 2010. Impaired advances as a percentage of gross loans and advances averaged 5.8 per cent in 2010, compared to 5.9 per cent in 2009 and just 3.2 per cent in 2008. As a percentage of gross loans and advances, impaired loans have remained between 5.7 per cent and 6 per cent since August 2009. Credit losses have returned to pre-crisis levels of about 0.1 per cent of gross loans and advances.

The minimum capital adequacy ratio for South African banks is 9.5 per cent, which is higher than the minimum 8 per cent ratio established by the Basel II requirements. The actual capital adequacy ratio for the banking sector increased from 13 per cent at the end of 2008 to 14.1 per cent at the end of 2009 to 14.9 per cent at the end of 2010. Tier 1 capital adequacy improved from 10.2 per cent at the end of 2008 to 11 per cent at the end of 2009 to 11.8 per cent at the end of December 2010 (well in excess of even Basel III's 7 per cent requirement).

Nevertheless, certain features of the South African banking system can create potential vulnerability to funding market illiquidity, in particular the reliance on short-term wholesale funding from a concentrated depositor base. This places a burden on banks to ensure that they are constantly able to roll over borrowed funds from their corporate clients and other financiers. While foreign exchange liquidity risk is currently low, the gradual liberalization of exchange controls can place a higher burden on the financial system to monitor and manage liquidity vulnerability. So far, SARB has imposed a prudential liquid asset requirement on all banks, which stands at 5 per cent of average liabilities, as adjusted for non-remunerated reserves. South African policymakers, who have amended pension fund rules to encourage pension funds to place longer-term funding with banks, will review securitization rules and investigate why retail depositors have short-dated holdings in banks. In relation to the proposed global liquidity standards, South Africa will take a cautious, gradual approach in adopting standards such as those proposed by the Basel Committee on Banking Supervision (BCBS), in order to minimize their impact on the profitability and credit extension of banks in South Africa. While South Africa generally takes a proactive approach to adopting international banking supervision standards once they are finalized, the global liquidity standards are likely to have a significant impact on the economy as a whole, and not just the banking sector. As a result, a more conservative approach is being taken with respect to this specific area of the proposed global standards.

ACCESSIBILITY OF FINANCIAL SERVICES

The accessibility of the banking sector for the common man can be measured by various indicators. Some of these indicators are number of branches per unit area, branches per population, automatic teller machines (ATMs) in a unit area and per unit of population, and the depth of banking penetration at the aggregate level using indicators like deposit-to-GDP and loan-to-GDP rates. Based on available and comparable data for the period from 2005 to 2010, BRICS economies significantly improved the accessibility of banking services to the common man. Branches per 1,000 sq. km and branches per 100,000 adult population have increased in both India and Brazil, the number of ATMs per 1,000 sq. km and per 100,000 adult population has increased in Brazil and Russia, and deposit to GDP as well as credit to GDP have increased significantly in all the BRICS economies (Table 1.44).

In South Africa, the banking sector is continuously studying ways to serve the previously unbanked market. The launch of the Financial Sector Charter (FSC) led to the establishment of an entry-level basic bank account called the Mzansi bank account in 2004. It is estimated that by the end of June 2010 more than 5 million Mzansi accounts had been opened. Banks also introduced additional products for low-income people, and engaged with key partners to improve market share and the product base available to customers. Having surpassed their original target of R42 billion for the provision of affordable housing in terms of the FSC, banks made further strides to enhance access to housing finance. Among other things, a guarantee fund of R1 billion was made available to the banking sector by the government to accelerate the delivery of housing to low-income earners. Other initiatives by the South African banking sector, aimed at financial inclusion, are related to increasing points of access in low income areas, especially due to the competition introduced by smaller banks focusing on unsecured lending, and the innovative use of technology to reach under-served areas.

CREDIT DEPTH

Credit depth information, which is measured in terms of accessibility and quality on a scale of 1–6 with higher values indicating easier and

Table 1.44 Financial Services Accessibility in BRICS

	Brazil			Russia			India			China			South Africa		
Indicator	2005	2009	2010	2005	2009	2010	2005	2009	2010	2005	2009	2010	2005	2009	2010
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Number of commercial bank branches per 1,000 sq. km	2.08	2.37	2.33	–	–	–	23.86	27.86	29.14	–	–	–	1.91	2.64	2.8
Number of commercial bank branches per 100,000 adults	13.06	3.95	13.76	–	–	–	9.69	10.43	10.91	–	–	–	7.19	9.37	10.1
Outstanding deposits with commercial banks (per cent of GDP)	34	46.32	47.51	18.66	33.12	–	47.31	60.11	–	123.21	137.11	–	41.31	44.68	41.62
Outstanding loans from commercial banks (per cent of GDP)	18.09	26.28	29.04	26.46	50.76	–	31.21	43.62	–	85.33	107.62	–	62.55	75.27	69.65

Source: IMF.
Note: – Not available.

better quality of credit, showed that while Brazil had maintained a depth throughout the period of 2005–10, China and India improved from 2006 and remained stable since then, and Russia improved significantly from 2009 onwards. South Africa maintained the highest credit depth of information among BRICS during 2005–10 (Table 1.45).

Table 1.45 Credit Depth of Information Index (0 = low to 6 = high)

Country	2005	2006	2007	2008	2009	2010
1	2	3	4	5	6	7
Brazil	5	5	5	5	5	5
Russia	0	0	4	4	5	5
India	2	3	4	4	4	4
China	2	4	4	4	4	4
South Africa	5	5	6	6	6	6

Source: World Bank, Doing Business Project (http://www.doingbusiness.org/).
Note: The credit depth of information index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries. The index ranges from 0 to 6, with higher values indicating the availability of more credit information, from either a public registry or a private bureau, to facilitate lending decisions.

DOMESTIC CREDIT TO GDP

The depth of credit in terms of domestic credit to GDP varies widely among the BRICS economies. While the ratio increased in the case of Brazil, India, and China during the period 1995–2009, there was a decline in the ratio in Russia during 2000–5. The quantum of domestic credit has been higher than GDP in South Africa since 1990 and in China since 2000 (Table 1.46).

Table 1.46 Domestic Credit Provided by Banking Sector

(per cent of GDP)

Country	1990	1995	2000	2005	2006	2007	2008	2009
1	2	3	4	5	6	7	8	9
Brazil	89.3	58.9	74.6	81.5	86.6	92.2	96.9	97.5
Russia	0	25.5	24.7	20.6	22.4	25.5	25.1	33.8
India	51.4	44.1	53	60.1	60.9	60.8	68.2	69.4
China	89.4	87.7	119.7	135.6	133.5	127.8	120.8	145.2
South Africa	107	150.5	162.5	209	192.9	195.2	172.2	183.5

Source: IMF, International Financial Statistics and data files, and World Bank and OECD GDP estimates.

Note: Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available (including institutions that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other banking institutions are savings and mortgage loan institutions and building and loan associations.

Concluding Observations

Since the macroeconomic parameters and features of development vary within BRICS economies, the challenges they face in making their growth processes sustainable also vary. In Brazil macroeconomic stabilization is a key precondition for successful reforms and sustainable growth. The challenges that the Brazilian economy faces are (i) its tradeable goods sector is small when compared to other EMEs like China; (ii) saving and investment rates have to increase as in other BRICS economies like China and India; (iii) improvements are required in the public sector, the public debt structure, and financial intermediation; and (iv) it needs to enhance the depth and efficiency of the financial sector.

In the case of Russia, the key challenges are accelerating the implementation of structural reforms, particularly in inefficient and undercapitalized natural monopolies, and strengthening the investment climate. For India, the major challenges are (i) making the growth process more inclusive, (ii) improving physical infrastructure, (iii) developing the agriculture sector, and (iv) enhancing delivery of essential public services, such as education and health, to large parts of the population.

Similarly for China, policy changes are needed to address both domestic and external challenges. If China is to sustain its rapid economic growth, the economy needs to be restructured away from heavy dependence on export-led growth towards self-sustaining domestic demand, and the opportunity to share in the benefits of growth needs to be spread more equitably across all levels of society. To facilitate all-round, balanced, and sustainable development, financial sector reforms are needed to improve the intermediation of China's large private savings. The government also needs to raise social spending in the areas of education, healthcare, and pensions, which will serve to reduce precautionary saving and boost consumption over time. There is also a need to improve the investment structure, advance reforms in the healthcare, pension, and education systems, and provide more support to rural areas and less-developed regions.

In South Africa, the key challenge is to achieve higher levels of inclusive growth that raise employment and reduce inequality. Policies proposed in the New Growth Path constitute the key means to address these challenges through a development state that places employment at the center of the fight against inequality within a prudently managed macroeconomic framework. Policy measures focused on skill development, the expansion of infrastructure networks, small enterprise promotion, the development of rural economies, industrial policy that promotes higher-value added exports, green economy initiatives, and regional integration are prioritized. Low domestic savings, currency volatility, inadequate investment in productive sectors of the economy, and the efficiency of government services delivery are some of the other challenges.

To conclude, even though the BRICS have pursued different paths of growth with different macroeconomic parameters and varied institutional strengths, the world seems to be optimistic about their emergence based on their respective durable comparative advantages. The growing role of the BRICS is confirmed by the rapid recovery of these economies from the global financial crisis, which demonstrates that optimal global economic policy-making cannot be undertaken without including the BRICS economies at the highest levels of decision making.

2 Impact of the Financial Crisis on BRICS

Introduction

The recent global financial crisis that engulfed almost all economies marked a painful adjustment at the macro level coupled with micro-level distortions and incentives created by past policy actions. This included excessive leverage combined with inadequate regulation, lack of appropriate financial supervision, flawed credit ratings, and failure to appropriately identify the build-up of risks associated with financial innovations. The low interest rate regime, which was the result of an accommodative monetary policy, led to debt levels acquiring unsustainable proportions. The global savings glut combined with aggressive marketing by housing finance institutions and under-pricing of risks fuelled the build-up of sub-prime mortgages. Thus, a number of micro- and macro-economic factors have been listed in the literature as the proximate causes of the crisis—the role of easy money, financial innovations, and regulatory loopholes.

The intensification of the financial crisis in September 2008 caused an abrupt increase in uncertainty and led to a downward reassessment of wealth and income prospects. These developments, in turn, prompted households to postpone spending on most durables, even though falling commodity prices helped boost real disposable income. This drop in demand and dearth of credit set off an unprecedented collapse of real economic activity, sending a feedback loop to the stressed financial sector. As a result, average growth in 2008 slowed by almost similar magnitudes in advanced and emerging economies, with some differentiation because of country-specific circumstances.

Manifestation of the Global Crisis

Global trade linkages and financial integration led to the rapid transmission of shocks from the US and Europe to the rest of the world. The impact of the crisis was felt in almost all the economies of the world to varying degrees. The crisis spread to the BRICS through all four channels—trade, finance, commodity, and confidence channels. The slump in export demand and tighter trade credit caused a deceleration in aggregate demand. The reversal of capital flows led to equity market losses and currency depreciations, resulting in lower external credit flows.

During the initial phase of the crisis, the financial shock was transmitted to the real economy, primarily through the equity price channel and, in a more differentiated fashion, through the credit channel. The shock to international confidence had an immediate and sharp effect on capital flows to emerging markets, as investors reassessed risks and global capital flows collapsed. In addition to poor confidence and wealth effects, the fall in equity prices led to a rise in the cost of capital and dampened investment confidence. In terms of real linkages, the collapse in demand from advanced economies was transmitted through the integrated supply chain to developing economies, with dramatic effects on trade in these countries.

Among the BRICS, the global financial crisis erupted after the collapse of the US-based investment bank Lehman Brothers in September 2008. The banking sectors of the BRICS economies performed relatively well. In Brazil, the local currency and stock market saw huge fluctuations as foreign investment dwindled, demand for commodity exports dried up, and external credit decreased. The external shock did interrupt the accelerated growth path by prompting a slight fall of 0.6 per cent in GDP in 2009 (Table 2.1). In terms of foreign trade, Brazilian exports reached US$ 160.6 billion in 2007, about 11.8 per cent of GDP and 1.18 per cent of world exports. In 2009, total Brazilian foreign trade registered a figure of US$ 281 billion in its flow, a reduction of 24.3 per cent relative to 2008 when US$ 371 billion was traded. This drop was the direct result of the global financial crisis, which led to a reduction in the international prices of mineral and agricultural commodities and in the overall external demand for goods and services.

In the midst of the crisis, the financial markets in Russia froze due to a rise in risk aversion and significant correction of equity markets since 2007. Sovereign credit default swap (CDS) spreads also jumped by several hundred basis points. The sudden change in exchange rate expectations triggered by the collapse of oil prices in September 2008 led Russian banks and firms to seek to hedge their foreign currency exposures, exacerbating pressures on the rouble. Early in the crisis, the banking system was put under additional stress by deposit outflows and some bank failures. Several mid-sized banks (Kit Finance, Svyaz Bank, Globex Bank, and Sobinbank) had to be rescued by

Table 2.1 Global Financial Crisis and BRICS: Summary Indicators

Indicators/Country	Brazil		Russia		India		China		South Africa	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
1	2	3	4	5	6	7	8	9	10	11
GDP Growth	5.2	–0.6	5.2	–7.8	7.3	5.7	9.6	8.7	3.6	–1.7
Investment Rate/GDP	18.2	16.6	26.2	22.7	35.6	34.5	42.5	44.8	22	19.4
CPI Inflation	5.7	4.9	14.1	11.7	8.3	10.9	5.9	–0.7	11.5	7.1
Fiscal Deficit/GDP	–1.3	–3.2	4.3	–6.2	–7.4	–9.6	–0.4	–3	–0.5	–5.2
Gross Debt/GDP	64.1	68.9	7.8	10.9	72.6	74.2	16.8	18.6	27.3	30.5
CAD/GDP	–1.7	–1.5	6.2	4.0	–2.2	–2.1	9.4	5.8	–6.2	–4.0
Exports Growth	23.2	–22.7	33.1	–35.7	29.7	–15.2	17.3	–15.9	41.1	–24.5
Imports Growth	43.4	–26.7	30.6	–34.3	40.3	–20.1	18.3	–11.3	38.5	–30.4
Exchange Rate*	31.9	–25.5	5.1	–5.6	22.9	–3.7	–6.4	–0.1	-8.1	4.1
Equity Market Indices (percentage change)	–57.6	121.3	–51.9	58.8	–65.1	100.5	–74.2	100.3	–5.0	–13.1

Market Capitalization (%GDP)	35.7	73.2	23.9	70.5	53.2	85.4	61.8	100.3	178.5	249.3
PE Ratio**	7.9	17	–72.4	128.6	10.5	21.8	10.3	21.1	9.6	21.8
NPA/Total Loan	3.8	9.7	2.4	1.6	2.3	2.3	2.4	1.58	5.9	5.8

Source: IFS and World Bank database.

Note: Sign '+' means rouble appreciation, sign '–' means depreciation.

* Real effective exchange rate of the rouble against the basket comprising currencies of major trade partners (annual average rate of change).

** RTS Stock Exchange, Bank of Russia calculations, and shares included in RTS Index calculation base; Bloomberg.

state entities or private investors between mid-September and mid-October 2008.

In the initial phase of the crisis, the Indian economy remained relatively insulated, but witnessed a slowdown in GDP annualized growth from around 7.5 per cent in the first half to 6.0 per cent in the second half of 2008, amplified by a sharp contraction in the performance of the manufacturing sector. The significant export-orientation of manufacturing exposed the sector to external demand shocks. Further, a large part of manufacturing exports (42 per cent) was accounted for by leather and manufactures, textile and textile products, gems and jewellery, and handicrafts, which are employment-intensive, with a major portion of exports in these sectors contributed by small-scale industries (SSIs). Thus, the external demand shock had a larger impact on output and employment in such industries, which had a direct bearing on domestic consumption demand.

The impact of the financial crisis on China took the form of a sharp drop in external demand, which in turn led to an economic slowdown, difficulties for businesses, and rising unemployment. Structural problems also became more evident. Two indicators are widely accepted and used by economists to figure out the impact of the financial crisis on China's real economy. The first one is industrial electricity consumption (which is a real indicator) and the other is industrial value-added (which is a value indicator). The trend of electricity use registered an increase of about 10 per cent every month, but from the third season of 2008, the rate of increase dropped dramatically. The outbreak and spread of the global financial crisis had a severe impact on China's financial and real estate markets, which were mainly reflected in the following: (i) The stock index fell in an accelerated manner. During the six months from May to October

2008, the Shanghai stock exchange composite index dropped over 50 per cent. (ii) Real estate prices continuously declined. Between July 2008 and February 2009, the average sales prices index for buildings in 70 medium-to-large cities in China fell by about 2 per cent cumulatively. (iii) Money supply and loan supply growth rate continued to fall. From May to November 2008, the year-on-year M2 growth rate fell by 3.3 per cent and loan supply growth rate for the same period remained low. (iv) From July 2008 to February 2009, the RMB's real effective exchange rate rose dramatically by 14.5 per cent, resulting in an unfavourable effect on China's exports. The sharp drop in China's exports lasted over a considerable period, and in the second half of 2008, 15 per cent of export firms were forced to reduce output or even shut down.

In South Africa, portfolio inflows, which had accounted for the bulk of the financing of South Africa's large current account deficits in the years leading up to the crisis, quickly turned to large net outflows, although overall net private flows remained positive as South African banks ran down foreign assets. Both export and import volumes plummeted, while the prices of most of South Africa's main export commodities weakened, although this was outweighed by the effect of lower oil prices, resulting in an improvement in the terms of trade. The stock market, weakened directly by net outflows on the part of non-residents and indirectly by the large corrections in equity prices elsewhere, began falling in May 2008 but saw sharp declines between September and November 2008 in line with equities in other emerging markets.

The global financial crisis inflicted significant loss in output in all the BRICS economies. In terms of real GDP growth, Russia witnessed the sharpest fall in growth on account of worsening oil prices exacerbated by a fall in other commodities prices. Brazil, which had significant trade linkages with Mercosur, the US, the Euro zone, and China, also witnessed a fall in external demand. The real GDP growth rate fell to (–) 0.6 per cent in 2009 mainly due to external sector shocks. South Africa also suffered its first recession since the early 1990s with a fall in the real GDP growth rate to (–) 1.7 per cent in 2009 due to the negative trade shock and sharp fall in domestic demand. Infrastructure spending in the run-up to the 2010 FIFA World Cup helped to mitigate some of the effects of the crisis, but did not fully offset weak private investment.

However, real GDP growth in India and China remained impressive even though they also witnessed some moderation on the face of weakening global demand. Large domestic demand and policy measures to move towards more domestic sectors-driven growth helped to achieve strong growth even during a period of shrinking external demand.

Policy Responses and Managing the Recovery by the BRICS

The global financial crisis resulted in significant weakening of economic activity led by poor consumer and investor confidence. As a result, all the BRICS countries initiated fiscal stimulus measures. In response to the global economic slowdown, the BRICS also pursued discretionary measures to move towards more domestic demand-driven mode (Table 2.2).

Brazil was one of the first countries to emerge from the crisis, engaging in a V-shaped recovery process after just two quarters of GDP slump. The combination of monetary easing, credit stimulus, and countercyclical fiscal policies had a positive impact on private

Table 2.2 Size of Discretionary Measures in Financial Crisis

(percentage of GDP)

Country	2008	2009	2010
1	2	3	4
BRICS			
Brazil	0	0.6	0.6
Russia	0	4.1	1.3
India	0.6	0.6	0.6
China	0.4	3.1	2.7
South Africa	2.3	3.0	2.1
Advanced Countries			
Italy	0	0.2	0.1
Japan	0.3	2.4	1.8
Korea	1.1	3.6	4.7
United Kingdom	0.2	1.6	0
United States	1.1	2.0	1.8

Source: IMF Staff Position Note, Fiscal Affairs Department, International Monetary Fund, July 2009.

consumption, propelling industrial growth. As consumption and the unemployment rate were quickly restored, a well-calibrated monetary policy allowed inflation to remain within its aimed oscillation boundaries. Brazil's strong macroeconomic fundamentals, including an adequate level of foreign exchange reserves and a sound financial system, were key factors in reducing the impact of the crisis and helping the country to emerge from it ahead of the other economies.

To provide adequate domestic liquidity in Brazil, the rules concerning reserve requirements were relaxed. This resulted in the injection of additional liquidity equivalent to 4 per cent of the GDP (Table 2.3). However, as most of the additional liquidity was concentrated in the

Table 2.3 Measures by Central Banks

Country	Monetary Measures
Brazil	Brazil has featured high levels of reserve requirements, allowing the central bank to lower reserve requirements for macro-prudential purposes following the Lehman Brothers episode. In particular, to confront liquidity problems in the inter-bank market, the central bank reduced reserve requirements to support lending from large liquid banks to small illiquid banks. By introducing this liquidity provision mechanism during the crisis, the central bank was able to avoid financial stability problems in the system.
Russia	The authorities' efforts to stabilize the banking system during the fourth quarter of 2008 aimed to provide significant liquidity while keeping the exchange rate stable to offset the abrupt loss of foreign financing. Starting in April 2008, the government auctioned excess budgetary funds to banks, while the Central Bank of Russia (CBR) provided an ever-widening array of liquidity facilities, including long-term subordinated loans and uncollateralized loans, which had been provided under special federal laws. In 2008–9 the Bank of Russia broadened the range of assets that banks could use as collateral in refinancing transactions and extended the terms of loans secured by non-market assets, such as promissory notes, credit claims, or credit institution guarantees. The CBR also offered guarantees for inter-bank lending to qualifying banks, covering losses in the event that the licence of the counterparty was withdrawn. In March 2009, another bank recapitalization scheme was announced that entailed an exchange of preferred shares for government bonds. Adjustments in the interest rates were active tools in the Bank of Russia's response to the global financial crisis. The refinancing rate was increased in the second half of 2008. Then the Bank of Russia implemented a series of reductions in the refinancing rate: from 13 per cent in April 2009 to 7.75 per cent in June 2010. The CBR temporarily lowered the required reserve ratios in September and in October 2008.
India	The policy repo rate under the liquidity adjustment facility (LAF) was reduced by 400 basis points, from 9 per cent to 5 per cent. The policy reverse repo rate under the LAF was

Country	Monetary Measures
	reduced by 250 basis points, from 6 per cent to 3.5 per cent. The cash reserve ratio (CRR) was reduced by 400 basis points from 9 per cent of net demand and time liabilities (NDTL) of banks to 5 per cent. The statutory liquidity ratio (SLR) was reduced from 25 per cent of NDTL to 24 per cent. The export credit refinance limit for commercial banks was enhanced to 50 per cent from 15 per cent of outstanding export credit. A special 14-day term repo facility was instituted for commercial banks up to 1.5 per cent of NDTL. A special refinance facility was instituted for scheduled commercial banks (excluding RRBs) up to 1 per cent of each bank's NDTL as of 24 October 2008.
China	China made efforts to guide financial institutions to make remarkable credit planning. Since September 2008, the PBC has lowered the benchmark deposit and lending rates five times, from 4.14 per cent to 2.25 per cent and from 7.47 per cent to 5.31 per cent, respectively. To amplify liquidity in the banking system, the PBC cut the RMB reserve requirement ratio of financial institutions four times in the latter half of the year 2008. Specifically, the reserve requirement ratio of large financial institutions was cut by 2 percentage points cumulatively, whereas that of small financial institutions was cut by 4 percentage points cumulatively. The 1-year central bank liquidity lending rate was cut from 4.68 per cent to 3.33 per cent. The rediscount rate was cut from 4.32 per cent to 1.8 per cent. At the same time, the PBC eliminated quantitative ceilings for financial institutions' credit lending and promoted greater support for SME lending to increase their credit supply and optimize the credit structure.
South Africa	In response to the financial crisis during December 2008, the Monetary Policy Committee of SARB reduced its policy rate by 50 basis points. Further cuts worth 600 basis points reduced the repo rate to an all-time low of 5.5 per cent by November 2010. Interest rate reductions were facilitated by an improved inflation outlook against the backdrop of slowing economic growth (increasing output gap) and declining commodity prices.

larger financial institutions, other measures were needed to spread liquidity to the whole system. To dispel fears about the soundness of the domestic banking sector, the central bank (BCB) allowed the Credit Guarantee Fund (FGC, known in Brazil as *Fundo Garantidor de Crédito*), the Brazilian deposit guarantee system that is privately funded and public regulated, to include an additional temporary guarantee for a special type of time deposit that was especially created to restore liquidity in the small and medium bank segments. Initiatives to inject liquidity in the foreign currency market comprised the selling of US$ 14.5 billion in the spot market, exchange rate swap operations of US$ 33 billion and auctions of US$ 24.4 billion to provide short-term financing to exporters. As the crisis deepened, the BCB initiated a series of interest rate cuts that lasted until July 2009 and totalled 5 per cent. To stimulate sales and production, the tax on manufactured goods (IPI) on vehicles, household appliances, capital goods, and building construction materials was significantly reduced or, in some cases, set to zero. In an additional effort to boost consumption, the tax on financial transactions (IOF) charged on credit operations to households was reduced from 3.0 per cent to 1.5 per cent. Apart from these measures, there were loans from state-owned banks, and injections by the treasury into BNDES, the state-owned National Development Bank, which boosted the bank's lending capacity to energy and infrastructure sectors and allowed the launching of new credit facilities for exporters and for the production of capital and consumption goods. These measures supplemented the growth recovery process in Brazil. Finally, in October 2008, the US central bank (the Fed) agreed to channel the BCB with a US$ 30 billion swap line, which was not drawn upon.

Russia came up with one of the largest fiscal stimulus packages in the G-20. The expansionary fiscal stance manifested in a rise in government expenditure and pushed up the government (non-oil) deficit from 8.25 per cent of GDP in 2008 to 15 per cent of GDP in 2009. In the second half of 2008 the main challenges of the monetary policy were to ensure financial stability and to curb capital outflow. Then the Bank of Russia started to ease monetary policy in order to support economic growth: between April 2009 and June 2010, the refinancing rate was reduced by 525 basis points to 7.75 per cent. Due to aggressive fiscal policies accompanied by monetary easing, Russia's fiscal health emerged almost unscathed from the global crisis. Though the economy contracted by 7.8 per cent in 2009, it reverted to the path of stability in the first quarter of 2010 with real GDP registering a growth of 3.5 per cent. In the case of Russia, prudent management of oil revenues provided the leeway, not only for substantial fiscal expansion in the face of the crisis, but also to monetize the deficit. The stabilization funds were drawn down without any significant risk to external vulnerability. As a result, apart from the improvement in the general indicators of economic recovery, Russia emerged from the crisis with a low public debt ratio (around 11 per cent of GDP), unlike the advanced economies of the West including those in the Euro zone and the US.

India's policy response to the crisis was aimed at containing the contagion from the outside—to keep the domestic money and credit markets functioning normally and to ensure that the liquidity stress did not trigger solvency cascades. In particular, three objectives were pursued with respect to the financial sector: first, to maintain a comfortable rupee liquidity position; second, to augment foreign exchange liquidity; and third, to maintain a policy framework that would keep credit delivery on track so as to arrest the moderation in growth. Besides challenges thrown by the global financial melt-down, the policy responses also involved the challenge of balancing short-term mitigation and medium-term sustainability. The measures to meet these objectives came in several policy packages from the Government of India and the RBI starting in mid-September 2008.

The fiscal policy measures undertaken by India in the form of three fiscal stimulus packages during the second half of 2008–9 constituted tax cuts, encouraging investment in infrastructure and increased expenditure on both investment and consumption. The expansionary fiscal stance continued in the Union Budget for 2009–10, which was presented against the backdrop of moderation of growth in the economy and signs of stabilization in the global economy. The allocation for crucial sectors such as infrastructure, education and health, rural employment, and empowerment of disadvantaged sections of the population was enhanced significantly. Additional expenditure amounting to 3 per cent of GDP was provided through three supplementary demands for grants during October–December 2008 and February 2009. The monetary policy response was in terms of easing liquidity in the system through conventional measures such as cutting policy rates (cash reserve ratio [CRR], reverse repo, and statutory liquidity ratio [SLR]) and open market operations, and unconventional measures, that is, opening refinance facilities to SIDBI and EXIM Banks and rolling back prudential norms with regard to provisioning and risk weights. The total amount of actual/potential liquidity injected was Rs 5,850 billion.

China adopted a proactive fiscal policy and a moderately easy monetary policy, and put in place a package plan to ensure steady and relatively rapid economic growth. The most immediate and important goal of the package plan was to reverse the economic downturn and maintain steady growth. It was also designed to address structural problems constraining China's economic development, speed up transformation of the growth pattern, and raise the quality and performance of factors of production in order to lay a more solid foundation for growth in the long run. First, it aimed to boost domestic demand in a comprehensive way and strengthen the role of consumer demand in driving economic growth to promote balanced economic development; second, it sought to improve infrastructure across the country and promote coordinated economic development; third, it attempted to enhance the competitiveness of industry and capacity for independent innovation and promote sustainable economic development; and fourth, it worked for all-round development of the people and promoted intensive economic development. To serve the overall objective of promoting economic growth and to expand domestic demand and restructure the economy, the People's Bank of China (PBC) implemented a moderately easy monetary policy by adopting flexible and effective measures to strengthen financial support for economic growth, ensuring that the aggregate money and credit supply satisfied the needs of economic development. The PBC has conducted open market operations, timely and appropriately, to ensure sufficient liquidity in the banking system in general, and to stabilize market expectations. In 2011, to tackle the potential risk of growth slowdown and the increasing pressure from rising prices, China continued its proactive fiscal policy and adjusted the moderately easy stance of monetary policy to a prudent one. Proactive fiscal policy effectively boosted domestic demand, promoted economic restructuring, and improved the people's livelihood. The problem of price rise was addressed through the use of prudent monetary policy tools.

Since September 2008, the PBC has lowered the benchmark deposit and lending rates of financial institutions five times, from 4.14 per cent to 2.25 per cent, and from 7.47 per cent to 5.31 per cent, respectively. The deposit and lending rates between financial institutions and the PBC were cut twice; in particular, the deposit rates of statutory reserve and excess reserve ratios with the PBC were cut from 1.89 per cent and 0.99 per cent to 1.62 per cent and 0.72 per cent, respectively. The 1-year central bank liquidity lending rate (re-loan rate) was cut from 4.68 per cent to 3.33 per cent; the 1-year central bank lending rate to rural credit cooperatives was cut from 3.96 per cent to 2.88 per cent; and the rediscount rate was cut from 4.32 per cent to 1.80 per cent. To ensure sufficient liquidity in the banking system, the PBC cut the required reserve ratios four times. Specifically, the reserve requirement ratio of large financial institutions was cut by 2 percentage points cumulatively, while that of small financial institutions was cut by 4 percentage points cumulatively. At the same time, the PBC eliminated quantitative ceilings for financial institutions' credit lending, guided financial institutions to increase their credit supply, and optimize the credit structure, following the principle of differentiated treatment which encouraged growth in some sectors. The PBC strengthened credit services to agriculture, rural areas, farmers, small and medium-sized enterprises, employment programmes, post-disaster reconstruction, consumption expansion, and independent innovation, while ensuring that loans to eligible central government investment projects were granted in a timely manner.

In South Africa, fiscal and monetary policies responded to the crisis in a countercyclical manner by allowing the fiscal deficit to increase as government revenues dropped, increasing government spending and sharply reducing interest rates. Sound public finances during the pre-crisis boom period (2002–7) provided South Africa with the fiscal space to provide stimulus during the 2008–9 recession. The size of the budget deficit had declined from 5.7 per cent of GDP in 1995 to a surplus of about 1 per cent of GDP in 2007–8, which helped to reduce the government's debt burden from 47 per cent of GDP to only 27.1 per cent in 2008–9. As a result, the government was able to sustain spending on crucial social services and infrastructure investment during the recession. The shortfall between expenditure and revenues was funded by increased borrowing.

The consolidated government budget balance worsened by about 5 percentage points of GDP in 2009–10, due in roughly equal measure to a decline in the revenue-to-GDP ratio and a rise in expenditures to GDP. Most of that deterioration was cyclical, reflecting the emergence of a negative output gap and the operation of automatic stabilisers on the revenue side, but about 1.4 percentage points of GDP corresponded to a structural increase in expenditure. This was less a function of discretionary anti-crisis measures than the maintenance of pre-existing ambitious public sector investment plans (both on the part of the government and government loans to key state-owned enterprises for capital purposes). Public consumption also supported output during the decline. This was driven by above-budgeted public-sector wage settlements in 2009 and the choice to extend the child support grant up to a child's 18th birthday, and finalization of previously announced extensions to the old age pension grant.

Interest rates were reduced by 650 basis points between December 2008 and November 2010. SARB began to ease rates in December 2008 after the effects of the collapse of Lehman Brothers became apparent. Soon after the international crisis struck, the Monetary Policy Committee (MPC) moved to monthly meetings, from the earlier frequency of once every two months, to be more responsive to developments. The SARB's repo rate bottomed out at 5.5 per cent and no emergency actions, like capital support for banks or quantitative easing to support lower interest rates were judged necessary, given the absence of severe difficulties in the banking sector. Real interest rates were negative in South Africa in the first half of 2009, but actually less than rates prevailing just before the crisis and, with the continued fall in inflation by the second half of the year had turned substantially positive again. The growing sense of normalization was reflected in the MPC's move back to bi-monthly meetings in November 2009.

An important element of South Africa's resilience to the global economic crisis was that it did not experience a banking crisis. Despite the sharp swing from rapid economic growth into recession, and in particular the decline in house prices after a long mortgage lending boom, South Africa experienced no bank failures. Non-performing loan (NPL) rates did surge in 2009, but the surge in bad loans was not reflected in major losses for the banks. There were several reasons for this, including the banks' strong profitability, the low level of NPLs and comfortable capital cushions going into the downturn; their lack of direct exposure to problem assets in the US and Europe; bankruptcy laws that favour creditors in recovering collateral for bad loans; and conservative approaches on the part of both the regulator and the banks themselves. In addition, the lending boom was already cooling prior to the intensification of the international crisis in September 2008, in part because the National Credit Act came into force and tightened standards on lending to households.

The framework for South Africa's response to the international economic crisis emphasised the urgent need to use industrial and trade policy, preferential treatment for domestic firms in procurement, and rescue packages for crisis-affected sectors, but there has been little concrete action in these areas. Some tariffs, mainly on clothing, were raised, and a small number of anti-dumping investigations were launched. Corporate bail-outs were also not a major feature of the downturn. Although macroeconomic policies were supportive and the downturn was not particularly deep compared to the international average, it was nonetheless relatively prolonged. The main reason why South Africa did not experience a V-shaped recovery, as did some other emerging markets, is that the country was already moving into a cyclical downturn when the international crisis struck.

Growth has resumed in South Africa and has been strengthening. After three negative quarters, real GDP growth turned marginally positive (+0.2 per cent quarter-on-quarter seasonally adjusted, and not annualised) in the third quarter of 2009 and quickened to 0.8 per cent in the fourth quarter, as private consumption growth resumed and the rate of inventory drawdowns slowed. Growth accelerated further in the first quarter of 2010 and GDP expanded by 2.7 per cent in the year as a whole. Government consumption contributed positively throughout the recession and subsequent recovery, but private sector gross fixed capital formation declined sharply and took a long time to recover. Both export and import volumes rebounded in the second half of 2009. Although some sectors, such as manufacturing, have experienced a significant bounce-back from the low point of the recession, others, including wholesale and retail trade, agriculture and fisheries, and finance and real estate, have lagged. Two important factors hindering the recovery appear to be credit growth and employment. With household debt levels remaining high and weakening labour market conditions, consumption has so far played less of a role in the recovery than in many other emerging countries.

Lessons from the Global Financial Crisis

In their well-researched book, *This Time is Different: Eight Centuries of Financial Folly*, Kenneth Rogoff and Carmen M. Reinhart show

how over a period of 800 years all financial crises can be traced to the same fundamental causes. Each time, experts have chimed that 'this time is different', claiming that the old rules do not apply and the new situation is dissimilar to the previous one. The crisis then came as a serious blow to the credibility of central banks and the reputation of central bankers. The challenge for central banks, as indeed for all policymakers, is to learn lessons from the crisis and incorporate them in their policies.

Balancing the Financial and Real Sectors

The fact that a well-developed financial sector is necessary to act as the intermediary between entrepreneurs/investors and savers can hardly be overstated. An efficient financial sector reduces the cost and risk of producing and trading goods and services and, thus, makes an important contribution to raising the standards of living. The recent crisis, however, showed that the financial sector had apparently assumed a quasi-autonomous existence without close connection with the financing requirements of the real economy. The financial industry, indeed, grew oversized in the preceding years as reflected in rapid credit creation, asset price bubbles and high levels of indebtedness, particularly in advanced financial systems. The disproportionate growth in the global financial sector was largely due to the aggressive search for yield, engendered by easy liquidity in the global system that triggered a wave of financial innovations. Complex financial products were created by structuring and hedging, originating and distributing, all under the belief that real value could be created by sheer financial engineering. As mentioned earlier, there were hardly any signs of growing capital formation due to the growing and increasingly complex financial sector.

In short, as a result of the excess liquidity that permeated the global economy, particularly in the US but also in other countries, there was excessive 'financialization'. The financial sector grew more rapidly than other goods and services sectors. In a way, that made the growth of finance an end in itself and not a means to meet human needs such as food, fuel, health, and education. Given that the bursting of the oversized financial sector has a devastating impact on the real sector, it becomes important (i) to examine the optimal size of the financial sector relative to growth and development needs and (ii) to make financial sector innovations more meaningful to cater to the needs of the real sector.

Domestic Demand as a More Durable Source of Growth

The impact of the crisis on the external demand of EMEs has been clearly visible since the last quarter of 2008. In the first instance, the downturn in the US, Europe, and subsequently in Japan was manifested in a sharp contraction in exports from those EMEs that had become the largest exporters to the industrial world. Subsequently, exports of raw and intermediate goods from relatively smaller EMEs to larger EMEs declined. In some commodity-exporting countries, particularly Russia, exports fell by more than 40 per cent in the first quarter of 2009. Since prices fell sharply as world growth slowed, they led to declining incomes in EMEs which, in turn, tended to reduce demand and growth. In view of the adverse impact of the crisis on domestic growth, EMEs may need to review their undue dependence on external demand and attempt to generate demand within their economies. A reasonably balanced macroeconomic management strategy appears to have enabled the BRICS economies to minimize the spill-over effects of the external shocks to a great extent.

Financial Sector Reforms

Emerging market economies, still in the process of developing their financial systems, can take up this opportunity to learn from the crisis and develop a robust financial sector with a sound systemic oversight framework. The experience of the recent crisis demonstrates that the financial system in most emerging Asian countries was relatively resilient to global shocks as reforms, which had been put in place after the East Asian crisis, fostered transparency and governance, and strengthened regulation and supervision. The crisis lessons do not call for overregulation as this could restrain growth impulses. A judicious approach while formulating financial liberalization measures, however, proved to be extremely effective as reflected in the strengthening of banks by public recapitalization in some advanced economies. Alternatively, regulators and supervisors should work on proper regulation of the so-called 'innovations' that allowed the build-up of risks within the financial sector to be disguised; monitoring and establishing limits to tame the overexposure of domestic banks to toxic assets globally; adequately regulating and supervising the real estate market, in order to avoid the excessive artificial growth of financial investors in real estate; regulating the activities of systemically important non-bank financial institutions as well as submitting all systemically important financial institutions to intensified supervisory procedures; and speaking out against hasty and potentially risky attempts to liberalize the capital account of the balance of payments. Thus, countries should self-insure against future crises by putting in place, as best as they can, robust economic and financial policy frameworks that help minimize their vulnerabilities.

It has been observed that banks that rely heavily on wholesale funding are naturally more vulnerable to any shock to market liquidity. When loans are larger than deposits, banks may resort to funding from foreign parents or domestic and international wholesale markets to finance the gap. Likewise, there is anecdotal evidence that the presence of foreign banks was associated with currency mismatches. This indicates that emerging markets, while encouraging the entry of foreign banks, should simultaneously strictly regulate their local lending practices.

Social Security System

The resilience of EMEs to external shocks is unlikely to be fully guaranteed given the increasing trade and financial integration with advanced markets. Therefore, it becomes important, *albeit* challenging, for emerging and developing countries to gradually put in place an effective social safety net system which not only helps as an automatic stabilizer but also attenuates the need for undertaking sudden large-scale discretionary fiscal policy measures that lead to long-term fiscal sustainability concerns. An improvement in both the social safety net system and financial markets may foster the development of domestic demand contributing to enhanced market strength. An improvement in the social security system and the financial markets may also decrease private savings in the long run.

Concluding Observations

The global economic crisis which originated in the financial sector inflicted significant output loss, impaired the balance sheets of households and corporations and caused an overall fall in economic activity. The crisis also exposed the structural weaknesses of the financial and real sectors. The BRICS economies recovered swiftly with the support of domestic demand. Still, the recovery is yet to be made compatible with the fiscal consolidation process. Besides the current recovery process, there are specific lessons for BRICS economies from the recent crisis. These lessons include (i) recognizing the invalidation of the decoupling hypothesis, (ii) allowing domestic demand to serve as a durable source of growth, (iii) instituting financial sector reforms, (iv) monitoring speculative capital flows, (v) recognizing the creation of fiscal policy space on a sustainable basis as a central feature of their reform agenda, and (vi) focusing on infrastructure development and employment generation.

3 Best Practices

This chapter looks at the best practices and institutions within the BRICS economies that have made significant differences to these economies and contributed to their high growth rates. The purpose is to showcase successful practices and institutions for the rest of the world to draw lessons for social upliftment, poverty reduction, financial sector stability, and faster economic growth. Many of these practices and institutions have relevance within the BRICS bloc for enhancing cooperation and creating synergies, so that the BRICS could collectively grow faster. This is the case despite the fact that the BRICS are culturally, demographically, and politically disparate, each with its own unique identity and institutions.

Major showcase areas for Brazil include agricultural research, which has transformed the country into a major exporter; the use of bio-fuel for road transport, and the emergence of Embraer as a high-technology aircraft manufacturer. In the social sphere, Conditional Cash Transfers that target poverty and the success of the anti-AIDS policy provide useful lessons. A regulatory framework that helped Brazil withstand the shock of the global crisis and the issuance of domestic currency-denominated international bonds, which transfer currency risk to investors, are other successful practices that have been highlighted.

Russia's major achievements include reforms during 1999–2009 that promoted economic growth, lowered inflation, and led to a dramatic fall in the number of people living below the poverty line. Specific achievements include setting up of the Oil Stabilisation Fund that was successful during the crisis, budgetary reforms through the devolution of decision-making powers, and the introduction of a flat personal income tax rate of 13 per cent that ensured improvement in compliance.

The main showcase institution for India is private entrepreneurship which has been instrumental in achieving 8–9 per cent annual growth of the economy in recent years. Private initiative has been responsible for the excellence achieved in the information technology sector and the innovative streak that has led to improvization and production of low-cost goods for the Indian mass market.

Besides, the calibrated approach to capital account convertibility and the External Commercial Borrowing Policy have helped insulate the economy against surges and reversals of debt flows and maintained the external debt at sustainable levels. The Right to Information Act is increasing transparency and accountability of government operations and the Mahatma Gandhi National Rural Employment Guarantee Scheme is a major step towards making growth inclusive.

The best practices and institutions of China are those that have helped ensure progress in terms of economic growth, enhancing its national strength and improving the living standards of its people as well as the success in making the historic transition from a highly centralized planned economy to a robust socialist market economy and from a closed and semi-closed country to a country that is open to the outside world. Specific areas are FDI attraction and utilization, and infrastructure financing, among others.

The Chinese globalization model has also been different, in that foreign direct investment was encouraged. The sub-national governments (cities/provinces) have been successful in attracting foreign investment by providing improved infrastructure and a favourable regulatory environment. China also has experience in financial macro-management. The reform and development of China's banking industry and financial market played a key role in promoting rapid and sustainable economic growth.

South Africa has a long record of responsible macroeconomic management, which has helped to promote the development of a deep and liquid bond market and reduced external vulnerability. South Africa has strong institutions and a highly developed, well-regulated banking sector that escaped the worst effects of the financial crisis. With the most developed industrial and financial capabilities on the African continent, South Africa's role in the integration of policies, markets, finance, and infrastructure is vital to Africa's economic development and realization of the continent's potential as a growth pole in the global economy. Outwardly oriented South African companies are among the largest sources of FDI in Africa and the country's development financing institutions are playing an increasing role in the funding of regional infrastructure investment.

Brazil

Agriculture

Brazilian agriculture has undergone dramatic changes in the past few decades. From a net importer of food grains, Brazil has emerged as a major exporter of food products. This change has been possible due to major technological breakthroughs and the extension of cultivation to previously uncultivable land. More important, the change has not happened at the expense of the Amazon rainforest, as is sometimes believed, but through the extension of cultivation to a region called the *Cerrado*, which is 1,000 km south of the Amazon forest and was earlier regarded as having limited cultivation potential.

The FAO estimate for the total potential cultivable land of Brazil is over 400 million hectares. Thus far only 59.5 million is being used, with most of the new land in the *Cerrado*. The success of agriculture has also raised expectations that Brazil may be able to meet the growing global food demand–supply gap resulting from growth in population and per capita income.

Agricultural Research

Much of the credit for agricultural transformation in Brazil goes to Embrapa, which is the abbreviation for *Empresa Brasileira de Pesquisa Agropecuaria* or the Brazilian Agricultural Research Corporation. The organization was set up by the national government in April 1973 to develop agricultural technologies through research and innovation. The decision was prompted by a period of rapid population growth and a large increase in per capita income, which created the risk that the country might not be able to meet its growing domestic demand for food. The organization has since developed more than 9,000 technologies for Brazilian agriculture, reduced production costs, and increased the supply of food while conserving natural resources and the environment.

Among its major achievements, Embrapa is largely responsible for expanding the agricultural frontier into a region called the *Cerrado*, which was previously considered uncultivable. The *Cerrado* occupies about 23 per cent of the Brazilian territory and has acidic soil with low levels of nitrogen and phosphorous. To overcome this limitation, Embrapa developed, *inter alia*, acidity correction technologies by pouring industrial quantities of lime (pulverised limestone or chalk), encouraged the expansion of Brazil's beef herd and adapted soybeans (a temperate climate crop) for the tropical climate. Today, the *Cerrado* accounts for 70 per cent of Brazil's farm output. The region also accounts for 60 per cent of the country's production of soybeans. This was followed by the development of a new variety of grass, which is a crossbreed with an African grass called brachiaria. The new variety produced 20–25 tonnes of grass feed per hectare, many times the native *Cerrado* grass output. This helped turn parts of the *Cerrado* into pastures, making possible the enormous expansion of Brazil's cattle herd.

In addition, Embrapa was successful in turning soybean into a tropical crop. Soybean is a temperate climate crop native to north-eastern Asia (Japan, the Koreas, and north-east China) and is sensitive to temperature changes. All other large soybean producers (notably America and Argentina) have temperate climates. Earlier, Brazil was growing soybean in its temperate southern states. However, with cross-breeding, Embrapa began growing soybean in a tropical climate, on the rolling plains of Mato Grosso state, and in the *Cerrado*. More recently, Brazil has been importing genetically modified soy seeds and is now the world's second-largest user of genetically modified seeds after the United States. Embrapa has won approval for its first genetically modified seeds. Embrapa has also pioneered 'no-till' agriculture, where the soil is not ploughed nor the crop harvested at ground level. Instead, the crop is cut high on the stalk and the remains of the plant are left to rot into organic material. Next year's crop is then planted directly into the material, retaining more nutrients in the soil. In 1990, Brazilian farmers used no-till farming for 2.6 per cent of their grain output, which has now risen to over 50 per cent.

Embrapa has a budget of over US$ 1.0 billion per year and employs almost 9,000 people. It is organized as a large network, comprising 41 decentralized centres in all regions of the country. It has signed 68 technical co-operation agreements with 46 countries and 89 foreign institutions, particularly in the area of agricultural research, and has ongoing multilateral agreements with 20 international organizations, involving research partnerships and technology transfers. The institution has established partnerships with laboratories in the United States and Europe (France, England, and Netherlands) for research in advanced technology. In the sphere of technology transfer to developing countries, achievements include the opening of the Embrapa's technology transfer projects in Africa (Ghana), South America (Venezuela), and Central America and the Caribbean (Panama), which has allowed wider dissemination of innovations and technologies developed by Embrapa.

Bio-energy Fuels: Ethanol

Brazil has a track record of running the most successful bio-fuel programme in the world. The main objective of the *Proálcool* Programme, which was launched by the Brazilian government in the mid-1970s, was import substitution. The idea was to reduce imports of petroleum products by using ethanol in transport vehicles. Government subsidy was extensively provided for this purpose.

In addition to government subsidy to promote ethanol use, the Brazilian car industry played a major role in disseminating this technology by developing flex-fuel engines that could run on both gasoline and ethanol. Consumers, therefore, have a choice regarding the use of gasoline or ethanol—the choice often depending on the relative prices. Last year, the proportion of flex-fuel vehicles in the Brazilian market exceeded 90 per cent. Ethanol now accounts for 90 per cent of liquid biofuels consumed in the world and ethanolproduction in Brazil and the world nearly quadrupled between 2000 and 2008.

Research on the use of ethanol as a transport fuel began in Brazil in the 1930s and benefited from strong government support. The Proálcool Programme was launched in 1975, and provided for a 20 per cent gasoline mix. The main purpose was to lower dependence on oil imports. Hydrated alcohol was introduced as a direct substitute for gasoline in 1979. This led to a sizeable increase in consumption and production of alcohol between 1976 and the mid-1980s.

The programme received a setback at the beginning of the 1990s, due to the macroeconomic crisis that affected the Brazilian economy. Oil prices were falling and there was a lack of trust among consumers regarding hydrated alcohol. As a result, few cars using ethanol fuel were produced. The use of alcohol as a transport fuel was receiving hardly any serious international attention.

The programme was revived early in 2000, with government support limited to supervision and regulation. A milestone was achieved in 2003 with the introduction of flex-fuel vehicles that are dual-fuel, that is, running on gasoline and ethanol. The decision regarding fuel choice lies with the consumer, depending on a comparison of prices. As a result, the production of ethanol doubled between 2003 and 2010 from 12.6 to 25.7 billion litres. By 2005, 50 per cent of the cars sold in Brazil had flex-fuel engines and the figure rose to

90 per cent in 2010. Brazil became the first country in 2008 to use more biofuels than gasoline. This extraordinary success helped lower petrol dependency in the energy matrix from 45.5 per cent in 2000 to 37.3 per cent by 2008.

Environmental considerations have been fully integrated into the ethanol production policy. Net CO_2 emission is calculated at 260 kilos for each 1,000 litres of ethanol against 2,280 in the case of gasoline, implying an 89 per cent reduction in emissions. Such a calculation takes into account the production/consumption cycle: from planting/harvesting; the high absorption capacity of gases during cultivation; the co-generation of energy as well as emissions in the process of generating energy; and the emissions during transport and consumption. The high absorption capacity of gases by sugarcane cultivation was recognized by the UN when it included ethanol in the Clean Development Mechanism (CDM) Scheme. Based on its success and the increasing efforts by the world to expand the use of renewable energy sources, ethanol stopped being treated as a curiosity from Brazil. Indeed, key international players like Shell, BP, Cargill, and Bunge, among others, have stepped in through acquisition and joint-ventures since 2007 and reinforced the process of concentration and capitalization of the sector. Petrobras itself has set up a special division for biofuel and in 2010 ranked fourth in production in Brazil. In 2009, one of the major Indian sugar refineries, Shree Renuka Sugars, also entered the market through acquisition of a Brazilian ethanol company. Ethanol as a bio-fuel has enormous potential for future development, as it is more efficient and drastically diminishes land use. New technological pathways (hydrolyses of cellulosic materials) are being explored. The Brazilian experience suggests, therefore, that it is possible to harmonize food and bio-fuel production in a sustainable way.

Conditional Cash Transfers

The Conditional Cash Transfer (CCT) programme aims at directly transferring cash to the poor, provided that beneficiaries fulfill certain conditions like enrolling children in school, getting regular medical check-ups, and receiving vaccinations. The programme is running in many South American countries along with Brazil and is regarded as an example of a best practice in the provision of a social safety net.

The *Bolsa Família* programme in Brazil was created in October 2003 to improve the efficiency and coherence of the social safety net. It is designed to meet two major goals: short-term poverty alleviation and the fight against intergenerational poverty traps. The former is addressed through cash-transfers, while the latter uses conditionalities to encourage families to persist in human capital investment. The programme requires 85 per cent school attendance for school-aged children, updated immunization cards for children up to six years of age, and regular visits to health centres for lactating and pregnant women. Conditional cash transfers proved to be an important factor in reducing inequalities. A study by the International Policy Centre for Inclusive Growth (IPC-IG) shows that, despite its small share in total income (about 0.5 per cent of GDP), the programme has helped reduce inequalities in Brazil by about 21 per cent between 1995 and 2004.

Bolsa Família has also been effective in poverty reduction. The share of population living in extreme poverty (on less than US$ 1.25 per day) reached 5.5 per cent in 2007, from about 11 per cent in the mid-1990s and 15 per cent at the end of the 1980s. According to the World Bank (Press Release No. 2011/093/LAC), the programme is among the most effective social protection programmes in the world, having helped raise approximately 20 million people out of poverty between 2003 and 2009 as well as significantly reducing income inequality.

Anti-AIDS Policy

Brazil was the first nation to provide anti-AIDS therapies at no cost to all patients who needed them since 1991 and has played a pivotal role in public policy debates concerning HIV/AIDS. Its national HIV/AIDS programme was praised as the best of its kind in the developing world by the United Nations and has served as a model for 31 other developing countries as well as for the global HIV/AIDS policy adopted by the World Health Organization (WHO) since 2003. By 2010, about 200,000 patients in the country benefited from these therapies. By providing universal treatment, the country proved that it was possible for developing countries to offer efficient AIDS treatment. Moreover, Brazil has demonstrated that a strategy that combines prevention and treatment is far more effective than concentrating on prevention alone.

The success of the anti-AIDS programme can be seen from the fact that (i) the occurrence of opportunistic infections in Brazil fell by 80 per cent since triple therapies began to be administrated in 1996. As a result, around 358,000 AIDS-related hospitalizations were avoided in the country, saving the Ministry of Health over US$ 2.1 billion between 1996 and 2002, and (ii) anti-AIDS cocktails have prolonged and sensibly improved the life-quality of those infected with AIDS in Brazil. A study conducted throughout the country found a twelvefold increase in mean survival time of AIDS patients from the 1980s to the 2000s—a result similar to that observed in high-income countries. The study also showed that anti-retroviral therapies have allowed these patients to continue to work and interact with their families and friends.

Although in 1992 the World Bank projected that by the year 2000 Brazil would have 1.2 million HIV-positive people, it has in fact had only half as many, that is, about 600,000. From 1994 to 2000, it is estimated that Brazil's treatment policy has avoided a large number of AIDS cases. Anti-retroviral treatment has thereby also significantly reduced the economic costs generated by the loss of productivity of individuals deceased or handicapped by AIDS.

AIDS treatment in Brazil has relied heavily on the local production of generic anti-retrovirals as a strategy to contain treatment costs. This strategy has not only reduced imports of unpatented anti-AIDS drugs but also forced brand-name pharmaceutical companies to concede large discounts in their prices of patented drugs in order to avoid having their patents' monopoly rights overrun by compulsory licensing. Crucially, since the Ministry of Health began substituting expensive imports with local generic equivalents in 1996, the prices of unpatented anti-retroviral drugs fell by an average of 80.9 per cent in Brazil until 2001. By 2011, 11 of the 19 anti-AIDS drugs offered in Brazil were locally supplied.

Regulatory Framework

During the global financial crisis, the Brazilian banking system proved to be substantially resilient. This ensured that the crisis had a minimal effect on the Brazilian economy and there was a quick recovery. Four important aspects stand out and need highlighting as best practices: (i) *supervision*: Brazil adopted a consolidated approach, requiring that even non-financial subsidiaries in a banking group undergo supervision and be subject to controls; (ii) *regulatory capital*: an 11 per cent capital requirement is demanded, compared to the 8 per cent recommended by the Basel Committee on Banking Supervision standards; (iii) *stability*: financial innovations are permitted only after an analysis of their impact on financial stability; and (iv) *transparency*: all operations must be kept on balance, with respective risk requirements and provisions. Operations concerning over-the-counter derivatives must be registered at a clearing house. Regulators have full access to information on all such operations. Accounting Reports show that Brazil's credit provisioning criteria were effective during the last international financial crisis. Since 1999, regulation requires risk classification on all credit operations, considering not only the effective but also the expected loss. Moreover, regulation requires provisioning at the time the operation takes place, based on borrower and operation risks. Additionally, there is progressive minimum provisioning after 15 days of delinquency. Further enhancements, such as the write-off of disposed portfolios, are under consideration.

Public Debt Management

Brazil has frequently been mentioned by emerging markets as a reference in terms of public debt management due to its successful recent experiences. It has managed to considerably minimize its financing costs and risks, when, for example, it moved from a participation of more than 70 per cent of its debt linked to the exchange rate in 1994 to a modest share of 5.1 per cent in December 2010. The favourable macroeconomic environment over the past 10 years, a consequence of sound monetary and fiscal policies combined with the reduction of external vulnerability, mainly by accumulation of international reserves, allowed the government to adopt good debt management practices, culminating in its assignment as an investment-grade economy in 2008.

One of the main strategies responsible for such a change was the consistent replacement of exchange rate instruments by fixed-rate and inflation-linked debt since 2003. The pace of the substitution was intensified after the adoption of capital gains tax exemption for public debt bonds held by foreign investors in 2006. As these investors are less risk-averse and are used to investing in instruments with long-term maturities, their increasing presence in the domestic market helped to lengthen the maturity profile of debt. Another sound practice adopted by Brazil is long-term debt planning through the definition of an optimal debt structure, a medium-term debt strategy and an annual borrowing plan (which has been released regularly since 2001). Finally, the efforts of the Debt Management Office to increase its transparency levels should be mentioned, making Brazil the first country to achieve maximum score in Investor Relations and Data Transparency Practices at the Institute of International Finance (IIF).

Regarding external debt, since 2006 the country no longer depends on external issuances as a source of funds, due to the considerably decreased need for external borrowing and the strong inflow of dollars. This allowed the government to adopt several measures to improve the profile of external debt and reduce its size, through measures that include prepayment of the IMF (2005) and the Paris Club (2006) debt, the recall of the Brady bonds and the introduction, in 2006, of a permanent programme to repurchase external debt bonds along the entire maturity curve. Nevertheless, the issuances in the external market continue, mainly in dollar and in Real, the

Brazilian currency, whose yield curves are very useful as benchmarks to national companies' issuances offshore. The external issuances in local currency are especially important since the currency risk is transferred to investors and helps to set a reference in the external market for a yield curve in domestic currency. In October 2010, Brazil issued US$ 650 million in local currency (R$ 1.1 billion), paying a yield of just 8.85 per cent and maturing in 2028.

Embraer

Embraer is currently the third-largest producer of civil aircraft in the world, only surpassed by Boeing and Airbus. Embraer was founded in 1969 by the Brazilian government as a mixed capital company, being '… the realisation of an old project of some Air Force military officers to constitute an aeronautical industry in the country'. The Aerospace Technical Center (CTA) of the Brazilian Air Force (FAB) had developed the Bandeirante aircraft, intended for civil and military use, and the company was initially created to produce it in series. With the creation of the company, its engineers, mostly from the Institute of Aeronautical Technology (ITA), but also from FAB and the CTA, began to develop other models of aircraft. The company was privatized and re-structured in 1994 with a focus on regional commercial jet planes (up to 120 passengers). Embraer, therefore, operates in a market space less occupied by the two giants of the aerospace sector, Boeing and Airbus, which are engaged mainly in the development and production of aircraft with capacity of over 120 passengers.

During its 40 years of existence, the company has already manufactured over 5,000 airplanes. The ERJ family models have been sold to over 37 companies in 24 different countries. Its current structure employs more than 24,000 people worldwide. In the period 2000–9, its net earnings were, on average, US$ 8.6 billion annually. The company's shares are traded as blue chips in Bovespa and are rated as investment-grade by both Moody's and S&P.

Russia

Russia has undertaken major reforms in several sectors of the economy in the post-Soviet era. The Russian economy as a result grew by 5.3 per cent per annum during 1999–2009, following a period of stagnation in the 1990s. The rate of inflation decreased from 84.4 per cent in 1998 to 8.8 per cent in 2009 and real average monthly wages increased by 7.4 per cent during the period 1999 to 2009. The growth has been accompanied by a rise in real incomes and a halving of the population living below the poverty line.

Stabilization Fund of the Russian Federation

The setting up of the Stabilization Fund of the Russian Federation in 2004 has helped Russia in several ways, including building up of international reserves, maintaining low public debt levels, and allowing fiscal space for expansionary policies during the financial crisis. The Stabilization Fund of the Russian Federation could be drawn down during the crisis without significant risk to the economy. As a result, the budget could swing from a surplus of 0.25 per cent of GDP in 2008 to a deficit of 0.25 per cent of GDP in 2009 without major risk to external stability. Russia, as a result, emerged from the crisis with a low public debt ratio (around 7 per cent of GDP), unlike the situation in advanced economies. The Stabilization Fund of the Russian Federation was bifurcated in January 2008 to form the Reserve Fund (designed to weather and counter the effects of the financial crisis) and the National Welfare Fund (that aided pension reform).

Labour Market

Supported by continued output growth, labour market conditions improved noticeably in 2010. The effect of seasonal unemployment appears to have been limited in 2010, suggesting robustness in the underlying recovery of the labour market. Unemployment fell from 9.2 per cent in January 2010 to 7.2 per cent in December 2010 (International Labor Organization definition), with the lowest level of unemployment registered in September and November 2010 at 6.6 per cent. With the decline in seasonal employment at the onset of the Russian winter, however, unemployment started to pick up, reaching 7.6 per cent in January 2011. But this figure is still significantly lower than the 9.1 per cent rate registered in January 2010. This situation is reflected in the relatively stable number of vacancies.

Russia's national poverty rate was broadly flat in 2009 and continued to fall in 2010, essentially because of a massive counter-cyclical stimulus, increases in pensions and wages, and unemployment that was much lower than expected. Both the unemployment and poverty rates increased sharply in early 2009; however, as the large increases in public sector wages and pensions and unemployment benefits kicked in, and as unemployment began to fall as firms shifted to labour hoarding, the national poverty rate fell from 13.4 per cent in

2008 to 13.2 per cent by the end of 2009. In 2010, the poverty rate was at 12.7 per cent, approximately 0.5 percentage point lower than in 2009 with about 0.7 million people moving out of poverty. The poverty rate is expected to decline in 2012 (10.0 per cent).

Tax Reforms

Tax reforms have boosted revenue collections of the Russian government. Most important has been the 13 per cent flat tax on personal incomes. As a result, personal income tax collections registered a rise of 36.1 per cent between 2006 and 2007 due to better compliance. The lower and flat tax slab offers a useful lesson for other countries from the point of view of widening the tax base and increasing compliance.

Budgetary Reforms

Russia has undertaken budget reforms in stages over the period 2001–10. These reforms signify a move towards a more transparent budgetary framework. The emphasis has been on administrative decentralization via earmarking expenditure and revenue responsibilities to lower tiers of the government. The underlying non-oil deficit of the federal government was projected to remain at around 9 per cent of GDP in 2010, above its pre-crisis level. Withdrawal of the fiscal stimulus and fiscal consolidation, therefore, remain an important priority. The government has also set explicit targets for lowering the budget deficit to zero by 2015. The annual goals, based on a projected oil price of US$ 70 per barrel, have been a budget deficit of 4 per cent of GDP in 2011, 3 per cent in 2012, 2 per cent in 2013, 1 per cent in 2014, and 0 per cent of GDP in 2015.

Pension Reforms

A major achievement of the Russian government has been pension reforms. Pensions were raised in 2009–10 through comprehensive pension reforms, which were part of the stimulus package. The move was especially relevant because the share of the aged in the total population has been significant. Increasing pensioners' income was one of the major elements of the anti-crisis policy in 2009. During the course of the year, pensions were increased four times; as a result, an increase by 25 per cent in real terms was achieved in 2009. This policy helped prevent deterioration of the pensioners' standard of living, mitigated the social consequences of the acute phase of the crisis, and resulted in an increase in demand for goods and services, which supported the Russian economy. Starting from 1 January 2010, the so-called valourization of pensions, implying revision of the monetary value of pension rights acquired before 1 January 2002, has taken place. As a result, the value of the pensions for the corresponding group of retirees was substantially increased. Moreover, in 2010, the new concept of 'minimal level of citizens' pension provision' was introduced, whereby starting from 1 January 2010, the sum of the pension and other social support measures for retirees would not be lower than the subsistence level for retirees. According to government estimates, the average level of old-age pensions in 2010 grew by 36 per cent, while their ratio to the average salary reached 40 per cent.

Monetary Policy Conditions

Over the period of reform, Russia has undergone a number of drastic changes related to the development of market mechanism in the economy and the financial system. These changes have increased the share of private sector in the economy, developed the banking system, created foreign exchange and securities markets, and considerably increased the role of monetary policy in the process of macroeconomic stabilization.

From mid-2006, Russia terminated the provisions of the legislation 'On Foreign Exchange Regulation and Foreign Exchange Control', which had given the Russian government and the Bank of Russia the powers to set limits on foreign exchange operations by residents and non-residents related to capital flows. Therefore, Russia completed the final stage of liberalizing foreign currency legislation. With its current managed floating exchange rate regime, Russia is striving to make the mechanism of setting the exchange rate more flexible. Russia has been able to overcome dollarization/foreign currency dominance in the economy and make the national currency—the rouble—a reliable payment and settlement instrument to be used in international transactions.

Strengthening of integration processes in CIS is a key factor in enhancing the role of corresponding countries, including Russia, in the global economy. In the EurAsEC framework, the treaty concerning the encouragement and protection of mutual investments has been concluded. It is expected to accelerate modernization of the member states' economies and enhance the efficiency of utilizing their productive potential. In the context of cooperation between Russia, Belarus, and Kazakhstan, the Common Economic Space is currently being formed. Its first stage, that is, the Customs Union, is largely completed, with positive consequences including widening of markets, strengthening old production links, and forming new ones.

India

Private Entrepreneurship

A major attribute of India's business environment is the presence of home-grown private entrepreneurship, which has been playing a key role in taking the country forward on a higher growth trajectory. It is sometimes said that India is being driven by 45 million entrepreneurs. There are also a large number of private business conglomerates with diversified business interests and international footprints. The acquisition of companies abroad in order to diversify into foreign markets has been one of the attributes of Indian business groups. Such outward foreign direct investment was of the order of US$ 18.8 billion in 2007–8, US $ 17.5 billion in 2008–9, and US$ 12 billion in 2009–10. This excludes the money raised abroad for acquisitions.

The information technology (IT) sector that accounted for net receipts of US$ 48.2 billion in 2009–10 is almost entirely dominated by the private sector. Some of the names with a large global presence in this sector are Tata Consultancy Services, Wipro Technologies, Infosys, and HCL. The role of the private sector is set to increase with further liberalization of the Indian economy.

Innovations

Grassroots innovation and improvization have been other hallmarks of Indian entrepreneurship. The main attribute has been lowering of costs to take advantage of economies of scale in a large domestic market. Such innovations are often an integral part of a supply chain, providing low-cost components to a larger production unit.

Realizing the market potential, many Indian firms have joined the race for low-cost innovations. Tata Chemicals, for example, makes a water filter that requires no power and can give safe drinking water to a family of five for a month for Rs 30 ($0.65). Researchers at the Indian Institute of Technology and the Indian Institute of Science produced a prototype for a $35 laptop in July 2010. A firm called Ayas Shilpa makes suspension bridges for a tenth of the price of conventional ones; in a country where countless villages are connected to the outside world only by perilous rope bridges, this is a major way forward. Indian firms are also devising new business models. HCL Technologies, for example, helps clients to improve their IT systems on the understanding that if they reap no benefits, they pay nothing.

Telecommunications

India's telecom sector has been one of the success stories of the market-oriented reforms. Deregulation and liberalization of telecommunication laws and policies have prompted rapid growth of the sector. The total number of telephones increased from 494.07 million in August 2009 to 706.39 million in August 2010, showing an increase of 13.7 per cent and making India's telecommunications network the second largest in the world. A characteristic feature has been the extremely rapid growth of cellular services combined with modest declines in fixed lines. Wireless connections increased during the period from 456.74 million to 670.62 (14.8 per cent increase), while wire lines declined marginally from 37.3 million to 35.8 million (3.2 per cent decline). The rise in rural connectivity has been more impressive, with an increase from 150.83 million in August 2009 to 230.24 million in August 2010 (an increase of 14.7 per cent), with many attendant benefits for the farming community. As a result of the sharp rise in the number of connections, wireless density increased from 42.3 per cent in August 2009 (98.7 per cent urban and 18.4 per cent rural) to 59.6 per cent (134.1 per cent urban and 27.8 per cent rural) in August 2010.

Inclusive Growth: MGNREGA

A large-scale employment guarantee scheme under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) was introduced in India in a phased manner from February 2006. The Scheme covers all the districts in the country and provides the option of guaranteed 100 days paid employment in a financial year at the minimum prescribed wage to all adult members of a rural household. MGNREGA has focussed on creating tangible assets, which include water conservation and water harvesting, drought proofing, micro and minor irrigation projects, flood control, and rural road connectivity. Assured employment and enhanced wage earning have led to improved living standards in rural areas. As a result of the Scheme, a number of states have reported a rise in minimum wages. There has also been a fall in labour migration during lean periods. A total of 42.7 million household were provided employment during March 2009 and December 2009, and 2,007 million person days of employment was generated.

Right to Information

In order to promote transparency and accountability in administration, the Right to Information Act was enacted in October 2005. The law empowers Indian citizens to seek information from a public authority, thus making the government and its functionaries more accountable and responsible through mandating a timely response to citizen's requests for government information. The Act has now been in operation for over four years and has led to the empowerment of the common man including the poor and the underprivileged.

In the political sphere, the law contributes to the ability of citizens to become aware of the activities of the government. It raises the level of political debate and leads to a more productive process of policy-making. In the economic sphere, transparency increases efficiency by making the investment climate more conducive. In public administration, transparency improves the decision-making of public servants by making them more responsive and accountable to the public and reduces corruption by making it more difficult to hide illegal agreements and actions. It also improves legitimacy and trust in the government, allowing for more effective implementation of public policies.

Capital Account Liberalization

India has followed a calibrated approach to capital account liberalization. While there is full convertibility on the current account, the capital account is being opened in phases, in line with development requirements and financial sector developments. An important achievement of the calibrated approach was that India could largely avoid the fallout of the Asian crisis of the late 1990s. Similarly, the country was less affected by the global crisis of 2008–9, with the growth rate moderating to 6.7 per cent. A major advantage of the approach is that the flow of 'hot money' opportunely seeking interest arbitrage has been limited as foreign financial institutions are not allowed unrestricted access to fixed interest rupee debt market.

External Debt Management

Successfully lowering the external debt burden has been an important achievement of the Indian government. The country faced a balance of payments crisis in 1991–2, when foreign exchange reserves fell to two weeks' worth of imports, the debt–GDP ratio had risen to 39 per cent and the debt–service ratio had risen to 30 per cent.

Concerted efforts were then made to lower the external debt burden of the economy. First, liberalization of the economy was introduced in stages, which helped build the growth momentum; this, in turn, helped lower the debt–GDP ratio with a higher GDP denominator. Second, an External Debt Monitoring Unit was set up in the Ministry of Finance to monitor long- and short-term debt and bring out an annual status report on external debt to increase transparency and provide Management Information Service (MIS) inputs for debt management decisions.

The External Commercial Borrowing (ECB) Policy that places all-in-cost and end-use restrictions on commercial borrowings from abroad, plays a key role in external debt management. It has helped prevent the build-up of external debt to unsustainable levels and ensured that foreign debt flows were directed to priority sectors. The ECB Policy has also played an effective countercyclical role. This meant liberalization of the policy during downturns to attract higher capital flows and tightening during booms to discourage excessive flows. The Policy, therefore, has been an effective instrument for managing balance of payments in the changing global situation. Restrictions on ECB also minimized the risk of a balance sheet recession for Indian corporates during the recent global crisis, which could have arisen due to excessive borrowing in the pre-crisis period together with currency risks due to a fall in the value of the rupee.

Accounting and Audit Standards

The Indian financial system has been evolving and has withstood testing times during the recent global financial crisis. Indian accounting standards are stringent. In some aspects, India has gone ahead of other countries in implementing additional regulatory safeguards with respect to, *inter alia*, countercyclical provisions and risk weights and safeguards for securitization. While depreciations in assets are taken into account, appreciations in such assets are ignored in accounting practices. Similarly, under securitization, the profits are not front-loaded, but distributed over the entire life of the asset. The inherent strengths that existed even prior to the crisis, as well as the reforms now being contemplated based on the recommendations of international standards-setting bodies, lend it resilience and have ensured that its stability has not been threatened.

China

Attracting FDI

Several factors contribute to the successful and rapid development of a country, of which attracting and utilising FDI is one. Attracting foreign investment is an important part of China's national policy of opening up and remarkable achievements have been made in this field. By October 2010, a total of 704,000 foreign invested enterprises have been set up in China; a total of US$ 1.03 trillion of foreign investment has actually been used; 190 countries or regions have made investments in China; and 480 of the world's top 500 enterprises have invested or done business in China. According to the 2010 *World Investment Report* by UNCTAD, China ranked second in the world in attracting FDI and it has ranked first among developing countries for 18 years at a stretch. Foreign invested enterprises have been an important component of China's national economy, evidenced by the fact that 21 per cent of tax revenue, 27 per cent of industrial output, 54 per cent of import and export, and about 45 million of employment are from such enterprises in 2010.

Foreign investment has not only brought to resources to China but also advanced concepts and technological and managerial experience as well as international professionals, all of which have had a profound impact on different aspects of the Chinese economy and its society. Foreign investment has greatly boosted China's economic reforms and speeded up China's participation in economic globalization. Foreign investors have earned substantial returns from investment in China and many foreign subsidiaries have become growth and profit centres for their parent companies.

The objective of the Chinese government, while furthering opening up, is to continue to attract foreign investment in an active and effective manner. China intends to step up efforts at reform and innovation, by expanding the horizons of investment, improving investment facilitation, as well as enhancing and improving the services provided to foreign investors in order to create a more open and optimal investment environment and improve the quality and level of foreign investment utilization on a continuous basis.

After opening up the economy in 1978, China received substantial labour-intensive FDI. In the 1990s, through further opening up, China took effective measures to push its integration with neighbouring economies. This was long before worldwide trade and investment liberalization set in following the Uruguay Round of negotiations and helped the country to successfully avoid the Asian financial crisis. China's economic performance has been outstanding in the early 21st century with the country turning out to be the 'hot spot' of global FDI. With its huge foreign exchange reserves, robust financial system and strong fiscal position, China also remained in a relatively stronger position vis-à-vis other countries on the face of the global financial crisis.

In attracting foreign investment, China pursues a self-dependent industrial and economic development model instead of relying entirely on multinationals. Foreign investors play an important role in China's economy by boosting its economic growth.

China has been adjusting the FDI policy framework in line with its level of economic development to give full play to the positive role of FDI. By tapping China's comparative advantage in manufacturing, the labour-intensive and export-oriented nature of FDI has also been successful in promoting China's integration into the global economy. More importantly, FDI has brought market economy concepts and rules, the business philosophy of foreign enterprises, and managerial skills into the country. Such spill-over effects have led to market reforms and economic transformation in China, and enabled the local enterprises and industries to achieve a relatively advanced level of efficiency within a short period.

Infrastructure Financing

The Chinese government has taken a number of steps to promote infrastructure development. The government's role in infrastructure development has been defined and is confined to areas where the market cannot play a role. China, therefore, has been adjusting its investment structure by reducing investment in competitive sectors and increasing inputs into other sectors. Priority has been given to important sectors such as agriculture, forestry and water conservation, projects relating to public well-being including affordable housing for low-income groups, and areas of environmental protection like wastewater treatment.

The roles and responsibilities of the central and local governments have been clearly defined. The central government, in addition to projects at the central level, is responsible for cross-regional and cross-river valley projects, as well as those having a greater impact on overall economic and social development. Other projects fall within the responsibility of local governments, with support from the central government, in terms of planning, guidance, and subsidy.

The financing mechanism for public infrastructure has been diversified and improved over time. Direct investment by the government is in projects involving pure public goods, such as the treatment of major rivers. Subsidies or 'substituting awards for subsidy' are used to encourage social funding of profit-oriented projects such as wastewater treatment in urban areas. The Build-Operate-Transfer (BOT) mode is used for projects with yields potential such as expressways that can be built and operated by social funds. New infrastructure financing methods that include interest subsidy are emerging. Such new sources of financing include local bank loans from policy banks and/or commercial banks; investment by public, quasi-public, or local private enterprises; foreign direct investments and loans; grants or concessional loans from multilateral and bilateral agencies; holding funds in trust; and bonds issued by the central government.

The funds for infrastructure development have been well managed. First, performance budget management is implemented to urge the departments in charge of the projects to improve budget expenditure. Second, the treasury management system has been reformed to ensure that funds are used in a safe, timely, and effective manner. Third, supervision and regulation have been enhanced and mechanisms for budget compilation, implementation, and supervision have been put in place.

Investment and financing reforms are promoted through system innovation. The investments in infrastructure, which used to be governmental activities, are now open to market participants; public–private partnerships (PPP) are promoted to encourage social capital into infrastructure investment and to open up incremental asset markets. The attractiveness of infrastructure investment has been enhanced by creating market-oriented projects.

Macro-management of the Financial Sector

Since the reforms and opening up in 1978 and against the backdrop of the gradual introduction of a socialist market economy, China's financial macro-management has facilitated stable and healthy development of the national economy. The major approaches and experiences in this regard are elaborated in the following paragraphs.

In China's perception, financial macro-management should gradually give way to indirect management. Macro-management should follow the principles of the socialist market economy and take initiatives to adapt to its requirements and should mainly rely on economic means, with legal and administrative instruments as supplementary tools. The market formation mechanism should be continuously optimized to gradually make use of price-based levers, like the interest rate, to guide the behaviour of the private sector. It is important to develop and optimize the financial market and let it exercise various functions including that of price discovery, resource allocation, and risk evaluation.

Financial macro-management must be in accordance with domestic conditions. When the per capita national income is relatively low and the economy is yet to catch up, it is important to concentrate on development, reform, and employment, with monetary policy supporting these objectives. At the same time, when economic development and employment growth are taking place, maintaining economic stability becomes an indispensable target. Macro-management should, therefore, underscore its price stabilizing function through gradual optimization of monetary policy targets and by attaching increased importance to the application of price-based tools so as to adapt to the requirements of the development of the socialist market economy.

Financial macro-management should be self-initiated, proactive and effective. With a gradual increase in economic aggregates and further advancement in the level of opening up, a lack of flexibility in the exchange rate mechanism could, to some extent, limit the manoeuvrability of domestic interest rates and increase the difficulties in money and credit management; it is also disadvantageous to maintain a self-initiated and effective quantity management. Therefore, it is necessary to increase the flexibility of the exchange rate; promote exchange rate reform in a self-initiated, controllable, and gradual way; and strengthen the ability to manage the economy by means of money, credit, and interest rate management. Further, since there is always a time lag involved in monetary policy to have its desired effects, the monetary authority should be far-sighted, scientific, and dynamic in formulating and implementing policies.

The coordination between monetary policy and other macro-policies such as fiscal and industrial policy should be strengthened. The complexity of macroeconomic operation determines that it is unrealistic to rely exclusively on monetary policy to solve all problems. The smooth implementation of monetary policy goes hand-in-hand with the coordination of other macro-policies including fiscal policy. Monetary policy concentrates more on short-term quantity management, while fiscal policy is more concerned with middle-to-long-term structural adjustment. Consequently, macro-management must make use of both monetary and fiscal policies in their own ways according to the conditions of the economy, and implement appropriate and well-targeted policy portfolios in order to obtain the best of results.

Managing the relationship between financial stability and monetary policy should be emphasized. A stable system provides an environment in which financial macro-management plays its part. Along with continuous deepening and refining of the financial market, the process of market integration and the development of industry and institution-wide financial products require measures to avoid systemic risk. The central bank must play a greater role in maintaining the overall financial system stability instead of concentrating only on the risks of individual financial institutions or individual industries. This requires the central bank to address financial risks from a systemic perspective, build a macro-prudential policy framework, curb pro-cyclical fluctuations in the financial system, and promote policies that ensure sustainable support of the financial system to the development of the economy. The central bank should also fulfill its responsibility as 'lender of last resort' according to law, maintain market confidence and a complete and effective payment system, while ensuring the stable operation of the financial system so as to guarantee a smooth operational environment for monetary policy.

Reform and Development of the Banking Industry

Since the reform and opening up of the economy, China's banking industry has undergone major changes. First, a modern banking system has been established in the country. A service system has been preliminarily founded where big commercial banks are the main participants; policy financing and commercial financing are appropriately separated; different types of financial institutions with complementary functions cooperate and develop in a harmonized way; and multiple ways of financing co-exist. Various financial institutions have grown steadily, with the market share of small and medium-sized banking institutions rising steadily from 19.6 per cent in 1993 to 49.1 per cent in 2009. Meanwhile, a modern corporate governance structure has been established in banking institutions, the capacity and level of services have improved, a variety of financial products have been introduced, and financial services have moved from deposits and loans at the beginning of reforms to diverse and tailored activities.

Second, China continues to adhere to the policy of opening up the economy and learning from the experiences of foreign countries. China sticks to an opening strategy of self-orientation, opening up in a prudent and orderly manner without compromising independence, and learning from advanced foreign experiences so as to elevate the core competitiveness of the banking industry. The process of opening up extended from attracting funds and technology, in the beginning, to bringing in funds, intellectuals and systems, and achieving shareholding reform by introducing strategic investors at home and abroad to deepen the transformation of banking industry systems and mechanisms.

Third, international influence and status of the Chinese banking industry has steadily grown. According to the July 2010 Bankers' magazine, China has 84 banks among the top 1,000 banks in the world. At present, ICBC and CCB rank as the top two banks in the world in terms of market value with ICBC being the most profitable bank for two consecutive years.

Fourth, China has spared no efforts in introducing innovation in the banking industry. Ever since the reform and opening up 30 years ago, the country has been building a favourable environment for innovation and promoting innovation practices in every field of banking. Based on national conditions, the banking industry carried out innovations in institutions, products and systems, opened new types of financial institutions such as rural banks, micro-credit companies, automobile finance companies, money brokering companies, and developed business varieties including asset securitization, as well as domestic and overseas wealth management to meet the growing demand for financial services.

China has reinforced and improved macro surveillance and micro supervision to promote steady development of the banking industry. China strengthened and improved macro regulation to create a sound macroeconomic environment for the banking industry; reinforced micro supervision to consolidate the 'firewall' between credit and capital markets; and intensified stockholder supervision, control over related parties, and management for tackling conflicts of interest. Under the segregated operations and augmented supervision framework, China steadfastly promoted the pilot operation of comprehensive business, appropriately balancing regulation and financial innovation and prudently promoting financial innovation in the banking industry. Laws and regulations were established and perfected with financial infrastructure constantly being improved. In this way, the framework of macro and micro prudential supervision in China's financial industry gradually evolved and consistently improved.

In the process of reform and development, China's banking industry has accumulated rich experiences in the following areas. First, China persisted with the socialist market economy model and improved the quality of reforms. The reforms have extended from simple capital injection from the central government to spin-off bad loans, combining capital injection with transformation of bank ownership structure, corporate governance, and risk management systems. Reforms aim at enabling commercial banks in China to work under the principles of efficiency, safety and liquidity with full autonomy, making them responsible for their operations, risks, profits, and losses. As a result of the reforms, China's banking industry has been successfully transformed from being specialized banks to modern public banks.

Financial Market Developments

Since the beginning of reform and opening up, China's financial market has been transformed from a small and regional market to a large national market. During this process, with the scale of the market expanding, institutions achieving optimality and intermediary institutions and investors becoming mature, China's financial market evolved into a market that is in accordance with general international principles in terms of the legal system, trading rules, and the regulatory system. The transformation has made significant contributions to the process of economic reform as well as social and economic development.

China's experience of capital market development has differed from that in some advanced countries where markets evolved mostly on their own. China's capital market has been promoted both by the government and the market—a route of market economy reform that combines the government's supporting hand and the market's self-evolution. In the beginning, due to the limits imposed by the environment and the design of market institutions, China's capital market accumulated some deep-rooted structural problems. The approach has been to solve these problems and contradictions by deepening the reform process. In recent years, the securities regulatory authority has started a series of important reforms aimed at strengthening market infrastructure, improving market quality and structure, and enhancing market efficiency, which include, *inter alia*, non-tradeable share reform, comprehensive improvement in the quality of listed companies, reform of security company governance, deepening the share issuance system, reforms to promote the market-based fund industry and the development of institutional investors, and attempts to optimize the legal system in the capital market and quicken the pace of developing a multi-layered capital market. These reforms have achieved positive results and China's capital markets have undergone a complete transformation, with constant improvement in its socialist market economy structure, standardization, and internationalization.

China's capital market developments also exhibit some basic principles. First, it is necessary to treat development of the capital market as an essential national strategy, constantly deepening society's understanding of the importance of sound capital markets, and striving for coordination and consensus on various policies. Second, the development of the capital market should serve the national economy. In this context, it is important to ensure coordinated development of the capital market with the national economy and society. Third, the development of a socialist market economy has to be the focus of reform, and efforts have to be made to encourage participants to move towards this objective. Fourth, endeavour must be made to strengthen the legal system in order to strengthen the capital market and, fifth, opening up and enhancing the international competitiveness of capital markets must be steadily promoted.

China's bond market, which started in the 1980s, focused on private investors and small-to-middle institutional investors and was based on strict regulation and government guidance. The market is geared to meet the financing of the development needs of the real economy. It developed from OTC trading (1988–91), exchange-traded market(1992–2000) to inter-bank bond market (2001–until now). During that time, the lack of efficient market disciplines caused relatively large risks in the market. In recent years, the process of reform and innovation in the Chinese bond market has quickened and the market has already become an important platform for investment, financing and liquidity management for financial institutions and firms. The main development experiences are the following: First, China has positioned institutional investors as the principal players in the inter-bank bond market and has gradually pushed for a multi-layered investor structure that takes market-makers as the core, the financial institutions as the main part, and combines the participation of other investors as well. Second, China steadily promotes financial product innovation. To provide tools for commercial banks to manage balance sheet and increase capital, products viz. commercial bank financial bonds, junior bonds, and hybrid capital bonds have been successively launched; to broaden the enterprises' financing channel, the People's Bank of China has introduced short-term financing bonds and medium-term notes, derivatives viz. loan-backed securities, bond forwards, bond borrowing and lending, forward rate agreements, and RMB interest rate swaps. Third, China continuously develops the bond market infrastructure and optimizes the institutions of market-makers, bond settlement agency, currency brokerage, information disclosure, credit rating, and so on. Fourth, it prudently promotes the opening up of the bond market. Fifth, it is in the process of developing the exchange security market and establishing the interconnection with the inter-bank bond market.

China's money market has become an important channel for monetary policy transmission and influences aspects such as capital adjustment and the market interest rate. The money market is composed mainly of sub-markets, such as the inter-bank borrowing market and repo market.

The inter-bank borrowing market started in 1984. After undergoing development for 20 years, it has evolved into a unified inter-bank market with a unified inter-bank interest rate that is determined by market demand and supply. Its development experiences include the following: The first has been the establishment of a nationally connected inter-bank borrowing network and the gradual formation of a national unified inter-bank borrowing market. The second was to continuously enlarge the scope of market participants and increase trading at the national inter-bank borrowing market. The third was to gradually abolish limits on inter-bank interest rate and establish an interest rate formation mechanism that is determined by demand and supply in the market. The fourth was to standardize management of the inter-bank borrowing market and avoid market risks by means of mechanisms including inter-bank borrowing market access management, duration management, quota management, record management, and transparency management. It was important to simultaneously guide market participants about the risks inherent in commercialization and the credibility of counterparties. The fifth was to continuously optimize the functions and services of the trading and information system.

The repo market was started in 1991 and has been developed into a market the structure of which focuses on inter-bank bond market repurchase with the functions of financing and price discovery gaining prominence. The repo market has offered a satisfactory market environment for resource allocation and macro-management reform. The development experiences include the following: First, it has continuously optimized the legal system that combines regulation, self-discipline, and market supervision, which has effectively restrained the tendency of market participants to break rules and/or default. The second has been to raise the level of safety of clients' assets, reducing institutional risks, and guaranteeing stable operation of the repo market under low trading cost and low risk conditions through the proper design of a trading mechanism. The third has been to ceaselessly promote product innovation, enrich product lines, enlarge the scope, and deepen the market, while raising market liquidity and operational efficiency.

Development-oriented Poverty Reduction Programme

The Chinese government has always made poverty alleviation as an important goal and task of national development, and worked hard to enable everyone to enjoy the fruits of economic and social development. Since the mid-1980s, the Chinese government has organized a large-scale, well-planned rural development-oriented poverty reduction programme, which has been incorporated into the Overall Plan of National Economic and Social Development. The government has formulated and implemented the National Seven-year Poverty Reduction Programme (1994–2000) and the Outline for Poverty Reduction and Development in China's Rural Areas (2001–10), and earmarked special fiscal poverty reduction fund for the poor population and poor areas. Through the execution of the key anti-poverty measures such as 'Village-based Poverty Reduction Project', 'Agricultural Industrialization', 'Labour Transferring Training', and 'Voluntary Resettlement', China has achieved large-scale poverty reduction, with the population of the poor declining from 250 million in 1978 to 26.88 million in 2010 and poverty incidence going down from 30.7 per cent to 2.8 per cent during the same period. Massive poverty has been basically eliminated in rural areas and production and employment structures in poverty-striken areas have been optimized remarkably with significant improvement in income, living standards, and development capacity of farmers. These achievements have contributed enormously not only to the economic development of the nation as a whole, political stability, and social harmony but also to the undertaking of global poverty reduction.

Significant achievements of China in poverty reduction are the result of the comprehensive strategic framework. Apart from special poverty interventions, other supplementary policies include institutional reforms, economic growth, industrial restructuring, public service delivery, and social security. Therefore, rural poverty reduction has been achieved by optimizing asset distribution, market improvement, increasing productivity, adjusting the economic structure, promoting coordinated development among different regions, between rural and urban areas and among industrial sectors, and advancing balanced economic and social progress, all of which have fundamentally altered the rural landscape.

In 2011, given the new challenge to rural poverty reduction, the Chinese government has unveiled the Outline for Poverty Reduction and Development in China's Rural Areas (2011–20). The Outline has set new goals for consolidating achievements already made, in solving the problems of food and clothing, accelerating the progress of poverty reduction, ameliorating the eco-system, enhancing development capacity, and narrowing development disparities. It aims to promote poverty reduction centreing on 14 extremely poor areas and consequently lays a solid foundation for the achievement of the national goal of building an all-around better-off society by 2020.

South Africa

Sound Macroeconomic Management

Successful fiscal adjustment was one of the major achievements of the post-Apartheid government. In the mid-1990s, a debt crisis was averted when the government took steps to reduce dissaving and broaden the tax base through more efficient tax collection. Strong revenue growth through this period allowed the government to consolidate debt and tax relief for households and companies. The fiscal deficit declined from almost 8 per cent of GDP in the early 1990s to a small budget surplus before the onset of the global crisis. The ratio of government debt to GDP declined sharply to a low of 27.1 per cent in 2008–9, from 49.5 per cent in 1995–6. Lower debt service costs created space for strong real growth in non-interest expenditure in the 2000s, which allowed the government to expand access to social services and step up infrastructure investment.

The countercyclical fiscal stance adopted during the economic boom in 2006 created space for the government to sustain spending during the recession by increasing borrowing. South Africa‘s strong fiscal position meant the country could finance the R60 billion shortfall in tax revenue through additional borrowing in order to sustain existent spending on social grants, infrastructure investment, education, and health. In addition, the government extended the child support grant up to a child's 18th birthday (previously only accessible until the age of 15). The government extended the expanded public works programme to support employment and increased the benefit period for unemployment insurance from 6 to 9 months.

South Africa will continue to manage public finances in a countercyclical manner to support long-run fiscal sustainability. The narrowing of the consolidated government balance will continue over the medium-term expenditure framework. This will be done through a moderation in the growth of expenditure and a recovery in revenue in line with the economic cycle. The public sector will continue to support large-scale infrastructure projects to address transportation, water, and energy sector bottlenecks. Social income grants provide a safety net for the poor, while initiatives to support job creation will be intensified. The ratio of debt to GDP is expected to stabilize in 2015–16 before declining.

The 2011 Budget Review outlined a proposal for the adoption of fiscal guidelines to underpin the fiscal stance. These would be based on three principles: (i) countercyclicality, (ii) long-term debt sustainability, and (iii) intergenerational equity.

Monetary policy has operated under an inflation-targeting regime since 2000. During this period, average headline inflation has fallen from 9.9 per cent in the 1990s to 6.3 per cent in the period from 2005–10. The average level of headline CPI inflation declined to 3.5 per cent in the second half of 2010, from 5.1 per cent in the first half of 2010, notwithstanding substantial upward shocks to oil and commodity prices in 2007–8.

Since the adoption of the inflation-targeting framework, the average level of inflation and real interest rates has declined, growth in real GDP and fixed investment has been higher and less volatile, while monetary policy has generally been countercyclical. Communication between SARB and the public has become more transparent, and the SARB has an active engagement with key sectors of society, including business and unions which has encouraged greater policy debate. The independence of SARB and its focus on the inflation target has improved policy credibility and helped to reduce the inflation risk premium in South Africa and appears to have helped contain inflation expectations.

Public Debt Management and the Development of the Local Bond Market

The management of South Africa's government debt has evolved over almost two decades, with a notable and continuous improvement of the government debt management framework since 1994. South Africa has one of the most liquid local currency bond markets in the world with about 90 per cent of government debt denominated in rand. As a risk benchmark, foreign currency denominated debt is limited to a maximum of 20 per cent of total debt. This has helped reduce the vulnerability of fiscal policy to fluctuations in the exchange rate. External bond issuance by government has been primarily aimed at setting benchmarks for state-owned enterprises and private corporates, and at maintaining a presence in the key currency markets to diversify the country's investor base.

Prudent fiscal policy and active debt management helped to reduce debt service costs from a high of 5.7 per cent of GDP in 1998–9 to a low of 2.3 per cent in 2009–10. Active debt management entailed the consolidation of debt that was very costly for the government, limited issuance in offshore markets, and the introduction of more diverse local currency funding instruments—such as inflation-linked bonds, floating rate notes, strips, and retail savings bonds—in order to deepen the investor base and enable the government to fund in all market conditions.

Initiatives to consolidate debt have included switches and buybacks in the domestic market where high coupon, illiquid bonds with smaller outstanding amounts were either bought back or switched into large, liquid benchmarks bonds with low coupons. This has helped to consolidate and smooth the bond portfolio to ensure that instruments are efficiently priced, thus reducing funding costs for the government over a sustained period. The tradability of bonds in the secondary market has increased considerably, with annual turnover reaching a high of R28 trillion in 2008.

Sound macroeconomic policies have contributed to the deepening of South Africa's capital markets. The responsibility for debt management was shifted from the South African Reserve Bank to the National Treasury early on to remove the inherent conflict between monetary policy and debt management. Other initiatives that have contributed to domestic capital market development were the introduction of the primary dealer system in the late 1990s, setting of clear debt management objectives, and the publication of the government's medium-term funding strategy in the National Budget.

Active debt management has also helped to reduce South Africa's external vulnerability by helping to sterilize the accumulation of official foreign exchange reserves and lengthening the maturity profile of the government's debt portfolio by restructuring short-term foreign debt.

Since 2006, South Africa has partnered with the OECD and regional debt managers to encourage the development of bond markets on the African continent and mutually agreed best-practices. The Centre on African Debt Management and Bond Markets based in South Africa was established in July 2011. The Centre will, amongst others, focus on: (i) promoting policy dialogue among African debt managers; (ii) drafting and publishing an African Bond Market monitor and compiling debt data and statistics; (iii) sharing exemplary practises in public debt management and the development of bond markets; (iv) engaging in capacity-building programmes to enhance skill levels; and (v) promoting the cooperation and coordination of the Centre with multilaterals, regional institutions, and other financial institutions of complementary projects and activities.

Sound Institutions and Social Dialogue

According to the WEF's 2010 Global Competitiveness Report, South Africa (54th overall) remains the highest-ranked country in sub-Saharan Africa, and second in Africa behind Tunisia, due to its strong performance in the quality of its institutions. The protection provided to intellectual property ranks South Africa 27th in the world and 29th in terms of property rights.

There is strong accountability of private institutions, with South Africa ranking 3rd globally. This is underpinned by the success of institutions and regulatory bodies such as the Competition Commission, Competition Tribunal, Financial Services Board, Registrars of Pension Funds and Medical Schemes, Securities Regulation Panel, and the new Companies and Intellectual Property Commission (CIPC).

Since the 1990s, the multidisciplinary King Commission has produced a succession of increasingly stringent corporate governance standards—King 1, 2, and 3—that set out best practices in corporate governance. Their recommendations have informed legislation including the New Companies Act and market regulation, with the Johannesburg Stock Exchange adopting many of the King standards as part of its listing requirements. Likewise, the strength of auditing and reporting standards is supported by legislation that limits ownership and management of audit firms to registered auditors whose qualifications and right to practise are assured by law and by the Independent Regulatory Board for Auditors (IRBA) instituted in terms of the Auditing Profession Act (Act 26 of 2005) and the South African Institute of Chartered Accountants (SAICA). These bodies work closely with the Johannesburg Stock Exchange to ensure compliance with IFRS standards and the development of new standards, such as the recently launched Integrated Reporting Standard Guidelines. This is now the principal annual report for all listed companies which flows from the latest *King III Report*.

The National Economic Development and Labour Council (Nedlac) was established in 1995 to usher in a post-apartheid era of inclusive decision-making and consensus-seeking on major economic, social, and development policies between government, business, and labour.

Strong Financial Sector

The South African financial sector did not experience the financial upheaval seen in advanced economies, and thus the economy is in a favourable position to recover from the downturn and emerge stronger than before. The relative health of the financial sector is emphasized by the 2010–11 WEF *Global Competitiveness Report*. South Africa ranked 6th out of 139 countries for the second year in a row in respect of soundness of banks for 2010 (up from 15th place in 2008), and 1st for regulation of securities exchanges (up from 2nd in 2009 and 5th in 2008). The policy components that protected the country from a financial and subsequent sovereign crisis are elaborated in the following paragraphs.

- **A sound framework for financial regulation and well-regulated institutions.** This ensured that potential risks were anticipated and appropriate action was taken to mitigate them. South African regulators have generally not followed a light-touch approach. Sustainable credit extension has been possible through effective legislation, such as the National Credit Act, strong regulatory action, and good risk management systems at banks. Further, to avoid complacency, additional work is being done to strengthen the regulatory framework, bearing in mind the lessons of the global financial crisis. These are discussed in a recent document released by the National Treasury entitled 'A Safer Financial Sector to Serve South Africa Better'.

- **Appropriate and conservative risk management practices at domestic banks.** The experience of the small banking crisis in 2002 and the adoption and implementation of the Basel II Capital Accord in 2008 have led to improved risk management practices and stronger crisis management arrangements at domestic banks. In addition, conservative practices at banks have ensured that far less securitization and derivatives trading has taken place relative to advanced markets.
- **Limited exposure to foreign assets.** The prudential regulation of foreign exposure as applied in the past decade, including limits on the extent of exposure to foreign assets by institutional investors and banks, has helped to limit overall foreign risk.
- **Subsidiary structure and listing requirements.** Registered banks have to be subsidiaries of the domestic or foreign parent company, so their assets and liabilities are ring-fenced even when the parent company is in distress. The listing requirement also ensures transparency, rigorous disclosure standards, and high standards of corporate governance, forcing banks to satisfy shareholders and stakeholders at all times.

The South African financial system was protected by a broader set of prudent economic, fiscal, and financial sector policies that insulated the economy from the worst of the global shocks. These include: a robust countercyclical monetary policy framework capable of absorbing relatively large external shocks with minimum impact on the domestic economy; low private and public foreign indebtedness; countercyclical fiscal policy; a proactive approach to dealing with bank credit risks, including changes in capital adequacy requirements and conservative leverage ratios to curb excessive credit growth; and legislation to protect households from reckless lending practices (National Credit Act). These elements are part of a comprehensive set of policies that will continue to ensure financial stability and provide an excellent foundation to build on to increase the resilience of the financial sector.

Expanded Public Works Programme

The expanded public works programme aims to increase employment opportunities for the most vulnerable. Focusing on infrastructure, social, environmental, and community projects administered by various departments, municipalities, and partner organizations, the programme has created about 1 million short-term jobs since Phase 2 began in April 2009. The programme empowers individuals by offering learnerships, training programmes, mentorships, and other skill development certifications, in an attempt to create a skilled labour force to achieve a sustained reduction in unemployment. Key success factors have been the technical assistance provided to under-skilled municipalities to enable them to expand access. A target of 800,000 short-term jobs has been set for 2011–12.The budget for the programme is around R73 billion for the next three years.

Environmental and Climate Change Policies

The South African government has made a commitment to undertake initiatives as part of its response to climate change. Consequently, South Africa has adopted targets for reducing the country's carbon emissions. Conditional on the country receiving financial assistance, South Africa plans to reduce its emissions by 34 per cent and 42 per cent by 2020 and 2025, respectively, relative to business as usual. The government is also responding to the challenge by placing a green economy at the centre of the New Growth Path. This builds on work undertaken on the National Climate Change Response Policy, the Green Economy strategy, the South African Renewable Initiative, the Energy Efficiency Strategy, the Integrated Resource Plan, and the Integrated Policy Action Plan.

Through these government policy initiatives, South Africa is tackling development issues innovatively while also considering the challenges of climate change. For instance, the Integrated Resource Plan departs from previous cost-based approaches to electricity generation strategies and focuses on a balanced approach to designing such strategies. Both traditional and alternative electricity generation methods are being included in the Integrated Resource Plan.

Resource Plan

South African business has also taken up the climate change challenge, launching the Carbon Disclosure Project (CDP) as early as 2000. The CDP is a voluntary global private sector initiative that aims to encourage companies to measure and report their carbon emissions and integrate the cost of climate change into the assessment of their financial health and business prospects. Since the introduction of the project in South Africa, the response rate of South African businesses has been increasing with each passing year. In South Africa, 74 of the 100 largest corporations on the Johannesburg Stock Exchange participated in CDP 2010 (up from 68 in 2009), 31 companies have adopted greenhouse gas reduction targets, and 22 firms have committed to developing such targets. Carbon-intensive sectors, such as energy, industrials, and minerals, have the highest response rates for the CDP. The CDP response rate in South Africa is the fourth highest internationally, and this suggests that climate change remains sufficiently high on the corporate agenda and South African companies are willing and ready to deal with the challenges.

South Africa has a well-developed policy and legislative framework for the conservation and sustainable use of biodiversity. It is one of the few countries in the world to have a Biodiversity Act and a National Biodiversity Institute. By 2008, South Africa had 19 marine-protected areas, covering almost 18 per cent of the South African coastline, declared under the Marine Living Resources Act of 1998. The government's goal is to have at least 20 per cent of South Africa's coastline declared as protected areas.

South Africa hosted the Conference of Parties 17 (COP 17) in November and December 2011, an international event as important as the Kyoto Protocol. South Africa's hosting of the negotiations indicates its commitment to addressing this global challenge.

Competition Policy

The South African Competition Commission was set up in 1999 under the Competition Act of 1998. The Commission is tasked with investigating anti-competitive conduct. It also assesses the impact of mergers and acquisitions on competition and takes appropriate action; monitors competition levels and market transparency in the economy; identifies impediments to competition; and plays an advocacy role in addressing these impediments. The Commission has prioritised its work in four sectors in order to maximize the benefits to consumers from its work. These sectors are food, agro-processing and forestry, infrastructure and construction, intermediate industrial products, and financial services. Major progress has been made as a result of the Commission's sustained focus on its priorities. The total amount of penalties confirmed or determined by the Competition Tribunal in 2009–10 was higher than in any previous year and close to R500 million.

The 2011 *Global Competition Review*, which is primarily based on a survey of legal practitioners, recently awarded South Africa's Competition Commission the accolade of 'Agency of the Year in Asia-Pacific, Middle East & Africa'. The Commission was also short-listed in the category 'Enforcement Matter of the Year' for its innovative structured settlement with Pioneer Foods, which was concluded in November 2010. Separately, the 2010 WEF *Global Competitiveness Report* has ranked South Africa 40 out of 139 countries for goods market efficiency. The Competition Commission is committed to increasing its enforcement capacity, particularly in the area of cartel investigations. To this end, the Commission has established a special investigative unit.

Industrial Policy

The South African government's broad development strategy aims to promote and accelerate economic growth along a path that generates sustainable, decent jobs in order to reduce poverty and extreme inequalities that characterize South African society and economy. The National Industrial Policy Framework (NIPF), adopted in 2007, is a central component of this strategy. The NIPF seeks to encourage value-added, labour-absorbing industrial production and diversify the economy away from its current over-reliance on traditional commodities and non-tradeable services, thereby stimulating employment growth. Broader-based industrialization will assist in enhancing the participation of historically disadvantaged people and marginalized regions in the mainstream of the industrial economy.

The implementation of industrial policy is set out in two Industrial Policy Action Plans (IPAP), namely, IPAP1 (2007/08) and IPAP2 (2010/11–2012/13). IPAP targets sectors of the economy with high potential for export growth, employment creation, and technological upgrading. In addition, IPAP2 outlines four major transversal interventions: industrial financing, competition policy, developmental trade policies, and public procurement.

Trade Policy

Tariffs are instruments of industrial policy and have implications for capital accumulation, technological change, productivity growth, and employment. South Africa has adopted a strategic approach to tariff reform that supports industrial and employment objectives. An evidence-based, case-by-case assessment will inform changes to tariffs. Tariffs on mature upstream input industries could be reduced or removed to lower the costs for downstream, labour-creating manufacturing. Tariffs on downstream industries with employment or value-addition potential could be retained or increased to ensure sustainability and job creation while observing international trade obligations in the WTO and other trade agreements.

Trade Strategy, including South–South Cooperation

South Africa's trade strategy aims to consolidate links with key economies in the North, and build industrial complementarities with dynamic growing economies in the South to support the NIPF's industrial development objectives and shift the structure of trade towards more diversified, value-added exports. Given the widespread poverty, unemployment, and a host of other development challenges, global integration must not undermine domestic production or exacerbate unemployment.

South Africa sees enormous opportunities for ongoing engagement with BRICS countries to structure new kinds of trade and investment agreements that foster complementarities and cooperation in the industrial, agricultural, and service sectors and that avoid destructive competition. Appropriately structured preferential trade agreements (PTAs), procurement arrangements, sectoral cooperative agreements, alongside targeted investment and export promotion activities, can shape strategic integration among the BRICS. Such arrangements can encourage value added, sophisticated production and trade that embody higher levels of technology, support industrial upgrading, and place each of the BRICS on a long-term, sustainable economic development path.

South Africa, together with its partners in the Southern African Customs Union (SACU), signed a PTA with Mercosur in 2009 and PTA negotiations with India are currently underway. In 2010, South Africa and China established a Comprehensive Strategic Partnership, which aims to promote value-added South African exports to China and increase inward investment by China in projects around mineral beneficiation. Working groups have also been established to resolve non-tariff barriers with Brazil and India, which are often significant barriers to higher levels of intra-South trade.

South Africa is a strong proponent of multilateralism as the inter-government response to managing globalization and the deepening interdependence of national economies. South Africa plays an active role in the WTO, both individually and collectively through its membership in key Southern coalitions: the Africa Group, G-20 and NAMA-11. South Africa will continue to press for a development outcome to the Doha Round to re-balance trade rules in favour of the development interests of developing countries. For South Africa, a development outcome is more important than an early conclusion of the trade round that does not deliver on the development mandate agreed on at Doha in 2001.

The emerging deal at the Doha Round is particularly harsh for South Africa. While South Africa stands to gain very little or no additional market access for its agricultural exports due to the flexibility granted to industrial countries, it will be required to make the deepest and widest industrial tariff cuts of all other WTO Members. This is the result of South Africa's peculiar tariff structure which is an outcome of the Uruguay Round, where it was required to undertake tariff reduction commitments as a developed country.

Regional Integration

Deeper regional integration in Africa and Southern Africa are vital for engaging more competitively with the world economy. South Africa's continental trade agenda is focused on supporting Africa's economic integration in line with the New Economic Programme for African Development (NEPAD), the African Union, and the Abuja

Treaty to establish the African Economic Community. South Africa is committed to promoting 'developmental integration' in Southern Africa, which combines trade integration with infrastructure development and sectoral policy co-ordination. These interventions aim to build regional productive capacity and infrastructure, as experience has demonstrated that the main barriers to increasing intra-regional trade are often not tariffs. In particular, South Africa is expanding the role of its development finance institutions (DFIs) in supporting regional infrastructure development across Southern Africa.

Consolidating regional economic integration among the Southern African Customs Union (SACU), the free trade area and integration agenda in the Southern African Development Community (SADC), East African Community and COMESA are vital in this respect.

Outward FDI and Internationalization of South African Companies

Several South African firms have expanded internationally and become major players in the global economy. During 2008, eight South African companies were among the top 100 non-financial transnational corporations from the developing world, ranked by foreign assets. The list included: MTN Group Limited (telecommunications), Sasol Limited (chemicals), Sappi Limited (wood and paper products), Netcare Limited (other consumer services), Steinhoff International Holdings (other consumer goods), Gold Fields Limited (metal and metal products), Medi Clinic Corp. Limited (other consumer services), and Naspers Limited (other consumer services).

South Africa is the only African country whose private sector has a strong corporate profile and presence in the Chinese market, with investment valued at over US$ 600 million. Some South African firms have become market leaders in China, including SABMiller (breweries), Naspers (media), and Sasol (coal-to-liquid).

South African firms are among the main investors in Africa. According to UNCTAD, South Africa was the largest emerging market investor in Africa between 2006 and 2008, with US$ 2.6 billion in average annual FDI flows more directly invested than by China. The share of African host countries in the outward stock of South African FDI increased from less than 5 per cent before 2000 to 22 per cent in 2008, reaching almost US$ 11 billion.[1] Compared to Brazil, China and India, outward FDI from South Africa into Africa is more diversified, with a strong presence in six sectors: mining, retail, construction and manufacturing, financial services, telecommunications, and tourism and leisure.

International Investment Treaty Policy

The South African government adopted a new investment policy framework in July 2010. The policy aims to modernise and strengthen South Africa's investment regime by implementing a series of policy measures that will ensure South Africa remains open to foreign investment, and provides adequate security and protection to all investors, while preserving the sovereign right of the South African government to pursue development public policy objectives. The new framework also aims to empower the domestic adjudication of investment disputes.

[1] UNCTAD (2010). *World Investment Report: Investing in a Low-carbon Economy*. UNCTAD: New York and Geneva.

A core concern is that foreign investors' claims against governments can bypass national courts and be brought directly to international arbitration. Experience shows that in international arbitration, matters of vital national public policy are subjected to a process where arbitrators tend to focus on narrow commercial interests over broader societal or development considerations. Core provisions of Bilateral Investment Treaties (BITs), such as 'expropriation' and 'standards of treatment', are often ill-defined. Expansive interpretations provide the grounds for foreign investors to challenge any policy deemed to undermine their investment interests. In this way, BITs have limited the government's right to regulate in the public interest.

4 Major Challenges

Introduction

In the past decade, the world has experienced significant transformations in geopolitical and economic terms, as also in the organization and distribution of production. For several reasons, countries such as Brazil, Russia, India, China, and South Africa (BRICS) have acquired a key role in the world economy as producers of goods and services, receivers and exporters of capital, and/or as consumer markets with large potential. Given their large population (more than 40 per cent of world population), resurgent middle class and huge share of land (nearly 30 per cent of global share) and natural resources, the BRICS form a significant part of the world economy. Further, the recent recovery of BRICS economies from the global economic crisis points towards their robust macroeconomic fundamentals and the nature of the recovery shows the growing significance of the BRICS in the new global order.

Important features of BRICS economies include their large geographical dimensions and the size of the population that represents an enormous potential consumer market, complemented by access to regional markets. The number of people at the middle income threshold in BRICS is expected to grow several times during the next decade. It is widely perceived that all the BRICS markets have great potential for establishing the most stabilizing of forces, that is, a prosperous middle class. This middle-income group in each country is growing at varying rates but the future direction is clear: the middle class will both broaden and deepen, providing a solid base for the growth and development of these economies. Income inequality in Brazil and Russia is reducing rapidly and thus leading to a growing and vibrant middle class and the total percentage of South Africans in the middle class is projected to increase at a rapid pace. Russia, India, and Brazil are relatively more domestic demand-driven economies while China's manufacturing success has boosted urban household spending.

All five countries are abundant in terms of workforce availability. This is significant in the present context, where, with a few exceptions, most of the Western world has a declining population and a dwindling workforce. In some advanced countries, rapidly ageing societies and longer life-expectancies pose challenges in terms of the availability of work force while BRICS countries, particularly China, India, and Brazil, could gain from such opportunities.

Brazil

Brazil's agricultural research has transformed the country into a major exporter; the use of bio-fuel for road and urban transport, and the emergence of Embraer as a high-technology aircraft manufacturer are major achievements. In the social sphere, Conditional Cash Transfers that target poverty and the success of the anti-AIDS policy provide useful lessons. The divergent challenges provide scope for cooperation and coordination in various socio-economic areas. For instance, in Brazil, macroeconomic stabilization is a key precondition for successful reforms and sustainable growth. The major challenges the Brazilian economy faces are (i) its tradeable goods sector is rather small in comparison to other EMEs like China; (ii) the saving and investment rates have to catch up with other BRICS economies like China and India; (iii) improvements are required in public sector management; (iv) the depth of the financial sector has to be further enhanced; and (v) long-term financing structure for the private sector needs to be improved.

Russia

Russia's major achievements include reforms during 1999–2009 that promoted economic growth, lowered inflation, and led to a dramatic fall in the number of people living below the poverty line. Specific achievements include setting up of the Oil Stabilisation Fund that proved useful during the crisis. Apart from its vast natural resources, Russia has vital capability in high-technology sectors, both 'traditional', where it already possesses some competitive edge (in nuclear and space technology and high-level programming), and 'new' (in nano- and bio-technology). Russia has made significant advances in building technological know-how in science and high-technology for defence and spacecraft. However, accelerating the implementation of structural reforms, particularly in efficient and undercapitalized natural monopolies, and strengthening the investment climate remain key challenges.

India

India's private entrepreneurship, which has been instrumental in the 8–9 per cent annual growth of the economy in recent years, can provide valuable lessons. Private initiative has been responsible for the excellence achieved in the information technology sector and the innovative streak that has led to improvization and production of low-cost goods for the mass Indian market. For India, the major challenges are (i) diversifying its growth towards manufacturing while maintaining its service-led growth model, (ii) making the growth process more inclusive, (iii) improving physical infrastructure, (iv) developing the agriculture sector, and (v) delivering essential public services such as education and health to large parts of the population.

China

The best practices and institutions for China are those that have facilitated a smooth transition to a robust economy that is economically wide open to the outside world. FDI and infrastructure financing, *inter alia*, have been playing an important role in promoting economic growth. The cities/regions have been successful in attracting foreign investment by providing improved infrastructure and regulatory environment. China has experience in financial macro-management. The reform and development of China's banking industry and financial market is an important driver of rapid and sustainable growth.

The policy challenges for China are to sustain rapid and stable economic growth which is driven by exports and domestic demand in a more balanced way. To facilitate restructuring of the economy, financial sector reforms are needed to improve the intermediation of China's large private savings. The government also needs to raise social spending in the areas of education, healthcare, and pensions, which will serve to reduce precautionary saving and boost consumption over time. There is also a need to improve the investment structure, advance reforms in healthcare, pension, and education systems, and provide more support to rural areas and less-developed regions.

South Africa

South Africa's major strength lies in its record of responsible macroeconomic management, together with strong institutions, a deep and liquid local bond market, and a sophisticated and well-regulated banking sector. South Africa's rich endowment of natural resources places it in a good position to benefit from high commodity prices and increased investment in resources. With the most developed industrial and financial capabilities on the African continent, South Africa role in the integration of policies, markets, finance, and infrastructure is vital to Africa's economic development and realization of the continent's potential as a growth pole in the global economy. Outwardly oriented South African companies are among the largest sources of FDI in Africa and the country's development financing institutions are playing an increasing role in the funding of regional infrastructure investment.

The key challenge for South Africa is to achieve higher levels of inclusive growth that raise employment and reduce inequality. Low domestic savings, currency volatility, inadequate investment in productive sectors of the economy, skills shortages, and inefficient government services delivery are some of the other challenges. Policies proposed in the New Growth Path constitute the key means to address these challenges through a development state that places employment at the centre of the fight against inequality. Within a prudently managed macroeconomic framework, the government is prioritizing policy measures focused on the expansion of infrastructure networks, skill development, interventions to raise youth employment, industrial policy that promotes higher-value added exports, the development of rural economies, small enterprise promotion, green economy initiatives, and regional integration.

Challenges to the BRICS as a Group

In the years to come, it is expected that the BRICS will become large global suppliers of manufactured goods and services as well as major suppliers and consumers of commodities. Thus, the BRICS have the potential to evolve into a powerful economic bloc.

In recent years, the BRICS have been taking advantage of their abundant population and resources and, on the whole, achieving steady economic growth. However, the trends in GDP indicate that the individual countries have different paces and levels of economic growth. China has been maintaining its long-term high economic growth trajectory, while India and Russia have been moving towards sustained high growth. In contrast, Brazil and South Africa have shown sustainable but lower economic growth rates since the early 2000s, but have been making rapid strides along the path from crisis to stability and growth. For South Africa, the major challenges are the development of the socio-economic infrastructure and furthering the reforms process.

Despite the resilience to the recent global crisis, there is a source of potential downward pressure on growth in the BRICS because of weak growth and the spillover effects of policy responses in advanced economies.

While the infrastructure requirements of the BRICS economies are huge, public–private participation can help relax this constraint, provided that the institutional mechanism is sound enough for their optimal combination. In this context, strategic cross-sector reforms, resulting in improved policy as well as legal and institutional frameworks for greater private sector participation, anchored in good governance norms are required.

A common challenge that the BRICS economies face is the need for institutional development without which sustainable growth cannot be ensured. Institutional development is still a long way off in most of these countries. At present, international investors may be bullish about the future potential of the BRICS economies as reflected in AT Kearney's FDI Confidence Index and Global Retail Development Index, the remaining challenges should not be overlooked. Similarly, the credibility of the policy of reforms is crucial for the BRICS economies to make their growth processes more durable and development-oriented.

In the BRICS countries, policy changes are needed to address both domestic and external challenges. China needs to take it as its priority tasks to transform the economic development pattern, expand domestic demand, and improve people's well-being in advancing economic and social development. In case of Brazil, Russia, and South Africa, their current reliance on exports of natural resources such as oil and other primary commodities needs diversification. Measures including industrial policy are required to improve the competitiveness of manufactures in order to make economic growth less vulnerable to adverse movements in commodity prices.

An important distinctive aspect among the BRICS economies lies in their respective levels of social and infrastructure development. Brazil, India, and South Africa are still to catch up with the level of infrastructure and human capital achieved by Russia and China. At the same time, growing inequality remains a problem in some BRICS countries. Such factors may lead to divergence in the speed with which the BRICS economies catch up.

In the next decade, the manner in which challenges such as high fiscal deficits in the post-crisis period, high global uncertainty leading to weak demand for exports, trade protectionism in the wake of the global financial crisis, intolerably high unemployment levels, poverty, and inadequate public health and education facilities are met would be crucial in determining the development trajectory of the BRICS economies.

Environmental degradation and climate change are grave threats for sustaining high levels of growth in the BRICS economies. The BRICS countries could collaborate in the above areas, complement and learn from each other, optimize each other's science and technology resources, and jointly address challenges in these areas.

The weight of the BRICS in investment portfolios could rise sharply. The volatility in capital inflows could pose threats to financial stability and the balance of payments.

Going forward, fiscal policy after the global financial crisis warrants a balance between supporting the recovery through sustained infrastructure investment and ensuring fiscal sustainability. The monetary policy stance has been appropriate and has to take into account the evolving global and domestic situation. More pressing are policies to engender higher economic growth. The various government initiatives to enhance the competitiveness of selected industries can be usefully complemented by reforms to improve the effectiveness and efficiency of labour and product markets.

In a post-global crisis world largely shaped by financial instability and weak growth in major economies, the BRICS countries have a remarkable opportunity to coordinate their economic policies and diplomatic strategies not only to enhance their position as a grouping in the international economic and financial system, but also to be a stabilization factor for the world economy as a whole. The BRICS should increasingly harmonize and coordinate their policies with a view to sustaining their growth momentum and capacity to weather global turbulence. The benefit of cooperation is immense not only for the BRICS but also for the global economy. A strategic agenda for forging closer links among the BRICS, as outlined in this joint report, may contribute to consolidating and expanding their roles in global affairs.

5 BRICS Cooperation

In the BRICS economies, there exists huge opportunities to extend economic growth and development to the next level. In this regard, there is a possibility to increase cooperation among the BRICS to gain competitive advantages. This chapter looks at areas where greater cooperation among the BRICS economies could be explored. It is important to note that all the proposals laid out in this chapter might contribute to promote synergetic relationships among the BRICS economies, but their political and technical feasibility is yet to be determined while their implementation may require further deliberations. The areas of cooperation listed below should be seen as exploratory items to be included in further discussions and the agendas of future meetings between BRICS policymakers. The focus areas suggested are as follows:

(i) Intra-BRICS Trade and Investment Cooperation
(ii) Cooperation in Infrastructure Financing
(iii) Industrial Development and Cooperation
(iv) Cooperation in Transportation

(v) Cooperation in Food Security
(vi) Cooperation in Technical Education
(vii) Cooperation in Financial Market Development
(viii) Cooperation in Research and Development
(ix) Cooperation in Area of Culture and Tourism
(x) Cooperation in International Issues
(xi) Cooperation in Energy Security
(xii) Cooperation to Build Effective Institutions
(xiii) International Development Bank for Fostering South–South Investment

(i) Intra-BRICS Trade and Investment Cooperation

There is scope for considerable increase in intra-BRICS trade, leading to a rise in income and employment. To build trade and investment relations, BRICS countries should work together to identify niche areas, sectors, and markets that offer potential for trade and investment expansion to bolster productive sectors for mutual benefit, avoiding destructive competition.

The BRICS banking sector could play an important role in promoting trade and investment through innovative trade financing facilities, export credit arrangements, and countercyclical measures which ensure that trade finance does not get affected during business downturns, as was the case during the recent global crisis. This would require concerted action by the banking sector in BRICS countries with the BRICS central banks playing the anchor role in chalking out a strategy to strengthen cooperation in trade and investment.

One means of promoting intra-BRICS trade is through invoicing and settlement of trade in domestic currencies. Exports and imports are subject to currency risk, because international trade transactions are mostly invoiced in major international currencies. Currency risk factors impede the growth of international trade, as exporters/importers are concerned about the implications of exchange rate fluctuations, especially during times of high currency volatility. A way forward could be to explore the prospects of invoicing of trade in domestic currencies, with settlement of transactions in major international currency equivalents. This would help mitigate the negative impact of currency volatility on trade and help promote the international use of BRICS currencies. In this regard, it is worth mentioning that the BRICS Development Banks are working out means of promoting financial transactions in local currencies.

China has already made a pioneering effort in this direction by invoicing some of its bilateral trade in Renminbi and promoting an inter-bank and offshore bond market (Hong Kong-based) for Renminbi. This would create investment opportunities and liquidity in the market, encouraging wider use of the Renminbi for trade invoicing and settlement. As far as Brazil is concerned, the Local Currency Payment System in Local Currency (SML acronym in Portuguese) with Argentina began to operate in October 2008. It is a unique system designed by both Central Banks, which carefully reviewed various international experiences in the area of payment systems, especially those of early intra-regional trade in Europe. The Central Banks of Brazil and Argentina are responsible for implementation of this unique regional payments system. All individuals and companies are eligible to participate in the SML in transactions relating to trade in goods and services (such as freight and insurance), which are imports denominated either in Argentine pesos or exports in Brazilian Reals (BRL). The Central Bank of Brazil has been conducting studies on the feasibility of similar arrangements with other trading countries.

(ii) Cooperation in Infrastructure Financing

Some BRICS economies suffer from a 'infrastructure deficit', especially in the areas of transport and energy. This deficit is a constraining factor in sustaining high growth rates in the long run. There is also scope to explore ways to enhance coherence among BRICS countries in promoting infrastructure development at the regional level.

To address the problem, there is scope for cooperation among BRICS in increasing the availability of infrastructure financing. This could be through setting up BRICS infrastructure funds to mobilize retail and institutional investors. Tax benefits could also be provided for investment in infrastructure bonds, as is being done in India.

While the infrastructure requirements in BRICS economies are huge, public–private participation can help relax this constraint, provided that the institutional mechanism is sound enough for their optimal combination. Private equity players could also be encouraged to invest in infrastructure projects. It is understood that many of the large global private equity funds have accumulated a huge cash corpus for lack of investment opportunities, especially due to the global crisis. Through favourable policies and tax incentives, some of this money could be encouraged to flow towards infrastructure sectors in BRICS economies.

Besides, attempts could be made to address the problem of excessive capital flows to emerging market economies by directing some of these flows to designated infrastructure sectors. The key to such a move is a policy framework with tax incentives that is carefully thought through. Brazil has already initiated steps to direct the flow of capital into long-term corporate bonds by providing tax incentives.

There are also many infrastructure companies operating in the BRICS economies, with specialized knowledge of project development in emerging economy environments. These may be encouraged to bid for road, railway, airport, and port projects in the BRICS, a measure that would help create a BRICS-wide infrastructure market.

(iii) Industrial Development and Cooperation

Sharing technology, expertise, and research in the industrial sector is another key area of cooperation among the BRICS. Exchanging experiences on policy measures that BRICS countries have undertaken to promote industrial development could be a valuable area of cooperation, including encouragement of industrial production networks amongst BRICS.

There are diverse areas where the BRICS could learn from the experiences of each other. In the first place, BRICS economies boast of some of the largest private sector conglomerates in the emerging market economies. Many of these have been active players in the international market through collaboration and acquisitions abroad. There is scope to learn from the experience of these countries to take the private sector forward in other BRICS and emerging economies. There is also scope for drawing valuable lessons from the experience of encouraging private entrepreneurship in some countries which have excelled in the high-technology sector. Pooling of expertise and collaboration in such areas could contribute to an improvement in skills and technologies, leading to higher growth of the BRICS economies.

(iv) Cooperation in Transportation

There is room for cooperation in building effective and efficient transport links among the BRICS via initiatives like the sharing of transport technologies. Countries in BRICS could also learn and share experiences of developing mass rapid transport system.

(v) Cooperation in Food Security

There is scope for increased cooperation among the BRICS to promote food security by raising agricultural productivity and output; promoting investments in the food supply chain; and developing a social safety net through conditional income transfer programmes for the poorest.

More specifically, BRICS countries can strengthen food security cooperation via initiatives including the creation of basic agricultural information exchange system of BRICS countries; development of a general strategy for ensuring access to food for the most vulnerable section(s) of the population; undertaking measures to reduce the negative impact of climate change on food security, adapting agriculture to climate change; and enhancing agricultural technology cooperation and innovation as well as through promotion of trade and investment in agriculture.

BRICS economies are major producers, consumers, and exporters of agricultural, horticultural, and meat products. The necessary expertise and research capabilities are already available in BRICS economies to raise production through increasing yields and to extend cultivation to previously non-cultivable land. With its credibility well established, the Brazilian Agricultural Research Corporation

(Embrapa) could play the anchor role in this respect. Arrangements to increase inter-agricultural trade among the BRICS could be mutually beneficial, given their complementarity in this area, and hence should be explored. The BRICS countries could also envisage ways to promote food security and food production in Third World countries with a focus on famine-affected areas.

(vi) Cooperation in Technical Education

BRICS economies have some of the best engineering, architectural, medical, scientific, and management institutes that cater to the specific requirements of emerging market economies. Their expertise lies in the fact that the faculty and students develop niche understanding of emerging economy requirements and business conditions. Cooperation among BRICS institutions through skill transfer and shared curriculum, and student and faculty exchange would help the quality of BRICS technical education move up the value chain. Some of the institutions could also be encouraged to set up campuses in other BRICS countries on a reciprocal basis.

(vii) Cooperation in Financial Market Development

The financial markets in BRICS are at different stages of development. There is considerable scope for the BRICS to learn from each other by exchanging experts and country experiences.

A greater emphasis, however, has to be placed on a BRICS-wide corporate bond market, which still lacks depth and liquidity in some BRICS countries and has been the missing link in mobilizing resources for corporate investment.

Many emerging sovereigns and corporations have been issuing international bonds on a regular basis. To create a BRICS-wide market for sovereign and corporate bonds, international and domestic bonds by BRICS sovereign, and corporate issuers that target the BRICS investor base could be explored. This will help create a niche BRICS bond market and forge closer links among sovereign/corporate borrowers and the investor community in the BRICS economies. It would also help widen and deepen the BRICS sovereign/corporate debt markets. The main advantage for the investor would be the diversification of the investor base and a greater choice of risk/return/maturity profiles. Key aspects like size, deepness, liquidity, fair pricing, pricing disclosure, clearing structure, regulation, taxation, investors base, hedging possibilities, transparency, and money market structure would need to be studied in detail for the purpose.

It is difficult to identify similarities in each bond market specifically and to share usable experience in order to enhance market infrastructure. Starting with the sovereigns, local markets are far diverse from the common external market environment (either US-Dollar denominated or the Euro bond markets). These markets are tagged with mainstream securities standards that fulfil investor expectations in terms of market functioning and overall segmentation across different investor classes. Sovereign local markets, despite their size, may operate in disparate ways across nations. The corporate bond market is even more segmented.

Public debt managers of BRICS could meet periodically to exchange information on best practices and recent initiatives undertaken in the field of public debt management.

(viii) Cooperation in Research and Development

BRICS countries can explore cooperation in the areas committed in the first BRICS Senior Official Meeting on Science, Technology and Innovation in 2011: exchanging of information on STI policies and programmes, promotion of technology transfer, new energy, renewable energy and energy efficiency, nanotechnology, basic research, medicine and biotechnology, as well as setting up of STI Working Group responsible for promoting and materializing cooperation.

In order to improve cooperation among BRICS countries, there is a need to conduct research studies at the inter-government level in potential areas of cooperation. These studies may be undertaken in existing research institutes by providing academic support. In this regard, the existing cooperation among BRICS think tank institutes could be emphasized, and the Sanya Action Plan suggestion could be implemented by 2012.

Creation of BRICS institutes in certain specific areas could be considered with the purpose of strengthening research in areas of collective interest. These institutes should not necessarily be set up from scratch. They could be formed by agreements of existing government-sponsored organizations as well as private and academic research centres that conduct research in areas of international trade, capital markets, and environment studies (either academic or funded by government think tanks) in each BRICS country.

(ix) Cooperation in the Area of Culture and Tourism

There is remarkable diversity in culture, language, history, economy, and institutions among the BRICS. To enhance knowledge and understanding of this diversity, cooperation could be extended to cultural exchange and tourism. In the area of tourism, joint initiatives by official tourism promotion agencies could be put in place to arouse interest in the private sector operators regarding the other BRICS countries. These initiatives could also include information and educational exchanges with official support, wherever required.

The BRICS Bibliographic Catalogue, which contains works in many different areas, such as history, literature, political science, and sociology of the BRICS countries, is an initiative which helps promote knowledge of each country, and, in this respect, the catalogue could be distributed in schools and universities located in the BRICS countries.

(x) Cooperation in International Issues

The global economy continues to face uncertainty. The eurozone debt crisis, high fiscal and sovereign debt levels, and weak aggregate demand are affecting recovery prospects in the advanced economies, with attendant implications for EMEs.

These risks have created fresh challenges for the BRICS economies, especially given the key role that the BRICS are expected to play in the post-crisis 'new normal' of the world economy. The BRICS should endeavour, therefore, to strengthen macro-prudential policies and supervision and address some of the causes of the global weaknesses.

The BRICS could further cooperate among themselves in taking a coordinated position in several international organizations like the IMF, G-20, BIS, FSB, WTO, IOSCO, BCBS, etc. Given their size and role in the global economy, the coordinated approach could lead to better synchronization of policies and improved outcomes.

(xi) Cooperation in Energy Security

The BRICS economies need to work towards increasing energy security. This would include coordination in multilateral fora to achieve better supervision of long-term swap contracts to fix the price of future oil supplies, cooperation in oil exploration and refining, increasing natural gas supply through pipelines and setting up liquefied natural gas (LNG) terminals, raising the share of renewable energy in energy consumption, and encouraging conservation. Research and cooperation in renewable energy sources like solar, wind, tidal, biomass, and hydro-electric power would be important areas of cooperation and would go a long way in increasing energy security among the BRICS and other emerging economies. Lessons could also be drawn from the bio-fuel industry in Brazil especially in the motor transport sector.

(xii) Cooperation to Build Effective Institutions

If one compares BRICS economies with the most advanced ones in terms of governance indicators, there is still a wide gap in governance effectiveness. The BRICS countries need to improve their governance and related institutional frameworks. Improvements in corporate governance, accounting standards, and the regulatory framework are essential to align standards in BRICS economies with the best international practices. Institutional soundness would enhance the capacity of the government to effectively formulate and implement sound policies.

(xiii) International Development Bank for Fostering South–South Investment

In order to safeguard against the emerging risks and uncertainties and to meet the challenges of development, it is critical for the BRICS countries to have an establishment like an international development bank for fostering South–South investment. The issue is particularly significant in the context where global economic prospects remain fragile, contributing to instabilities in the financial and investment flows across the economies amid varying risks and uncertainties, together with concerns on dangers arising from climatic and environmental changes. Such an institutional set-up may ensure a better allocation of hard-earned savings of developing and emerging economies, while rebalancing savings and investments within emerging and developing countries that would finance infrastructure and nurture higher growth in these economies. The proposal for international development bank for fostering South–South investment could also fill the gap in achieving their development goals through reorienting investments in low carbon infrastructure and technologies consistent with a more resilient and sustainable growth path.

CLEAN TECHNOLOGY FUND
UPDATE
OF
INVESTMENT PLAN FOR THE PHILIPPINES

December 2011

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BRT	Bus Rapid Transit
CIP	CTF Country Investment Plan
CTF	Clean Technology Fund
EE	Energy Efficiency
EEEVs	Energy Efficient Electric Vehicles
FIT	Feed-in Tariff
GHG	Greenhouse Gas
GoP	Government of the Philippines
IBRD	International Bank for Reconstruction and Development
ICE	Internal Combustion Engine
IFC	International Finance Corporation
$MtCO_2e$	Million tons of carbon dioxide equivalent
RE	Renewable Energy
WBG	World Bank Group

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Government of Philippines (GoP) proposes to reallocate resources in the Clean Technology Fund (CTF) Country Investment Plan (CIP) which was endorsed by the Trust Fund Committee (TFC) in December 2009.

The Philippine Energy Reform Agenda has three pillars: (i) ensuring energy security, (ii) achieving optimal energy prices, and (iii) developing sustainable energy systems. Consistent with this reform agenda, the proposed changes to the CIP will attain timely use of CTF resources through reallocation of previously endorsed funds for renewable energy (net metering with rooftop solar) to energy efficiency via deployment of more efficient domestic appliances and energy efficient electric vehicles (EEEVs).

Philippine consumers pay one of the highest electricity tariffs in the world. As there are no subsidies for the generation sector, consumers and policy makers are rightfully concerned about further electricity price increases. At the same time, the feed-in tariff proposed by the electricity regulator has created large interest from the private sector for new investment, especially in solar and wind energy. In this context, the government has decided not to “crowd out” this significant private sector interest, which would be the case if the net metering project proposed in the original CIP were pursued. A project to finance roof-top solar power with net metering still remains a priority project but is not the highest priority at this stage. The Government plans to pursue this project at a later date once the price incentives are in place, with approved feed-in tariffs and established portfolio standards for each of the renewable energy technologies. At that time, if the sector requires public sector financing for market transformation, concessional resources may be sought to facilitate market penetration and transformation.

Since the original CIP was endorsed in December 2009, the GoP strategy has evolved to increase investment in end-use energy efficiency via public-led investment, as the highest priority project for market transformation. As a net importer of energy, the shift in priority for CTF funding will improve energy security caused by rising global concern over heightened competition for depleting energy resources and greater price volatility.

The overall context and objectives of the CIP remain unchanged. No changes have been proposed to the CTF allocation for the World Bank Group (WBG) projects and programs. The proposed change will reallocate funds for public sector investments led by Asian Development Bank (ADB) to include energy efficiency (EE) and cleaner transport investments, consistent with the long-term objectives of the original CIP. Table ES1 summarizes the indicative financing plan as endorsed in December 2009. Table ES2 presents the indicative financing plan after the proposed reallocations.

The overall context and objectives of the CIP are the same as the original CIP. The change in proposed ADB projects will achieve a better balance between supply and demand side investments without crowding out private sector investment in renewable energy and without compromising the Philippines energy reform objectives for affordable and sustainable energy security. The proposed projects will result in greater and more cost-effective GHG emissions than proposed in the original CIP, with enhanced development impacts.

This document has been revised considering CTF Trust Fund Committee discussion on 4 November 2011 and subsequent written comments. Additional project-specific considerations will be addressed when specific projects reach the appraisal stage and are presented for funding approval by the Trust Fund Committee.

Table ES1: Indicative Financing Plan Endorsed in December 2009 ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	RE and EE (ADB)	Total
CTF	75	50	125	250
GoP / DBP	180	50	50	280
IBRD Loans	250	250	0	500
IFC Loans	250	0	0	250
ADB Loans	0	0	400	400
Private sector	750	0	350	1,100
Total	**1,505**	**350**	**925**	**2,780**

Source: CTF Investment Plan for Philippines 2009
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, WBG=World Bank Group

Table ES2: Indicative Financing Plan After Reallocation ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Appliances (ADB)	Energy Efficient Electric Vehicles (ADB)	Total
CTF	75	50	24	101[a]	250
GoP / DBP	180	50	46	99	375
IBRD Loans	250	180	0	0	430
IFC Loans	250	0	0	0	250
ADB Loans	0	0	100	300	400
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing	0	20	0	0	20
Total	**1,505**	**300**	**170**	**500**	**2,475**

Source: MDB teams
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, (tbd)=to be determinedWBG=World Bank Group
Notes:
[a] A CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan).
[b] Private sector entities will participate in project implementation via supply of goods and services. For the EEEVs project, private sector investment is expected during replication and scale-up, and as such no private sector cofinancing is shown in Table 4. Private sector cofinancing for the EE appliances project has yet to be determined.

I. INTRODUCTION

1. The Philippines Clean Technology Fund (CTF) Country Investment Plan (CIP) was endorsed by the Trust Fund Committee (TFC) in December 2009, with an envelope of $250 million in CTF cofinancing. The original CIP comprised clean energy and transport sector investments in both the public and private sector.

2. The proposed change will reallocate funds for public sector investments led by Asian Development Bank (ADB) in net metering with solar power generation to include energy efficiency (EE) investments in public vehicles and domestic appliances. This change in investments is consistent with the long-term objectives of the original CIP. The overall context and objectives of the CIP are the same as the original CIP. The updated CIP is a business plan owned by the Government of the Philippines (GoP), and is a dynamic document with the flexibility to consider changing circumstances and new opportunities.

3. No changes have been proposed to the CTF allocation for the International Bank for Reconstruction and Development (IBRD) and International Finance Corporation (IFC) and the IFC-led investment programs. Therefore, this document primarily covers the proposed changes and program to be implemented by the Asian Development Bank (ADB), and is organized as follows:

- Section II -- Review of the status of the implementation of the original investment plan;
- Section III -- Explanation of the circumstances and rationale for revising the investment plan and making changes to the projects or programs included;
- Section IV -- Description of the proposed changes, i.e., proposed reallocation of funds as requested by the GoP through the Ministry of Finance's letter dated 4 October 2011 to the CTF Trust Fund Committee; and
- Section V -- Assessment of the potential impact of the proposed changes on achieving the objectives and targets of the original investment plan.

II. STATUS OF ORIGINAL INVESTMENT PLAN IMPLEMENTATION

4. The status of project development and approvals is presented in Table 1 and discussed below.

Table 1: Processing Status of IBRD and IFC Investment Programs

Project	TFC Approval Date	CTF Amount ($ million)	Leveraged Funding ($ million)
IFC RE Accelerator Program	September 2010	20	330
IFC Sustainable Energy Finance Program	February 2011	10	209
IBRD RE/EE Project	May 2012	45	200
IBRD Urban Transport (BRT)	June 2012	50	250

Source: MDB project teams

IBRD Renewable Energy Program

5. The IBRD/CTF operation would support investments in renewable energy (RE) generation and in utility-level energy efficiency (EE). The operation would build on IBRD projects that are active in these sub-sectors. In RE, the focus will be on leveraging private

sector investment in the context of the emerging policy and regulatory framework for renewables, and ensuring that CTF is used strategically to leverage as much private investment as possible. In EE, the goal is to scale-up the efforts of electric cooperatives (ECs) to continue to reduce losses, as one key input for enhancing the financial strength of these service providers. Stronger ECs will be better able to expand their customer bases, contributing to critical access objectives, and to serve those new customers with an increasing proportion of clean energy.

6. While the Philippines has an advanced framework for private participation and for attraction of private financing, there are significant barriers to the scale-up of RE and utility-led EE. For example, for administrative ease, the country has opted for a single, national feed-in tariff (FIT) rate per technology; but supply chain and other costs vary widely in the country, so some economically beneficial projects will not be financially viable under the FIT mechanism. The FIT regime will also not extend to certain renewable technologies (e.g., geothermal), nor will it cover off-grid generation. CTF will be used to provide critical additionality and leverage such that more, good projects will be financed, especially in regions of the country that might not otherwise see much activity. In the EC sector, there are 119 service providers but only about half are currently rated credit-worthy, and investment flows are falling well short of requirements even for the credit-worthy. CTF is targeted at both the supply side – by leveraging the flow of private credit to support investments – and at the demand side, by establishing programmatic eligibility criteria that will help incentivize more ECs to become credit-worthy.

7. GoP has made its formal request for project preparation funds from the CTF, and project preparation work is set to accelerate. Project appraisal is targeted for May 2012 and presentation to the IBRD Board is scheduled for October 2012.

IBRD Urban Transport Program

8. The Program comprises Investment and Advisory Services components to support the implementation of Bus Rapid Transit (BRT) projects in Cebu and Manila. The advisory services component includes support for implementation of the National Environmentally Sustainable Transport Strategy (NESTS). Since the Philippines CIP was prepared in December 2009, there have been a few minor changes made to the scope and design of the urban transport component. These adjustments are outlined below.

9. Through project preparation work undertaken since the initial CTF investment proposal, it has become evident that to ensure successful implementation of a bus rapid transit (BRT) system in the Philippines, substantial capacity and institution building work will be necessary. To this end, it has been agreed with the counterparts that the BRT program would be undertaken in two phases, beginning with a demonstration project in Cebu City, from which lessons learned and institutional structures derived would be applied to the second phase, the development of a BRT in Manila. Given the substantive social and political hurdles involved in the Manila phase, the counterparts agreed that a successful demonstration in Cebu would facilitate more rapid implementation in Manila.

10. Also, for Phase I, to maximize greenhouse gas emissions mitigation benefits, as well as safety, gender, and poverty impacts, the program scope has been slightly expanded to also include upgrading the existing SCATS area traffic control system to better manage traffic and non-motorized transport (NMT) flows, not only on BRT corridors, but for the entire transport network. Further, Phase I will include significant training and capacity building work not just for the local government, but also relevant stakeholders, such as the jeepney operators.

11. Finally, since the initial CTF proposal, a parallel Sustainable Urban Energy Program (P125401) has been undertaken by the IBRD in Cebu City, through which it was determined that the greenhouse gas emissions from the transportation sector were 721,000 tons CO_2e in 2010, about 40 percent of Cebu's total greenhouse gas emissions. While this figure will be verified and refined during the CTF project preparation, the estimate provides a basis upon which to develop preliminary greenhouse gas emissions reduction targets that may be attributable to Phase I in Cebu, versus Phase II in Manila. Through the expanded project scope, a range of 100,000 to 150,000 tons CO_2e emissions reductions per year may be a reasonable estimate for Phase I, with more substantive emissions reductions to be expected in Manila, which is many times the size of Cebu City and has a much higher motorization rate. The success of Phase 1 is critical to expanding the scope to Phase ii. However, in addition to CO_2e emissions reductions, it is expected that Phase I demonstration project would have considerable impact on improving access to the poor, providing a safer and more effective transport services to all residents, and influencing changes in land use design with a long-term impact on the city's ability to address climate change related issues.

12. Since the program will be undertaken in two phases, rather than one, funding allocations have been adjusted accordingly, as shown in Table 2. Further, additional financing and technical assistance funding has been secured from the Agence Française de Développement (AfD), which is also reflected in the revised figures. The CTF funds will continue to be needed to cover part of the additional costs of BRT systems compared to conventional bus networks.

Table 2: Revised Financing Plan for IBRD Urban Transport Program (US$ million)

Funding Source	**December 2009 Original Proposed Contribution**	**October 2011 Revised Proposed Contribution**	
		Phase I	**Phase II**
Government of the Philippines	50	15	35
IBRD	250	90	90
Clean Technology Fund	50	25	25
Agence Française de Développement	0	20	*tbd*
Total	**350**	**150**	**150**

Source: IBRD

13. Overall progress is shown above in Table 1. Project preparation work is proceeding well and three missions have been undertaken since April 2011. The Government has made a formal request for project preparation funds from the CTF. Appraisal of the project is targeted for June 2012 and presentation to the Bank's Board for November 2012.

IFC Programs

14. As of October 2011, two private sector program proposals have proceeded: $20 million was approved in September 2010 for the IFC Renewable Energy Accelerator program, and $10 million was approved in February 2011 for the IFC Sustainable Energy Finance program.

IFC Renewable Energy Accelerator Program (REAP)

15. IFC would provide appropriate incentives for qualified solar, wind, and biomass developers to accelerate the implementation of RE projects. These projects would provide immediate GHG reduction impact and provide valuable information on the types and amounts of incentives required to catalyze RE development in the country. IFC will continue to develop

projects with CTF support in close coordination with the GoP and the policies that govern private sector growth. The rationale is the same as envisioned in the original CIP. IFC continues to work with project developers and refining financial structures in the development of projects. Overall progress is shown above in Table 1.

IFC Sustainable Energy Financing Program (PSEFP)

16. The program supports the scale up of sustainable energy finance projects in Philippines. It aims to contribute to increasing private sector involvement, support captive and grid-tied RE development, EE market transformation, and enhance energy savings. The CTF funds will continue to be needed to incentivize local financial institutions to undertake financing in lower carbon emitting technologies. The rationale is the same as envisioned in the original CIP. IFC continues to work with various stakeholders in developing projects under the program. IFC has a pipeline of projects that are at various stages of development that would fully utilize IFC's CTF allocation.

III. CIRCUMSTANCES AND RATIONALE FOR INVESTMENT PLAN UPDATE

17. The overall rationale for CTF intervention in the energy and transport sectors remains unchanged. GoP has requested that the ADB allocation be revised to accommodate 2 projects, instead of the single intervention proposed in the original CIP. Major changes in circumstances since 2009 are as follows:

(i) The specific rules for the Renewable Portfolio Standard (RPS), feed-in tariffs, and net metering have yet to be finalized and become fully effective. GoP is fully committed to the RPS, FIT, and net metering programs; finalization of the implementing rules is expected sometime in 2012.
(ii) The Philippines Department of Energy has proposed that the RPS for solar power will be 50 MW over a 3-year period, limited to ground-mounted installations.[1] The proposed feed-in tariff has attracted initial private sector interest for several times this capacity, obviating the need for concessional financing for solar power in the near term.
(iii) Increases in fossil fuel prices since 2009 point to the need for additional investments in energy end-use efficiency, including in the efficient energy use by the transport sector.
(iv) A successful pilot test of energy efficient electric vehicles (EEEVs)[2] conducted with ADB support is ready for scale up.

18. Based on circumstances (i) and (ii), the net metering project using distributed solar power proposed in the original CIP is not yet ready for implementation, and given private sector interest under the proposed FIT and RPS it is not obvious that concessional finance is needed in the near term for the net metering program (or for other utility-scale solar power projects). Based on circumstances (iii) and (iv), GoP believes that concessional financing could be better utilized in the near term to begin converting the public vehicle fleet to electric vehicles. Introduction of electric and hybrid vehicles is being complemented by other alternative and

[1] Philippines Department of Energy, Resolution dated 28 June 2011.
[2] The vehicles are motorcycles with side cars which provide taxi services, known locally as “tricycles”; this tricycle design is somewhat unique to the Philippines. The pilot-tested EEEVs are also referred to as “e-trikes.” The transport services provided by tricycles are similar to auto-rickshaws utilized in other Asian countries including Bangladesh India, Indonesia, and Thailand. Hence the potential for replication and scale-up is regional in scope.

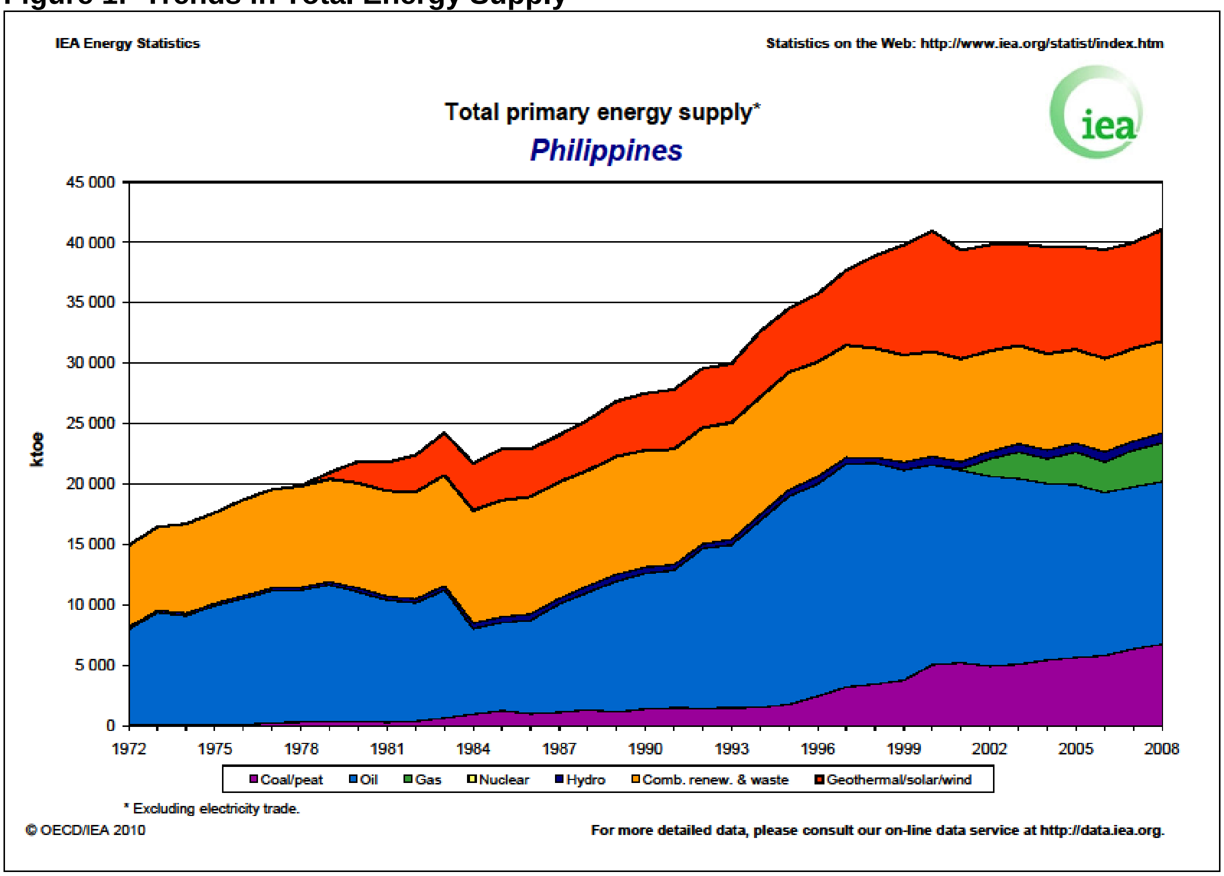
cleaner fuel development including domestic production of renewable diesel and ethanol to meet mandated blending requirements.

19. Given the need for convergence between climate change and energy security objectives, GoP has requested to shift the original $125 million of CTF resources slated for the net metering project, and re-direct $24 million to investments in energy efficient appliances and $101 million to the EEEVs project. The prospective investments are appropriate for CTF support given their transformational nature and the replication and scale-up potential. The shift toward demand-side investments from the original net metering project—which combines supply- and demand-side aspects—is fully consistent with GoP energy and transport policies. The proposed projects are discussed in more detail below and in Appendices 1 and 2.

Addressing Energy Security and the Philippines Energy Roadmap

20. GoP is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework as described in the original CIP. Figure 1 illustrates trends in total primary energy supply, indicating that coal and natural gas have displaced oil for power generation, while the share of renewables has not increased substantially during the past several years. The trend of increasing coal use is of particular concern with respect to energy security and GHG emissions. The IBRD and IFC programs (noted above in Section II) will continue to focus on RE and EE investments which are intended to reduce demand, add clean generation capacity, and offset future fossil power capacity additions.

Figure 1: Trends in Total Energy Supply

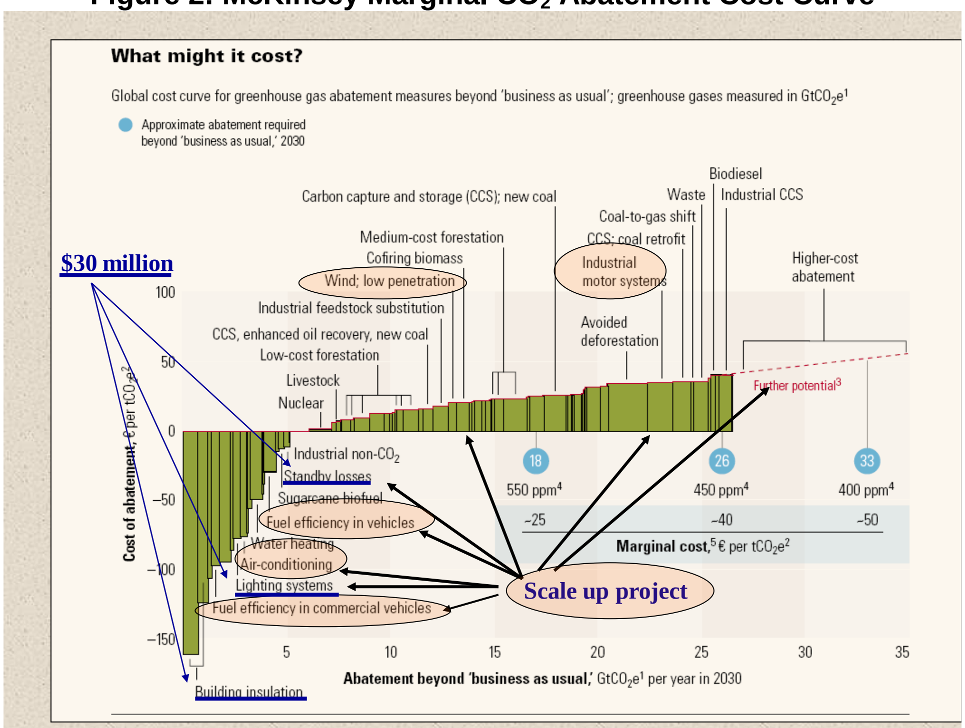


Source: IEA, accessed on 11 August 2011 from: http://www.iea.org/stats/pdf_graphs/PHTPES.pdf

21. In 2010, the Philippines spent approximately \$8.78 billion[3] on imported oil–39% more than in 2009, about 66% of which was used by the transport sector. With growing population and urbanization, the cost of fuel imports is likely to grow by multiple times in the next 10-15 years. GoP plans to improve energy security—a national priority—with EEEVs, RE, and other EE investments.

22. Based on the McKinsey marginal abatement cost curve (Figure 2) and a study by ADB (Figure 3), GoP developed the investment strategy for the energy sector as shown in Figure 4, where \$250 million was to be financed by the CTF. Energy efficient vehicles, although a GoP priority, were not part of the original CIP prepared in 2009 as no project or program had been formulated at that time. GoP proposes to change the prioritization considering the changed circumstances in relation to increased private investor interest in RE generation projects, consumers' concern on potential impacts of feed-in tariff, and prospect of higher electricity tariffs.

Figure 2: McKinsey Marginal CO_2 Abatement Cost Curve



23. The government's priority projects are illustrated in Figure 4, below. The outer circle represents overall potential investment in various clean energy interventions, including private sector investments, superposed on the McKinsey curve for the Philippines. The small ellipse at the lower left represents investment potential in more efficient lighting, which has been partly addressed through public sector investment with ADB financial support. The larger ellipse represents the bulk of potential clean energy investment, toward which the original CIP directed \$250 million in CTF cofinancing. Of this \$250 million, \$125 million was proposed to cofinance the startup of the net metering program with solar photovoltaic (PV) systems.

[3] Source: Department of Energy, available at: http://www.doe.gov.ph/DO/Report2010.htm

Figure 3: Philippines Marginal CO_2 Abatement Cost Curve

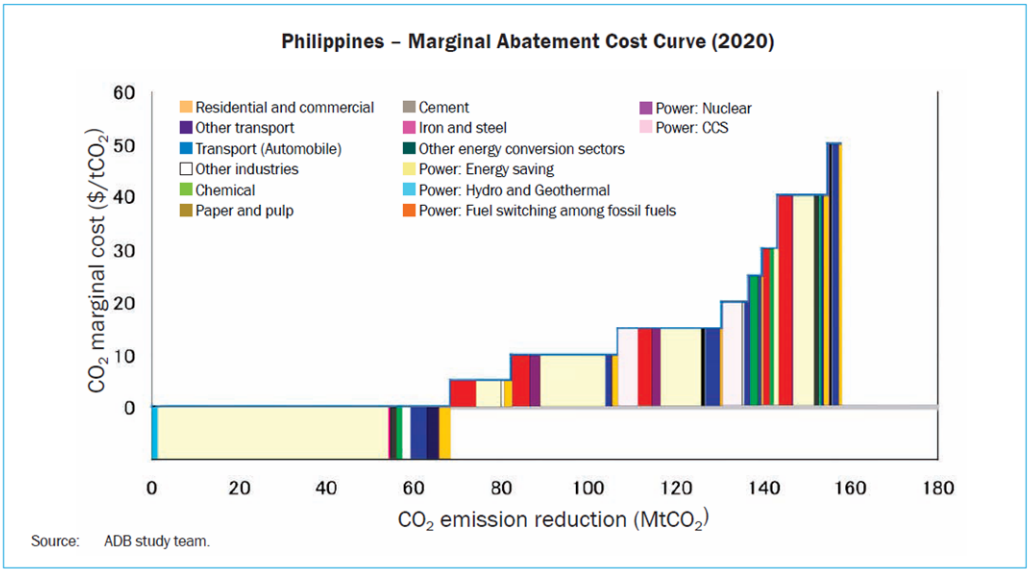
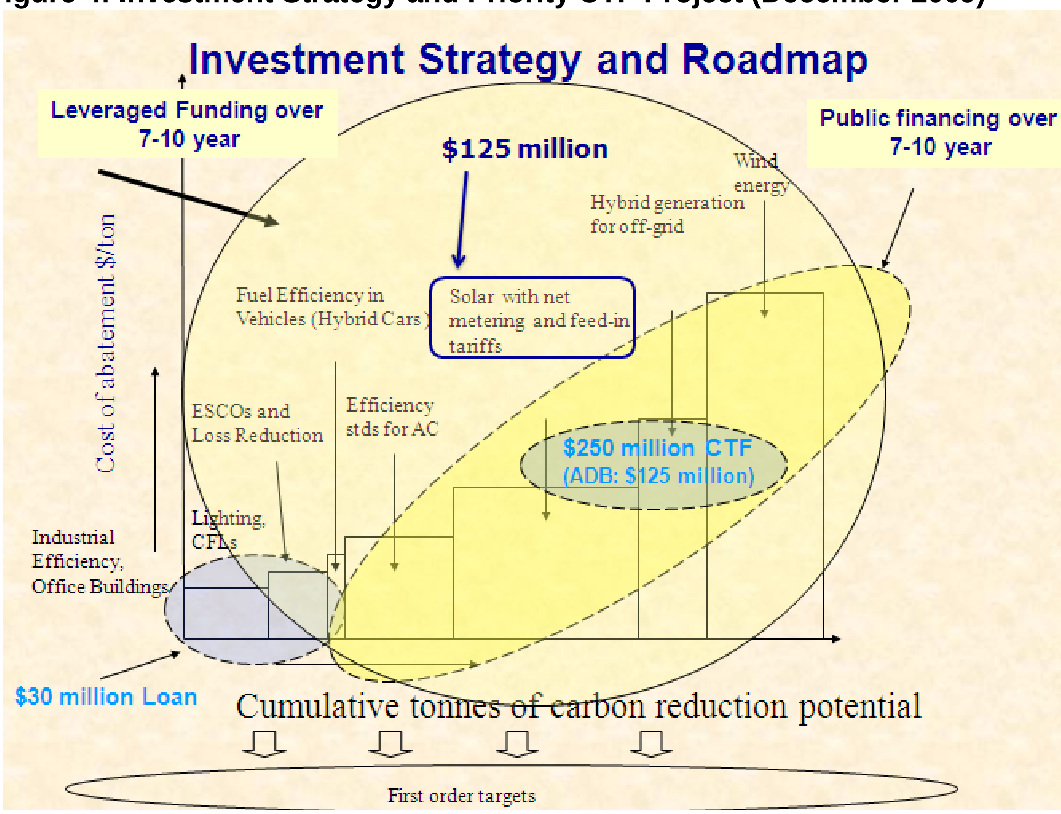


Figure 4: Investment Strategy and Priority CTF Project (December 2009)

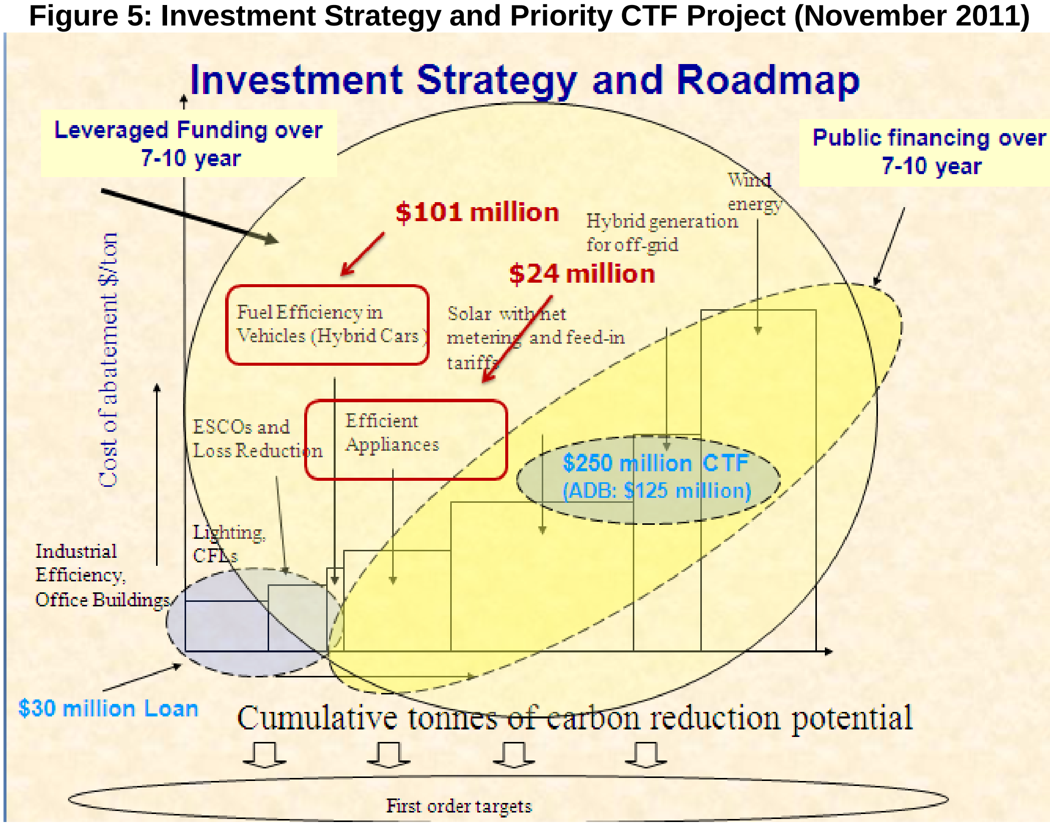


24. ***The GoP remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health.*** The general

approach and overall objectives for low-carbon development presented in the original CIP remain the same. GoP is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework as described in the original CIP. The energy and transport policy frameworks discussed in the original CIP remain in effect. The GoP remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health. The general approach and overall objectives for low-carbon development presented in the original CIP remain the same.

25. ***The strategic rationale for CTF intervention in the energy and transport sectors remains unchanged.*** The transport sector, power generation, and other energy end-use are highly dependent on imported fuels, which render the country vulnerable to energy supply disruptions and global price fluctuations. The Philippines has a variety of RE resources—biomass/biogas, geothermal, small hydropower, and wind—with estimated total potential of about 7400 MW, of which about 60% has been developed. In the near term, biomass, geothermal, hydropower, and wind are expected to account for most of the new RE capacity additions. Additional potential from solar and waste-to-energy is high but commercial development of these resources has very high start-up costs; solar and waste-to-energy are not expected to contribute at the gigawatt scale in the foreseeable future. Therefore, investments in more efficient appliances and energy efficient transport systems are critical in the near to medium term. Figure 5 illustrates the proposed reallocation of CTF funding to EEEVs and energy efficient appliances which are discussed in more detail below. Comparison of Figures 4 and 5 clearly shows that the underlying clean energy and cleaner transport strategies have not changed.

Figure 5: Investment Strategy and Priority CTF Project (November 2011)



Status of Renewable Energy and Energy Efficiency Development

26. The Philippines RE potential is high, but new investment has been limited during the last several years relative to the potential (except in wind energy). The estimated RE potential is 2,000 megawatts (MW) for biomass; 3,400 MW for hydropower, of which 1,700 MW is small hydro; 1,070 MW for geothermal; and 500 MW for wind, as well as large potential for solar.[4] To catalyze investment in RE, the government approved the Renewable Energy Law in 2009. The Renewable Energy Law mandates a universal charge on all customers to finance the proposed incentives for renewable energy, especially the proposed feed-in tariff.[5] The potential increase in electricity price from this tariff could potentially further harm the broader economic development and investment climate. Although high electricity prices in the Philippines make clean energy projects financially attractive, without broad market transformation the desired objectives of the Renewable Energy Law will be difficult to achieve. The desired transformation requires adoption of new clean energy systems at scale, more responsive regulation, and consumer acceptance.

27. With the region's highest retail electricity tariffs, the Philippines should be the one of the most attractive places for investments in EE. The high electricity prices provide excellent incentives to undertake EE projects; unfortunately, very few EE projects have been implemented to date. The main barriers are lack of flagship projects and general awareness of EE opportunities by end users. The government has addressed the issue of lighting and building inefficiencies through the Philippine Energy Efficiency Project (PEEP), which is being implemented with ADB support. The PEEP is financing development of energy service companies (ESCOs) and implementation of a large-scale program to switch from incandescent to compact fluorescent lamps (CFLs); the PEEP is providing valuable learning experience to inform project design for EEEVs and EE appliances.

Priority Introduction of Energy Efficient Electric Vehicles

28. Transport sector energy consumption will continue to grow at an average annual rate of 3.2%, with road transport accounting for 90% of energy demand for transport by 2030. The transport sector, mainly tricycles, jeepneys, and buses, contributes a large portion of CO_2 emissions: 3.5 million registered motorcycles and tricycles release 10 million tons of CO_2 into the atmosphere each year and consume close to $3 billion worth of fuel. Introducing new technology is the best immediate option to mitigate transport emissions. Electric vehicles are 3–5 times more efficient than internal combustion engine vehicles (ICE), whether fueled by gasoline, compressed natural gas (CNG), or liquefied petroleum gas (LPG). The public transport sector can save a significant portion of imported energy by switching to energy-efficient electric vehicles (EEEVs).

29. EEEVs represent a new technology with the promise to transform the way energy is used compared to today's ICE vehicles. For net energy importing countries such as the Philippines, EEEVs can dramatically reduce the country's oil dependency and improve long-term energy security. EEEVs generate no harmful air and noise pollution [at street level] and can be powered by indigenous RE sources such as solar, hydropower or geothermal resources. The envisioned fleet conversion will contribute to making the transport sector's energy use sustainable, by introducing new technology that eventually will allow domestic solar, wind and

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[4] Commercial potential is noted as at least 800 MW, based on private sector commitments pursuant to the proposed feed-in tariff.

[5] The incentives include a renewable energy certification scheme, feed-in tariffs, renewable energy portfolio standards, net metering schemes, priority dispatch options, and support for renewable energy host communities.

hydropower power to be used as a fuel source for the transport sector, replacing the fossil fuels used today.[6]

30. GoP's preliminary modeling shows that a 7% electric vehicle penetration by 2015 and 15% by 2030 can reduce fuel imports by approximately 6% in 2015, 13% in 2020, and more than 40% by 2030 with concomitant reductions in GHG emissions and other air pollution. The proposed electric vehicle policy[7] directly supports electric vehicle related businesses and will exempt importation of all electric vehicles (plug in and hybrid) from taxes for nine years. The proposed EEEVs project will support the Department of Energy's Fueling Sustainable Transport Program and the Alternative Fuel Vehicles Incentives Act of 2011. ***This move to begin electrification of the vehicle fleet is fully consistent with the National Environmentally Sustainable Transport Strategy (NESTS) described in the original CIP.***

31. The transport sector accounted for about one-third of total GHG emissions in 2009 (excluding emissions from land use change and forestry). Transport sector emissions have increased by about 6-10% per year since 1990, from about 10 million tons per year carbon dioxide equivalent ($MtCO_2e/y$) in 1990 to about 29 $MtCO_2e/y$ in 2007.[8] Vehicles are one of the dominant sources of urban pollution that threatens both people's health and economic activity. In the Philippines, motorcycles and tricycles comprise more than 52% of vehicle population, and these vehicles are the bottom of the transport sector "pyramid." Compared to other vehicles, motorcycles and tricycles are less expensive (and therefore more affordable), they are very visible in most cities of the country, and play an important role in the transport market, particularly as a key short-distance transport mode. However, the use of these vehicles contributes to the already declining state of the environment, particularly air quality in urban areas. In an ADB study, transport sector emissions accounted for 30% of air pollution in the Philippines and about 80% of air pollution in Metro Manila.

32. In order to improve urban transportation systems, control pollution from fossil fuels, enhance energy security, and mitigate long-term GHG impacts, the GoP has embarked on an ambitious program to introduce electric and compressed natural gas (CNG) vehicles into the public transportation fleet.[9] ADB is supporting a demonstration project[10] for introduction of e-trikes in Mandaluyong City (part of the Metro Manila core urban area). The initial results have been positive[11], and GoP has requested ADB to provide financial support for the commercial deployment of 20,000 e-trikes, first phase of the 100,000 e-trikes to be eventually set out by 2016.[12] The proposed EEEVs project will create an early-adopter opportunity to innovate in establishing sustainable local e-Trike manufacturing capacity, battery and vehicle leasing schemes, and associated services for vehicle operation and maintenance: the project is being designed to deliver an end-to-end infrastructure solution for cleaner transport which is

[6] Today, fossil fuels are trucked to the remotest consumption points from thousands of kilometers away. Domestic petroleum production (dominated by natural gas) is predominantly in basins located hundreds of kilometers offshore.
[7] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid and Other Alternative Fuel Vehicles Incentives Act of 2011.
[8] CTF Investment Plan for the Philippines; paragraph 8 and Figure 3.
[9] CNG is used in some other countries (e.g., South Asia) for autorickshaws, and conceivably could be used for tricycles. However, GoP's emphasis on energy security and reduction of petroleum product imports points toward electrification as a preferred option.
[10] Financed by RETA 6441: *Efficiency Improvement and Connectivity Strengthening in Southeast Asia*. Manila.
[11] A summary of the initial results of the pilot and project concept can be found at: http://www.adb.org/projects/etrike/etrike-industry-presentation.pdf
[12] ADB. 2010. *Technical Assistance to the Republic of the Philippines for Mitigation of Climate Change through Increased Energy Efficiency and the Use of Clean Energy*. Manila. (TA 7754-PHI).

consistent with GoP's overall energy security, economic development, and climate change objectives.

IV. PROPOSED CHANGES TO THE INVESTMENT PLAN

33. The original CIP identified several prospective interventions in EE, RE, and urban transport. The indicative financing plan endorsed in December 2009 is summarized in Table 3.

Table 3: Indicative Financing Plan Endorsed in December 2009 ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	RE and EE (ADB)	Total
CTF	75	50	125	250
GoP / DBP	180	50	50	280
IBRD Loans	250	250	0	500
IFC Loans	250	0	0	250
ADB Loans	0	0	400	400
Private sector	750	0	350	1,100
Total	**1,505**	**350**	**925**	**2,780**

Source: CTF Investment Plan for Philippines 2009
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, WBG=World Bank Group

34. ***The major change proposed is to reallocate CTF funds for the Energy Efficient Electric Vehicles and Appliances projects to be cofinanced with ADB.*** In particular, EEEVs promise to transform the way energy is used by light-duty vehicles. For net energy importing countries such as the Philippines, electric vehicles can dramatically reduce the country's dependence on imported energy resources, which in turn will offset some short term price volatility and improve long term energy security. Electric vehicle technology presents the opportunity to transition from conventional fossil-fueled vehicles to vehicles which do not directly generate harmful air and noise pollution and can be powered by indigenous renewable energy resources such as solar, hydropower or geothermal.

35. These prospective investments are appropriate for CTF support given the transformational nature of the projects and the replication and scale-up potential.[13] The proposed changes will allocate $101 million to the ADB EEEVs project and $24 million to the EE Appliances project, as shown in Table 4. Concept papers for the candidate investments are presented in Appendices 1 and 2.

Table 4: Indicative Financing Plan After Reallocation ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Appliances (ADB)	Energy Efficient Electric Vehicles (ADB)	Total
CTF	75	50	24	101 [a]	250
GoP / DBP	180	50	46	99	375
IBRD Loans	250	180	0	0	430
IFC Loans	250	0	0	0	250
ADB Loans	0	0	100	300	400
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing	0	20	0	0	20
Total	**1,505**	**300**	**170**	**500**	**2,475**

Source: MDB teams
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and

[13] Pakistan, Indonesia, Malaysia, Bangladesh and Thailand have expressed interest in exploring options for implementing similar projects.

Development, IFC=International Finance Corporation, RE=renewable energy, (tbd)=to be determined, WBG=World Bank Group
Notes to Table 4:
[a] A CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan).
[b] Private sector entities will participate in project implementation via supply of goods and services. For the EEEVs project, private sector investment is expected during replication and scale-up, and as such no private sector cofinancing is shown in Table 4. Private sector cofinancing for the EE appliances project has yet to be determined.

V. POTENTIAL IMPACTS OF PROPOSED CHANGES ON INVESTMENT PLAN OBJECTIVES

36. The proposed changes will enhance both the EE and cleaner transport programs by using CTF resources to accelerate investment in advanced electric vehicle systems, and will contribute directly to the near-term strategic EE investment program. An assessment of potential impacts of the proposed changes on achieving the objectives and targets of the original CIP is summarized in Table 5 and discussed below.

37. ***Transformational impact will be enhanced.*** The scope of EE and cleaner transport sector interventions will be expanded relative to the original CIP, bringing additional value by opening a new "window" for deploying EEEVs in sustainable transport systems. More efficient battery technologies are providing a cleaner alternative to pollution-emitting ICE-powered vehicles. In some cases, conventional motorcycles emit more pollution than large sport utility vehicles because the former are not equipped with equivalent emissions-control technology.[14] Electric motorcycles and tricycles can immediately eliminate tailpipe emissions, significantly reducing urban air pollution. Commercial success of e-trikes can be replicated in other types of vehicles, including jeepneys and buses (although technical complexity increases with larger vehicles).

Table 5: Summary Assessment of Proposed Changes

CTF Investment Criteria	Original Investment Plan: Net Metering with Solar PV	Updated Investment Plan: EE Appliances and Energy Efficiency Electric Vehicle Projects
Potential for GHG Emissions Savings	Direct reductions would be relatively modest but replication and scale-up potential is quite high as the investments would promote GHG reductions through RE and EE.	ADB program will target end-use efficiency improvements which represent permanent energy savings via avoided generating capacity and avoided fuel imports. Replication and scale-up potential is high for both EE and electric vehicles.
Cost-effectiveness	Initial direct reductions of 100,000 tCO_2e per year with 10 to 1 replication and scale-up potential Cost effectiveness: CTF$125 / $MtCO_2e$ / year with replication and scale-up (see additional calculations presented in Tables 9 and 10)	EE appliances project: 10 – 30% annual electricity savings are expected at a cost of 1/3 or less of new generating capacity. Energy savings of about 250 gigawatt-hour per year are expected to deliver GHG reductions of about 125,000 tCO_2e per year; with 10-year lifetime, total GHG reductions are 1.25 $MtCO_2e$. Replication and scale-up potential is at least 10 to 1. Cost effectiveness: CTF$24 million / 1.25 $MtCO_2e$ = CTF$19 / tCO_2e, declining to CTF$1.92 / tCO_2e with replication and scale-up. EEEVs project: 100,000 vehicles will deliver net reduction of 270,000 tCO_2e per year; with 10-year

[14] The Technology Review, published by MIT, 2007, available at: http://www.technologyreview.com/energy/19069/

CTF Investment Criteria	Original Investment Plan: Net Metering with Solar PV	Updated Investment Plan: EE Appliances and Energy Efficiency Electric Vehicle Projects
		vehicle lifetime total GHG reductions are 2.7 $MtCO_2e$. Replication and scale-up potential is at least 20 to 1. Cost effectiveness: CTF\$101 million / 2.7 $MtCO_2e$ = CTF\$37 / tCO_2e, declining to CTF\$3.74 / tCO_2e with replication and scale-up of 10 to 1 [See additional calculations in Tables 9 and 10 and Appendix 1]
Demonstration Potential at Scale	Transformation potential [a] of at least 10	Transformation potential is estimated to be > 10 for EE appliances and > 20 for EEEVs
Development Impact	The proposed investment would demonstrate viability of the net metering system (and business model) and accelerate development of the solar PV industry in the Philippines	The EE appliances and EEEVs projects will accelerate growth of the respective industries in the Philippines by demonstrating new technology / systems and business models. Impacts with respect to energy security and environmental benefits will be higher than the original CIP; impacts on employment also may be higher than the original CIP given the potential benefits accruing to e-trike owner/operators and private sector firms involved in supply of hardware and after-market services.
Implementation Potential	As the implementing rules and feed-in tariff for net metering have not been finalized, the originally proposed project is not ready for implementation.	The EEEVs project has been developed based on a successful pilot project in the Metro Manila region and is at an advanced stage of preparedness. The EE appliances project is in early development and is tentatively scheduled for ADB Board consideration in 2012. See Table 7 for discussion of implementation risks and mitigation.
Additional Costs and Risk Premium	The additional costs of the solar PV systems and first-mover risk associated with net metering clearly justified the use of CTF resources.	The proposed projects will focus on using CTF for covering additional costs associated with introduction of electric vehicle systems and for covering additional costs and first-mover risks in EE investments (see Appendices 1 and 2).

[a] Transformation potential is defined in paragraphs 15 - 17 of the *CTF Investment Criteria for Public Sector Operations* dated 9 February 2009.
CIP=CTF Country Investment Plan, CTF=Clean Technology Fund, EE=energy efficiency or energy efficient, EEEVs=energy efficient electric vehicles, GHG=greenhouse gas, RE=renewable energy, tCO_2e=tons carbon dioxide equivalent

38. ***Emissions reductions from the EE Appliances and EEEVs investments will be higher than the original investment plan, with higher replication and scale-up potential.*** The direct investments in the EE Appliances and EEEVs projects will result in net avoided fossil fuel emissions estimated to be at least 0.4 million $tCO2_e$/y, but with better cost-effectiveness and higher replication and scale-up potential than the original CIP as shown above in Table 5 (see additional discussion below at Tables 9 and 10, and in Appendix 1). The EEEVs project will bring environmental and public health co-benefits equal to or greater than that which would be realized under the original Investment Plan.

39. ***Replication and scale up potential will be higher than originally planned.*** Commercial deployment of EEEVs will expand the urban transport program beyond the original CIP. The replication potential for e-trikes and motorbikes alone is at least 20 to 1 based on the

current vehicle fleet size; however, replication and scale-up is conservatively assumed to be 10 to 1 for purposes of calculating total emissions reductions and cost-effectiveness. Replication potential for investment in EE appliances is well over 10 to 1. Using CTF to cofinance investment on these types of pioneer projects will eliminate first-mover risk and will help mobilize future commercial investment for replication and scale up. Private sector firms will be actively engaged in project implementation via service, supply, and maintenance contracts; the private sector is expected to take a more prominent role in replication and scale-up.

40. ***Development impacts and co-benefits will be maintained or enhanced.*** Expanded investment in EE appliances and new investment in EEEVs will improve energy security, reduce GHG emissions, and reduce conventional pollutant emissions with substantial public health benefits. Using CTF to cofinance these types of pioneering projects will help mobilize future commercial investments (mainly by private sector entities) for replication and scale up, which will stimulate economic growth and facilitate the long-term transition to low-carbon development. A comparison of proposed results indicators is presented in Table 6.

Table 6: Results Indicators

Results Indicator	Baseline	Expected Program Results in Original CIP: Net Metering with Solar PV	Expected Program Results For EE Appliances and EEEVs Projects
Cost of solar power units	$18,000 with 9.8 year payback	$10,000 with 2.5 year payback [a]	n/a
Number of commercial buildings with solar panels and net metering	Limited	30,000 buildings	n/a
Number of e-trikes and support infrastructure in commercial operation	20 (with lithium ion batteries, post-pilot test) and about 200 using conventional lead acid batteries and less efficient motors.	n/a	15,000 e-trikes operating by 2013 and about 100,000 by 2016. Public charging infrastructure and battery leasing established in respective regions.
Overall quality of appliances in the Philippines	Most commonly used 32 inch TV wattage is 100 Watt to 125 Watt	n/a	Benchmark Wattage established (40 Watt – 50 Watt). At least 50% of TV Wattage is below 60 Watt by 2015. Similar benchmark for (Computer monitors, refrigerators, room air-conditioners and fans)

Notes: [a] Indicators are from Table 1 of Executive Summary of the original CIP.
Source: October 2011 Joint Mission

41. ***Implementation potential for the EE Appliances and EEEVs projects is high.*** The EEEVs project is nearing the appraisal stage and is scheduled for presentation to ADB's Board of Directors in early 2012. The EE Appliances project is under preparation and is expected to be presented for ADB Board consideration in the first half of 2012. Risks and mitigation measures are summarized in Table 7.

42. The Philippines Department of Energy (DOE) will be the executing agency for these proposed projects, as DOE is the designated agency for EE activities as well as alternative fuels including electric vehicles. The scope and implementation arrangements of the proposed projects have considered substantial learning curve from the Philippines Energy Efficiency Project (PEEP, supported by ADB financial and technical assistance), and the EEEVs pilot projects in Mandaluyong and Taguig Cities. A key lesson learned from the EEEVs pilot projects

is that for transformational impact to be realized, the investments must include the complete spectrum of stakeholders including vehicle owner/operators, equipment suppliers, and after-market service providers, i.e., the project must facilitate "end-to-end" infrastructure development including the development of a credible battery industry with new technology.

Table 7: Risks and Mitigation Measures

Risk	Mitigation Measure	Residual Risk
Policy and regulatory framework: Clarity of policies related to EE and cleaner transport	• High energy prices and price volatility provide macro-economic support to end-use efficiency investments • Application of innovative financing to cover part of front-end capital costs and to reduce first-mover risks	L
Implementation Capacity: Readiness of owner-operators to procure and operate electric vehicles	• Technical assistance to transfer know-how on project planning, financing, risk management, especially for pioneering projects	L/M
Technology: Limited know-how for after-market service of electric vehicles	• Technical assistance and know-how transfer for newly-introduced electric vehicles will be provided based on experience from pilot project	M/H
Finance:	• E-trike operators are expected to improve net income by 50% • Carbon finance will be mobilized to the maximum extent possible, including prospective post-2012 carbon revenue.	L/M
Environmental Management: Management and disposal of used appliances and batteries	• Battery leasing and recycling programs are integrated into the e-trikes projects. Recycling / de-manufacturing program will be included in the EE appliances project. • Rigorous application of GoP regulatory framework and ADB safeguards for environmental and social impact.	L
Development Impact: Mobilization of investment for replication and scale-up; potential disruption of access to energy to "last mile" consumers	• Work closely with vehicle owners, business associations, and domestic financial institutions to raise awareness and promote future investment in EE appliances and electric vehicles. • Electricity demand from the EEEVs project will be offset by efficiency gains from the EE appliances project and near-term solar power capacity additions funded by the private sector	L
Carbon finance delivery risk: Verification bottlenecks are currently delaying annual payments and affecting the financing structure of large scale transactions. Adders may preclude demonstration of CDM additionality.	• Coordinate with ADB Future Carbon Fund to identify opportunities to maximize potential carbon revenues, and reduce or eliminate delays in methodology and verification processes • Consider voluntary transaction in secondary carbon markets	M/H
Procurement : Limited number of global suppliers for electric vehicle technologies may limit competition in some instances	• Competitive bidding will be utilized in accordance with MDB and GoP requirements.	M/H
Overall risk after mitigation	**Moderate**	

43. ***Additional costs and risk premiums justify use of CTF.*** The EEEVs and EE appliances projects are both first-of-a-kind in the Philippines, and the e-trikes project will be the largest effort in the Asia region to begin electrification of the public vehicle fleet. These pioneer projects face first-mover risk, and present higher-than-normal end-user costs with respect to purchase of new vehicles and appliances (e.g., the e-trikes cost at least $1000 more per unit than conventional gasoline-powered trikes). Lower operating costs will offset the initial purchase

costs, but at present there is no mechanism to monetize the life-cycle savings to assist end-users in the initial purchase.

44. Carbon finance is increasingly at risk due to post-2012 market uncertainties. Carbon finance opportunities will be pursued but any revenue is expected to be "on delivery" and will not be sufficient to catalyze up-front investment. Also, any CDM funds are uncertain until registration with the UN, which typically occurs after the projects' financial close.

VI. ADDITIONAL CONSIDERATIONS OF THE PROPOSED PROJECTS

Net Impact on the Electricity Grid and GHG Reductions

45. Overall, the additional energy required by the electric vehicles under the proposed ADB project will depend on the relative contribution of public charging stations used during peak time (6 MW, distributed and non-coincident) and overnight home-based chargers (60 MW, off-peak). As both modes of charging will be implemented, and considering that overnight charging will provide night-time "valley filling" benefits, the incremental demand presented by the EEEVs project is expected to be less than 60 MW. A "maximum demand" case of 60 MW represents incremental demand of about 0.37% of total installed generating capacity of 16,359 MW.[15] Total incremental energy demand due to the project is estimated at 150 GWh per year (assuming e-trike consumption of 5 kWh per day, 300 days per year operation, and fleet of 100,000 vehicles), which represents incremental consumption of about 0.22% of reported generation output in 2010. This additional demand on grid-supplied electricity is considered to be negligible.[16] Table 8 presents estimated changes in energy balance assuming that the EEEVs and EE appliances project are both implemented, along with the near-term solar power development (noted above in Section III).

46. The efficient appliances component will include about 200,000 efficient air-conditioners, 150,000 refrigerators, 350,000 fans and 100,000 televisions. Collectively, the avoided energy consumption will be about 250 GWh and GHG reductions are estimated at 125,000 tCO_2e per year (additional information on estimated GHG reductions is presented in Appendix 2). The energy saved by the appliances (efficient and super-efficient) will more than offset the increase in demand by EEEVs, even if 100% of the electricity is taken from the existing grid, as shown in Table 8.

Table 8: Avoided New Energy Capacity, Megawatts (MW)

Avoided Capacity Additions from Energy Efficient Appliances	**MW**
Air-conditioners	60
Refrigerators	22
Fans	18
Televisions	10
Subtotal	110
Near-term RE Power Additions (see Appendix 1, Table A1.2)	138.5
Subtotal	248.5
Maximum Demand from EEEVs Project	60

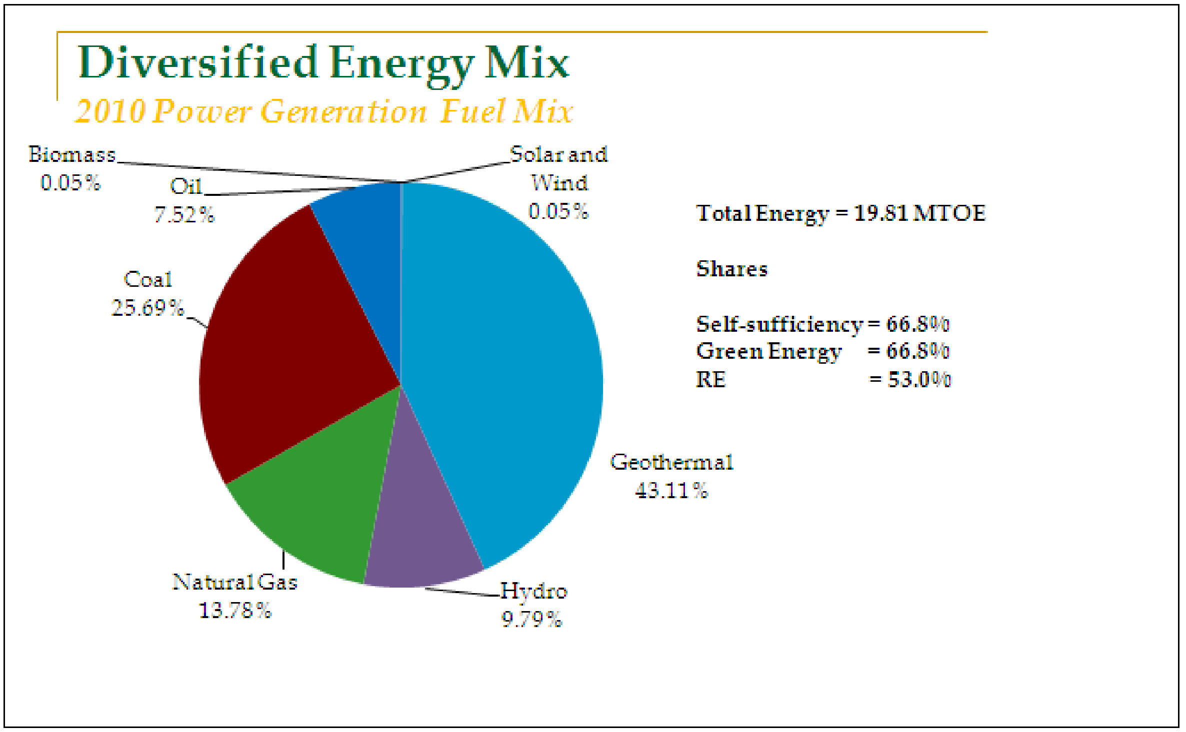
[15] Installed capacity is spread across 3 regional grids, as illustrated in the original CIP, Figure 11.
[16] Considering that 1200 MW of coal-fired capacity is being developed in addition to the 138.5 MW of RE noted in Table 8, grid-supplied electricity would not be stressed until replication and scale-up of 20:1 is achieved, i.e., deployment of 2 million e-trikes.

Net	-188.5

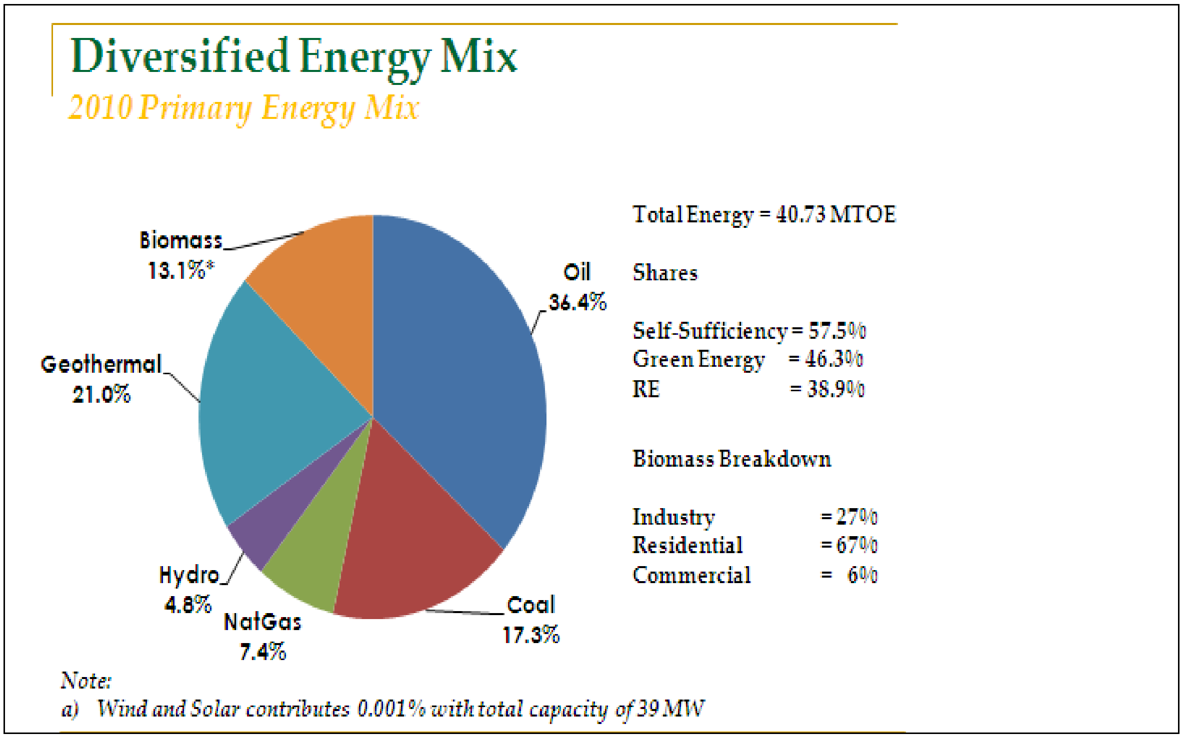
Source: ADB staff estimates

47. In the case of the Philippines with a large share of RE in the generation mix, the GHG reductions and overall end-use EE gains will be quite significant. As shown in Figure 6, clean energy accounts for about 66% of power generation and about 39% of total primary energy.[17] The GoP plans to establish solar charging stations wherever area and site access constraints do not exist, which will make the carbon footprint of these vehicles close to zero. With consumption of 5 kWh per day and 300 days per year operation, an electric tricycle will use about 1.5 MWh of electricity per year, resulting in 780 kg CO_2e per year using a grid emission factor of 0.52 tCO_2e/MWh,[18] versus an equivalent ICE tricycle which produces about 3.5 tons of CO_2 each for the same service delivery—more than 70% GHG reduction. This estimated GHG reduction is consistent with a recent study by MIT, which stated that accounting for the total energy consumed from well to wheel[19], electric vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared to ICE vehicles. The savings is in even more in congested urban areas as the average speed is low (no electricity is used while stranded in traffic jams and these vehicles will not use any air conditioning). The energy losses in electric motors are less than ICE vehicles, and transmission and distribution of electricity is more efficient and cost effective than transportation of liquid fuels to the end user. [Additional calculations of GHG reductions are presented in the Appendices.]

Figure 6: Primary Energy and Power Generation Mix (2010)



[17] Figure 6 reflects the current situation with oil dominating the transport sector, which presents a tremendous opportunity for end-use efficiency gains via electric vehicles.
[18] The grid emissions factor of 0.52 tCO_2e/MWh is consistent with 2010 generation output and various CDM projects, and is lower than equivalent emissions from gasoline-powered vehicles (see additional calculations and discussion in Appendix 1).
[19] Energy consumed and green house gases (GHGs) emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle, details available at: http://web.mit.edu/evt/summary_wtw.pdf



Choice of Lithium-ion Battery and Disposal Implications

48. ADB's publication on electric bikes[20] identified lead pollution as an inherent problem with electric vehicles and, as long as electric vehicles use lead acid batteries, the overall pollution loads will be several times higher than ICE. According to the United States Environmental Protection Agency, Li-ion batteries are not an environmental hazard[21], and are safe for disposal in the normal municipal waste stream. [22] While other types of batteries include toxic metals such as cadmium, the metals in Lithium-ion batteries–cobalt, copper, nickel and iron–are considered safe for landfills or incinerators. Therefore, the e-Trikes will use Li-ion batteries at the outset; the battery leasing business model will allow for more advanced batteries to be supplied in the future.

Cost Effectiveness of the Proposed EEEVs Project

49. Tables 9 and 10 show additional calculations of the cost effectiveness and transformative impacts of the EEEVs project, assuming a conservative replication and scale-up factor of 10 to 1. Table 9 indicates that cost effectiveness is well below the upper limit presented in CTF investment guidance, even in a pessimistic scenario discounted by 30% for potential "rebound effects." The pessimistic scenario shown in Table 9 shows that the proposed EEEVs project would be more cost-effective than the net metering project proposed in the original CIP.

50. Table 10 illustrates how the cost of avoided CO_2 drops significantly with larger transformation brought about by the CTF investment.[23] In the small, medium, and large project

[20] ADB. 2009. *Electric bikes in the PRC: Impact on the Environment and Prospects for Growth.* Manila.
[21] http://www.ehso.com/ehshome/batteries.php
[22] http://www.epa.gov/osw/hazard/wastetypes/universal/batteries.htm
[23] Table 10 assumes a replication and scale-up factor of only 10 to 1 versus the 20 to 1 factor used in Table 5.

scenarios, CTF cost-effectiveness is well below the upper limit guidance of $200 per ton. Assuming a full transformation and scale-up and replication of 10-to-1, the lifecycle CO_2 cost will be well below the $5 per ton estimated for the net metering project proposed in the original CIP. These e-trikes will generate significant fuel savings and other social co-benefits: about $10,000 over the 10 year life, the overall cost of avoided CO2 is about "**-$200 per ton**"—not uncommon for end-use EE projects, which is also reflected in the McKinsey abatement cost curve for "Fuel efficiency in vehicles" (Figure 2, above) of about "-Euro 50 per ton" or "-$69 per ton" (based on 8 November 2011 exchange rate).

Table 9: CTF Cost-effectiveness of EEEVs Project vs. Original Net Metering Project

Net GHG Reductions ($MtCO_2e$/year)	Cost Effectiveness (CTF$/$tCO_2e$/year)	Cost Effectiveness (CTF $/$tCO_2e$) [a]	Scenario / Assumptions
0.33	306.06	30.06	National electricity and heat emissions factor of 0.6 tCO_2e/MWh [b]
0.27	374.07	37.41	ADB base case with grid emissions factor of 0.52 tCO_2e/MWh [c]
0.231	437.23	43.72	0.33 $MtCO_2e$/year discounted 30% for "rebound effect" [d]
2.31	43.72	4.37	Replication and scale-up of 10:1 on case assuming "rebound effect"
0.1	1250	50	Original CIP: net metering with solar PV; 25-year project lifetime [e]
1	125	5	Original CIP: net metering with solar PV; replication and scale-up of 10:1 [e]

Source: ADB Estimates.
Notes:
[a] Clean Technology Fund, Investment Criteria for Public Sector Operations, 9 February 2009; paragraph 11 notes that "...CTF co-financing will ordinarily not be available for investments in which the marginal cost of reducing a ton of CO_2-equivalent exceeds US$200...." Considering estimated total project costs of $500 Million, the cost effectiveness estimates may be multiplied by 5.
[b] Emissions factor calculated for Philippines electricity and heat consumption by UK Defra.
[c] Additional discussion of emissions factors is presented in Appendix 1.
[d] Consideration of potential rebound effects is not required by CTF guidance.
[e] Adapted from Original CIP, Annex 2.

Table 10: EEEVs Project Cost-Effectiveness vs. Investment Scale

CTF Allocation and Scale Effects	Small isolated grids/ no CTF	Small Project	Medium Project	Large Project
Transformational Impact	Zero	Minimum	Partial transformation	Full transformation
Net Avoided CO_2e (t/y)	2.5	2.6	2.6	2.7
Number of EEEVs	5,000	20,000	50,000	100,000
EEEV Cost ($/unit)	5,000	4,700	4,500	4,000
Total Cost ($ Million)	25	94	225	400
CTF Amount ($ Million)	0	30	70	101
CTF Cost-effectiveness ($/t/y)	n/a	576.92	538.46	374.07
Lifecycle Cost-effectiveness ($/t)	n/a	57.69	53.85	37.41
Cost-effectiveness with 10x Replication and Scale-up ($/t)	n/a	5.77	5.38	3.74

$ = US dollars, CO_2e = carbon dioxide equivalent, t = ton carbon dioxide equivalent, y = year
Source: ADB staff estimates

Technology Options

51. A recent ADB study concluded that to make tricycles more energy-efficient and green, two technology options were available: (a) retrofit of existing units using conversion kits to LPG and CNG fuels; or (b) replace the propulsion system with either hybrid or purely battery-operated, or with more efficient internal combustion engine (ICE). Only the battery operated option can reduce the country's reliance on fossil fuels. Battery operated electric vehicles can also be "zero-emission vehicles", because the electricity can be generated from 100% renewable sources and these vehicles have no tail-pipe emissions. The electric option also represents a one-step solution, while retrofitting from gas to LPG entails a two-step solution that merely postpones the inevitable shift to electric. E-trikes offer the highest net income potentials for tricycle operators and drivers. The annual operating cost is nearly 50% lower than a conventional gasoline-fueled trike.

52. The EE appliances project will support accelerated introduction of more efficient appliances (liquid crystal display (LCD) and light-emitting diode (LED) televisions (TVs), computer monitors, fans, air conditioners and refrigerators, etc.). The proposed investment project will address the market failure for efficient appliances in the Philippines. For example, a conventional 27 inch cathode ray tube (CRT) television contains 2 kilograms of lead and consumes about 125 watts. Consumers are now switching to new generation LCD and LED TVs and literally dumping old TVs in landfills, each with 2 kilograms of lead. However, currently in the domestic market, the most energy efficient 32 inch LCD consumes about 100 Watt and the most efficient LED TV consumes about 72 Watt, while the "best in the world" 32 inch TV consumes 40 Watts. This is an obvious market failure, as substandard products are being brought in the market.

Further, a large number of very old CRT TVs (which can be considered electronic waste) are being brought into the country from developed countries including Japan, Taiwan and South Korea; these obsolete TVs are mostly purchased by the poorest consumers at "throw-away" prices. A key objective of the proposed EE appliances project is to (i) build awareness, (ii) improve local standards (e.g., mainstream 32 inch TVs consuming 40-50 Watts), (iii) reduce price through bulk procurement, and (iv) establish a "hire-purchase" scheme working with local power and cable companies. For example if 10,000 televisions are bought in bulk for $35 million, it will reduce the electricity demand by 1 MW; the energy savings to the consumer will recover the investment for the TVs within 3 years. The proposed project will be implemented in a manner similar to that being implemented for more efficient lighting and the proposed EEEVs project.[24] Additional details of the proposed project, which is still in the initial development stage, are presented in Appendix 2.

[24] The physical investments will be complemented with technical assistance and capacity building including public awareness and retail consumer credit facilitation to ensure that more efficient lighting, appliances, and electric vehicles can be deployed to end-users at scale. Additional notes on recent experience and proposed implementation approaches are included in Appendices 1 and 2.

Appendix 1: Market Transformation with Energy Efficient Electric Vehicles (ADB)

Problem Statement

1. The Philippines transport sector accounted for about one-third of total GHG emissions in 2009 (excluding emissions from land use change and forestry); transport sector emissions have increased by about 6-10% per year since 1990, from about 10 million tons per year carbon dioxide equivalent ($MtCO_2e/y$) in 1990 to about 29 $MtCO_2e/y$ in 2007.[25] Vehicles are one of the dominant sources of urban pollution that threatens both people's health and economic activity. In the Philippines, motorcycles and tricycles comprise more than 52% of vehicle population. Compared to other vehicles, motorcycles and tricycles are less expensive. They are very visible in most cities of the country and play an important role in the transport market particularly used as alternative mode transport for short distances. However, the use of these vehicles contributes to the already declining state of the environment, particularly air quality in urban areas. In an ADB study, transport sector emissions accounted for 30% of air pollution in the Philippines and about 80% of air pollution in Metro Manila.

2. Accounting for the total energy consumed from well to wheel[26], electric vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared to internal combustion engine (ICE) vehicles. Electric vehicles will also reduce greenhouse gases and other harmful emissions because: (i) electric vehicles use no electricity while stranded in traffic jams (no air conditioning), (ii) electric motors have higher efficiencies than internal combustion engines, and (iii) transmission and distribution of electricity is more efficient and cost effective than transportation of liquid fuels to the end user.

3. In the Philippines, a typical tricycle driver uses about $5 worth (5 liters) of gasoline to drive 100 km in a day and can save about $4 a day by switching to an electric tricycle–for 100 km, an electric tricycle will consume about 5 kWh of power costing about $1[27]. With large-scale adoption, these individual savings would accumulate to a significant national savings. Replacement of 100,000 gasoline tricycles with electric tricycles at a cost of about $450 million, for example, can generate about $175 million each year from avoided fuel costs. As noted in the main text (paragraph 43), e-trikes are expected to cost at least $1000 more than conventional trikes, but this cost will be more than recovered through reduced operating costs over a nominal 10-year lifetime. <u>Although the daily and life-cycle cost savings favor electric tricycles, there is no ready mechanism to monetize these savings for acquisition and deployment of electric vehicles at fleet scale.</u>

Proposed Transformation

4. CTF cofinancing will be utilized to overcome the first-mover risks and cost barriers associated with introducing electric tricycles as a first step in electrification of the public vehicle fleet: the proposed project will facilitate deployment of 100,000 e-trikes. This will be the largest known project of this scope implemented in the Asia-Pacific region. The project outputs include: (i) e-trike procurement, (ii) battery leasing, (iii) efficient electric motor supply chain, (iv) public charging stations, (iv) recycling and disposal, and (vi) communication, social mobilization, and

[25] CTF Investment Plan for the Philippines, 2009; paragraph 8 and Figure 3.
[26] Energy consumed and green house gases (GHGs) emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle, details available at: http://web.mit.edu/evt/summary_wtw.pdf
[27] Assuming cost of electricity of $0.20 / kWh in the Philippines.

technology transfer. CTF funds will be used alongside ADB's loan to amortize up-front capital costs over a longer period than otherwise possible.

5. Successful demonstration of the electric vehicles at this scale will facilitate replication and scale up of e-trikes and other public vehicles including jeepneys and buses. Further, development of local battery suppliers and maintenance/service industries will be fostered.

Implementation Readiness

6. The E-trikes project is nearing the appraisal stage and is scheduled for presentation to ADB's Board of Directors in early 2012. The GoP is working on an electric vehicle policy[28], which among others will exempt importation of all electric and vehicle free of taxes for 9 years. In addition there will be others incentives to set up electric vehicle businesses in the Philippines.

Rationale for CTF Financing

7. Electric vehicle deployment is both constrained and favored by several factors:

- Commercial development and deployment of electric vehicles will increase Philippines's energy security, save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources.
- Fleet-scale electric vehicle projects are at the pioneer stage and face additional costs and risks which are not being covered by conventional project financing. Creative financing approaches, including the use of concessional funds, are needed overcome first-mover risks and mainstream large-scale vehicle fleet financing.
- Carbon finance can provide some financial support, but is not sufficient to overcome the cost and risk barriers noted above.
- CTF can provide a catalytic role in reducing or eliminating first mover risk for fleet-scale projects, and foster accelerated replication and scale-up in the near term.
- The replication potential for e-trikes alone is more than 20 to 1. A substantial learning curve has already been overcome during the pilot project.
- GHG reductions and cost-effectiveness are comparable to or better than the original CIP (as discussed in the main text).

Financing Plan

Source	**Amount (US $ million)**
GoP	99
ADB	300
CTF (loan)	100
CTF (grant) [a]	1
Total	**500**
Carbon Finance [b]	20

[a] A CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan).
[b] No provision has been made for the carbon finance risks associated with possible lack of agreement on a post-2012 successor to the Kyoto Protocol. The carbon finance estimate is preliminary and subject to further revision, and is not included as upfront project co-financing.

[28] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid and Other Alternative Fuel Vehicles Incentives Act of 2011.

Project Preparation Timetable

Milestone	Date
ADB Project Identification	May 2011
Appraisal / Negotiations	January 2012
ADB Board Consideration (Approval)	March 2012
Project Completion	March 2016

Additional Notes on GHG Calculations and Electric Vehicle Eligibility for CTF

Grid Emissions Factors

8. ADB has taken a reasonably conservative approach to estimating GHG reductions. The main text notes that GHG reductions are based on a grid emissions factor of 0.52 tCO_2e/MWh, which is at the mid-range of emissions factors used for several recently registered Clean Development Mechanism (CDM) projects in the Philippines. Typical emissions factors[29] reported the following margins[30] assuming that the Luzon and Visayas grids are taken as a common unit:

Operating Margin: 0.598 tCO_2e / MWh

Build Margin: 0.339 tCO_2e / MWh

Combined Margin: 0.469 tCO_2e / MWh

9. The combined margin for the combined Luzon-Visayas grid is 9.8% less than the grid factor of 0.52 tCO_2e / MWh noted in the main text. Considering that most of the EEEVs would be deployed in the Luzon-Visayas grid, the estimated GHG reductions are conservative (alternatively stated, about 10% "rebound effect" has already been considered for the Luzon-Visayas grid, even though CTF guidance does not require any consideration of rebound effects).

10. As the pilot-tested EEEVs have higher passenger capacity than conventional trikes, potential GHG reductions have been estimated on a per vehicle basis as well as a per passenger-kilometer basis. The range of estimates is shown in Table A1.1, assuming 100,000 vehicles in full operation.

Table A1.1: Emissions Reduction Estimates (tCO_2e/year)

Case	Reduction on Per Vehicle basis	Total Reductions	Reduction on Per Passenger Basis	Total Reductions	Grid Mix
Optimistic	3.634	363,400	6.361	636,100	100% RE
Base	2.698	269,800	5.425	542,500	Current mix
Worst case	1.834	183,400	4.561	456,100	100% coal

Source: ADB staff estimates

[29] Taken from Project Design Document for "ANAEROBIC DIGESTION SWINE WASTEWATER TREATMENT WITH ON-SITE POWER PROJECT (ADSW RP2024)," registered on 7 January 2011. The Project Design Document was accessed online on 14 November 2011 at: http://cdm.unfccc.int/filestorage/S/2/Z/S2ZGB9RM5FO7D6W0E4PL3INVQCK8TH/2010.pdf?t=RFR8bHVvMXd5fDDh1GRICO3d4xwrYQ2HbisL

[30] These margins are lower than the first CDM project registered in the Philippines, the Northwind Bangui Bay Project which was registered in 2006.

Electric Vehicle Eligibility

11. Clean Technology Fund, Investment Criteria for Public Sector Operations, 9 February 2009; footnote 6 to paragraph 6 (b) (iv) states:

> "Plug-in electric vehicles would be considered only when the energy systems from which they draw the power are less carbon intensive than the emissions from a stand-alone electric hybrid."

12. In this case, the pilot-tested e-trikes are considered to be "plug-in electric vehicles." However, to the best of ADB and GoP knowledge, "stand-alone electric hybrid" trikes or motorcycles have not been marketed and pilot-tested, so an "apples-to-apples" comparison is not possible. The calculations presented below are intended to demonstrate that the EEEVs project meets the CTF eligibility criteria.

13. The grid-equivalent emissions factor for gasoline is calculated as follows:

Gross energy content: 34.2 Megajoule (MJ) / liter (L)

Converted to kWh: 34.2 MJ / L x (1 kWh / 3.6 MJ) = 9.5 kWh / L

Theoretical Carbon intensity: (2.3 kg CO_2e / L) / (9.5 kWh / L) = <u>0.2421 kg CO_2e / kWh</u>

14. This theoretical carbon intensity of gasoline, which assumes 100% thermodynamic efficiency, appears to be much lower than the emissions factors noted above (at paragraph 8). More realistic carbon intensities of gasoline-powered tricycles, assuming 40%, 30%, and 20% thermodynamic efficiencies, are higher than the Operating Margin of 0.598 tCO2e / MWh noted above:

(0.2421 kg CO_2e / kWh) / 0.4 = 0.605 kg CO_2e / kWh

(0.2421 kg CO_2e / kWh) / 0.3 = 0.807 kg CO_2e / kWh

(0.2421 kg CO_2e / kWh) / 0.2 = 1.211 kg CO_2e / kWh

15. In practice, thermodynamic efficiencies of motorcycle/tricycle engines are probably on the order of 20%, suggesting that the emissions factor of no less than 0.807 kg CO_2e / kWh is an appropriate benchmark for the current fleet of gasoline-powered tricycles. Matching the Combined Margin factor for the Luzon-Visayas grid noted above would require a thermodynamic efficiency greater than 51% (which is unrealistic for gasoline-fired internal combustion engines[31]), calculated as follows:

0.2421 / 0.469 = 0.5162 = ~ 52%

16. Until a stand-alone electric hybrid 3-wheeler appears on the market so that an apples-to-apples comparison can be made the foregoing calculations indicate that the proposed e-trikes project meets the CTF eligibility requirement. Changes in the grid emissions factor are discussed below.

[31] Automobiles with internal combustion engines have typical efficiencies of about 25%; the highest reported efficiency for ICEs is 52% for the Wartsila-Sulzer marine engine. The Toyota Prius equipped with an Atkinson cycle engine has efficiency of 34% at peak power output of 52 kW. Source: David J.C. MacKay. 2009. *Sustainable Energy Without the Hot Air*;" page 262. Available on line at: www.withouthotair.com.

Projected Changes in Grid Emissions Factors

17. The Philippines Department of Energy *Power Development Plan 2009-2030* reports that near-term generation expansion comprises 1338 MW of committed capacity, of which 1200 MW is coal-fired, 70 MW is geothermal, 51 MW is hydropower, and 17.5 MW is biomass (see Table A1.2, below). Projecting beyond the current commitments is difficult, as the generation mix will be affected by the renewable portfolio standard and feed-in tariffs discussed in the main text. Table A1.3 presents generation output for 2010 and expansion scenarios assuming (i) current commitments shown in Table A1.1, (ii) increase in emissions factor equating to 40% gasoline thermodynamic efficiencies noted above, and (iii) increase in emissions factor equating to 30% gasoline thermodynamic efficiencies noted above. Of these 3 expansion scenarios, the first is considered to be firm, the second is considered to be plausible, and the third is considered to be unlikely.

18. The third scenario presented in Table A1.3 would presents a grid emissions factor which is lower than the emissions factor of 0.807 kg CO_2e / kWh noted above as an appropriate benchmark for the current fleet of gasoline-powered tricycles. Alternatively stated, even with expansion of coal-fired power 10 times beyond current level, with no additional RE capacity additions, the grid supplied power would still be less carbon-intensive than the gasoline-fired ICE vehicles being replaced. This conclusion is consistent with the estimates shown in Table A1.1.

Table A1.2: Near-term Generation Expansion

Grid	Project Name	Capacity (MW)	Target Completion	Location	Proponent
Luzon	2x300MW Coal-Fired Power Plant	600	4th Qtr. Of 2012	Mariveles, Bataan	GN Power
	Sub-total Luzon	**600**			
Visayas	3x80MW CFB Power Plant Expansion Project	240	Unit I-March2010 Unit II-June 2010 Unit III-Jan 2011	Brgy. Daanlungsod, Toledo City, Cebu	Cebu Energy Development Corporation (Global Business Power Corp.)
	2x100MW Cebu Coal-Fired Power Plant	200	Unit 1-Feb 2011 Unit 2-May 2011	Naga, Cebu	KEPCO SPC Power Corporation (KSPC)
	17.5MW Panay Biomass Power project	17.5	2011	Brgy. Cabalabaguan, Mina, Iloilo	Green Power Panay Phils., Inc.
	Nasulo Geothermal Plant	20	2011	Nasuji, Valencia, Negros oriental	Energy development Corporation
	2x80MW CFB Power Plant	160	Unit I-Sep 2010 Unit II-Dec 2010	Brgy. Ingore, La Paz, Iloilo	Panay Energy Development Corporation (Global Business Power Corp.)
	Sub-total Visayas	**638**			
Mindanao	Sibulan Hydroelectric Power (Unit I-16.5MW) (Unit II-26MW)	43	Unit I-Feb2010 Unit II-Apr 2010	Sta. Cruz, Davao del Sur	Hedcor Sibulan, Inc.
	Cabulig Mini-Hydro Power Plant	8	June 2011	Plaridel, Jasaan, Misamis oriental	Mindanao Energy Systems,Inc. (MINRGY)
	Mindanao 3 Geothermal	50	July 2014	Kidapawan, North Cotabato	Energy Development Corporation
	Sub-total Mindanao	**101**			
Total Philippines		**1,338**			

Note: Mindanao 3 Geothermal Plant was moved to 2014 from its original target year of 2010

Source: Philippines Department of Energy, *Power Development Plan 2009-2030*; Table 4.

Table A1.3: Grid Emissions Scenarios

Source	Output in GWH	% of grid mix	Emissions Factor (t/MWh)	Total Emissions (t/y)
Base Case: generation output in 2010				
Oil-based	7101	10%	0.6	4260600
Hydro	7803	12%	0	0
Geothermal	9929	15%	0	0
Other RE	90	0%	0	0
Coal	23301	34%	0.9	20970900
Natural gas	19518	29%	0.5	9759000
Total	67742	100%	0.517	34990500
Expansion Scenario 1: Current Generation Expansion shown in Table A1.2; no other renewable energy is added. Grid factor increases to 0.553 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	9%	0.6	4260600
Hydro	8026	10%	0	0
Geothermal	10420	14%	0	0
Other RE	213	0.3%	0	0
Coal	31711	41%	0.9	28539900
Natural gas	19518	25%	0.5	9759000
Total	76989	100%	0.553	42559500
Expansion Scenario 2: Coal output expanded by 2x; all others fixed at 2010 output. Grid emissions factor would be slightly higher than gasoline emissions factor @ 40% thermodynamic efficiency of 0.605 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	8%	0.6	4260600
Hydro	7803	9%	0	0
Geothermal	9929	11%	0	0
Other RE	90	0%	0	0
Coal	46602	51%	0.9	41941800
Natural gas	19518	21%	0.5	9759000
Total	91043	100%	0.615	55961400
Expansion Scenario 3: Coal output expanded by 10x; all others fixed at 2010 output. Grid emissions factor would approximately equal gasoline emissions factor @ 30% thermodynamic efficiency of 0.807 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	3%	0.6	4260600
Hydro	7803	3%	0	0
Geothermal	9929	4%	0	0
Other RE	90	0%	0	0
Coal	233010	84%	0.9	209709000
Natural gas	19518	7%	0.5	9759000
Total	277451	100%	0.806	223728600

Source: ADB staff estimates, based on Philippine Power Statistics, 2010.
Note: Scenario 1 assumes that the additional biomass, coal, and geothermal, run at 80% output; and that additional hydropower runs at 50% output.

Appendix 2: Accelerated Introduction of Energy Efficient Appliances (ADB)

Problem Statement

1. Under the business-as-usual scenario (2010 – 2030), energy-related emissions from the commercial, industry, power, and residential sectors will increase by 123% from 77.4 MtCO2e/y to 172.5 MtCO2e/y.[32] Aggressive development of RE resources and investments in EE throughout the supply chain are necessary to promote energy security and reduce the economic and financial impacts of energy imports and price volatility.

2. The Philippines is leading energy efficiency and use of indigenous renewable energy in the ASEAN region: it was the first country to declare plans to phase out incandescent bulbs and was the first country to establish energy labeling for air-conditioners (1992). In March 2009 ADB approved a loan project and a grant (Philippine Energy Efficiency Project, PEEP),[33] to start up a comprehensive energy efficiency program to identify a range of pilot which could be scaled up later.

3. Retail electricity tariffs are the highest in the region after Japan, which should provide a ready market for the most efficient appliances; unfortunately the reality is quite different. The power consumption (wattage) of locally available "best" main consumer appliances (TVs, fans, computer monitor, air-conditioners, refrigerators etc.) consume more than 100% of the "world's best". For example, the local "best" of commonly used 32 inch TV (100 Watt) consumes 150% more energy than the world's best (40 Watt).

4. Based on a recent Lawrence Berkeley Lab report, the global TV market has undergone a quantum transition from cathode ray tube (CRT) TVs to Liquid Crystal Displays (LCDs). It is expected that LCD TVs will represent 90% of global TV market through 2012. At the same time, LCDs using cold cathode florescent lamp backlights are rapidly being replaced by LCDs using light emitting diode (LED) backlights[34]. Based on market research, without government intervention, the average power consumption of a typical 32 inch TV will not fall below 100 Watts, as the manufacturers are unwilling to bring the more efficient products to this price-sensitive market. Improving appliance efficiencies requires market intervention and transformation.

5. The Government of the Philippines (GoP) has requested ADB assistance in a longer-term investment program which will build on the success of the PEEP, including accelerated introduction of more efficient appliances - especially TVs, air conditioners, and refrigerators - which account for the bulk of residential electricity consumption. More efficient appliances can reduce household consumption by an estimated 10 - 30%, but the upfront cost presents a barrier to most consumers. <u>At present there is no mechanism to monetize the life-cycle savings of more efficient appliances to support consumer purchases.</u>

Proposed Transformation

6. The legal framework and the economic incentives provided by high energy cost have not been sufficient for adoption of clean energy and EE by ordinary citizens and businesses. The

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[32] Emissions data are from APEC Energy Demand and Supply Outlook of 2006.
[33] ADB. 2009. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Republic of the Philippines for the Philippine Energy Efficiency Project.* Manila.
[34] Display Research (2011) Global TV Shipment Growth Improves to 15% Y/Y in Q4'10 as LCD Share Surges http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/110222_global_tv_shipment_growth_improves_to_15_y_y_in_q4_10_as_lcd_share_surges.asp

recent development in EE actually is growing the technology divide, most evident by average citizen's ignorance not just of how to utilize EE in everyday life but more importantly in even knowing what technology choices they have. The proposed project will bridge the growing technology-divide between the informed (often public sector and the rich among the population) and the ill-informed (non-urban and poor) by attacking it from two different angles: usability (through implementation) and education (through awareness). In addition, the project will incorporate the three proven elements from the CFL distribution component of the PEEP which set it apart from similar initiatives: (i) *scale economy*-bulk procurement of 13 million CFLs reduced unit cost by more than 60 percent of the retail price, (ii) *improve technology credibility*-the consumer markets were made aware of the benefits of the technology and pushed "10,000 hour" bulbs when the local market only carries CFLs with life between 1000 and 6,000 hours, and (iii) *CDM ready*-being a large project, it qualified and was able to finance the initials costs for CDM under the "Program of Activities" approach. The "CFL experience" has taught all a lesson: compelling economics, short-payback periods and friendly regulation is not sufficient for "big-bang" large impact changes, which is only possible with large investments that can "shake up" the existing paradigm and mindsets which are often the main barrier to new technology investments.

7. As part of GoP's plan to scale up the PEEP success, a new project is being prepared to support the long-term EE investment program. The proposed project will transform the appliance market which comprises (i) about 5 million air-conditioners which are more than 5 years old, (ii) 10-15 million refrigerators in the market, (iii) 7 million TV sets (with 1 million cable subscribers), (iv) more than 2 million computer monitors, and (v) close to 30 million in-efficient fans.

8. The project will purchase about 200,000 efficient air-conditioners, 150,000 refrigerators, 350,000 fans and 100,000 televisions under the program and a revolving energy efficiency trust fund will be established. The consumers will pay for the appliances over a 36 months hire-purchase scheme. Collectively, the avoided energy consumption will be about 250 GWh and GHG reductions are estimated at 125,000 tCO_2e per year.

9. CTF cofinancing will be utilized to support accelerated introduction of more efficient appliances by overcoming the cost barriers to consumers. CTF funds will be used alongside ADB's loan to amortize up-front capital costs over a longer period than otherwise possible. The proposed project is still at the definitional stage; lessons learned from PEEP implementation will be incorporated into project design.[35]

Implementation Readiness

10. The EE project is under preparation and is expected to be presented for ADB Board consideration in the first half of 2012. The GoP is working on additional incentive policies to promote EE investments, including possible import tax waivers for a limited period.

Rationale for CTF Financing

11. Introduction of more efficient appliances is both constrained and favored by several factors:

[35] The general approach for accelerated introduction of appliances is not unlike the "cash for clunkers" program for introduction of more fuel efficient vehicles in the United States.

- Accelerated introduction of more efficient appliances will increase Philippines's energy security, save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources.
- Consumers face additional costs for more efficient appliances which are not being covered by conventional supplier credit or other retail financing. Creative financing approaches, including the use of concessional funds, are needed to cover additional up-front capital costs to consumers.
- Carbon finance is not expected to overcome the cost barriers noted above.
- CTF can provide a catalytic role in removing the cost barriers for wide scale adoption of more efficient appliances, and foster accelerated replication and scale-up in the near term.
- The replication potential is at least 10 to 1.
- GHG reductions and cost-effectiveness are comparable to or better than the original CIP (as discussed in the main text).

Financing Plan

Source	**Amount (US $ million)**
GoP	46
ADB	100
CTF	24
Total	**170**
Carbon Finance[a]	5

[a] No provision has been made for the carbon finance risks associated with possible lack of agreement on a post-2012 successor to the Kyoto Protocol. Carbon finance estimate is preliminary and subject to further revision.

Project Preparation Timetable

Milestone	**Date**
ADB Project Identification	March 2012
Pilot Project ("TV Olympics")	June 2012
Appraisal / Negotiations	January 2013
ADB Board Consideration (Approval)	March 2012
Project Completion	June 2016

Additional Notes on GHG Calculations

12. Figures A2.1, A2.2, and A2.3 (below) present additional information about estimated energy savings, financial benefits, and GHG reductions. As noted above, the EE Appliances project is still in conceptual developmentthe detailed project scope has not been finalized, and projected market penetration rates and GHG reduction estimates are subject to evolution going forward.

Figure A2.1: Sample Cost Benefit Analysis for Energy Efficient TVs

Sample Cost Benefit Analysis

Indicators	21" CRT	22" LED	32" LED
Wattage	100W	25W	40W
Annual Electricity Cost ($)	41	9	15
Annual Savings ($)		32	26
Lifetime Savings ($)		320	260
CO_2 Equivalent Avoided (Metric Tons)		1.08	0.89

Assumptions:

Current electricity cost: 0.2$/kWh
Daily TV usage: 5 hours
Electricity Use Emission Factor = .00068951 MT/kWh
TV Life span = 10 years

Figure A2.2: Estimated Financial Benefits and GHG Reductions (Base Case)

Scenario Analysis Scale Up (100,000 Units)

Indicators	29 Inch CRT	22 Inch LED	32 Inch LED
Annual Savings (Million $)	-0.6	3.2	2.6
Lifetime Savings (10 years in Million $)	-6.4	32	26
CO2 Equivalent Avoided (Metric Tons)	-22,000	108,000	89,000

Figure A2.3: Estimated Financial Benefits and GHG Reductions with Replication and Scale-up to 90% of Philippine Households

Scenario Analysis Scale Up (12.6 million Households)

Indicators	29 Inch CRT	22 Inch LED	32 Inch LED
Annual Savings (Million $)	-0.6	403	328
Lifetime Savings (10 years in Billion $)	-10.2	4.03	3.28
Lifetime Savings (10 years in Billion PhP)	-434	171.3	139.4
CO2 Equivalent Avoided (in Million Metric Tons)	-3,700,000	13,608,000	11,214,000

CLEAN TECHNOLOGY FUND

MARKET TRANSFORMATION THROUGH INTRODUCTION OF ENERGY EFFIICIENT ELECTRIC TRICYCLES PROJECT

Independent Review Letter: June 22, 2012

1. Endorsement

I have reviewed the Asian Development Bank (ADB) draft Report and Recommendation of the President (RRP) dated June 2012 for Republic of the Philippines: Market Transformation through Introduction of Energy Efficient Electric Vehicles Project, which is proposed for Clean Technology Fund (CTF) co-financing. In order to assess the decision-making context for this project, I have also reviewed the original CTF Country Investment Plan (CIP) and the proposed revision to the Philippines CIP (also dated June 2012). The findings from this review – summarized below – are that the proposed changes are consistent with both the criteria for the CTF and the long-term objectives of the original CIP. I conclude that the proposed electric vehicles project is consistent with the CIP Update and meets the CTF eligibility criteria.

2. Review Summary

The proposed revision to the CIP would reallocate the $125 million of CTF funds originally identified for a net metering program using distributed solar power to cover two new projects – one for energy efficient electric vehicles (EEEVs) and the other a reformulated solar energy development project. The major circumstances leading to the change are cited as: promotional rules for renewables (RPS, feed-in tariffs, and net metering) have yet to be finalized and are being focused on large ground-mounted systems; and a successful pilot test of 3-wheel EEEVs was recently conducted with ADB support is ready for scale up. The Government of the Philippines (GoP) supports the funding shift to re-direct $105 million to EEEV project and $20 million to the reformulated solar energy development project centered on rooftop PV applications. This review focusses on the EEEV project and finds that the prospective investment is consistent with the long-term objectives of the original CIP – as noted below – and appropriate for CTF support given their transformational nature and replication and scale-up potential.

Potential for GHG Emissions Savings: The EEEV project has significantly greater GHG emission reduction potential. 100,000 3-wheel EEEVs will deliver 270,000 tCO_2e per year compared to a GHG reduction potential of about 100,000 tCO_2e per year for the original project. In addition, the reformulated solar energy project is expected to achieve approximately 30,000 tCO_2e per year GHG reductions.

Demonstration Potential at Scale: The potential of the EEEV project at scale is considered quite significant given its high likelihood of being replicated and its broader market size both in the Philippines as well as the region. The replicability of the EEEV project is considered high because of the fundamental cost-effectiveness of the EEEVs on a life-cycle basis. The primary market entry barriers (and first-mover risks) are the lack of a mechanism to monetize the life-cycle savings to assist end-users in the initial purchase, which is what this project is designed to do. The scale-up potential is estimated to be more than 20 to 1 for the EEEVs, given the similarities to auto-rickshaws used in other Asian countries including Bangladesh India, Indonesia, and Thailand. However, the analysis assumes a more conservative 10 to 1 scale-up.

Cost-effectiveness: The EEEV project is also more cost-effective with CTF funds than the original. The EEEV project is projected to achieve 0.27 MtCO2e per year of GHG reductions at a CTF cost of $105 million, which is $39/ton-year, declining to $3.89/ton-year with replication and scale-up. The original solar net metering projects was projected to achieve 0.1 MtCO2e per year of GHG reductions at a CTF cost of $125 million, which is $125/ton-year, declining to $12.50/ton-year with replication and scale-up.

Development Impact: The EEEV project will accelerate the growth of new industries in the Philippines by demonstrating new, cost-effective technologies, systems and business models and by reducing first-mover risks for both vehicle purchases and charging stations. Impacts with respect to local environmental benefits, energy security and employment are considered to be much more significant than in the original project. In particular, the solar charging station component, for which CTF grant support is requested, would demonstrate technological viability and help set the stage for more EEEV charging by renewable energy, which will maximize their GHG emission reductions in the longer term.

Implementation Potential: The EEEV project addresses significant market entry barriers and is evaluated as having moderate implementation risk as discussed below.

The project is based on a successful pilot project in the Metro Manila region but will face technical, marketing and systems development challenges. The pilot project involved 20 locally made electric 3-wheelers (e-Trikes) powered by lithium-ion batteries. The proposed project intends to scale-up the program to 100,000 e-Trikes and transform the electric tricycle industry of the Philippines by establishing new electric vehicle supply and support industries and developing new marketing, sales, financing mechanisms. The project outputs appear inclusive and consist of (i) e-Trike procurement including a standard (not less than 3-years) warranty on mechanical and technical performance, (ii) development of battery supply chain and e-Trike service businesses, (iii) establishing 4 pilot projects for solar charging stations, (iv) development of recycling and disposal programs for both batteries and retired gasoline-engine tricycles, and (v) public communication, social mobilization and technology transfer. Interestingly, no new or changed government policy is required to develop this market.

The project investment plan is understandably dominated by the e-Trike purchases. Funds for supporting infrastructure and consulting support appear adequate. Implementation arrangements appear well designed with a Steering Committee consisting of the major government stakeholders, a financial executing agency and technical implementing agencies at the national and local levels. The establishment of an effective project management unit will be critical to the project's success – as noted in the RRP, and the project will benefit from staff and consultants experiences with ADB procurement guidelines.

Rationale for CTF Financing: The new EEEV project proposes to use CTF for covering additional costs associated with first-mover risks. These are related to the introduction of electric vehicles, solar charging stations and new business models for vehicle ownership and operations.

3. Conclusions

In this reviewer's assessment, the proposed EEEV project is clearly eligible for CTF co-financing, and in the broader development context the updated CTF Investment Plan for the Philippines is an appropriate and rational adjustment in response to changing circumstances and new opportunities. Commercial development and deployment of electric vehicles will decrease gasoline consumption and increase energy security in the Philippines thereby saving foreign exchange and protecting consumers against global price fluctuations.

Carbon finance – an increasingly uncertain area - can provide some financial support, but is unlikely to be sufficient to overcome the cost and risk barriers noted above. The CTF is better suited to provide a catalytic role in reducing or eliminating first mover risks and cost barriers for wide scale adoption of efficient electric vehicles at the fleet-scale.

Respectfully submitted,

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CTF PRIVATE SECTOR PROPOSAL

Name of Project or Program	ADB Thailand Private Sector Renewable Energy Program [the Program]
CTF amount requested	Investment – up to US$99.5 million equivalent in loans and guarantees Implementation and supervision budget - US$500,000
Country targeted	Thailand
Indicate if proposal is a Project or Program	Program. The proposed program comprises a pipeline of renewable energy projects being developed by the private sector. The program will catalyze the demonstration, replication, and scale-up of utility scale projects in Thailand.

As part of the development of this program proposal ADB has already begun to engage with clients for the proposed sub-projects. To maintain credibility in the market, ADB could only engage further if there is confirmation that funds would be available to disburse when called by the client. For this reason, per paragraph 34 of the CTF Financing Products, Terms and Review Procedures for Private Sector Operations, dated on March 17, 2010 and approved on March 29, 2010, ADB is requesting the CTF Trust Fund Committee to approve and direct the Trustee to provide ADB with an unconditional letter of commitment for the entire amount of funds required for the Program. Such approval would allow for the upfront transfer of up to the entire amount of the Program from the Trustee to the ADB, based on the confirmation of availability of US $100 million by the Trustee as evidenced in Annex B. The transfer would be subject to (a) approval by the ADB Board of Directors of the investment sub-projects, and (b) submission of a transfer request to the Trustee including the anticipated closing date of the relevant sub-projects.

DETAILED DESCRIPTION OF PROGRAM

Fit with Thailand's Country Investment Plan (CIP) and CIP Update (CIP-U)

This proposal is consistent with Thailand's Country Investment Plan (CIP) which was endorsed by the CTF Trust Fund Committee (TFC) on 2 December 2009 and Thailand's Country Investment Plan Update (CIP-U) which was endorsed by the CTF TFC in March 2012. Thailand's CIP and CIP-U describe the country's GHG emissions profile and indicate that energy efficiency (EE) and renewable energy (RE) are key strategic areas where Clean Technology Fund (CTF) resources can be applied, including through direct private sector initiatives. The Thailand CIP/CIP-U specifically endorses the multilateral development banks to support private sector RE projects.

The Government of Thailand (GoT) is committed to mitigating climate change. Among the developing countries, Thailand has developed a "National Strategy on Climate Change (2008-2012)" approved by the Cabinet in January 2008, and identified greenhouse gas reduction in the energy sector through clean technology implementation as one of its core approaches in its climate change mitigation agenda. Thailand's 11th National Economic and Social Development Plan (NESDP) also aims to build energy security to support the country's path towards sustainable development and low carbon economy[1].

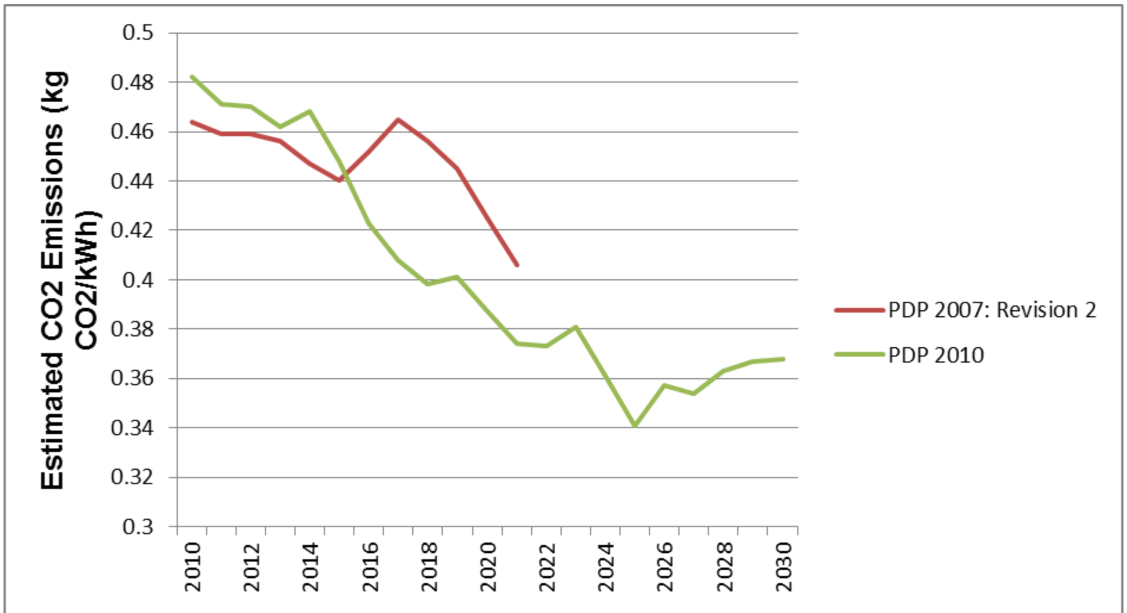
The GoT remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health. The general approach and overall objectives for low-carbon development presented in the CIP and CIP-U remain valid. GoT is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework.

The government is also focused on its policy of having alternative energy as a national agenda through encouraging production and use of indigenous renewable resources. The Electricity Generating Authority of Thailand (EGAT) Power Development Plan 2010 – 2030 (PDP), released in 2010 has been found to be fully consistent with the

[1] GoT targets the energy production sector to reduce CO_2 emissions intensity to 0.42 kg CO_2/kWh by the end of the 11th NESDP (2012-2016).

earlier RE Development Plan covering the 2008 to 2022 planning period. The PDP calls for electricity supplies to be progressively decarbonized, requiring the continued addition of clean energy to the generation mix, complemented by conservation and efficiency gains. The goal of decarbonization requires that all future fossil electric power generation capacity additions be completely offset by electricity produced through the utilization zero-carbon electric power generation methods, coupled to an additional 25% decrease in GHG intensity. This decarbonisation objective requires the effective neutralization of GHG emissions from approximately 12,000 megawatts (MW) of existing and future coal-fired generating plants by 2030, as shown in Figure 1. To this end, the Ministry of Energy (MOE) through the Department of Alternative Energy Development and Efficiency (DEDE) is preparing an updated RE Development Plan with a revised target for alternative energy use to increase to 25 % of total energy consumption in the year 2022 from the previous target of 20%.

Figure 1. GHG Intensity for Electricity Supply.



Source: EGAT, Thailand Power Development Plan 2010 - 2030, Table 10.1

In a recent statement, the Thai Council of Ministers approved as policy, the utilization of sustainable energy sources to resolve the energy requirements of the country with a target of replacing 25% of the energy generated through the use of fossil fuels with clean energy within the next decade.[2] The GoT has further identified RE industries, among others, as a "new industry" sector to foster the creation of income from domestic demand and increased employment.

As such, CTF support will have the transformational impact of scaling up utility-scale solar, wind, and waste-to-energy (WTE) projects in the country, which would substantially curb Thailand's emission growth curve. Private sector RE projects will establish additional benchmarks for cost and performance, which will facilitate institutional and policy reforms, and promote economies of scale that could ultimately make the cost of RE-based power development more competitive with fossil-fuel based power sources.

Overview of the ADB Renewable Energy Program

The program represents an initiative of the ADB, as implemented in part by the Private Sector Operations Department (PSOD), towards accelerating the participation and scale-up of investments by the private sector, with

[2] Policy Statement delivered by Prime Minister Yingluck Shinawatra to the National Assembly on 23 August 2011. Accessed on 10 October 2011 from http://www.mfa.go.th/internet/document/govPolicyEng.pdf

particular focus on the development of utility-scale solar, wind, and WTE power generation projects. Specifically, the program targets the utilization of CTF funds along with ADB financing support to implement candidate projects located in various provinces within the country being considered by PSOD for further development. The completion of these projects has been expected to provide Thailand with a total aggregate capacity addition amounting to approximately 520 MW while diversifying the primary energy mix and reducing GHG emissions.

Financial support for most of the individual projects included in the program will be provided on a non-recourse project finance basis with revenue streams generated from the supply of RE electricity to EGAT and the Provincial Electricity Authority (PEA) under standard power purchase agreements (PPAs) with additional regulatory supports, such as feed-in tariffs ("adders"), provided under the Small Power Producers (SPP) and Very Small Power Producers (VSPP) Program.

Under the ADB initiative, PSOD has recently closed financing on two utility-scale solar projects with additional financial support in the form of grant resources from other fund sources and commenced with the construction of the facility. Additional private sector investments on projects of similar nature are currently under consideration by PSOD, with more prospective projects in the pipeline.

While there has been increased interest in entering the RE market, private developers implementing these "pioneer" projects continue to face additional costs associated with state-of-the-art RE technologies and systems and first-mover risk associated with deployment of these RE systems in Thailand. Regulatory support, though significant, has not been sufficient to mobilize capital financing at the scale necessary to meet RE electricity objectives as proposed by the GoT (as discussed in the original CIP and the CIP-U). In order to overcome these barriers, ADB provided grant resources to assist the project owners in project development and financing enhancing overall financial profile of these projects. Additional concessional funds are being sought from CTF to support a much larger investment pipeline and accelerate the growth of the sector to a sustainable scale.

In a wider scope, the program seeks to establish a track record of completed projects and investments, with high replication potentials and demonstrable developmental effects, to facilitate private sector participation and further catalyze market transformation within a realistic economic and technical context.

Thailand's GHG emissions profile

Thailand has been one of the fastest growing economies in Asia during the last decade, with GDP averaging 7% annually, even allowing for the economic slowdown experienced from 2007 to 2009. The growth in economic activity from 1990 to 2007 correlates to a higher demand for energy, met primarily by increasing energy production and electric power generation capacity, resulting to a corresponding growth in total emissions, per capita emissions, and per capita energy use (Figure 2).

The energy demand has been estimated to increase at an average rate of 4.2% annually from 146,182 gigawatt-hours (GWh) in 2009 to 347,947 GWh in 2030. Energy sector related emissions based on the 2000 National GHG Inventory in Thailand reached 159.38 million tons of CO_2 equivalent accounting for 69.6% of the total Thai national CO_2 emissions, with more than 40% of the energy sector related emissions attributed to activities related to energy production and electric power generation.[3]

In addition, studies conducted in 2010 estimated the annual rate of CO_2 emissions from the combustion of fossil fuels in thermal power plants to be 172.04 kilotons of CO_2 per year, with a thermal plant producing 0.31 to 1.03 kilograms of CO_2 for every kilowatt-hour of electricity generated depending on the type of fuel used.[4]

RE Market Description

Thailand is endowed with abundant renewable energy resources—biomass/biogas, small-scale hydropower, solar, and WTE —with estimated total potential of 57,000 MW. Less than 3% of this potential has been developed. As

[3] Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment, 2010. *Thailand: Second National Communication under the United Nations Framework Convention on Climate Change*. Bangkok, Thailand.

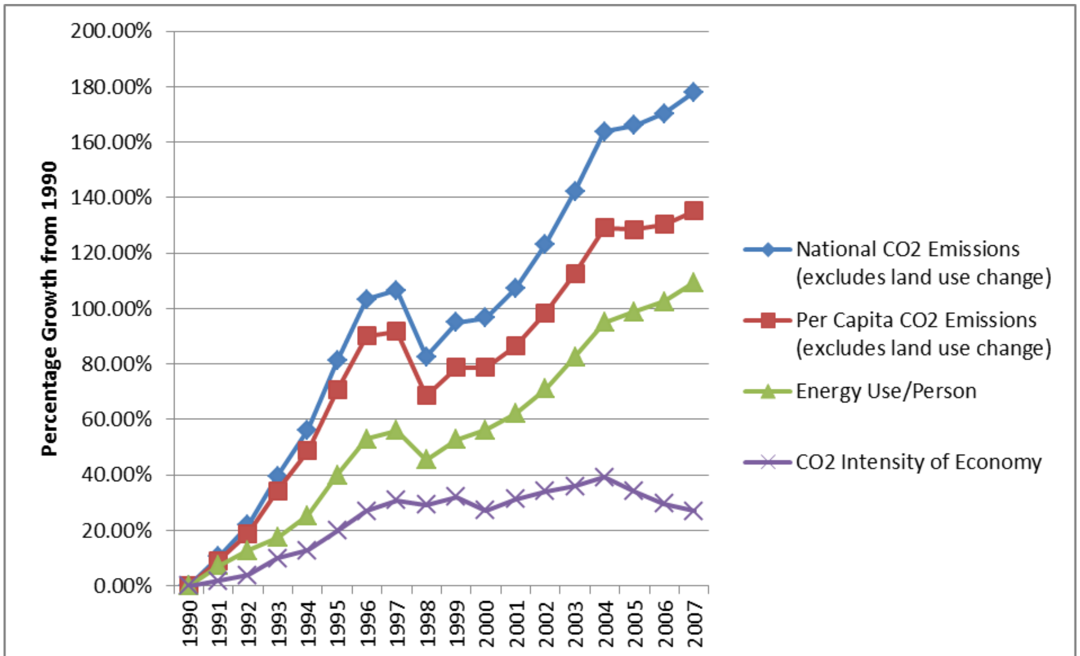
[4] N. Parkpoom. 2010. *Generation Planning in the Context of Carbon Dioxide Emission and Associated Risk in the Thailand Power System*. Bangkok, Thailand. http://www.aesieap0910.org/upload/File/PDF/4-Technical%20Sessions/TS07/TS0703/TS0703_FP.pdf

of 2010, total alternative energy consumption was estimated at 7,148 kilotons oil equivalent, of which 62% was in the form of heat, 22% in the form of natural gas for transport, 6.6% biodiesel, and 4.6% ethanol; only 4.3% was in the form of electricity.[5]

Solar potential accounts for the vast majority of RE resources, with aggregate estimated generation potential of more than 50,000 MW.[6] Wind potential is estimated at 1,600 MW. WTE is estimated at about 400 MW. In 2009, GoT launched its 15-year Renewable Energy Development Plan and targets to increase the share of RE from 6.4% to 20% in 2022. Specifically, it originally targets a 500 MW capacity to be supplied by solar power. As of July 2011, the installed power generation capacity in Thailand was 31,447 MW with VSPP's contributing less than 1% of the total.[7]

Thailand's plentiful solar resources make it an ideal location for solar photovoltaic (PV) energy installations. Solar development has been limited to stand-alone decentralized solar PV systems, with utility scale installations still in the early development stage. Wind and WTE are in early stages of exploitation. Several projects are under development, but none have been completed. Despite the favourable presence of feed-in tariffs ("adders"), the RE sector remains underdeveloped (with the exception of first-generation renewable fuels). As discussed in the original CIP and the CIPU, the adders have not been sufficient to mobilize financing at the scale necessary to meet the renewable electricity objectives.

Figure 2. Thailand's GHG Emission Profile



Source: Climate Analysis Indicators Tool (CAIT) Version 8.0. (Washington, DC: World Resources Institute, 2011).

Sector and project level barriers

While there is great potential, the renewable electricity sub-sector is still in its nascent development stage. Challenges to large-scale development include lack of long-term financing, higher upfront capital costs, and higher back-ended risk premium for new technology deployment.

[5] Department of Alternative Energy Development and Efficiency. 2010.*Thailand Energy Statistics (Preliminary) 2010*. p.10.

[6] Department of Alternative Energy Development and Efficiency. 2008. *Fifteen-Year Alternative Energy Plan of Thailand*.

[7] Source: Energy Planning and Policy Office (EPPO). http://www.eppo.go.th/info/stat/T05_01_01.ppt

ADB's long-term local currency loan combined with upfront monetization of expected Certified Emission Reductions (CERs) and CTF support will help to provide sufficient amortization profile and tenor needed in order to reach financial close and achieve economic and financial viability of RE generation plants.

Thailand's increasing demand for electricity, abundant RE resources, available land area for solar and wind installations, favorable feed-in tariffs ("tariff adders"), and grid connection readiness encourage RE power development investments in the country. The regulatory and financial support for RE projects are expected to sustain projects in the long term but, in the short and middle-term, there is still need for concessional funding and risk mitigation mechanisms to make sure that first-mover projects move from planning to commissioning and operation phase. The limited experience of grid-connected, utility-scale RE power projects in Thailand and the still high perceived risk of these resources and technologies necessitate CTF support.

Summary of the Program and use of CTF funds

The Program falls under the GoT's Alternative Energy Development Plan and will support GoT's objectives for alternative energy development and climate change mitigation. The Program will help clean energy projects move towards implementation stage, and will have a catalytic effect with respect to mobilizing additional development and expansion in the solar, wind, and WTE sub-sectors. CTF funds may be structured as loans or guarantees alongside ADB. ADB would ensure that all projects also comprise funding from at least one commercial bank in order to achieve a catalytic effect over the medium term as local banks get more familiar assessing credit risk of RE projects.

The Investment Component

The Program comprises solar, wind, and WTE projects across several provinces in Thailand, with aggregate capacity of up to 520 MW. . Most of the projects will be financed on a project finance basis. Individual projects may benefit from the upfront financing of CERs by ADB's Carbon Market Initiative (CMI). The CMI team will work on the Clean Development Mechanism (CDM) component with Sponsors, in parallel with the ADB financial assistance discussions.

Market Transformation

The CTF supported investments will help Thailand hasten and expand private sector investment in RE infrastructure to facilitate the attainment of targets contained in the GoT's Alternative Energy Development Plan.

By demonstrating the commercial viability of private sector utility-scale energy generation projects, the Program with assistance from CTF has been envisaged to bridge the gap between perceived and actual risks associated with investments in a relatively new industry, serving as a catalyst towards encouraging the participation of other private sector developers, investors, and financial institutions in subsequent power development projects utilizing solar, wind, and WTE technologies.

The Program presents a further transformational role by enhancing sectoral capacity in implementing RE and WTE projects by establishing replicable business models and performance benchmarks within the technical and economic realities of these RE technologies in the Thai context. These models and metrics may also provide a suitable framework for other ADB developing member countries (DMCs) in the development and conduct of RE based power projects.

As mentioned above, ADB would ensure that at least one commercial bank also participates in the financing of each project (albeit with shorter debt tenors) in order to achieve a catalytic effect. As such, the support of CTF and the potential demonstrable effects triggered by implementing the Program offer added assurance for local financial institutions to lend to future RE projects, which in turn will sustainably accelerate the growth of the sector and subsequently serve as a mechanism to achieve GoT's long-term development objectives.

Terms of the CTF funds

The program will cover multiple RE projects which face similar development and implementation barriers as discussed above and in the original CIP and CIP-U. Detailed financing plans will vary from project to project.

FIT WITH INVESTMENT CRITERIA

i) Potential GHG Emissions Savings:

Emissions reductions are estimated as follows:

Estimated GHG Reductions [a]

Total GHG reductions directly supported by CTF		*Total GHG Reductions with potential replication and scale up*	
Wind power projects	643,860 tons / year CO_2e	1250 MW [b] wind at 30% output	2,299,500 tons / year CO_2e
Waste-to-energy projects	245,280 tons / year CO_2e	350 MW [c] waste-to-energy at 80% output	1,716,960 tons / year CO_2e
Solar power projects	183,960 tons / year CO_2e	5000 MW [d] solar at 25% output	7,665,000 tons / year CO_2e
Total	1,073,100 tons / year CO_2e	Total	11,681,460 tons / year CO_2e

[a] GHG reductions assume that RE displaces fossil power in the grid at 0.7 tons CO_2e/MWh. Using an average grid emissions factor of 0.55 tons CO_2e/MWh, the total direct emissions reductions would be about 843,150 tons CO_2e/year.
[b] Assumes replication and scale-up potential is limited to total of 1600 MW potential identified in the AEDP (see Table 8 of original CIP)
[c] Assumes replication and scale-up potential is limited to total of 400 MW potential identified in the AEDP (see Table 8 of original CIP)
[d] Assumes replication and scale-up potential is 10% of total of 50,000 MW potential identified in the AEDP (see Table 8 of original CIP)

ii) Cost-Effectiveness:

Based on the table above, cost effectiveness assuming $100 million in CTF cofinancing:

Cost Effectiveness based on total GHG reductions directly supported by CTF	*Cost effectiveness based on Total GHG Reductions with potential replication and scale up*
CTF $93 ton / year CO_2e ~ CTF $4.66 / ton assuming 20 year project lifetime	CTF $8.56 ton / year CO_2e ~ CTF $0.43 / ton assuming 20 year project lifetimes

iii) Demonstration Potential at Scale:

The Program targets the acceleration and scale-up of investments by the private sector, with particular focus on the development of utility-scale solar, wind, and WTE power generation projects, through the use of CTF funds along with ADB financing support. The completion of individual projects under the Program will have high demonstration impact by developing a replicable model for national and regional independent SPPs and VSPPs which generate electricity from RE resources and by establishing a track record of completed projects that will reduce the perception of risk, resulting in a significantly lower cost of capital and in turn enable future projects to achieve financial close and sustainability through domestic regulatory support (feed-in tariffs/adders) alone.

With the reduction of financial and market risks, the Program anticipates the further participation of private sector project developers and additional end users at scale.

Based on initial estimates for the Program, the installation and operation of an additional renewable generating capacity amounting to approximately 520MW will result in the avoided GHG emissions estimated at 1 million tons of CO_2 equivalent per year at the end of a five-year period commencing of the date of operation. Given a 10:1 replication potential, the Program further estimates the potential avoided GHG emissions to amount to about 11 million tons of CO_2 equivalent per year.

iv) Development Impact:

The primary development impact from the implementation of the Program includes the diversification of Thailand's energy mix through the addition of RE-based generating capacity and demonstration of the viability of utility-scale private sector RE power generation projects. The completion of these projects will greatly assist in propelling the country to achieve the target of having 20.3% of the primary commercial energy supply coming from alternative and renewable resources by 2022, which ensures the access of the Thai people to secure, reliable, and sustainable sources of electricity, reduced reliance on fossil fuels, and a lower exposure to commodity and exchange rate risk. Specifically, the demonstrable outcomes of the Program are the increased generation of electricity supplied by the use of solar, wind, and WTE resources through the installation, commissioning and operation of up to 520 MW of RE power generation facilities and a reduction in GHG emissions. Other specific performance indicators to quantify developmental impacts shall be finalized on a project-by-project basis.

The Program will enable the development and completion of private sector RE projects that would otherwise not be implemented by reducing financial and market risks associated with “pioneer” projects by establishment of a track record of completed projects and investments that in turn would further capacitate the private sector and catalyze market transformation. As a result, the anticipated increase in participation by the private sector through project development and scale-up of investments should initiate direct and indirect prospects for the creation of employment opportunities.

The environmental co-benefits of improved air quality due to reduced emissions of local pollutants (NOx, SO_2, particulate matter, mercury and other heavy metals) from avoided coal-fired power plants, minimal waste, reduced noise, and a lower carbon footprint provide healthier and more sustainable living condition for the people of Thailand in consonance with the goals of the 11th National Economic and Social Development Plan. Moreover, the Program also supports the GoT’s long-term objective, as contained in the CIP and CIP-U, to reallocate CTF resources to the private sector.

The implementation of the Program will be expected to have a direct effect on local poverty reduction within the vicinity of individual projects. During construction and eventual operation of electricity generation facilities, the employment opportunities for local skilled/unskilled labor should increase the level of income for men and women who qualify for employment. In turn, the added income will increase consumption of goods/services and contribute to the economic activities within the project area. In addition, the Program will be expected to indirectly increase the economic well-being in individual project areas by providing a clean and reliable source of electricity that will serve as an investment multiplier in the production of goods and delivery of services. Further discussions on specific performance indicators for measuring direct and indirect poverty reduction impacts will be finalized on a project-by-project basis.

On a wider scale, the high level of replication potential and the scalability of the Program indicate a good probability of extending developmental effects and the spillover of environmental and economic benefits to countries within the Greater Mekong Subregion.

v) Implementation Potential:

As of January 2012, ADB has closed financing for two utility-scale solar projects which are now under construction, and additional projects are presently under consideration. Individual RE projects will enter into standard PPAs with EGAT or PEA, fixed-price turnkey Engineering, Procurement and Construction (EPC) arrangements for plant installations, and interconnection arrangements with EGAT or PEA. The operation and maintenance of the individual projects will be undertaken by the sponsors or qualified operators. These activities are significantly less complex than conventional power plants and are not expected to present major technical challenges.

The CIP-U supports the acceleration and expansion of private sector investment in clean energy infrastructure in the country. The Program will play a significant role in achieving the updated CTF targets for Thailand. The ADB and CTF assistance will play a crucial role in helping individual projects to obtain financial close and appropriate long-term financing.

vi) Additional Costs & Risk Premium:

As discussed above, the RE projects to be supported by the Program entail additional costs and risks. CTF funding will be structured to achieve the envisioned market transformations with minimum concessionality appropriate to the needs of the individual projects.

vii) Financial Sustainability

The viability of individual projects comprising the Program will be ensured primarily through the off-take pricing arrangements in the PPAs negotiated for each project, with additional revenues from regulatory support (supplemental feed-in tariffs) provided through the SPP and VSPP Program of the GoT and from CERs from carbon trading in the long-term.

CTF cofinancing will be structured to enhance the financial viability of the project by reducing the weighted average cost of capital.

viii) Effective Utilization of Concessional Finance

The total cost of projects to be supported by the Program is estimated to be $1 billion. The demonstration impact is expected to facilitate replication and scale-up via other solar, wind, and WTE power projects. CTF cofinancing for individual projects will be priced in accordance with minimum concessionality principles.

ix) Mitigation of Market Distortions

The Program will "crowd in" commercial investment and will not distort the market, as there is still limited private sector investment in the RE market at present. ADB will ensure that at least one commercial bank participates in the financing of each project (albeit with shorter debt tenors) in order to achieve a catalytic effect. ADB's and CTF's longer tenor will reduce risks for all financing parties because annual debt service payments are reduced and debt service coverage improved. Lower risk for debt service will play a crucial role in mobilizing commercial bank funding for RE projects with intermittent revenue generation, such as solar and wind power.

The GoT remains committed towards continuing support to RE development via public sector financing through EGAT and PEA.

x) Risks

The major implementation risks and proposed mitigants for the Program are as follows.

(i) Solar radiation and wind variability risk. Solar panels should be installed in a location with good and reliable sunlight since the intensity of solar irradiance impacts the capacity factor. Solar plant design will be based on insolation data available from GoT agencies, US NASA, METEONORM, and other sources. Wind farm design will be based on at least 1 year of site-specific wind mapping data, consistent with industry best practice. Individual projects with be subject to due diligence on renewable resource availability, by qualified technical advisors.

(ii) Cost of installation / technology risk. Key challenges for solar power generation projects are managing high upfront costs for the solar PV panels and ensuring the panels' efficiency over the long-term in converting solar radiation to electricity in the specific climatic conditions of the project site. Unlike conventional energy projects where ongoing fuel expenses are a key driver of commercial viability, solar power projects' viability is primarily a function of capital, financing costs and variability of power generation. Therefore, choosing the right solar PV technology is important in order to strike a balance between cost and efficiency. For individual projects, qualified technical advisor will review and confirm the reliability and durability of the selected technology, the adequacy of the panel supplier's performance warranties, the project costs, as well as construction and interconnection arrangements. Wind power technology is subject to lesser perceived risks, as the available technologies for the wind farms under consideration are well-established, although the intermittency of power generation has to be carefully assessed. Wind power projects and WTE projects will be subject to similar technical advisor review and assessment as required.

(iii) Off-take risk. The electricity generated from each project will be purchased by EGAT or PEA, so the ability of both to fulfil its obligations under the PPAs will be carefully reviewed. EGAT and PEA creditworthiness, GoT support, the reasonableness of the PPAs, and the fundamental demand-supply in the power market will be examined during the due diligence.

(iv) Legal and regulatory risk. The legal and regulatory environment pertaining to the SPP and VSPP programs and to the power market in general in Thailand may change over the course of the Program. Legal due diligence will include a review of the regulatory framework for the energy sector and include an analysis of the risk of change in law during the term of the financing. Legal due diligence will also include a review of all major project documents, including the PPAs, supply contract and all interconnection arrangements.

xi) Performance Indicators

The performance indicators outlined below are derived from the CTF Results Measurement Framework and Thailand's CIP and CIP-U. These indicators will be tracked at least annually.

1) CTF Related Performance Indicators

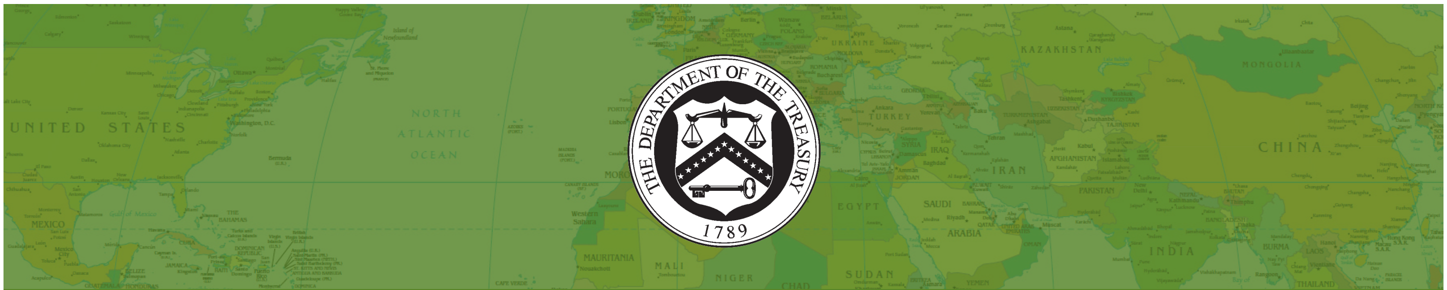
Program Performance Indicator	Baseline	Anticipated Results by December 2017 (5 years)
GHG emissions avoided by the Program (including replication and scale up)	N/A	1 $MtCO_2e$/year at the end of the five-year period 2012 to 2017 as direct result of ADB/CTF resources[8]
CTF financial leverage for the Program	N/A	
CTF cost effectiveness for the Program	N/A	Replication and scale up achieves 5 $MtCO_2e$/year at the end of the 15-year operation period through 2027. Total emissions for the 20 years of the Program is estimated at 85 $MtCO_2e$[9]

[8] This estimate assumes that 520 MW of capacity is operating with emissions reductions as estimated in the table above.

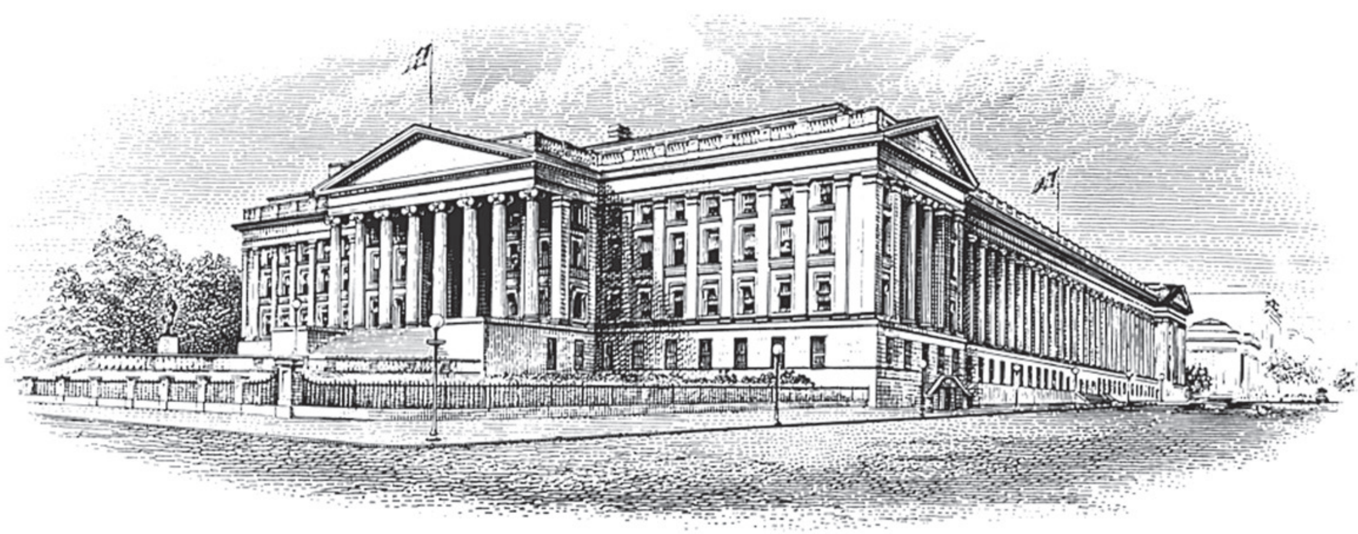
		Direct reductions => CTF$5 / ton CO_2e decreasing to CTF$1.18 / ton CO_2e Or 0.2 t CO_2e ton CO_2e /CTF$ invested, increasing to 0.85 ton CO_2e /CTF$ invested with replication and scale up

NOTE: Other performance targets and indicators quantifying developmental impacts will be included in the formulation of a Project Design and Monitoring Framework for each individual project to be supported under this program.

[9] This assumes that RE capacity is built out with GHG reductions of 1 Mt/y for years 1 – 5 [5 million tons total], 5 Mt/y for years 6 – 15 [50 million tons], then 6 Mt/y for years 16-20 [30 million tons]; total is 85 million tons over 20 years.



U.S. DEPARTMENT OF THE TREASURY
INTERNATIONAL PROGRAMS



JUSTIFICATION FOR APPROPRIATIONS
FY 2013 BUDGET REQUEST

TABLE OF CONTENTS

Treasury International Programs
Justification for Appropriations
FY 2013 Budget Request

DEPARTMENT OF THE TREASURY
WASHINGTON, DC

Dear Member:

On behalf of President Obama, it is my pleasure to submit the Congressional Presentation Document for the Department of the Treasury's International Programs for Fiscal Year 2013.

Treasury's FY 2013 request follows on Congress's landmark actions in FY 2012 in support of the multilateral development banks (MDBs). For FY 2013, our request is for a continuation of funding for our multi-year commitments to the MDBs, as well as to the Food Security and Environment trust funds at the World Bank. Congress provided funding toward these commitments last year. In addition to funding these commitments, we are seeking funding in support of anticipated bilateral debt forgiveness obligations and for the ninth replenishment of the International Fund for Agricultural Development (IFAD). While the IFAD request reflects a new replenishment, we are not seeking an increase in funding as our pledge maintained funding at current levels.

Investments in multilateral institutions remain a cost-effective way to promote our national security, support future economic growth, and address key global challenges. Our continued support also will preserve U.S. leadership at the MDBs – leadership that has greatly benefited both the MDBs and U.S. taxpayers for the last 60 years.

In this past year, we sought the support of the MDBs in leveraging economic reform in the Middle East and North Africa in the wake of the Arab Spring. The successful transformation of this region is critical to our national security, and will depend on countries' ability to generate broad-based growth and jobs.

As we know from the experience of the transition in Eastern Europe and the former Soviet Union, fundamental change on this scale requires substantial resources and sustained and intensive engagement. The MDBs are well-positioned to provide the investments in soft and hard infrastructure that underpin growth as well as the long term strategic engagement needed to support the transition to democratic governance and a market economy. As I have noted previously with Secretary Panetta in a joint letter to Congress, "the MDBs are essential partners with the United States as we confront and contain emerging threats."

In addition to supporting our strategic interests and national security priorities, we look to the MDBs to drive domestic growth by developing the open and transparent market economies that will become the next generation of U.S. trading partners, supporting U.S. exports and jobs. The MDBs complement our bilateral assistance programs by leveraging capital to mobilize financing for large-scale infrastructure and other private investment. For example, in countries such as Turkey, Colombia, and Indonesia that have benefited from MDB investments, development has fueled rapidly increasing demand for U.S. products, and our exports to these economies have grown by more than 200 percent over the last ten years.

The MDBs, as well as specialized trust funds such as the Global Agriculture and Food Security Program (GAFSP), are also uniquely designed to help address critical global priorities such as food insecurity, energy insecurity, and environmental degradation. These complex challenges, which know no geographic boundaries, were put into stark relief this year as millions suffered in famine ravished parts of Africa. This crisis underscored the need to invest in sustainable food security and adaptations of agriculture to changing weather patterns. This crisis also highlighted the instability that the lack of such investments can yield. GAFSP, in its first two years of operation, has worked to address the global challenge of food insecurity by providing nearly $500 million to poor countries that are demonstrating strong leadership and results in transforming their agriculture sectors. The MDBs contributed to the initial, immediate relief effort in the Horn of Africa, with the World Bank approving $250 million from its new Crisis Response Window last September. Equally important, the World Bank, the African Development Bank, and IFAD are making crucial investments in agricultural productivity to address some of the underlying causes of this humanitarian catastrophe.

While these institutions actively promote critical U.S objectives, our commitments represent only a fraction of the resources that they bring to bear. For example, at the World Bank, burden-sharing with other shareholders coupled with an increase in the Bank's ability to borrow from markets allows each dollar of U.S. capital to support additional Bank lending of $25. Over time, this effect is compounded, as demonstrated by a capital increase contribution of $420 million made under the Reagan Administration that helped support $325 billion in lending over the subsequent two decades. In FY 2013 alone, financial commitments from the MDBs are expected to approach $80 billion.

For these reasons, I believe that the investments outlined in this document continue to represent an outstanding value for money. At a time when we must continue to seek the best returns for taxpayer resources, these commitments are an extremely sound investment in national security, future economic growth, and the preservation of global public goods.

I look forward to working with you on this important request.

Sincerely,

Timothy F. Geithner

Timothy F. Geithner

"These institutions [the World Bank and Asian Development Bank] are the largest donors to Afghanistan after the United States, and they have been critical to the success of important projects, such as the Ring Road and the Uzbek-Afghan railroad. We need these critical enabling institutions, and further U.S. support for them will ensure that they are able to continue to contribute as significantly as they have in the past."

– General David H. Petraeus
Commander, International Security Assistance Force and Commander U.S. Forces Afghanistan
Statement Before Senate Committee on Armed Services, March 15, 2011

"As we carefully shift our major combat engagements towards long term partnership and cooperation efforts across the whole of government, the multilateral development banks can play an even greater role helping to restore stability, prosperity, rule of law and good order to these nations."

– Rear Admiral Michelle Howard
Testimony before the House Financial Services Subcommittee on
International Monetary Policy and Trade, September 21, 2011

"As U.S. Forces leave Iraq and Afghanistan, we need international institutions to provide front-line States with sufficient support for lasting economic development. In fact, one of the most important lessons of the wars in Iraq and Afghanistan is that military success is not sufficient to win peace. Broad-based economic development, institution building, and provision of basic services to the people are essential for long-term success."

– Secretary of Defense, Leon E. Panetta
and Secretary of the Treasury Timothy F. Geithner
Joint Letter to Congressional Leaders, September 21, 2011

"American businesses understand these institutions' vital role in fostering prosperity. MDB loans and expertise help developing countries become reliable trading partners and open up their markets for U.S. goods, and over half of all U.S. exports now go to developing countries that have received assistance from the MDBs. These loans come with conditions, such as strengthening transparency, promoting good governance, and improving the investment climate."

–Business Roundtable, Coalition for Employment through Exports,
Emergency Committee for American Trade, National Foreign Trade Council, U.S. Council for
International Business and U.S. Chamber of Commerce
Letter to Members of the United States Congress, June 7, 2011

"They [the multilateral development banks] provide opportunities for developing nations to build economic infrastructure and capacity, create private sector growth and supply chains, and reform custom regulations and barriers for economic growth, all of which raise the standard of living in these nations and create new markets and consumers for U.S. companies."

- James T. Kolbe, Former Member of Congress, Senior Transatlantic Fellow,
German Marshall Fund of the United States
Testimony before the House Financial Services Subcommittee on
International Monetary Policy and Trade, July 27, 2011

"With downside risks still threatening the global economic outlook, MDB assistance to poor and emerging economies also means preserving and advancing the interests of U.S. business and American workers of companies that trade and invest in these countries."

Henry Kissinger, Lee Hamilton, Brent Scowcroft, William Cohen,
Charlene Barshefsky and other members of the Bretton Woods Committee
Joint Letter to Congressional Leaders, October 4, 2011

EXECUTIVE SUMMARY

Economic Growth, National Security and Poverty Reduction: Multilateral Development Banks

The FY 2013 request for the multilateral development banks (MDBs) is comprised almost entirely of annual commitments negotiated in previous years. This includes a continuation of funding for the General Capital Increases (GCIs) at the International Bank for Reconstruction and Development (IBRD), the Inter-American Development Bank (IDB), the Asian Development Bank (AsDB), and the African Development Bank (AfDB). The only new commitment, for the ninth replenishment of the International Fund for Agricultural Development (IFAD), is a flat line of our current contribution level. Meeting these commitments will secure our leadership at these institutions, enabling them to continue their vital roles in boosting economic growth in export markets for American businesses and strengthening our national security.

Our MDB request includes a first year payment of $70 million for the Selective Capital Increase (SCI) at the IBRD. Treasury requested and obtained authorization to subscribe to the SCI in FY 2012. Proceeding with the first year payment of $70 million will enable us to begin to meet our obligations under the World Bank's "voice and vote" reform, which was agreed by World Bank shareholders in 2010. Meeting this obligation is necessary to prevent a drop in U.S. shareholding below the 15 percent threshold. This threshold is critical, as it enables the United States to block amendments to the World Bank's Articles of Agreement, which govern critical issues such as the role of the World Bank President, membership, and the role of the Board of Executive Directors. We are the only member with this veto power.

Treasury's request also includes funding for the special MDB facilities that support the world's poorest countries: the International Development Association (IDA), housed at the World Bank; the Asian Development Fund (AsDF), based at the Asian Development Bank; and the African Development Fund (AfDF), which is part of the African Development Bank Group. These facilities are the most important sources of financing of development needs and priorities in many of the world's most fragile states.

In addition to the annual commitments for FY 2013, the request includes funds to pay for arrears associated with our general capital increase commitment at the AsDB. These arrears were generated by the 0.2 percent across the board rescission in FY 2011, and their payment is necessary to prevent a permanent loss of U.S. shareholding. A loss would end the U.S. status as a co-equal shareholder with Japan and forfeit influence at a time when other shareholders have expressed interest in purchasing any shares we relinquish.

Food Security

The FY 2013 request includes $134 million for a contribution to the Global Agriculture and Food Security Program (GAFSP). This global fund partners with developing countries to enable small farmers to grow more and earn more. It is one of the most effective ways of working to end global hunger, because it rewards developing countries that are contributing their own resources and demonstrating leadership to improve agriculture. To date, the fund has allocated nearly $500 million based on a competitive application process. Through FY 2012, the United States (through funds from the Department of Treasury and the Department of State) will have contributed $341 million, or nearly 72 percent of the U.S. pledge. The FY 2013 request will bring the total U.S. contribution to the $475 million pledged by the United States in 2010.

In addition to GAFSP, the food security budget includes $30 million for first year of the ninth replenishment of the International Fund for Agricultural Development (IFAD), the only global development finance institution solely dedicated to improving food security for the rural poor. The $30 million is equivalent to our annual commitment under the previous replenishment (which was made in 2008).

Environment and Clean Energy

The FY 2013 request includes $364.4 million for the Global Environment Facility (GEF), the Clean Technology Fund (CTF), and three Strategic Climate Funds (SCF): the Pilot Program for Climate Resilience (PPCR), the Forest Investment Program (FIP) and Program for Scaling up Renewable Energy in Low-Income Countries (SREP). FY 2013 funding for Treasury's multilateral environment and clean energy programs will directly result in action and investments by other countries to reduce their pollution, curbing the damage that they inflict on our shared spaces, such as the atmosphere and the oceans. Such global action mitigates threats to our domestic environment that increasingly originate beyond our borders, enhances our national security, and provides opportunities for U.S. businesses, particularly in clean energy.

Addressing global environmental challenges now will significantly reduce what we would otherwise have to pay later. By acting now, we avoid paying even higher costs in the future for natural disasters, instability, and conflict emanating from environmental degradation. These programs also provide access to modern forms of energy, critical for helping the world's poorest countries advance out of poverty. Moreover, these programs offer cost-effective returns on our investments. The U.S. contribution leverages significant funding from other donors, developing country governments, development institutions, and the private sector. Each U.S. dollar contributed to the GEF, CTF, and SCF leverages four to five additional dollars from other donors and six to 10 times that from other funding sources (including private sector).

Debt Relief

The FY 2013 budget includes $250 million for the debt restructuring account to meet potential U.S. bilateral debt relief commitments under the Heavily Indebted Poor Country (HIPC) framework. Specifically, Treasury anticipates that Sudan could become eligible and reach HIPC decision point in FY 2013. The $250 million request reflects the estimated budget cost of forgiving 100 percent of Sudan's outstanding debt to the United States (currently $2.4 billion). Prior to obligating funds for HIPC treatment of Sudan's debt, the U.S. will require progress on various fronts that we have identified as pre-conditions for any U.S. support for debt relief. These pre-conditions include fulfillment of the agreement reached by the governments of Sudan and South Sudan under the Comprehensive

Peace Agreement. The obligation of funds will also depend on Sudan's ability to meet current legislative requirements tied to HIPC debt relief, including determinations on human rights and state sponsorship of terrorism.

Given the uncertainty of the situation in Sudan at the time of this submission, Treasury is also requesting transfer authority that would enable the Department to repurpose these funds to help meet other multilateral assistance commitments in the event that Sudan is not likely to reach the HIPC decision point by the end of FY 2014.

Although we are not seeking funds for FY 2013 in support of our Multilateral Debt Relief Initiative (MDRI) commitments, we do continue to anticipate the need in future years for a combination of appropriated funds and early encashment credits to meet our obligations during the IDA16 and AfDF12 replenishment periods.

Technical Assistance

The FY 2013 request includes $25.4 million for Treasury's Office of Technical Assistance (OTA). This is equal to the FY 2012 base funding level, but the FY 2013 request does not include a request for Overseas Contingency Operations (OCO) funding for OTA. The FY 2013 request would enable OTA to maintain its current footprint of technical assistance programs globally. OTA helps finance ministries and central banks of developing countries strengthen their capacity to manage public finances and mobilize domestic resources. OTA also helps countries develop anti-money laundering regimes and fight corruption.

Summary of Appropriations and Requests
Treasury International Programs
FY2011-FY2013 (in millions of $)

	FY 2011 Approp.	FY 2012 Approp.	FY 2013 Request	FY 2013 Request Full Numbers
Economic Growth, National Security and Poverty Reduction (MDBs)				
International Development Association (IDA)	1,232.5	1,325.0	1,358.5	1,358,500,000
Int'l Bank for Reconstruction and Development (IBRD)	0.0	117.4	187.0	186,956,866
Inter-American Development Bank (IDB and FSO)	0.0	75.0	102.0	102,020,448
Multilateral Investment Fund (MIF)	25.0	25.0	0.0	0
Inter-American Investment Corporation (IIC)	21.0	4.7	0.0	0
Asian Development Bank (AsDB)	106.4	106.6	106.8	106,798,868
Asian Development Fund (AsDF)	0.0	100.0	115.3	115,250,000
African Development Bank (AfDB)	0.0	32.4	32.4	32,417,720
African Development Fund (AfDF)	109.8	172.5	195.0	195,000,000
European Bank for Reconstruction & Development (EBRD)	0.0	0.0	0.0	0
Subtotal	1,494.6	1,958.5	2,096.9	2,096,943,902
Food Security				
Global Agriculture and Food Security Program (GAFSP)	99.8	135.0	134.0	134,000,000
Int'l Fund for Agricultural Development (IFAD)	29.4	30.0	30.0	30,000,000
Subtotal	129.2	165.0	164.0	164,000,000
World Bank Environmental Trust Funds				
Clean Technology Fund (CTF)	184.6	184.6	185.0	185,000,000
Strategic Climate Funds (SCF)	49.9	49.9	50.0	50,000,000
Global Environment Facility (GEF)	89.8	89.8	129.4	129,400,000
Subtotal	324.4	324.4	364.4	364,400,000
Debt Relief				
Bilateral Debt Reduction	33.5	0.0	250.0	250,000,000
Multilateral Debt Relief Initiative (MDRI) for IDA15	0.0	91.0	0.0	0
MDRI for IDA16, AfDF12	0.0	83.5	0.0	0
Tropical Forest Conservation Act (TFCA)	16.4	12.0	0.0	0
Subtotal	49.9	186.5	250.0	250,000,000
Technical Assistance				
Treasury Office of Technical Assistance	25.4	27.0	25.4	25,448,000
TOTAL TREASURY REQUEST	**2,023.5**	**2,661.4**	**2,900.8**	**2,900,791,902**

Summary of Arrears
Multilateral Development Banks
FY2002 - FY2012
(Budget Authority; in $)

MDBs	Arrears end-FY2002	Arrears end-FY2003	Arrears end-FY2004	Arrears end-FY2005	Arrears end-FY2006	Arrears end-FY2007	Arrears end-FY2008	Arrears end-FY2009	Arrears end-FY2010	Arrears end-FY2011	Arrears end-FY2012
IDA	73,015,000	78,540,000	120,727,880	327,527,880	337,027,880	377,877,880	385,572,880	505,572,880	478,072,880	480,542,880	423,042,880
MIGA	10,892,087	9,271,689	8,154,321	8,154,321	6,867,321	6,867,321	6,867,321	6,867,321	6,867,321	6,867,321	6,867,321
AfDF	220,000	10,849,144	16,789,221	29,637,221	30,994,221	32,351,221	33,366,261	39,421,261	40,476,261	86,636,261	109,136,261
AfDB	13,420	42,126	67,315	619,934	2,036,730	3,453,526	1,433,026	631,375	615,239	615,239	615,239
AsDF	133,158,400	138,908,527	98,339,611	102,139,611	118,389,611	134,639,611	175,345,350	185,595,350	195,845,350	311,095,350	326,345,350
AsDB	0	0	0	0	0	0	0	0	0	213,020	212,868
IDB	0	0	0	0	0	0	0	0	0	0	27,022,861
MIF	88,772,000	64,341,172	39,488,672	28,576,672	26,852,572	50,128,472	50,330,972	50,330,972	50,330,972	50,380,972	50,380,972
IIC	16,055,000	22,822,619	47,822,619	47,822,619	46,098,519	46,098,519	46,098,519	46,098,519	41,428,519	20,470,519	15,800,519
IFAD	11,000	104,857	189,339	309,339	459,339	3,609,339	3,683,722	3,683,722	3,683,722	4,243,722	4,243,722
GEF	210,937,600	171,585,848	140,668,364	141,528,364	169,828,364	170,628,364	169,527,644	169,527,644	163,027,644	205,057,644	258,987,644
EBRD	0	232,732	441,776	725,225	10,157	10,157	0	0	0	0	0
TOTAL	**533,074,507**	**496,698,714**	**472,689,118**	**687,041,186**	**738,564,714**	**825,664,410**	**872,225,695**	**1,007,729,044**	**980,347,908**	**1,166,122,928**	**1,222,655,637**

Notes:
1. The amount of AfDB arrears ($615,239) corresponds to the 51 capital shares from GCI-V forfeited by the United States
2. The United States has not had arrears to the IBRD, IFC, IDB FSO or NADBank during the FY2002-FY2012 Period

ECONOMIC GROWTH, NATIONAL SECURITY AND POVERTY REDUCTION

The World Bank Group

International Development Association (IDA) Request: $1,358.5 million
Second of three installments
Start of current Replenishment: FY 2012

Treasury requests $1,358.5 million for the second of three annual payments to the Sixteenth Replenishment of the International Development Association (IDA16).

IDA:

- makes highly concessional loans and grants to the world's 79 poorest countries – home to 2.5 billion people, 1.5 billion of whom survive on $2 a day or less;
- is the single largest source of development finance in the world's poorest countries, and operates across a range of sectors, including primary education, basic health, clean water and sanitation, the environment, infrastructure and agriculture; and
- was ranked "best performer" in aid transparency status in an independent ranking of 58 donor organizations in 2011.[1]

IDA's strong leveraging of other donor contributions, coupled with internal World Bank resources, make it an effective organization in which to invest limited U.S. development resources. Every $1 contribution from the United States leverages almost $12 in contributions from other donors and internal Bank resources. There are now 52 country donors to IDA.

In 2011, IDA's commitments reached a record $16.3 billion, funding 230 new operations in 72 countries. This funding led to improved lives for tens of millions of people in all corners of the globe while fostering global stability and promoting U.S. security interests. Specific examples of IDA engagement include:

- A $300 million IDA loan for the Primary Education Development Program in Bangladesh, expanding on two previous programs that resulted in marked improvements in enrollment and completion rates, achievement of gender parity in access and construction of 30,000 new classrooms.

1 The ranking appeared in the 2011 "Aid Transparency Index" released by Publish What You Fund, a U.K.-based coalition of civil society organizations working on governance, aid, effectiveness and access to information.

- An $18 million IDA project in Mongolia that has created a new insurance market to support the 30 percent of Mongolians who are nomadic farmers. This type of risk management has been identified as an essential component of strategies designed to support smallholder farms. Building on the success of the Second Sustainable Livelihoods Project in Mongolia, IDA approved an additional $11 million credit in 2011 to scale up activities in pastoral risk management and community initiatives, such as health facilities and improved water supply.

- An $82 million loan to encourage local and foreign currency private financing of a natural gas-fired power plant in Cameroon. The project – owned and operated by U.S.-based AES Corporation – will add over 200 megawatts of generating capacity in Cameroon. The project is an example of how IDA is providing innovative tools to help Africa address its infrastructure needs to spur economic growth.

- A $22 million IDA credit in Afghanistan to help develop the legal and regulatory regime for the telecommunications sector, which has attracted $1 billion in private investment and led to a 95 percent decline in the cost of phone calls to 10 cents/minute.

Country-specific results can be found at: http://www.worldbank.org/ida/ida_abc.html.

U.S. Leadership

The United States was the driving force behind the creation of IDA in 1960 and remains its largest shareholder. U.S. funding for IDA has helped save tens of millions of lives, eradicating extreme hunger and poverty around the world while promoting global stability and prosperity. This work helps to support U.S. national security objectives by addressing the root causes of extremism and conflict.

In 2011, we strongly encouraged IDA to support South Sudan's transition to statehood. IDA has responded by providing technical assistance to help the newly independent country build the institutional capacity to take full advantage of its programs once the country completes the steps to becoming an IDA member. In anticipation of engagement by IDA, the World Bank established a $75 million South Sudan Transition Trust Fund (SSTTF) to help provide health care, infrastructure, and employment for the people of South Sudan.

As part of the IDA16 replenishment negotiations, we supported a Crisis Response Window (CRW) within IDA, designed to provide resources for countries hit by natural disasters (such as Haiti) and severe, external economic shocks, such as global food price spikes or regional financial crises. This past year, IDA was able to mobilize this new window in response to the crisis in the Horn of Africa, a region facing its worst drought in 60 years. IDA mobilized a total of $1.9 billion in resources for the crisis, including $250 million in front-loaded financing from the CRW. IDA's response in the Horn of Africa is appropriately balanced between rapid response and the type of long-term recovery and resilience efforts that fall squarely within its area of comparative advantage.

International Bank for Reconstruction and Development (IBRD) Request: $187.0 million

Second of five installments for the GCI ($117.4 million)

First of four installments for the SCI ($69.6 million)

Treasury requests $117.4 million for the second of five installments of the United States capital subscription to the World Bank's General Capital Increase (GCI), which funds the IBRD. Treasury is also requesting $69.6 million for the first of four installments of the World Bank's Selective Capital Increase (SCI). This is needed to allow the U.S. claim the portion of shares that will preserve our shareholding above the 15 percent veto threshold. With 15.8 percent, the United States is the World Bank's largest shareholder and the only country with a valuable veto over changes to the World Bank's Articles of Agreement.

IBRD:

- is the largest global development institution;
- aims to reduce poverty in middle-income and creditworthy poorer countries, where one-third of the world's people are living on less than $2 per day live, through loans, guarantees, risk management products, and analytical and advisory services;
- helps poor people gain access to jobs, markets and social services;
- provides financing for essential services such as water, electricity and roads;
- is uniquely positioned to address global challenges, such as food insecurity and environmental degradation; and
- yields healthy returns for U.S. economic, security and humanitarian interests by strengthening new sources of global growth, working effectively with governments to improve governance, accountability and public financial management, and supporting and coordinating post-conflict relief efforts.

IBRD General Capital Increase

In 2010, IBRD shareholders committed to increase the Bank's capital so as to forestall a substantial decrease in lending capacity, from an average of $15 billion a year to less than $8 billion a year. The reduced level would be less than a third of even the most conservative projections of demand for Bank funding, and would dramatically curtail the Bank's ability to respond to regional and global challenges.

A key outcome of the capital increase negotiations was a commitment to transfer additional IBRD resources to finance IDA. As a result, each $1 contributed to capital will leverage nearly $8 in income transfers from IBRD to IDA, providing a total of $6.6 billion of internal transfers over the next nine years. Without the capital increase, the dramatic decline in lending would mean that the income from loan reflows needed to support the internal transfers to IDA would be absent—leav-

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ing donor nations to shoulder a greater burden for IDA contributions.

U.S. support for the IBRD's capital increase has a strong multiplier effect. Each dollar of U.S. capital supports additional Bank lending of $25, due to burden-sharing with other shareholders and an increase in the Bank's ability to borrow from markets. This funding will enable the Bank to continue vital work to improve health and educational outcomes and to expand the access of poor people to basic services. For example, between 2005 and 2007, an IBRD project aimed at HIV prevention in the Dominican Republic resulted in a tenfold increase in voluntary HIV testing. A similar project in Jamaica resulted in an increase in voluntary HIV testing from under 30 percent in 2004 to nearly 50 percent in 2008.

In Brazil, the World Bank's Second Bolsa Família Project ($200 million), approved in 2010, is helping to reduce poverty and inequality. Bolsa Família is the core of Brazil's social safety net strategy. The key project component is the conditional cash transfer that provides grants to mothers or other designated family members, enabling them to access health, education and other services. The project will further improve targeting and integrate other social programs. In Mexico, 6.8 million students received better education when coverage under the Quality Schools Program was increased from 21,000 to 39,000 schools in poor and very poor communities (2006 to 2009). Both these projects demonstrate the IBRD's strength in promoting economic development in key U.S. trading partners: U.S. goods exports to Mexico and Brazil reached nearly $200 billion in 2010, up from $153 billion in 2006.

IBRD Selective Capital Increase

The Selective Capital Increase (SCI) is a mechanism to adjust ownership shares of the World Bank to enhance the voice and participation of developing and transition economies in the Bank, while preserving the voice of the very poorest members. The multi-year SCI negotiation was generated by a recognition that the Bank's legitimacy and effective governance required a shift in its ownership structure to better reflect major changes in the global economy. Under the SCI, the U.S. preserves both its relative voting share and position as largest IBRD shareholder, while "overrepresented" countries, principally in Europe, cede voting power to developing countries.

A key outcome of the SCI was to preserve the current shareholding of the United States in the Bank at 15.8 percent, above the threshold of 15 percent, below which we would lose our veto power over amendments to the Bank's Articles of Agreement. This objective is in line with our position as the world's largest economy with a legitimate claim to remain the largest shareholder at the Bank. Failure to fully finance the SCI at $69.6 million, however, could result in a permanent decrease in U.S. shareholding and voting share, as well as a loss of our veto power.

U.S. Leadership

As the Bank's leading shareholder for more than 65 years, the United States has helped shape the global development agenda, advancing approaches that encompass core American values, such as enabling environments for the private sector, good governance (e.g., transparency and accountability), a more prominent role for civil society, and universal access to health and education.

In the wake of the 2011 "Arab Spring", the World Bank, in close coordination with the United States, engaged actively in the Middle East and North Africa, providing critical financing and technical assistance in support of the historic transitions underway in the region. In Tunisia, for example, the IBRD provided a $469 million Development Policy Loan (DPL) to support citizen-demanded governance reforms by the interim government. The IBRD also partnered with the Bank's private sector window to provide Tunisia with $50 million from the Micro, Small and Medium Enterprise Facility.

The United States continues to be a vocal advocate for strong fiscal controls at the World Bank. For example, since FY 2006 the World Bank has operated under a flat real administrative budget framework, increasing efficiencies in order to achieve greater value for donor resources. In 2011, the Bank continued this work by strengthening the alignment between its strategic priorities and the allocation of its administrative budget.

African Development Bank Group

African Development Fund (AfDF)

Request: $195 million
Second of three installments
Start of current replenishment: FY 2012

Treasury requests $195.0 million for the second of three annual payments to the twelfth replenishment of the African Development Fund (AfDF-12).

AfDF:

- provides highly concessional loans and grants to the 40 poorest countries in Africa to support clean water and sanitation, a cleaner environment, business climate improvements, infrastructure and institutional development;
- supports recovery and rehabilitation in fragile states and war-ravaged communities;
- rewards performance by allocating resources based on results; and
- provides dedicated resources to support regional projects, helping to integrate regions into more economically viable market areas.

U.S. contributions to AfDF provide substantial returns for U.S. economic, security and humanitarian interests, particularly considering that every $1 provided by the United States leverages $9 from other donors.

AfDF investments in fragile states are supporting stability in countries such as South Sudan and Liberia, combating conditions that breed terrorism and trans-national crime. Based on her experience as Counter Piracy Taskforce Commander in 2009, Rear Admiral Michelle Howard emphasized in her September 2011 Congressional testimony that responding to trans-national crime in failed states like Somalia pulls U.S. military resources away from other priority missions, such as ballistic missile defense. Rear Admiral Howard also stressed the vital importance of the AfDF and other MDBs in strengthening governance and basic infrastructure in post-conflict states to enable the U.S. military to transition from its security role and return home.

Notable AfDF projects include the Lungi-Port Loko Road in Sierra Leone, which will connect the north and east of the country with the international airport in Lungi. AfDF's Fragile States Facility has also provided critical support to Liberia in recent years, helping to strengthen public financial management and the overall business environment in this transitioning economy.

In addition, AfDF investments in energy and transportation infrastructure are helping reduce bottlenecks that hold back private investment and job growth. For example:

- The AfDF's investment in the Bamako-Dakar road corridor, in Mali and Senegal, is providing strong benefits to communities along the route and is reinforcing regional integration. Associated activities, including the laying of secondary roads, the drilling of boreholes, and the construction of schools, health clinics and animal rest areas, have made a significant difference in the lives of rural dwellers in the region. The walking distance for women fetching water has been reduced to one kilometer (km) on average, from 5 km previously. The halving of travel times, decline in livestock losses, and drop in travel costs have breathed new life into local agriculture. Illicit fees and charges have fallen considerably, reaching $140 per truck trip on the Bamako-Dakar corridor, a steep decline from $351 per truck trip along the prior route.

- The AfDF-financed Nigeria-Benin Interconnection Project linked Nigeria's electricity grid to the already connected grids of Benin, Togo, Ghana, Cote d'Ivoire and Burkina Faso, making supply more reliable. Power from Nigeria now meets over 40 percent of demand in Benin and Togo, and the project helped forge stronger relations among power authorities in the three countries.

AfDF investments in water, sanitation and agricultural infrastructure are helping meet the basic human needs of Africa's poorest communities. Projects completed in 2008-2010 resulted in over 12,000 boreholes and wells drilled and equipped, 750 km in drinking water pipes constructed and nearly 26,000 latrines built. Through these projects, over 8.5 million people benefitted from new or improved access to water and sanitation.

- Water sector projects in Malawi, Mozambique, and Zambia have provided access to clean water and reduced the labor time of women and children, who are the primary collectors of water. There has been a reduction in water-borne diseases, increasing community well-being and productivity. The projects have also directly generated local employment opportunities.

- The Community Agricultural Infrastructure Improvement Program in Uganda is strengthening food security for 2.6 million people in eastern and central Uganda through investments in community access roads, district feeder roads, rural markets, and agro-processing facilities such as coffee hullers, maize mills and milk coolers. Project activities have contributed to dramatically higher farm gate prices of staples like cassava, maize and milk, a 50 percent reduction in travel times and costs, and an estimated 20 percent reduction on post harvest losses, especially for perishables such as cabbage, tomatoes, pineapple and watermelon.

U.S. Leadership

With our strong support, the AfDF has undertaken significant reforms to strengthen institutional effectiveness in recent years, including identification of a limited set of strategic objectives in areas of comparative advantage and the development of a robust Results Measurement Framework.

African Development Bank (AfDB) — Request: $32.4 million
Second of eight installments for the GCI

Treasury requests $32.4 million for the second of eight installments for the AfDB's sixth General Capital Increase (GCI-6).

AfDB:

- serves 46 countries in Sub-Saharan Africa in addition to the Arab Spring countries of North Africa;
- makes public sector loans to middle income countries in Africa where over 400 million people live on less than $1.25 dollars a day;
- extends private sector loans to both middle- and low-income countries at market-oriented rates that are below what these borrowers could access independently;
- yields healthy returns for U.S. economic, security and humanitarian interests by strengthening new sources of global growth, supporting nascent democracies in North Africa, and lifting people from poverty.

The United States' contribution is generating a substantial increase in the AfDB's sustainable lending capacity, from $1.8 billion per year (before the GCI) to $5 billion per year. Our support for the capital increase has a strong multiplier effect, as each additional dollar of U.S. capital supports additional lending of $20 due to burden-sharing with other shareholders and an increase in the Bank's ability to borrow from markets.

The United States is the African Development Bank's largest non-regional shareholder with a 6 ½ percent voting share. The United States needs to fulfill its financial obligations under the GCI to avoid any dilution of this shareholding, and the associated loss of the privilege of maintaining a single seat on the Executive Board. (The U.S. is the only country with a single seat on the Board of each MDB.)

The AfDB is a leader in supporting transportation and energy infrastructure in middle-income countries on the continent, investments that are critical to unleashing the region's growth potential. For example, the AfDB-financed Marrakech-Agadir highway in Morocco cut travel time between the two cities in half, promoting tourism and agro-industrial development in Grand Agadir and neighboring provinces. The National Rural Roads program has supported construction of 6,700 km of rural roads throughout Morocco, serving to reduce travel times and costs, and leading to higher school attendance and access to health facilities.

In addition to supporting the enabling environment for the private sector through lending to governments for physical infrastructure and strengthening legal, regulatory and financial policies, the AfDB also provides catalytic support directly to private sector projects continent-wide.

AfDB lending to the private sector has grown substantially in recent years, averaging about $1.5 billion annually in support of projects such as a line of credit to support affordable housing development in Uganda, and the Kivuwatt integrated-methane gas extraction and power facility in Rwanda. AfDB private sector loans are boosting growth prospects and regional integration on the continent. For example, an AfDB loan of $14.5 million to the East African Submarine Cable System (EASSy) financed a high-capacity fiber-optic telecommunications network spanning 9,000 km along Africa's east coast, connecting 20 coastal and land-locked African countries and dramatically reducing the cost of voice and data communications. Together with other cable companies, this project has contributed to a 60 percent reduction in bandwidth prices in Tanzania and a 90 percent reduction in wholesale rates by Kenya's largest wholesale provider. Kenya and Tanzania each registered increases over 150 percent in international bandwidth use within six months of the EASSy cable coming into use in 2010.

U.S. Leadership

As the largest non-regional shareholder in the AfDB, the United States championed a number of key institutional reforms during the GCI negotiations. These included adoption of a comprehensive income model to ensure financial sustainability, budget discipline and steady transfers to the soft loan window (the AfDF); increased transparency and disclosure; stronger risk management; and a heightened focus on results. Such reforms are aimed at solidifying the major strides that the AfDB has taken over the past five years to improve its institutional effectiveness by narrowing its strategic focus and strengthening controls on project quality.

In 2011, the AfDB was very responsive to U.S. requests to play a major role in supporting the transitions of the North African countries. For example, working closely with the World Bank, the AfDB supported governance and transparency reforms in Tunisia through a $500 million budget support loan. The AfDB also provided a $124 million loan to support water and sanitation improvements in Tunisia's poor rural regions, and $174 million to finance a key road corridor that will promote economic inclusion within Tunisia and support regional integration across the Mahgreb region. In addition, the AfDB's private sector window provided a $50 million line of credit for small and medium enterprises in Tunisia. SME development, which provides job opportunities particularly for youth and women, is a critical element of Tunisia's transition to more inclusive economic growth.

Asian Development Bank Group

Asian Development Fund (AsDF)

Request: $115.3 million
Fourth of four installments
Start of current replenishment: FY 2010

For FY 2013, Treasury requests $115.3 million for the fourth installment of a four-year commitment under the agreement of the ninth replenishment of the AsDF (AsDF10).

AsDF:

- is the primary source of financing for development in the 15 poorest countries in the Asia-Pacific region, focusing on the construction of critical infrastructure such as roads, water and sanitation infrastructure, electricity grids, and schools;
- is a key source of financing for an additional 13 countries, which are making the critical transition from low- to middle-income status;
- rewards performance by allocating resources based on results; and
- has been recognized by the United States national security community as critical to the success of our political and security objectives in Afghanistan.

Between 2004 and 2010, AsDF operations have generated impressive results. The impact of AsDF projects is exemplified by better access to economic opportunities and social services for more than 211 million people. Over this period, the AsDF has financed the construction and rehabilitation of more than 44,000 km of roads, provided access to clean water for over 2 million households through the installation or rehabilitation of 18,000 km of water supply pipes, and improved industrial productivity and economic growth through the connection of over 1.6 million households and firms to electricity by building or upgrading more than 34,000 km of power transmission and distribution lines. In addition, the AsDF has provided expanded access to quality education for more than 21 million children through the delivery of over 135,000 new or upgraded classrooms and 667,000 trained teachers.

The scope of the AsDF's operations is illustrated by the following project outcomes:

- In 2001, the AsDF began a decade-long project to support microfinance institutions in Papua New Guinea, many of which were barely surviving. Recognizing the importance of a vibrant microfinance sector to stem poverty and help move the population out of subsistence, the AsDF supported the microfinance industry through intensive training and the generation of products designed to meet the needs of the poor and those not served by regular banks. The project brought financial services to over 400,000 new clients in rural areas and helped establish Nationwide Microbank, which now serves more than 100,000 clients through 14 branches.

In addition, the AsDB created an institution to provide support and training to microfinance institutions and set up the country's first credit agency.

- In Lao PDR, the AsDF has helped to introduce innovation and incentives to address a serious widespread problem of poor water supply and unhealthy sanitation conditions in the country's small towns. To improve living conditions in these urban centers, especially for the poor, the project tied the construction of household latrines to the availability of free water supply connections. By amortizing these connection costs through the fees charged for water delivery, and structuring the fees in a way that attracted the majority of town residents, this project made the new water system more affordable. Demand for the connections has been high and the use of basic sanitation facilities in the 12 targeted towns has soared, with significant grant assistance provided to the poorest households to allow them to install their sanitation facilities.

- The $9.4 million Rural Electrification and Network Expansion Project in Bhutan, which began in 2004, brought electricity to over 8,000 new consumers, including poor households, hospitals and schools. The project included a special feature to provide electrification kits to the poorest households to help address the connection costs and internal wiring for their homes. As a result, children can study in the evening, women have more time to augment family income, and environmental pressure on forests as a source of fuel has abated.

The United States' contribution to AsDF10 is leveraged by a factor of nearly 24 by other funding sources – including that of other donors and net income transfers from the Asian Development Bank – stretching each dollar invested in the AsDF.

U.S. Leadership

The AsDF has been highly responsive to U.S. interests. Management has channeled resources towards infrastructure finance in U.S. priority countries, including Afghanistan, where the AsDF is the third largest donor. For example, in 2011:

- $754 million was approved to rebuild Afghanistan's shattered road and rail network, bringing to more than $1.7 billion the amount that the AsDF has contributed to reconstruction of the country's infrastructure over the past decade. The multi-tranche financing facility will upgrade 600 km of priority roads – some 7 percent of the total national and regional highway network. It will also fund construction of new facilities to complement the recently completed train line connecting the northern hub of Mazar-e-Sharif and Uzbekistan. An AsDF project is underway to complete the final section of the Afghan ring road, for which a U.S. company was awarded the $397 million civil works contract.

Other U.S. priorities adopted by the AsDF in 2010-2011 include:

- introduction of a more systematic process to assess the effectiveness of AsDF operations through the use of impact evaluations;

- more effective implementation of the AsDF's Safeguard Policy Statement by adding more safeguard staff positions at the AsDB, and providing training and tool kits for its developing member country stakeholders; and

- promotion of gender equality through increased mainstreaming of gender strategies and sector gender diagnostics in virtually all new country partnership strategies, together with greater senior staff accountability for achieving gender goals.

Asian Development Bank (AsDB) — Request $106.8 million
Third of five installments for the GCI

Treasury requests $106.8 million for the third of five installments of the United States capital subscription to AsDB's GCI. This includes $213,000 to cover arrears created by the FY 2011 0.2 percent across the board rescission. These arrears have reduced U.S. shareholding below parity with Japan (the AsDB's other largest shareholder), lowering U.S. standing within the institution as a result. Further, a failure to meet this commitment could force us to forfeit these shares to other countries like China, who have been eager to increase their shareholding and influence in the Bank.

AsDB:

- meets important needs in 31 creditworthy developing economies in Asia through the provision of loans, technical support and policy advice;
- extends private sector loans to both middle- and low-income countries at market-oriented rates below what these borrowers could access independently; and
- supports US. economic, security and humanitarian interests by strengthening new sources of global growth through the construction of thousands of schools, bridges, health clinics and roads, providing opportunities for people to lift themselves out of poverty.

The United States and Japan have historically been the Bank's largest shareholders, with 15.7 percent each, though with the shortfall in FY 2011, U.S. shareholding has been temporarily diluted below this level.

In 2009, the AsDB sought support for a General Capital Increase – its first in 15 years – to forestall a dramatic drop in lending from $10 billion annually to $4 billion. With the onset of the global financial crisis and a G-20 request for increased lending from the MDBs, shareholders agreed that new capital was necessary to ensure an adequate level of development assistance to the region with the world's largest number of people living in absolute poverty.

Each dollar of U.S. capital supports additional Bank lending of $20, due to burden-sharing with other shareholders and an increase in the Bank's ability to borrow from markets.

The AsDB is a critical assistance provider in a region of significant strategic and commercial importance. For example, in 2010, the AsDB responded to the heavy flooding in Pakistan – which inundated entire villages and destroyed thousands of hectares of crops – by immediately undertaking an assessment of the flood's impact in conjunction with the World Bank. Recognizing the special vulnerability of women and girls to natural disasters, and the important role they must play in recovery, the AsDB is developing a project that will not only transfer assets and skills to women, but also empower them and include them in public life outside the domestic sphere.

In the Philippines, the AsDB helped the government expand its social protection program and associated sector reforms through a $400 million project, which was based on globally successful conditional cash transfer programs. More than half a million poor families will benefit.

In Indonesia, the AsDB has supported the provision of key infrastructure to over 36,000 village communities, including building or upgrading more than 40,000 km of rural roads, 9,000 bridges, 1,000 irrigation systems, 10,450 clean water supply units, and 4,822 sanitation units. In addition, the AsDB's support to upgrade urban slums assisted some 180,000 poor urban households in 32 cities, with plans to further provide 2.7 million people with access to improved sanitation.

U.S. Leadership

The AsDB has aligned itself with key U.S. priorities, including support for global economic growth and national security.

The AsDB is providing significant assistance to bolster growth in the region by lending to build critical infrastructure to relieve bottlenecks and to educate and provide health services to growing populations. This region has served as a vital engine of growth for the global markets, with estimated real GDP growth of over 8 percent in 2011. This high growth has fueled demand for U.S. exports to Asian countries, which grew by over 13 percent from 2010 to 2011.

The AsDB's work in Pakistan and throughout Central Asia helps to address U.S. national security interests by tackling poverty, corruption and other potential sources of instability.

U.S. engagement and leadership during the GCI negotiations enabled us to leverage meaningful changes within the Bank to strengthen safeguards, improve internal accountability, measure results, increase civil society participation and direct more resources to the poor.

In 2011 at U.S. urging, the AsDB reviewed its Public Communications Policy to determine ways to increase transparency and accountability to the people it serves. The following reforms were adopted as a result of this review:

- a commitment to disclose audited project financial statements;
- the creation of an independent appeals mechanism for information requests;
- agreement to increase access to Board decision-making through simultaneous disclosure of the majority of Board documents to the Board and the public; and
- better integration of communications plans and information sharing into projects and programs.

Inter-American Development Bank Group

Inter-American Development Bank (IDB) — Request: $102.0 million
Second of five installments for the GCI

For FY 2013, Treasury is requesting $102.0 million for the second of five installments for the Inter-American Development Bank's (IDB) ninth General Capital Increase (GCI).

The IDB:

- is the largest source of development financing for Latin America and the Caribbean, a region of significant commercial and strategic importance to the United States;
- provides 26 borrowing member countries close to half of their multilateral financing for major development priorities, including infrastructure, private sector growth, regional integration and social safety nets; and
- buttresses U.S. strategic national security objectives by supporting citizen security initiatives.

The United States supported a recapitalization of the IDB in 2010 to avert a sharp reduction in lending to approximately $7 billion a year, well below our estimates of the $12 billion in borrowing needs of member countries. The GCI agreement also secures a total of $2 billion in grants for Haiti through 2020. With a 30 percent stake, the U.S. is the IDB's largest shareholder and has an effective veto on key governance decisions at the Bank.

The U.S. contributions leverage significant additional resources: every additional dollar of U.S. capital allows lending to increase by over $10 due to burden-sharing with other shareholders and the Bank's ability to borrow in the markets.

The IDB has been a strong partner for the United States in the region, particularly in Haiti where it is the lead provider of multilateral development assistance. In 2011, through the Haiti Grant Facility, the IDB approved seven projects for $241 million and financed more than 800 temporary classrooms across 57 sites, built or rehabilitated 160 kilometers of roads, and vaccinated 50 percent of Haitian farmers against swine fever and other diseases.

In addition, the IDB established a Haiti Social Investment Fund with assets totaling $68 million. This fund will operate for 12 years to provide financing for SMEs by increasing the availability of loans and reducing borrowing costs by offering preferential interest rates. In November, the Bank organized the Second Investment Forum in Port-au-Prince, bringing together over 1,000 entrepreneurs in a massive show of private sector interest in the country's economic potential.

The IDB has also been an important partner in promoting our national security objectives throughout the region. Most notably, the IDB recently announced a pledge of $500 million over the next two years to support a regional security strategy and citizen security programs in Central America, a key U.S. foreign policy objective. Since 1998, five IDB projects for citizen security with a total cost of $107 million have been completed, nine projects worth $274 million are currently being implemented, and nine more are in the 2012 pipeline for $286 million. The IDB's strong engagement in support of U.S. national security was recognized by Admiral Stavridis who stated that the "IDB plays an important role in the region contributing directly to U.S. strategic interests".

Finally, the IDB is helping to accelerate economic growth in leading markets for U.S. exports. From 2004 to 2009, U.S. exports to the region grew by 86 percent, and are on-track to more than double by 2014.

U.S. Leadership

By virtue of our large shareholding in the institution, the United States exercises strong influence over the Bank's policies and programs, which further strengthens the role of the IDB as a partner in advancing U.S priorities in the Western Hemisphere. The United States' influence was evident during the capital increase negotiations in which we effectively consolidated key institutional reforms to improve the strategic direction of the IDB. These reforms enabled us to shape important policy outcomes in 2011, including:

- *New sector strategies to address urgent regional needs.* The IDB adopted new sector strategies including: the Integrated Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy; the Strategy on Social Policy for Equity and Productivity; the Strategy to Support Competitive Global and Regional Integration; and the Sector Strategy on Institutions for Growth and Social Welfare, with special emphasis on access to financial markets for small- and medium-sized enterprises.

- *Improved resource management.* The IDB submitted its second budget subject to the discipline of the Income Management Model (IMM) that requires loan charges to cover 90 percent of administrative expenses, while allowing for full support of the $200 million in annual income transfers to Haiti.

- *New public information policy.* The new Access to Information Policy took effect on January 1, 2011. This policy's provisions meet best international practices in the field, and contain several significant advances with respect to the Bank's previous Information Disclosure Policy. In the first year of implementation, an online system was established to manage information requests; responses have been provided to nearly 1,800 requests received through this system.

- *New Independent Consultation and Investigation Mechanism.* This year was the first full cycle of operations for the new Independent Consultation and Investigation Mechanism (ICIM). An unprecedented milestone was met in relation to the number of requests received and declared eligible. ICIM handled a total of 31 requests (9 in 2010, and 22 received in 2011), 14 of which were declared eligible either for the Consultation Phase or for the Compliance Phase and processed as cases over the course of the year.

FOOD SECURITY

Global Agriculture and Food Security Program (GAFSP)

Request: $134 million
Trust Fund Contribution

For FY 2013, Treasury requests $134 million for the Global Agriculture and Food Security Program (GAFSP). Launched in April 2010, GAFSP, the multilateral component of the President's Feed the Future initiative, seeks to strengthen food security at the country level by:

- Providing additional financing for low-income countries that demonstrate a comprehensive approach to strengthening food security;
- Aligning the resources of other donors with U.S. global food security priorities;
- Promoting best practices in the transparency of its operations and in the measurement of results.

In its first two years of operation, GAFSP awarded $481 million in grants to 12 countries in Africa, Asia and Latin America through a competitive process. These initial investments are expected to help 7.5 million smallholder farmers and their families increase their income and strengthen their nutritional outcomes. These awards were possible due to contributions of $531 million from seven donors – the United States, Canada, Ireland, South Korea, Australia, Spain and the Bill and Melinda Gates Foundation.

The crisis in the Horn of Africa is a stark example of the continued importance of helping low-income countries become more resilient and food secure. In 2012, GAFSP will issue a third call for proposals and is likely to award new grants in the summer of 2012. Implementation of existing grant awards will also continue, with the majority of the first 12 grants disbursing by June 2012.

GAFSP's private sector window should also be fully operational in 2012, using contributions from the United States, Canada and the Netherlands.

U.S. Leadership

The United States has been a driving force behind GAFSP since its inception. We have worked to incorporate important design features in the fund that support high levels of transparency, include the voice of civil society, and closely track the results of GAFSP's investments. Our financial contributions to the fund have also underscored U.S. commitment and have mobilized additional contributions in the last year from Australia, South Korea, and the Netherlands. Key areas of U.S. focus include:

- *Transparency.* GAFSP strives for full transparency in its operations with all project proposals, Steering Committee meeting minutes, and other relevant governance documents posted online (www.gafspfund.org). GAFSP also recently completed its first annual report, which is also available online. As project result reporting and impact evaluations for individual grants become available, these will also be posted online.

- *Inclusive governance.* Key decisions concerning grant allocations and governance are made by GAFSP's Steering Committee, which is comprised of recipient country representatives, donor partners, civil society organizations, MDBs, and a representative of the UN Secretary General's Office. The discussions have been open and transparent, and minutes are posted online.

- *Results measurement.* The fund has put in place several mechanisms to track results. These include common results indicators for all GAFSP projects that will allow aggregation of results across the GAFSP portfolio, an annual GAFSP report, and the use of rigorous impact evaluations on at least 30 percent of all GAFSP-financed projects.

- *Competition.* Demand for GAFSP resources has been high, with 25 countries applying for grants in the first two calls for proposals. Grant awards have been based on objective criteria including need, the quality of a country's food security strategy and GAFSP proposal, and the policy environment. An independent group of experts, the Technical Advisory Committee, ranks country proposals against these criteria and makes recommendations to the Steering Committee.

International Fund for Agricultural Development (IFAD)

Request: $30 million
First of three installments
Start of current Replenishment: FY 2013

We request $30 million for the first of three installments for the Ninth Replenishment of the International Fund for Agricultural Development (IFAD-9).

IFAD:

- serves 138 countries globally, with 40-50 percent of resources dedicated to Sub-Saharan Africa;
- is a small, highly focused development finance institution that provides loans and grants to support smallholder agriculture and rural development, with the aim of improving food security and nutrition in the poorest regions around the globe;
- works with developing country governments, poor rural people's organizations, non-governmental organizations and the private sector to design innovative programs and projects that fit within national priorities for agriculture and rural development.

The U.S. investment of $30 million will support IFAD programs of about $1 billion annually. IFAD's projects have a strong track record of improving rural livelihoods. Over 80 percent of IFAD projects completed in 2009 through 2011 achieved positive scores on rural poverty impact, as confirmed by IFAD's Office of Independent Evaluation. This was up from 71 percent in the 2006 through 2008 period. One example of this positive impact is the Support Project for the Transformation of Agriculture in Rwanda, which contributed to increases in meat and milk consumption in the project area, as well as a doubling of yields of rice, maize, beans, cassava and sweet potatoes. These increases resulted from a combination of improved techniques (e.g. soil conservation and cultivation methods) and improved inputs (e.g. seeds and fertilizers).

IFAD program design takes into account the critical importance of women's empowerment in agriculture. Giving women the same access as men to agricultural resources and inputs has the potential to increase production on women's farms by 20 to30 percent. IFAD's Independent Evaluation Office found that 88 percent of IFAD projects completed in 2009 through 2011 had positive results in addressing rural women's specific needs, and improving their general situation with respect to education, workload, access to credit, and employment opportunities.

For example, IFAD interventions are bringing about important changes in the traditional village society of Mauritania. The Poverty Reduction Project in Aftout South and Karakoro has given women a voice in local decision-making through consultative communal committees that are established under the project and are direct partners of municipal councils. The project's employment of women trainers and the creation of 30 women's cooperatives have had a positive impact on the image of women at the village level.

IFAD programs in fragile states help improve rural livelihoods among people who have lost their farms or businesses during conflict, reducing the sources of conflict and promoting social cohesion and stability. For example, social instability and rebellion in Northern Mali have been a threat to peace over many years, and lack of development is a root cause. Following IFAD's long-term commitment to work in the northern regions at a time when no other donors were willing to engage there, the government of Mali designated IFAD as a lead donor. IFAD projects in Gao, Tombouctou and the pastoral regions of Kidal are working to reduce competition for access to natural resources and improve living conditions of poor rural people.

U.S. Leadership

The United States has been highly effective in encouraging IFAD to improve institutional effectiveness through measures such as stronger in-country project supervision and best-practice transparency policies. During the IFAD-9 replenishment negotiations in 2011, the United States successfully pressed for institutional strengthening in the areas of financial and human resources management and project impact evaluation. For example:

- IFAD's new Chief Financial Officer is modernizing the system for employing IFAD's own internal resources (loan reflows and investment income) to maximize their sustainable use and thereby reduce the burden on donor contributions.

- IFAD is playing a catalyzing role on human resource issues within the UN system, including by freezing administrative staff salaries in 2010 and forcing a UN reevaluation of all Rome-based administrative staff salaries. IFAD is also working within the UN system to pilot a new pay-for-performance model for its staff during the IFAD-9 period.

- IFAD is strengthening measurement of its programs' impacts on child malnutrition, length of hungry season, and household assets by undertaking impact assessments and, in select cases, rigorous project impact evaluations.

- Following recommendations from an independent evaluation, IFAD is developing a corporate gender policy to systematize, intensify and scale up its efforts to close gender gaps and improve the economic and social status of rural women.

WORLD BANK ENVIRONMENTAL TRUST FUNDS

Global Environment Facility (GEF)

Request: $129.4 million
Third of four installments
Start of current Replenishment: FY 2011

Treasury requests $129.4 million for the third of four installments to the fifth replenishment of the Global Environment Facility (GEF) covering the period from July 2010 to June 2014.

GEF:

- Is the largest funder of projects to improve the global environment, supporting capacity building and innovative, cost-effective investments whose design and environmental benefits can be replicated by others.

- Provides grants to developing countries for projects addressing biodiversity and conservation, clean energy and sustainable landscapes, international waters, land degradation and desertification, the ozone layer, and persistent organic pollutants.

- Directly benefits the United States by:

    - Reducing harmful, long-lived chemicals such as mercury in U.S. air and water
    - Protecting international marine resources including fish stocks
    - Protecting tropical rainforests and other natural areas that conserve biodiversity and absorb carbon dioxide emissions
    - Developing markets for the export of U.S. environmental technologies
    - Improving U.S. national security by reducing the instability caused by population displacement, declines in global food supply, and major water shortages.

Over its 20 year track record, the GEF has allocated $10 billion, supplemented by more than $47 billion in co-financing, for more than 2,800 projects in 168 developing countries and countries with economies in transition. Each dollar contribution from the U.S. leverages $30 to $50 in contributions from other donors and co-financiers, including internal resources from implementing agencies, to deliver cost-effective global environmental benefits. Through its Small Grants Program, the GEF has also made more than 13,000 small grants directly to civil society and community-based organizations, totaling $634 million.

The GEF has achieved significant global environmental benefits, including by:

- *Contributing substantially to the global achievement of 10 percent of the world's land area under protection.* As the largest funding mechanism for conservation areas worldwide, the GEF has invested in the establishment and management of 1,600 protected areas covering nearly 900 million acres, more than twice the size of Alaska. These investments include the world's largest tropical forest conservation program, the Amazon Region Protected Areas in Brazil.

- *Showing how small-scale technology demonstration and dissemination projects can make a difference in the poorest countries.* A $1.45 million grant to reduce barriers to the import of solar products was recently awarded to Liberia. The program will replace 100,000 kerosene lanterns with solar lanterns with a longer term goal of reaching 200,000 households or approximately 1 million people.

- *Working to reduce environmental degradation and improve food security,* including through limiting land desertification and degradation and promoting sustainable fisheries management. For example, a new $50 million grant will introduce sustainable management practices for tuna fisheries. Supported by $270 million in co-financing from public and private partners, including the Food and Agriculture Organization, the World Wildlife Fund, and the International Seafood Sustainability Foundation, the project will lead to restored ecosystems and result in a reduction in illegal, unreported, and unregulated fishing.

"Through this collective partnership of our sustainability allies, we can ensure that proper management systems are successfully developed and we can demonstrate to the world that we don't need to sacrifice economic development in order to maintain ocean biodiversity."

-- Christopher Lischewski, Board Chair of the International Seafood Sustainability Foundation, and President and CEO of Bumble Bee Foods

U.S. Leadership

The United States, one of the largest contributors to the GEF Trust Fund, has used its position to advocate successfully for strong fiduciary, environmental, and social safeguards while improving efficiency in the GEF's operations. During the GEF's fifth replenishment negotiations, the U.S. sought and achieved important policy reforms to improve the GEF's effectiveness, particularly with regard to results-based management and country-owned business plans for GEF funding and resource allocation.

Clean Technology Fund (CTF) — Request: $185 million Trust Fund Contribution

CTF:

- Improves global energy security
- Has become the largest vehicle for mobilizing multilateral finance for clean energy
- Delivers value for money: the $4.3 billion CTF pipeline is attracting co-financing of $36.7 billion for a leverage ratio of 1:8.6

The CTF improves global energy security by helping developing countries move towards reliable, diversified and more cost-effective energy supplies. Developing countries account for nearly all of the growth in global energy demand, increasing international competition for scarce conventional energy resources. Financing from the CTF mobilizes large-scale investment in clean power, transport, and energy efficiency by helping close the price gap between commercially available clean technologies and the conventional alternatives.

Through the CTF, 15 countries are implementing 63 projects, using $4.3 billion from the fund to mobilize total planned investments of over $36 billion. The CTF aims to transform energy sectors in CTF countries by introducing new clean technologies at scale and to crowd-in private investment. To date, $248 million in CTF funding has leveraged over $2 billion in direct financing for private sector activities. An excellent example of this is in Turkey, where the EBRD combined $50 million in funding from the CTF with $240 million in credit lines to 5 Turkish banks to create a fund that will provide energy efficiency and small-scale renewable investments. Spurred by the CTF experience, EBRD partnered with the same banks and other investors to create a $1.46 billion fund for larger scale renewable energy and industrial energy efficiency projects. Altogether, the initial CTF contribution of $50 million is catalyzing $1.8 billion in investments delivered through the Turkish banking sector by proving the viability of a new market.

CTF investments have spurred economic opportunities for our partners in developing countries. Egypt is using $150 million in CTF funds along with $646 million from the World Bank, European Investment Bank and others to construct over 300 km in transmission lines with capacity to transmit 3,000 megawatts of wind power. In Indonesia, which is estimated to have 27,000 megawatts of potential geothermal resources, the IBRD is pairing a $175 million loan with a $125 million CTF concessional loan as part of a $575 million project to develop geothermal power.[1] The project will help Indonesia set up a regulatory framework for geothermal investment, undertake costly exploration, and finance construction in order to catalyze further investments of this major domestic and clean, base load power resource.

The CTF contributes to broader efforts to position the United States as a world leader in the development and manufacture of innovative energy technologies that create jobs in the United States, build and innovate American industry, and expand exports. Through direct investments, technical assistance and capacity building, CTF helps to level the clean energy playing field by creating open, fair and functioning markets in which American businesses can compete and win.

U.S. Leadership

As a result of strong U.S. leadership working closely with other countries, over the past three years, the CTF has become the largest multilateral vehicle for mobilizing clean energy finance. This program is a critical complement to bilateral programs because it enables large-scale investments in energy infrastructure. U.S. efforts ensure that the funds make selective and targeted engagements and promote country ownership, international coordination, value for foreign assistance dollars and private sector participation.

Strategic Climate Fund (SCF) — Request: $50 million Trust Fund Contribution

SCF:

- Pilots ways to manage the environmental drivers of instability in poor countries
- Focuses on clean energy solutions that expand productive capacity in low income countries
- Encourages private sector expansion in clean energy, forestry sectors and adaptation investments

The SCF reduces global instability by combating environmental degradation in developing countries, and by helping the most vulnerable countries prepare for and respond to the impacts of global warming. Deteriorating environmental conditions abroad, including drought, melting glaciers, loss of biodiversity, contaminated waterways, desertification, rising sea levels, and deforestation, pose a long-term threat to our national security as migration, and scarcity of food and water exacerbate instability in vulnerable countries. Left unaddressed, these pressures threaten to roll back significant development gains in many vulnerable countries. SCF investments work to reduce the damage from such threats.

SCF is comprised of three targeted programs. The **Pilot Program for Climate Resilience (PPCR)** is working with 18 highly vulnerable countries to respond to climate change by integrating adaptation into core development planning in sectors such as water management, agriculture, land use and coastal zones and infrastructure. The **Forest Investment Program (FIP)** reduces deforestation in developing countries by addressing its underlying causes. The FIP will work with national governments, the private sector, indigenous peoples and local communities on sustainable management of forests. The FIP will also work to improve forest-related regulation and enforcement to reduce illegal logging, which can undercut the market for products of more responsible producers. This helps to level the playing field for U.S. producers who play by the rules. The **Program for Scaling-up Renewable Energy in Low-Income Countries (SREP)** helps the poorest countries use renewable energy to expand energy access, stimulate economic growth, and reduce vulnerability to energy shocks. SREP projects aim to develop best practices and viable business models for both utility-scale projects and small-scale projects in remote areas that can be used in all developing countries.

Through the SCF, 31 developing countries are accessing $1.96 billion to mobilize several billion dollars in external financing. The SREP has endorsed 4 investment plans which use $195 million to mobilize $1.8 billion in planned investments. For example, Mali will use SREP funds to develop sustainable, renewable energy mini-grids and mini hydro installations in remote communities. Honduras will use $30 million from SREP to leverage an additional $242 million in MDB finance, private investment and other public funds to deploy renewable energy connected to the grid and in remote areas.

The FIP recently approved $40 million in funding for a Mexico project that will pilot, in two large areas selected for replication potential, a multi-sectoral approach aligning forest, agricultural, and livestock programs and policies.

The PPCR has endorsed 12 investment plans that use about $800 million in grant and highly concessional loan resources to mobilize at least $1.7 billion in planned investments. The PPCR and Bangladesh are investing in coastal afforestation and climate resilient embankment infrastructure to protect Bangladeshi citizens and economic assets from extreme coastal weather events. In Niger, $15 million from the PPCR, coupled with $59 million of World Bank Group co-financing, will improve water resource management to help Niger adapt to changing climate patterns, increase agricultural production and enhance food security.

DEBT RELIEF

U.S. efforts on debt relief and debt restructuring are fundamental to helping some of the world's poorest countries generate economic growth and reduce poverty and instability. These programs include the Heavily Indebted Poor Countries (HIPC) initiative, the HIPC Trust Fund, the Tropical Forest Conservation Act, and the Multilateral Debt Relief Initiative (MDRI). Over 40 countries, including Haiti, Afghanistan, and Liberia, have benefitted from U.S. debt relief and restructuring programs.

Enhanced Heavily Indebted Poor Countries (HIPC) Initiative — Request: $250 million

The Enhanced Heavily Indebted Poor Countries (HIPC) initiative was launched in 1999 to provide deeper, broader, and faster debt reduction for the poorest heavily indebted countries that have made real commitments to economic reform and poverty reduction. Countries that demonstrate the performance on economic policies and poverty reduction required to complete the HIPC process also qualify for additional debt relief under the Multilateral Debt Relief Initiative (MDRI), which provides 100 percent debt cancellation on eligible obligations to the International Monetary Fund (IMF), the International Development Association (IDA), and the African Development Fund (AfDF).

With strong U.S. leadership, these multilateral debt relief initiatives have been widely recognized as successes, both in terms of effectiveness and donor follow through. A 2010 DATA report on G-8 debt relief commitments calls them "the clearest examples of a promise fulfilled." In total, 36 out of 40 HIPCs have qualified for HIPC initiative assistance, of which 32 have reached the "completion point" and received irrevocable debt relief from the international financial institutions. They are benefitting from debt relief that, together with MDRI and "beyond HIPC" relief from Paris Club creditors, will lower their stock of debt by over 90 percent, allowing for increased poverty reduction expenditures in areas such as health, education, and rural development. Debt relief committed under the HIPC and MDRI initiatives to date amounts to about $155 billion in nominal terms.

The FY 2013 budget includes $250 million to help fulfill the U.S. commitment to the Enhanced HIPC initiative. This request reflects the estimated budget cost of forgiving 100 percent of Sudan's outstanding debt to the United States (currently $2.4 billion). Sudan is one of three remaining potential HIPC-eligible countries, and developments related to the Comprehensive Peace Agreement (CPA) between Sudan and South Sudan create the prospect for HIPC treatment for Sudan during the FY 2013 period. While HIPC treatment is envisioned for debt assumed by Sudan, this arrangement is a critical component of the CPA, which led to the creation of South Sudan, and is supported by South Sudan. As such, proceeding with HIPC treatment of Sudan's debt at the appropriate time will ultimately help to ensure success for the new country of South Sudan.

However, in making this request, the Administration remains mindful that the situation on the ground in Sudan will have to change dramatically in order for the United States to participate in HIPC debt relief. Along with fulfilling CPA commitments -- including on Abyei, South Kordofan, and Blue Nile -- progress on Darfur will be necessary. Should Sudan make progress on these conditions, Sudan would also have to be removed from the list of state sponsors of terrorism. Because of these uncertainties, Treasury requests transfer authority for this $250 million to other multilateral assistance accounts in Treasury's portion of the 150 account, if it is determined that Sudan is not likely to reach HIPC decision point by the end of FY 2014, so that the funds may be put towards other priorities.

Multilateral Debt Relief Initiative (MDRI) Request: $0

Building upon the HIPC initiative, MDRI provides 100 percent cancellation of remaining eligible debts owed to the IMF, IDA and AfDF for countries that complete the HIPC initiative. MDRI is expected to provide over $53 billion in additional debt relief beyond HIPC to 42 countries.

To make this major debt relief possible, donors committed to offset the cost of MDRI debt relief at IDA and the AfDF on a dollar-for-dollar basis. To meet its share of this effort, the United States has committed, subject to the enactment of appropriations legislation, to provide a total of about $7.6 billion for IDA and $1 billion for AfDF over roughly four decades (2006 -2044). The timing of these contributions is spread out over a long period in order to match the period during which these debts would otherwise have been repaid. Internal resources were available to cover the costs at the IMF.

For FY 2013, we expect to rely on “early encashment” credits from our IDA and AfDF payments to partially meet our MDRI commitments for IDA16 and AfDF12. However, we anticipate the need for direct funding in future years since these credits will not be sufficient to fully meet our MDRI commitments. Treasury expects to meet its IDA16 and AfDF12 MDRI commitments by the end of their respective replenishment periods.

TECHNICAL ASSISTANCE

Office of Technical Assistance (OTA) Request: $25.4 million

Effective government financial management is a core element of a functioning state. It fosters national economic growth and enables a government to provide better services for its citizens. For over 20 years, Treasury's Office of Technical Assistance (OTA) has been highly successful in helping developing countries worldwide to strengthen their capacity to manage public finances – through efficient revenue collection, well-planned and executed budgets, judicious debt management, fundamentally sound banking systems, and strong controls to combat corruption and economic crimes.

The President's FY 2013 request for OTA provides $25.4 million to strengthen economic and financial governance in fragile and developing countries. This is equal to the FY 2012 base funding level, but the FY 2013 request does not include funding for Overseas Contingency Operations (OCO) for OTA.

The request supports OTA's focus on five core financial disciplines: revenue policy and administration, budget and financial accountability, government debt issuance and management, banking and financial services, and economic crimes. The President's request enables OTA to maintain its current footprint of technical assistance programs globally, including in priority areas, such as providing more infrastructure finance, increasing access to financial services, and better management of revenues derived from extractive industries, including oil and gas sectors. The request also furthers OTA's efforts to promote regional integration and increased capital flows among countries in East Africa, West Africa, and Central America.

U.S. Leadership

OTA's experts work side-by-side with government officials in finance ministries and central banks in approximately 50 countries around the globe – in Asia, the Middle East, Africa, Latin America and the Caribbean. OTA advisors are engaged in national security priority countries, including Iraq and Afghanistan. They are also helping to increase public financial management effectiveness and remove constraints on economic growth in countries targeted under the President's Partnership for Growth, such as El Salvador, Ghana, the Philippines and Tanzania. By building public financial capacity, OTA's work enables the success and sustainability of other U.S. foreign assistance programs – from agriculture to global health to democracy to conflict prevention. Further, Treasury technical assistance provides countries with the knowledge and skills required to move towards financial self-sufficiency – the capability to raise and better manage their own revenues and eventually to move beyond international aid. OTA programs build a framework for a country's anti-corruption efforts through direct means – mentoring the investigation of financial crimes – and indirect means – improving the professionalism of the civil service.

OTA is recognized as one of the most comprehensive repositories of U.S. Government expertise in financial sector capacity building and one of the greatest values for the U.S. development dollar.

With a relatively modest budget, OTA helps partner countries to safeguard scarce public resources, finance critical services, and achieve sustainable and tangible outcomes that affect peoples' lives.

- In Haiti, OTA, in cooperation with the U.S. Department of Justice (DOJ), increased capacity building at the country's specialized financial law enforcement agencies. These efforts resulted in the longest sentence ever imposed in a case involving the U.S. Foreign Corrupt Practices Act. DOJ singled out evidence-gathering assistance from the Haitian agencies as being instrumental in the case, in which the defendant received a 15-year sentence for his role in a scheme to pay bribes to officials at Haiti Teleco, a state-owned telecommunications company. OTA has been working with the Haitian agencies, including Haiti's Financial Intelligence Unit, since 2008 to improve their ability to investigate corruption and other complex financial crimes.

- In Liberia, OTA, in partnership with the Liberian tax administration, created an anti-corruption investigation unit from the ground up. OTA mentored the organization on everything from personnel policy and organizational structure to case management and standard operating procedures. In its first year of operation, the new investigation unit opened 55 cases and recovered $76,000 in revenue, an important achievement as the country works to increase domestic revenues to support critical government services to citizens.

- In Afghanistan, OTA mentored and conducted workshops for central ministries and their provincial directorates as part of a pilot budgeting project to link local projects with national priorities. Guidance was developed for provincial plans to elevate them from being "wish lists" and allow them to provide value as inputs to budget formulation.

- In Lesotho, OTA is working to upgrade the investigative capability of the local revenue administration. Efforts have focused on the creation of an organizational structure and development of position descriptions and standard operating procedures for the investigative unit. The unit's effectiveness was evidenced by the successful prosecution of a high profile tax evader, who faces fines and back taxes amounting to $872,000, important resources to support public programs. The case received considerable attention in the press, maximizing the deterrent effect of the conviction and providing a public relations boost for the revenue agency.

- In Cambodia, OTA is working with the Ministry of Economy and Finance to improve government budgeting, allowing for the decentralization of financial and budget controls to line ministries. The reforms will improve financial accountability for governmental services by making departmental managers responsible for their respective budgets, and improve the transparency of the budget through the inclusion of greater information on the services being provided at the departmental level of the ministries.

To ensure that program resources are wisely allocated and effectively spent, OTA has developed a robust project monitoring and evaluation process. The process features documentation of shared goals between partner country officials and Treasury in each project's Terms of Reference and work plans; regular project reporting to track progress on specific objectives and supporting activities; on-site review by Treasury senior managers; and an annual rating of success in achieving every objective in project work plans. At present, OTA is developing additional mechanisms to strengthen ties between project plans and results, and provide a structured system for soliciting and utilizing feedback from partner country officials to verify progress against mutually defined goals and objectives.

MDB BASICS

What are the MDBs?

The United States is a member of several multilateral development institutions, including the:

- World Bank
- Inter-American Development Bank
- Asian Development Bank
- African Development Bank
- European Bank for Reconstruction and Development
- International Fund for Agricultural Development
- North American Development Bank

The development banks are not banks in the usual sense. They are owned by member countries and provide financial and technical assistance to emerging markets and developing countries. The United States is the largest shareholder in the World Bank and Inter-American Development Bank, the co-largest shareholder (with Japan) at the Asian Development Bank, and the largest non-regional shareholder of the European Bank for Reconstruction and Development and the African Development Bank.

What is Treasury's role?

In the United States Government, Treasury is charged with leading the United States' engagement in the multilateral development banks. For the five largest institutions, the United States appoints an Executive Director (USED), who is based at the banks and represents U.S. interests. Treasury works closely with the USEDs and a wide-ranging interagency group on development bank issues, with the Department of State and USAID playing important roles as Alternate Governors of the MDBs.

How do the MDBs finance development projects?

Most of the MDBs have two financing facilities, which are frequently referred to as "windows," from which they make loans and provide grants:

- The "soft loan" window is for concessional lending that provides loans on highly favorable terms (e.g., extremely low or no interest, long repayment periods or grants) to countries that are too poor or unstable to borrow from private markets. These are the "soft loan" or concessional windows for each MDB:
    - International Development Association (World Bank Group)
    - Fund for Special Operations (Inter-American Development Bank)

- Asian Development Fund (Asian Development Bank Group)
- African Development Fund (African Development Bank Group)

Because the European Bank for Reconstruction and Development is private sector-oriented, it does not have a "soft loan" window.

- The "hard loan" window is for non-concessional lending that provides loans to middle-income countries, such as Colombia and Botswana, and some creditworthy low-income countries, such as Indonesia and Nigeria, at market-based interest rates. These are the "hard loan" or non-concessional windows for each MDB:
  - The International Bank for Reconstruction and Development (World Bank)
  - Inter-American Development Bank
  - Asian Development Bank
  - African Development Bank
  - European Bank for Reconstruction and Development

How are the MDBs funded?

Countries are referred to as "shareholders" in an MDB and hold a certain percentage of shares based on their contributions.

At times, shareholders provide new funding to support the hard loan or soft loan windows. This funding can take three forms:

- Capital replenishments
- General capital increases
- Selective capital increases

Capital Replenishments: Because financing for the "soft loan" windows is provided on such generous terms to the very poorest countries, concessional funds need to be replenished every three to four years. When fully funded, U.S. funding commitments are paid out in equal installments over the replenishment period.

General Capital Increases

Under a general capital increase (GCI), MDB shareholder governments agree to increase capital to support the MDBs "hard loan" windows by purchasing additional shares in the institution. Unlike replenishments, GCIs happen infrequently because these windows are largely self-financing. Periodically however, MDBs will seek to bolster their capital in order to increase or sustain lending levels.

The financing arrangements for GCIs are unique. Unlike replenishments, only a small portion of the total commitment is paid directly to an MDB. This portion is called "paid-in" capital, and typically ranges from 5-10 percent of the total increase. The pay-in period often ranges significantly (e.g., from three to eight years).

The remainder of the commitment is made in the form of "callable capital." Callable capital represents a financial commitment made by shareholders, but there is no actual transfer of funds. These commitments are meaningful because they enable the MDBs to borrow against them, and, in turn, lend to borrowers at rates lower than what they could obtain in the markets. An MDB can only seek the transfer of callable capital its own accounts in the unlikely event that it becomes unable to access private capital markets or use its own resources to cover obligations on its own loans (i.e., funds borrowed on the market) or on loans it has guaranteed. No MDB has ever made a call on callable capital.

Selective Capital Increases

A selective capital increase (SCI) is not used as, strictly speaking, a fundraising vehicle, but is used to allocate new shares to eligible members based on economic weight, financial contributions and development contributions. An SCI is a means of realigning shareholding to increase the share of developing countries and countries with economies in transition in an MDB's decision making. Unlike a GCI, where shares are allocated to members in proportion to their existing shareholding, an SCI realignment is important to better reflect global trends and ensure that the poorest countries have a voice.

What do new capital commitments mean for the United States?

Negotiations for new capital are not limited to questions of financing needs. In fact, the United States has used the opportunity created by capital increase negotiations to pursue a robust agenda for new policy commitments from the MDB and other shareholders. The United States has consistently used its leadership position to advocate for new initiatives designed to strengthen development effectiveness. Typically, we focus on policies to strengthen transparency, governance, accountability and results. Recently, we have also emphasized the need for policies to strengthen fiscal discipline within the MDBs and protect capital. In addition, we have successfully pressed for MDBs to transfer an increasing share of profits from the hard loan windows to the soft loan windows that support the poorest countries. These transfers achieve two important objectives: they help the MDBs maintain their focus on the neediest borrowers and they reduce the financial burden on shareholders.

What are the implications for failure to meet these U.S. obligations to the MDBs?

GCIs: When a shareholder fails to purchase the shares that it agreed to buy in the capital increase negotiations, the relative shareholding of that country will become diluted. Voting shares are adjusted to reflect contributions as they come in from shareholders, such that delayed contributions will have an impact on the current U.S.'s voting share. Any shares allocated to a country that are not paid for within the allotted subscription period will be moved to the MDB's unallocated capital, potentially making these shares available for other shareholders to acquire. Several countries seeking to expand their influence in the MDBs, have expressed an interest in purchasing shares when they become available in this manner.

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Replenishments: Almost two-thirds of U.S. arrears to the MDBs are to the institutions that provide support for the poorest countries (International Development Association, the Asian Development Fund, and the African Development Fund).

Our large and longstanding arrears not only deprive MDB borrowing countries of resources, they also undermine our leadership in these institutions. For example, during the negotiations at the latest replenishment of the GEF, the United States sought to leverage a significant increase in U.S. support in exchange for similarly large increases from other donors. However, other shareholders pointed to the significant U.S. arrears as evidence that the U.S. would not be able to deliver on an increased pledge and scaled back their own pledges accordingly. Similarly, some countries now link their contributions to U.S. payments, which magnifies the impact of any U.S. arrears.

Mobilizing Climate Finance

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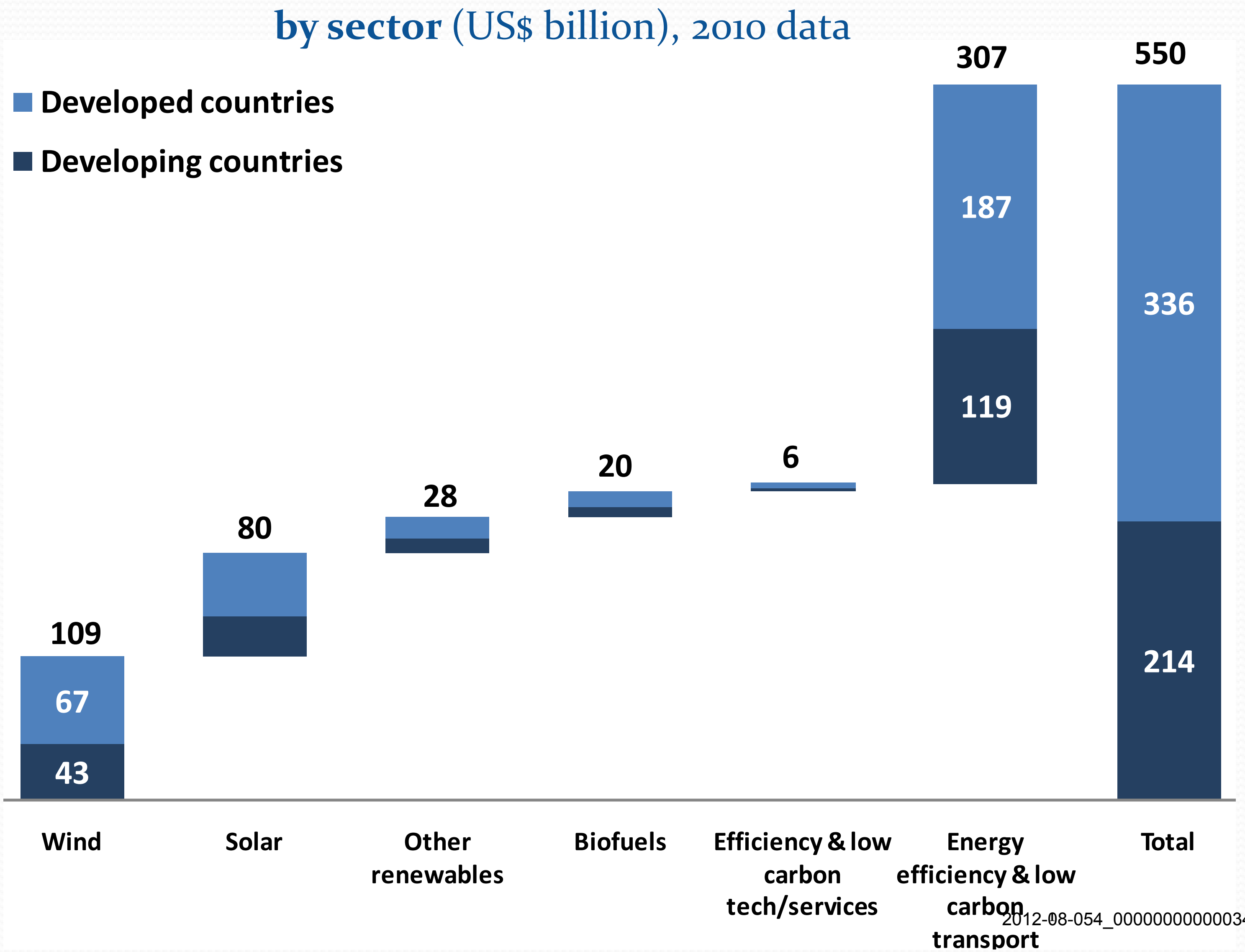
G-20 Study Group on Climate Finance

2012-08-054_000000000000338

23 September 2012, Mexico

I. Current Flows and the Need for More Capital Allocated Differently

Climate investment has grown fast and has more potential if market failures and barriers can be tackled



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[1]: Pro-rated split between developed and developing countries

Source: Bloomberg New Energy Finance, HSBC, staff estimates

ANNUAL INVESTMENT REQUIRED TO ACHIEVE 2°C PATHWAY

USD Bn, average per annum 2011–2020 to reach 14 Gt of abatement

More than 5 Bn | 1–5 Bn | Less than 1 Bn

	Nations													
	China	United States	EU 27	Africa and Middle East	Rest of developing Asia	India	Russia and Eastern Europe	Latin America	Japan	Rest of OECD Pacific	Canada	Rest of OECD Europe	Total	Percent
Power[1)]	65	47	44	21	22	20	12	10	14	12	5	3	275	41%
Industry	41	10	9	7	3	6	6	5	4	2	1	2	96	14%
Transport road	22	21	17	4	4	4	5	6	5	3	2	1	94	14%
Buildings	34	35	36	12	3	6	9	5	4	6	4	2	156	23%
Waste	1	3	2	3	2	0	2	2	0	1	1	0	16	2%
Forestry	1	0	0	2	11	1	0	2	0	0	0	0	17	3%
Transport Air and Sea[2)]	12												12	2%
Total	163	116	109	62	45	37	34	30	27	23	12	8	650–700	
Percent	24%	17%	16%	9%	7%	6%	5%	4%	4%	3%	2%	1%		

Note: Cement and Deforestation have been taken out
1) Represents total Capex
2) No breakdown on country level available

Some estimates suggest up to USD 2,100 bn p.a. of investment requirement

Source: Credit Suisse/WWF analysis based on McKinsey's Climate Desk tool. Any conclusions are the sole responsibility of Credit Suisse/WWF.

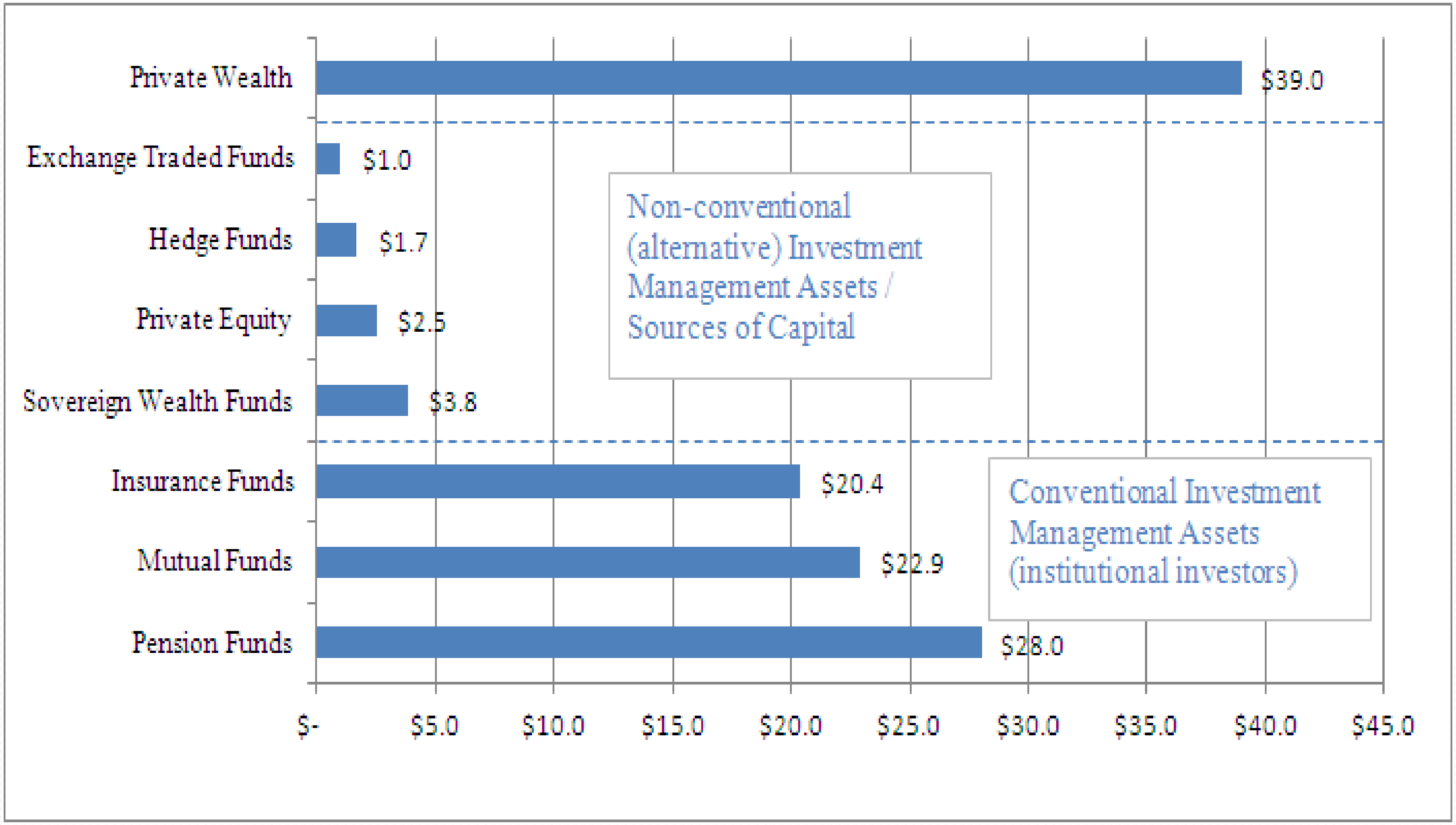
Source: Transition to a low carbon economy: the role of banks, (2011), by Credit Suisse and World Wildlife Fund

Climate Investment Goal: *More* Capital ***Allocated Differently***

- Investment for global energy *increases* due to high capital intensity of many productivity levers
- "Considerable shifts in the composition of this investment" -- energy supply drops 30%, efficiency, renewables and T&D increase markedly
- Mostly in developing countries – 90% of power generation improvements, 60 percent in transport, about 80% in agriculture
- Source: McKinsey, "Resource Revolution" (2011)

II. Potential Sources of Additional Private Investment

2009 GLOBAL FUND MANAGEMENT INDUSTRY: ASSETS UNDER MANAGEMENT (US$TN)



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Source: The Role of Pension Funds in Financing Green Growth Initiatives. (2011), Della Croce, R., Kaminker, C., Stewart, F., OECD

Carbon markets: alive despite very low prices

- A viable, cost-effective means to reduce emissions and to catalyze low-carbon investment
- Joining EU and NZ, 6 jurisdictions passed climate bills, including market initiatives
  - Australia, California, China, Quebec, Republic of Korea, Mexico
- Durban decisions increased the regulatory clarity on existing market and advanced on new market instruments

Partnership for Market Readiness (PMR)

A $100 mln global partnership for carbon market innovation:
• Build market readiness
• Pilot new concepts for market instruments
• Foster technical discussions and exchange on lessons and best practices
• Connect countries and collectively foster a global carbon market.

25 countries (15 implementing)

III. Barriers to the Increase of Private Climate Flows

RISKS INVOLVED IN SECURING CLIMATE CHANGE FINANCE

Transactional Risks	Project Risks	Policy Risks	Capacity Risks
• Risk/Reward Imbalance • Private Sector Funding Shortage • Complexity Risk • Policy Development Risk • Currency Risk • Economic/Commodity Price Volatility • Fungibility Risks • Liquidity Risk • Branding Risk	• Transaction Cost Risk • Fraud/Cash Leakage • Physical Risk • Scale Risk • Technology Risk	• Additionality Risk • Cannibalization Risk • Enforcement Risk • Illegitimate Policy Changes • Inconsistency Risk • Legitimate Policy Changes • Longevity Risk • Methodology, Reporting &Verification (MRV) Risk	• Multitude Risk • Aggregation/ Commoditization Risk • Human / Operational • Infrastructure • Institutional - property rights • Institutional - Regulatory • Quality assurance risk

Source: adapted from Can Capital Markets Bridge the Climate Change Financing Gap? (2010), by Parhelion and Standard & Poor's

BARRIERS FOR SELECTED CLIMATE SECTORS IN DEVELOPING COUNTRIES

PROJECT TYPE	KEY BARRIERS	HOW TO ADDRESS
Renewable Energy	• Fossil fuel subsidies • Large up-front capital cost • Some technology risk • Network effects	• Price externality • Feed-in tariffs • Predictable regulation • Risk reduction measures • Network upgrades • Develop project risk data
Industrial Energy Efficiency	• Energy pricing distortions • Lack of standards • Lack of ESCOs / in-house technical expertise • Transaction costs • Inability to price risk	• Develop and enforce standards • Local banking capacity • Risk reduction measures • Demonstration projects • Develop industry/risk data
Building Energy Efficiency	In addition to the barriers for industrial energy efficiency: • Agency problems	In addition to the measures for industrial energy efficiency: • Reduce builder-user information asymmetry by establishing building codes and performance standards
Supply Chains for RE and EE	• Dependent on downstream market	• Develop downstream markets for EE and RE
Cleantech	• Weak local venture capital or private equity markets • Most technology innovation originating from developed countries	• Support local R&D • Supportive tech transfer regime • Support local venture capital / private equity funds

Source: Climate Finance: Engaging the Private Sector, (2011), IFC

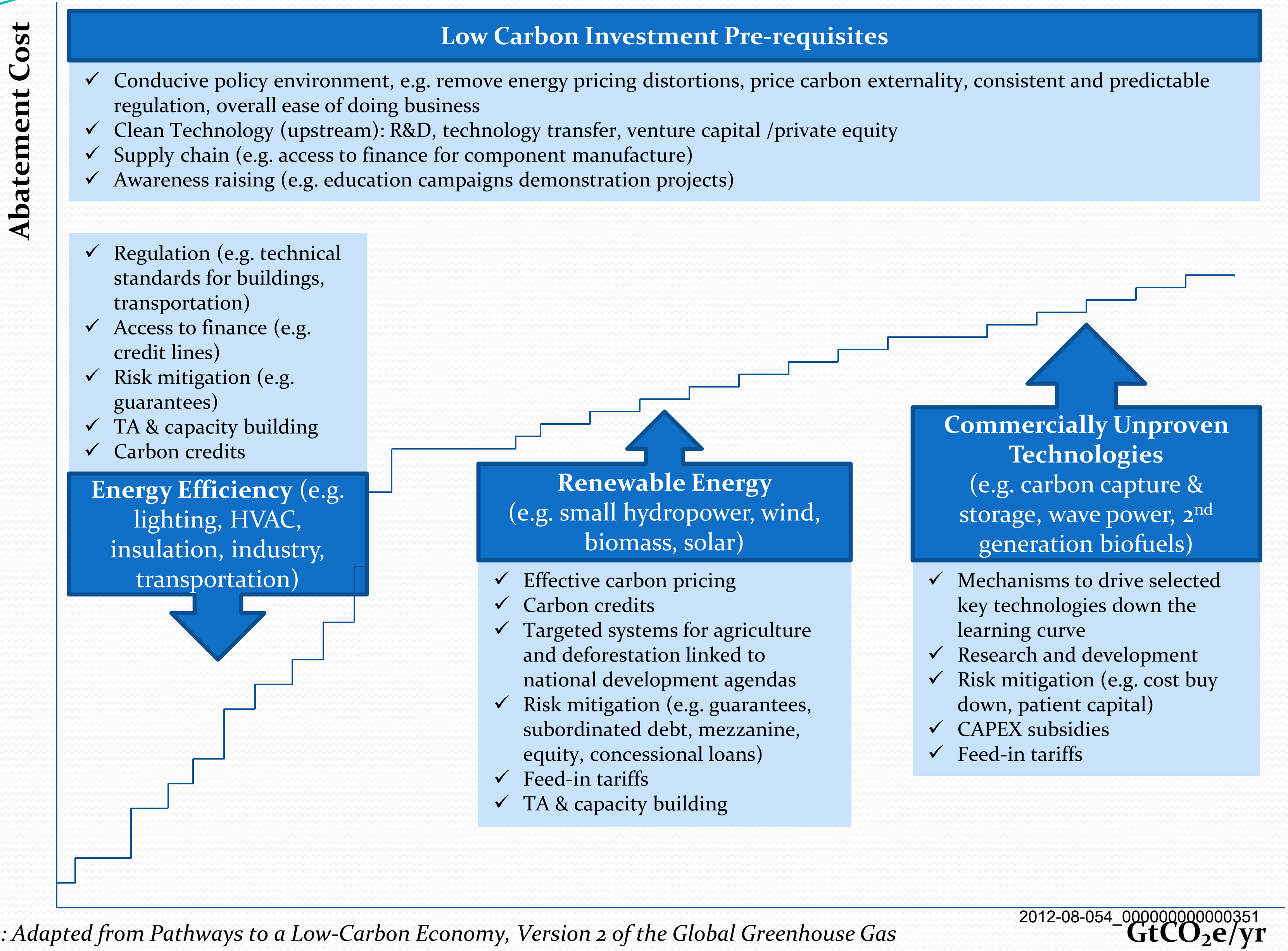
IV. Potential Solutions -- including MDB Financial Instruments -- to *Increase* and *Redirect* Financial Flows to Climate-Related Investments

SUMMARY OF FINANCIAL LEVERAGING TOOLS

Mechanism	Direct public financing or guarantees	Debt or equity?	Risk level	Mitigates many risks or few?	Estimated leverage ratio	When tool most useful /in what contexts?
Loan guarantees	Guarantee	Debt	High	Many	6x-10x	Countries with high political risk, dysfunctional energy markets, lack of policy incentives for investment
Policy insurance	Guarantee	Debt	Medium	Adaptable to many, but ultimately one	10x & above	Countries with strong regulatory systems and policies in place, but where specific policies are at risk of destabilizing
Forex liquidity facility	Direct Financing	Debt	Low	One	?	Countries with currency fluctuations
Equity ‘pledge’ fund	Direct Financing	Equity	Low	Many	10x	Projects with strong IRR, but where equity cannot be accessed. Projects need to be proven technology, established companies
Subordinated equity fund	Direct Financing	Equity	High	Many	2x-5x	Risky projects, with new or proven technologies, new or established companies

Source: Leveraging private investment: the role of public sector climate finance, (2011), Brown, J. and Jacobs, M., Overseas Development Institute

Financial instruments and support mechanisms can facilitate energy sector investments



Source: Adapted from Pathways to a Low-Carbon Economy, Version 2 of the Global Greenhouse Gas Abatement Cost Curve, McKinsey & Company, 2009

Role of MDBs:
Mobilizing and Leveraging Finance and Markets

A. Pooling flows to support targeted concessional lending	B. Leveraging shareholder capital with private market borrowing

• **New ways to contribute**, e.g., long-term concessional loans with Clean Technology Fund
• **New sources**, e.g., private foundations and emerging donors
• More **flexibility in structuring**
• **Learning opportunities** from health sector (AMC, IFFIm)
	• **Limited current headroom for additional climate financing**
	• A climate-focused capital increase could be considered in the longer term
	  • **Leverage factor of 3 to 4 for new climate loans**
	  • Solutions needed to **accommodate climate capital increase with shareholder structure**

Thank you

Public Sources of Climate Finance

Ian Parry
Fiscal Affairs Department, IMF

Carbon pricing vs other domestic, climate-related instruments

Carbon pricing—two advantages

- Exploits all emission reduction opportunities:
  - fuel switching in power generation, reducing demand for electricity, transportation, heating fuels
  - other tax instruments less effective

- Greater revenue potential—in US, revenue potential from (sector-based) taxes relative to that from comprehensive carbon pricing is about
  - 40% (electricity)
  - 35% (transportation)
  - 25% (heating)

Carbon taxes vs. ETS

- Choice less important than doing one of them, but getting design details right:
  - comprehensive coverage
  - raising revenue and putting it to good use
  - price stability provisions for ETS
  - aligning prices to environmental damages

A \$25/ton CO_2 charge in developed countries...

…in 2020 would:

- Provide \$25 bn for climate finance if 10% is made available
- Policy need not be costly if domestic revenues used to cut taxes on work effort and investment

Compensating households: options

- Reduce excise taxes on electricity, vehicle ownership.

- Strengthening social safety nets is more targeted way to help low-income households than holding down energy prices.

- Forthcoming IMF paper looking at case studies.

Addressing competitiveness/leakage: options

- Carbon price floor among major emitters

- Border tax adjustments (≈$10 bn of revenue).

- Production subsidies for trade-exposed firms.

Charges for International Aviation/Maritime

Natural source of climate finance

- National governments have weaker claim on tax base
- Under-taxed from
  - environmental perspective (no excise tax)
  - broader fiscal perspective (e.g., passenger tickets not subject to VAT)
- Reflects
  - legal constraints in aviation
  - competition for mobile tax base

Administration

- Charges could be levied on fuel (nationally or internationally):
  - at refineries (extension of motor fuel taxes)
  - as fuel is disbursed at airports and ports
  - directly on aircraft and ship operators

Cooperation and Compensation

- International coordination over fuel charges is especially important for maritime (ease of re-fueling at ports where charges not applied)
- But such measures will harm developing countries—compensation needed for fairness and to encourage their participation

Compensation Schemes: Aviation

- Much of the burden (including for tourism destinations) would likely fall on passengers from wealthy countries

- So fully rebating aviation fuel charges could provide over-compensation

- Alternatively, developing country participation could be voluntary (and they would gain from joining as revenues borne by overseas passengers)

Compensation Schemes: Maritime

- Ships may not re-fuel where they offload goods → fuel tax rebate may not provide adequate compensation (e.g., landlocked countries)

- Compensate by shares in seaborne imports (e.g. Ethiopia would receive $9 mn p.a. if revenue were $15 bn)

Revenue and price impacts

- Raise $22 billion for climate finance in 2020 (after developing country compensation)
  - $7 billion (aviation)
  - $15 billion (maritime)

- Price impacts relatively modest:
  - passenger tickets 2-4 percent
  - import prices 0.2-0.3 percent

Conclusion

- Further work is needed (e.g., compensation schemes)

- But acceptable and desirable proposals should be feasible

Thank you!

Inclusive Green Growth

The Pathway to Sustainable Development

THE WORLD BANK

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Contents

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Boxes

Figures

Tables

Foreword

Inclusive green growth is *the* pathway to sustainable development.

Over the past 20 years economic growth has lifted more than 660 million people out of poverty and has raised the income levels of millions more, but growth has too often come at the expense of the environment. A variety of market, policy, and institutional failures mean that the earth's natural capital tends to be used in ways that are economically inefficient and wasteful, without sufficient reckoning of the true social costs of resource depletion and without adequate reinvestment in other forms of wealth. These failures threaten the long-term sustainability of growth and progress made on social welfare. Moreover, despite the gains from growth, 1.3 billion people still do not have access to electricity, 2.6 billion still have no access to sanitation, and 900 million lack safe, clean drinking water. Growth has not been inclusive enough.

This report argues that sustained growth is necessary to achieve the urgent development needs of the world's poor and that there is substantial scope for growing cleaner without growing slower. Green growth is necessary, efficient, and affordable. It is the only way to reconcile the rapid growth required to bring developing countries to the level of prosperity to which they aspire with the needs of the more than 1 billion people still living in poverty and the imperative of a better managed environment.

Indeed, green growth is a vital tool for achieving sustainable development. But sustainable development has three pillars: economic, environmental, and social sustainability. We cannot presume that green growth is inherently inclusive. Green growth policies must be carefully designed to maximize benefits for, and minimize costs to, the poor and most vulnerable, and policies and actions with irreversible negative impacts must be avoided.

Green growth also requires improved indicators to monitor economic performance. National accounting indicators like GDP measure only short-term economic growth, whereas indicators like comprehensive wealth—including natural capital—help us determine if growth is sustainable in the long run.

The Conference on Environment and Development, held in Rio in 1992, focused on inclusion and the environment but failed to mention growth. In the lead up to Rio+20, we are reminded that, in 1987, Gro Harlem Brundtland, then Prime Minister of Norway, framed the call for governments to change their approach to growth: "*What is needed now is a new era of economic growth—growth that is forceful and at the same time socially and environmentally sustainable.*"

Today, more than ever, we must pay attention to the triple bottom line. Inclusive growth must be green. Green growth must be inclusive.

Rachel Kyte
Vice President
Sustainable Development Network
The World Bank

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Abbreviations

$	US$ unless otherwise indicated
AMMA	African Monsoon Multidisciplinary Analyses
ANS	adjusted net savings
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
COMTRADE	Commodity Trade Statistics database
ESCO	energy service company
ESTD	early-stage technology development
ETS	Emissions Trading System
EU	European Union
GDP	gross domestic product
GGKP	Green Growth Knowledge Platform
GRP	Green Rating Project (India)
Gt	gigatons
HPS	Husk Power Systems
IEUA	Inland Empire Utility Agency
IFI	international financial institution
ITQ	individual transferable quota
ITS	Intelligent Transport Systems
MCA4Climate	Multi-Criteria Analysis for Climate
MDG	Millennium Development Goal
NO_x	nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PES	payments for environmental services
PERP	performance evaluation and ratings program
PM10	particulate matter up to 10 kilometers in size

PNK	Putri Naga Komodo (Indonesia)
ppm	parts per million
PPP	purchasing power parity
PROPER	Program for Pollution Control, Evaluation, and Rating (Indonesia)
PV	photovoltaic
R&D	research and development
REDD	Reducing Emissions from Deforestation and Forest Degradation
RSPO	Roundtable on Sustainable Palm Oil
SME	small and medium enterprise
SO_2	sulfur dioxide
TAC	total allowable catch
UNEP	United Nations Environment Programme
UWMP	Regional Urban Water Management Plan
VC	venture capital
WAVES	Wealth Accounting and Valuing Ecosystem Services

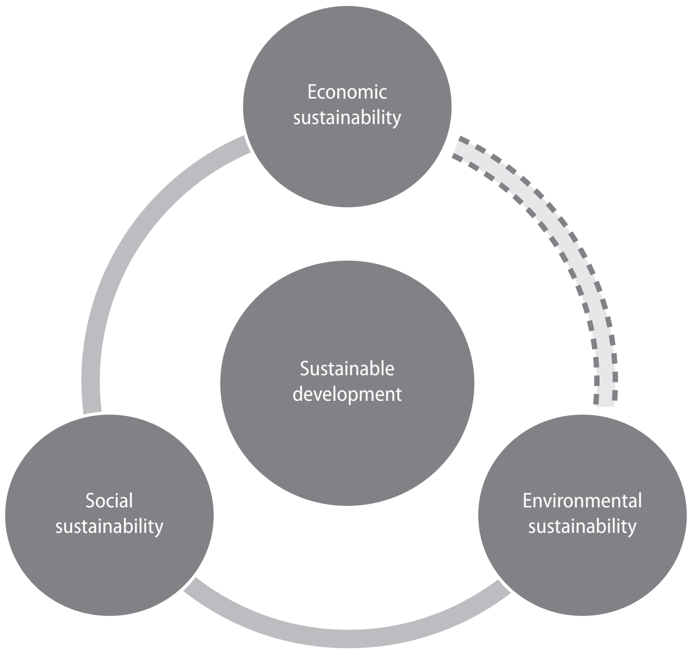
Overview

Key Messages

- *Greening growth is necessary, efficient, and affordable.* It is critical to achieving sustainable development and mostly amounts to good growth policies.
- *Obstacles to greening growth are political and behavioral inertia and a lack of financing instruments*—not the cost of green policies as commonly thought.
- *Green growth should focus on what needs to be done in the next five to 10 years* to avoid getting locked into unsustainable paths and to generate immediate, local benefits.
- *The way forward requires a blend of economics, political science, and social psychology*—smart solutions to tackle political economy constraints, overcome deeply entrenched behaviors and social norms, and develop the needed financing tools.
- *There is no single green growth model.* Green growth strategies will vary across countries, reflecting local contexts and preferences—but all countries, rich and poor, have opportunities to make their growth greener and more inclusive without slowing it.

Our current growth patterns are not just unsustainable; they are also deeply inefficient. As a result, they stand in the way of sustainable development and its objectives of social, environmental, and economic sustainability (figure O.1). The past 20 years have shown that the economic and social goals are not only highly compatible, but also largely complementary. Growth drives poverty reduction (though the extent to which it does so depends on the degree of inequality). And improved social outcomes, such as better health and education and greater equality of opportunity, are good

FIGURE O.1 The three pillars of sustainable development



Note: Economic and social sustainability, on the one hand, and social and environmental sustainability, on the other, have been found to be not only compatible, but also largely complementary. Not so with economic and environmental sustainability, as growth has come largely at the expense of the environment—hence, the dotted line on this figure—which is why green growth aims to ensure that economic and environmental sustainability are compatible.

for growth. Not so with the economic and environmental pillars: for the past 250 years, growth has come largely at the expense of the environment. And environmental damages are reaching a scale at which they are beginning to threaten both growth prospects and the progress achieved in social indicators.

What can be done to turn this situation around? We argue that what is needed is green growth—that is, growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters. And this growth needs to be inclusive.

Inclusive green growth is not a new paradigm. Rather, it aims to operationalize sustainable development by reconciling developing countries' urgent need for rapid growth and poverty alleviation with the need to avoid irreversible and costly environmental damage. As such, efforts to foster green growth must focus on what is required in the next five to 10 years to sustain robust growth, while avoiding locking economies into unsustainable patterns, preventing irreversible environmental damage, and reducing the potential for regret.

Moreover, rapid action is needed to keep the costs of greening growth manageable and avoid irreversible losses. This urgency applies to developing and developed countries alike:

- Developing countries—which will account for the vast majority of global growth in income, infrastructure, and population in the coming decades—need to choose whether to build right or risk facing costly policy reversals in the future.
- High-income countries—which, with 16 percent of world population, still account for more than 75 percent of global consumption and 41 percent of global emissions of carbon dioxide (CO_2)—must act according to their responsibility. Most important are changes in the patterns of consumption and production that boost demand for green technologies. This is essential to stimulate technological innovation and the scale of production necessary for prices to drop and green technologies to become competitive. Thus, Germany's aggressive solar feed-in tariff was critical in boosting global demand for solar panels, thereby reducing their cost.

As to *how* to make growth greener, textbooks going back at least to the 1950s offer the basic instruments, with environmental taxation, norms, and regulations being the main tools of a green growth strategy. Today, technology is making it easier to implement these measures and monitor their impacts. However, making these measures work is complex in real-world settings plagued by governance failures, market failures, and entrenched interests and behaviors. It requires complementary policies, including public investments, innovation and industrial policies, education and training, labor market reforms, and communication. Making matters worse is the urgency with which these policies must be designed and implemented, especially in the face of enormous uncertainty about the future climate and technology.

Although we have much theoretical and empirical knowledge to draw on, green growth raises challenging questions, especially when it comes to the developing world. For example, how can developing countries avoid locking in unsustainable and inefficient socioeconomic systems? Will technology allow developing countries to pursue a less environmentally damaging development path than industrial countries did? What is the best way to manage growth with scarce fiscal resources and limited planning and technical know-how? Is green growth just an aspirational goal—desirable from an environmental and ethical point of view, but unattainable given competing economic needs?

At heart, these are questions of economics, which is why the report takes an economic approach—using the standard tools of mainstream growth and environmental economics—with some forays into what social psychology can tell us about the determinants of human behavior. Chapter 1 examines whether green growth is, in fact, feasible and the implications for welfare—the ultimate goal of economic policy. It argues that our current system is inefficient, thereby offering opportunities for cleaner (and not necessarily slower) growth. And it identifies the flaws in the "grow now, clean up later" argument.

The next two chapters tackle the cross-cutting issues of market and governance failures. Chapter 2 looks at the range of tools that can be marshaled to change behavior with respect to environmental and natural resources—tools that aim to improve social welfare through greener growth. These include effective market signals, properly framed and judiciously used information, and rules and regulations. Chapter 3 explores the need to navigate between market and governance failures through the careful use of innovation and industrial policies, such as research and development (R&D) subsidies for drought-resistant crops, national strategies for electric cars, and efforts to create new green industries (such as China's promotion of solar photovoltaic production).

The subsequent three chapters focus on human, natural, and physical capital and their roles in a greener production function. Chapter 4 tackles the debate on whether green growth will create jobs, with political leaders keen to promote the idea of green jobs to reduce high unemployment levels. It finds that, while there is surely potential to create green jobs, the net impact is what matters, and that will depend largely on the nature of the policy chosen and the soundness of labor markets and the business environment. Importantly, evidence on past regulation suggests that fears about massive job losses are misplaced.

Chapter 5 reviews what we know about managing natural capital. Depending on the type of resource (such as extractable or cultivated renewable), the tools include defining property rights, helping firms to move up the value chain, managing trade-offs between higher growth and greener outcomes, and incorporating the economic values of services in policy decisions.

Chapter 6 explores why infrastructure is at the core of inclusive green growth policies, underscoring the high potential for both regret (given the tremendous inertia built into infrastructure investments) and benefits (given the need for massive increases in infrastructure services in developing countries).

Chapter 7 filters the key lessons through a political economy lens and provides a framework for building an inclusive green growth strategy—in light of the technical tools available, the need to maximize local and immediate benefits while minimizing lock-in, and the uncertainties about the future climate and technologies.

What are the overall messages of the report?

First, *inclusive green growth is necessary, efficient, and affordable.* It is necessary because sustainable development cannot be achieved without it. It is efficient in that addressing the market and governance failures that plague our economic systems will create plenty of scope for growing cleaner without necessarily growing slower. The best example is the $1 trillion to $1.2 trillion currently being spent on environmentally harmful subsidies for fossil fuel, agriculture, water, and fisheries. Green growth is affordable because many green policies pay for themselves directly, and the others make economic sense once externalities are priced and ecosystem services are valued.

Second, *greening growth is constrained by social and political inertia and by a lack of financing instruments—not affordability, as is commonly believed*. Entrenched behavior, special interests, and the complicated political economy of reform explain why measures that amount to good growth policies have not yet been implemented. Also, many green growth measures require increased up-front capital. Yet the debate on financing remains focused on who pays what, rather than on how to finance economically (let alone socially) profitable investments.

Third, *greening growth should be carefully sequenced—not occur in one fell swoop—with priority going to what needs to be done in the next 5 to 10 years, both to avoid getting locked into unsustainable paths and to offer immediate, local benefits*. Those benefits will help to reduce the cost of the transition and facilitate the political economy of reform. Urban forms that are created today will affect city structures and housing and transport options for decades or even centuries. With urban populations in developing countries set to increase by 1.5 billion over the next 20 years, there is a window of opportunity to affect urban patterns at low cost.

Fourth, *the search for solutions needs to shift from a search for more financial resources (difficult anyway amid today's fiscal woes) to "getting smart"*:

- Smart about learning the lessons of complex reforms to tackle difficult political economy questions, given that many green policies trade immediate costs for later benefits or redistribute benefits from one group to another. Notable successes include trade reforms across the world, reform of fisheries in Namibia, reform of the Common Agricultural Policy in the European Union (EU), and progress on fossil fuel subsidies in the Islamic Republic of Iran, where care was taken to manage the losers and publicize the benefits.
- Smart about changing the behavior of consumers and firms and the view of societies about what constitutes social success and acceptable behavior. This entails combining economic incentives with well-framed information and the marketing techniques that public health specialists (or car salesmen) commonly use.
- Smart about developing the appropriate financing tools for the private sector, especially small firms, for local governments (China's cities are developing in a sprawling fashion in part because land sales at their peripheries are an important source of revenue for city governments; World Bank and DRC 2012), and for national governments, which are sometimes so fiscally constrained that they have to choose the investment with the lowest up-front cost (such as a thermal power plant) over one that may be less expensive in the medium term (such as a hydroelectric plant in a country with abundant water resources).

Fifth, *there is no single green growth model*. Inclusive green growth strategies will vary across countries, reflecting local contexts, preferences, and resources, but all countries—rich and poor—have opportunities to green their growth without slowing it.

Greening growth is necessary, efficient, and affordable

Necessary: Making development sustainable requires inclusive green growth

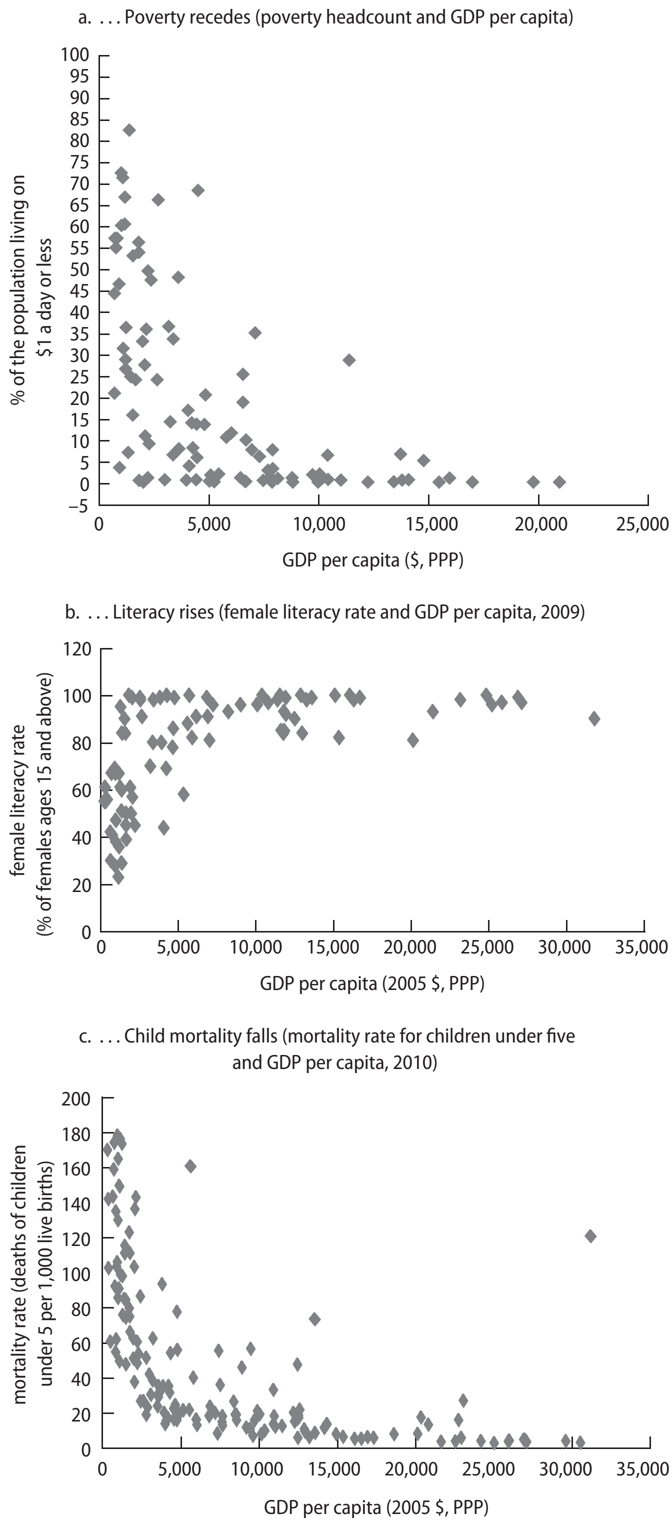
Growth—even measured with such an imperfect metric as gross domestic product (GDP)—is now recognized as a critical driver of poverty reduction (figure O.2, panel a; Ferreira and Ravallion 2009). It has resulted in an 80 percent increase in GDP per capita in developing countries over the past 20 years, despite substantial increases in population. Living standards have improved for many (figure O.2, panels b and c), with more than 660 million rising out of poverty and remarkable progress being made in literacy, education, life expectancy, malnutrition, and infant, child, and maternal mortality. And while China drove much of global poverty reduction, other countries that experienced growth also saw poverty decline rapidly. Ghana, for example, grew much faster than the African average and managed to reduce its poverty rate from 51 to 30 percent between 1990 and 2005 (World Bank 2011c).

Moreover, growth need not cause income inequality. The famous Kuznets curve argument, which posits that inequality first increases and then decreases with income, is not supported by the evidence. Inequality has increased substantially in recent decades in China, but also in the United States and most of Europe. And it has declined in much of Latin America (Milanovic 2010). Some countries reduce inequality as they grow; others let it increase. Policies matter.

Thus, the links between the economic and social pillars of sustainable development are generally self-reinforcing. But the story is not so simple when it comes to the economic and environmental pillars. Economic growth causes environmental degradation—or has for much of the past 250 years—driven by market failures and inefficient policies. As with inequality, overall environmental performance does not first get worse and then improve with income—no Kuznets curve here either. Of course, some local and visible environmental public goods do worsen at first and eventually improve with income—typically local air quality. But this is not true of local pollutants with invisible or long-term impacts (such as the accumulation of pesticides and toxic chemicals in land and water) or global pollutants (such as greenhouse gases in the atmosphere). These often get worse with higher income (figure O.3).

Against this backdrop, some observers, mostly in high-income countries, have argued

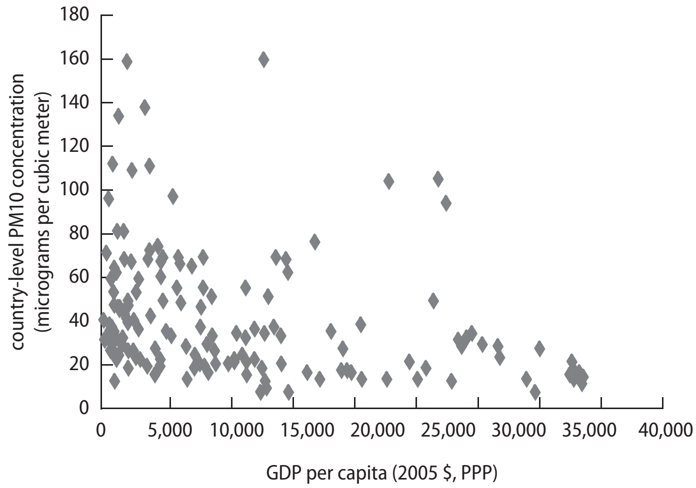
FIGURE O.2 As incomes increase . . .



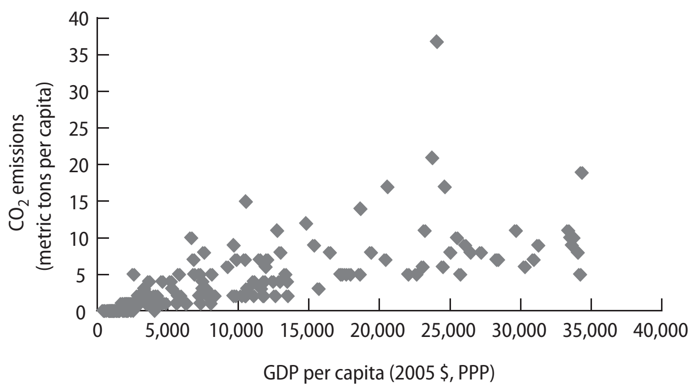
Source: For panel a, Ferreira and Ravallion 2009; for panels b and c, World Bank 2011c.

FIGURE O.3 As incomes increase . . .

a. . . . Local and visible pollutants tend to decline (PM10 concentration and income per capita, 2008)



b. . . . Global pollutants, such as CO_2 emissions, tend to increase (CO_2 emissions and income per capita, 2008)



Source: For both panels, World Bank 2011c.

against the need for more growth, suggesting that what is needed instead is a redistribution of wealth (Marglin 2010; Victor 2008). They point to the happiness literature, which suggests that above a country average of $10,000 to $15,000 per capita, further growth does not translate into greater well-being (Easterlin 1995; Layard 2005).

While this argument has value, it remains more relevant for high-income countries, where average annual incomes hover around $36,000. Developing countries—with average income of around $3,500 per capita—are still far from the point at which more wealth will bring decreasing returns to well-being. In fact, in low-income countries, average income is only about $500 (World Bank 2011c).[1] A redistribution of world income across rich and poor countries—even if it were politically feasible—would leave all with an income of about $8,000 per person per year.

Further, even after the rapid growth of the past decade, some 1.3 billion people do not have access to electricity, 900 million do not have access to clean water, 2.6 billion lack access to improved sanitation, and around 800 million rural dwellers do not have access to an all-weather road and are cut off from the world in the rainy season (Fay and others 2010; IEA 2011). Even with the rapid decline in the share of people living in poverty, close to 1 billion could still be living on $1.25 per day in 2015. With continued growth at about the same speed as during the past 20 years, developing countries would account for about half of the world's income and consumption (but close to 90 percent of the world population) by 2050.

Continued rapid population growth in several developing regions further complicates matters. Current projections are that the world will reach some 9 billion people by 2050. This implies that even more rapid growth is needed to tackle poverty, and more aggressive social policies are needed to ensure that children, especially girls, and mothers receive the care, nutrition, schooling, and employment opportunities they need. And, of course, this demographic challenge puts further stresses on the environment, particularly because much of the rapid population growth is happening in environmentally fragile locations, notably in Africa.

Thus, growth is a necessary, legitimate, and appropriate pursuit for the developing world, but so is a clean and safe environment. Without ambitious policies, growth will continue to degrade the environment and deplete resources critical to the welfare of current and future generations. And what about the argument that ambitious policies would be too costly and destroy jobs? The evidence reviewed in this report suggests that there is plenty of room to green growth without slowing it.

Efficient: Current patterns of growth are not only unsustainable, but also wasteful

There is mounting evidence that our patterns of growth and consumption are unsustainable at the scale required by our current and projected population. Much of this, however, is owing to inefficient production and consumption and poor management of natural resources.

Unsustainable

Population and income growth and the resulting increase in demand for food have driven the expansion of agricultural production around the world.[2] Intensification and productivity increases have helped to limit ecosystem loss in many countries, but poorly managed intensification has also exacerbated agrochemical and water pollution, soil exhaustion, and salinity. Extensive farming, driven by large-scale expansion in some regions and poverty-level subsistence agriculture in others, has contributed to land degradation and deforestation; forest losses averaged 5.2 million hectares annually between 2000 and 2010, mostly in tropical—and, hence, more intensely biologically diverse—regions (FAO 2010). By 2008 one quarter of the world's land surface was degraded as a result of soil erosion, salinization, nutrient depletion, and desertification (Bai and others 2008).

Income and population growth have also stretched water supplies. Water withdrawals have tripled in the past 50 years, leading to water scarcity and groundwater depletion (World Bank 2007b). Withdrawals are projected to increase in developing countries by another 50 percent by 2025, by which time roughly 5.5 billion people—two thirds of the projected global population—will live in areas facing moderate-to-severe water stress (UNESCO and WWAP 2006).

Growth has similarly strained ecosystems, with roughly 60 percent of ecosystem services now of lower quality than 50 years ago (MEA 2005). Additionally, the current rate of species extinction, stemming mainly from habitat loss and degradation, is 100 to 1,000 times higher than before humans walked the planet (Pimm and others 1995). In 2008, 875 species became extinct, and more than 17,000 others are at high risk (IUCN 2009).

Carbon dioxide emissions are accumulating in the atmosphere, approaching a level that will make it impossible to maintain global mean temperature below 2°C in excess of the preindustrial level, even though the probability of irreversible environmental changes is increasing with temperature (for example, rapid ice loss in Greenland and forest dieback in the Amazon). Carbon dioxide is also affecting the world's oceans. Because of global warming, we have already committed to high probabilities of coral bleaching and mortality by the late twenty-first century, which will significantly harm reef ecosystems (World Bank 2010d). The concurrent acidification of oceans, which absorb about one quarter of the excess carbon dioxide in the atmosphere, is threatening marine food webs and could undermine the global fishing industry and food security (Laffoley and Baxter 2009).

Lastly, energy prices are likely to be high in the future, because oil resources that are easy and cheap to extract and use have already been extracted, and the world is now turning toward fossil fuels that are more expensive—and more damaging to the environment—such as shale gas, tar sands, oil from deep offshore wells, or even liquefied coal. Without significant changes in energy policy, the amount of resources the world economy will have to dedicate to fossil fuel extraction and energy production is likely to increase substantially, making higher energy efficiency even more desirable in the future than it is today.

Wasteful

The environment can be thought of as natural capital that is often inefficiently managed, with many precious resources wasted. Investing in natural capital—just like investing in human or physical capital—is therefore good growth policy. The value of the services provided by well-managed ecosystems is illustrated by the impact of reforestation and watershed restoration programs. In China's Loess plateau, such programs were associated with a near doubling of household incomes as a result of higher-value agricultural production as well as reduced frequency of landslides and flooding and increased resilience to drought (figure O.4; World Bank 2005b).

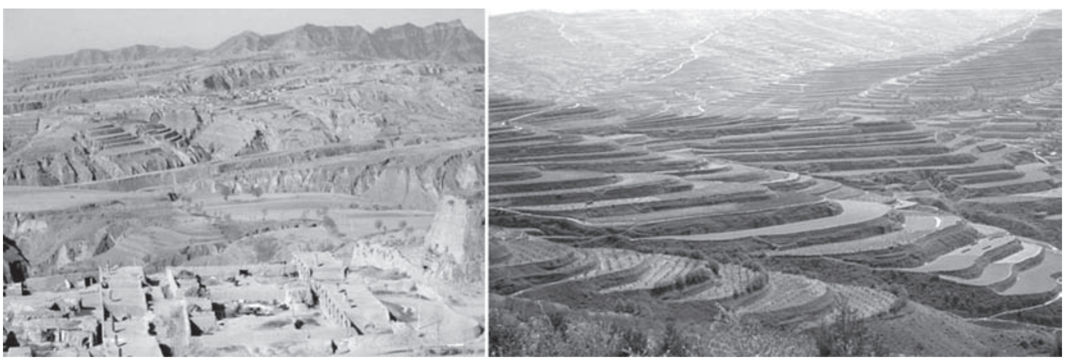
This inefficiency stems partly from the fact that many natural resources are common property, so consumption by one person precludes consumption by another, and it is hard to exclude potential users. Open-access regimes for common property create incentives to use up such resources as quickly as possible. Open access fisheries are a classic example in which catch per fisher and per vessel has been declining steadily because of overfishing, and continued depletion threatens the livelihood of more than 100 million people and the food security of many more.

Subsidies exacerbate common property problems, yet substantial resources are allocated to environmentally harmful price support schemes (box O.1). Global subsidies to fisheries are estimated at $10 billion to $30 billion and are partly to blame for the sixfold increase in the fleet capacity index between 1970 and 2005 (World Bank and FAO 2009).[3] In Mexico, subsidies for energy used in irrigation, amounting to around 1 percent of GDP, are exacerbating excessive groundwater withdrawals and the depletion of key aquifers. India suffers from the same problem in addition to spending some 2 percent of GDP on a fertilizer subsidy overly weighted in favor of nitrogen; the resulting use of fertilizer is causing serious pollution problems.

Production and consumption processes are often wasteful, too. This is particularly obvious in the energy sector. Existing energy efficiency technologies can cost-effectively reduce energy use in new buildings by at least 30 percent. In fact, making new buildings in China more energy efficient would reduce energy costs by more than 50 percent, while increasing construction costs by only 10 percent. Waste also plagues food production. Some 15 to 30 percent of food produced in developing countries is lost before it reaches the market due to poor storage and transport facilities. In high-income countries, meanwhile, one third of food is wasted through losses in supermarkets and homes and "plate-waste" (Foresight 2011).

The possibility of solving market and governance failures opens the way to policies that have both economic and environmental benefits and is at the heart of green growth strategies. (In that respect, greening growth is first and foremost based on good growth policies.) These market and governance failures have long been understood,

FIGURE O.4 The Loess plateau, before and after the watershed restoration program



Source: For the left-hand image, Till Niermann, March 25, 1987, http://en.wikipedia.org/wiki/File:Loess_landscape_china.jpg; for the right-hand image, http://digitalmedia.worldbank .org/slideshows/china1005/.

BOX O.1 What is the aggregate economic support to the (over)use of natural capital? $1 trillion to $1.2 trillion annually

A compilation of estimates by international organizations of aggregate support for the use of natural capital suggests an approximate total of $1 trillion to $1.2 trillion, consistent with McKinsey's estimate of $1.1 trillion (McKinsey and Company 2011). This support includes the following:

- *Fossil fuel subsidies: $455 billion–$485 billion.* This includes subsidies to fossil fuel production or use in Organisation for Economic Co-operation and Development (OECD) countries ($45 billion to $75 billion a year between 2005 and 2010) and consumption in developing economies ($409 billion in 2010; IEA 2011).
- *Water subsidies: $200 billion–$300 billion.* This represents subsidies to groundwater extraction or irrigation infrastructure—estimated as the difference between the market value of water and the part of costs covered by tariffs. Limited data are available, but Myers and Kent (2001) estimate water sector subsidies at $230 billion in 2000 and McKinsey (2011) cites estimates of $200 billion to $300 billion.
- *Fishery subsidies: $10 billion to $30 billion.* This encompasses a wide variety of instruments such as fuel price supports, grants, concessional credit and insurance, and direct payments to industry. Estimates range from $10 billion per year (World Bank and FAO 2009) to $27 billion per year (UNEP 2011).
- *Transfers to agriculture: $370 billion.* This represents total support to the agriculture sector in OECD countries (OECD 2011a) and includes different types of instruments, some environmentally harmful, such as market price supports, but some not, such as payments decoupled from production levels.

While these estimates suffer from errors of inclusion (some of the OECD countries' agricultural subsidies that were included are not environmentally harmful) and exclusion (they do not include developing countries' subsidies to agriculture, estimated by the OECD at about $200 billion for the few emerging economies for which data were available) and are therefore neither precise nor exhaustive, they do suggest that substantial resources go to environmentally harmful subsidies.

and their persistence suggests that the difficulty of correcting them should not be underestimated.

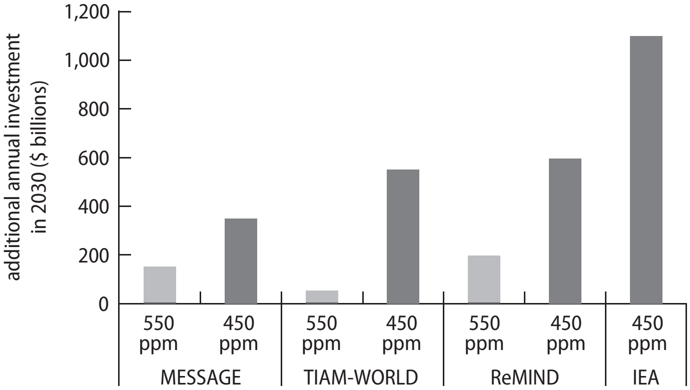
Affordable: Much of green growth pays for itself, and an innovative private sector keeps costs in check

Environmental policies should, in principle, improve social welfare and economic efficiency by reducing excessive pollution and other environmental bads. Nevertheless, such policies clearly have costs. They can hit taxpayers who have to pay the bill (for subsidies to renewable energy or public spending on green R&D) or producers and consumers if the policies mandate the use of more expensive or less productive technologies (such as renewable energy resources that are more costly than fossil fuel). Environmental policies alter relative prices and therefore change the structure of demand, requiring costly adjustments in the structure of production. Demand may decrease in sectors that have high capacity (coal production) and increase in sectors that have limited capacity (public transport). As a result, efficiency may fall, at least during an adjustment phase, jobs may be lost, and the poor may suffer if compensatory measures are not adopted.

Moreover, the up-front capital requirements are high. The energy investments needed globally to achieve greenhouse gas concentration of 450 parts per million (ppm) carbon dioxide equivalent (CO_2-eq; the level needed to maintain a 50 percent chance of not exceeding global warming of 2°C above preindustrial temperatures) could amount to

FIGURE O.5 Up-front investment costs for energy supply and energy efficiency could be substantial

(additional investment needed in the energy sector, both in energy supply and demand, in 2030 to reach a 450 ppm and a 550 ppm CO_2-eq objective, according to four global models)



Source: More information on these models can be found in the following sources: on MESSAGE, van Vliet and others 2012; on ReMIND, Luderer and others 2012; on TIAM-WORLD, Loulou and Labriet 2008; on IEA, IEA 2011.
Note: IEA (2011) does not provide estimates for a 550 ppm scenario.

between $350 billion and $1.1 trillion per year by 2030 (figure O.5). A 550 ppm target appears much easier to achieve, requiring some $50 billion–$200 billion of additional investments per year, but an additional $75 billion to $100 billion would still be needed to adapt to climate change (World Bank 2010d). Adding needed investments in water and land to energy, annual investments of $900 billion to $1,700 billion could be needed over and above business-as-usual requirements (McKinsey and Company 2011).

But many of these capital investments will be recouped through subsequent savings, so the net financial costs will be much lower. For example, the high capital cost of wind and solar energy or hydropower is offset by their low operating costs. Globally $1 spent on energy efficiency saves $2 through investments in new supply, with the savings even greater in developing countries (World Bank 2010d). As a result, the World Bank estimates that more than half the measures needed to decarbonize the energy systems of developing countries would eventually pay for themselves, bringing the financial costs down to between $140 billion and $175 billion per year in 2030 or perhaps half a percentage point of developing countries' GDP (World Bank 2010d). In East Asia, the estimated additional net financing required for a sustainable energy path is $80 billion, not much more than the $70 billion the region currently spends on fossil fuel subsidies (Wang and others 2010; IEA 2008).

Furthermore, determining affordability is about more than a financial ledger. Green policies can contribute to growth (box O.2) and boost a nation's overall wealth. And they help to reduce the damage done by environmental degradation, which is costly for an economy: equivalent to 8 percent of GDP across a sample of countries representing 40 percent of the developing world's population (figure O.6). As a result, benefits may well outweigh the costs (implying a negative net economic cost). $900 billion to $1,700 billion of green investments in land, water, and energy could yield economic returns of around $3 trillion per year, rising to $3.7 trillion with carbon at $30 per ton and no energy, agricultural, or water subsidies (McKinsey and Company 2011).

Thanks to such benefits, the net costs of greening growth appear manageable, although affordability will, of course, depend on the speed and ambition of the greening (as illustrated by the difference between the 450 ppm and 550 ppm targets) and on the design of policies. But the worse the environmental degradation and existing inefficiency, the greater the potential benefits to be obtained from green policies.

At the firm level, the cost of environmental regulation to firms is typically modest, with costs lower than expected thanks to the ability of firms to adapt and innovate (chapter 3). As a result, there is no evidence that environmental regulation systematically hurts profitability. While studies from the 1980s and 1990s found negative impacts, more recent papers find more positive results, partly because they allow a few years for firms to adapt and partly perhaps because we have become better at designing environmental regulations that promote efficiency gains

BOX O.2 The many ways in which green policies can contribute to growth

Green policies and practices can contribute to growth through three channels (see chapter 1). First, *they can help to increase the amount of natural, physical, and human capital available*: Better-managed soil is more productive. Well-managed natural risks result in lower capital losses from natural disasters (Hallegatte 2011). Healthier environments result in more productive workers: a recent California study shows a strong impact of air quality on the productivity of farm workers (Graff Zivin and Neidell 2011).

Second, *they can promote efficiency*. For instance, imposing environmental taxes (taxing "bads") and removing distortionary subsidies creates fiscal space for governments to lower labor taxes or subsidize green public "goods" such as public transport or renewable energy. In London, congestion taxes, besides reducing traffic, helped to finance investments in the aging public transport system, thereby increasing effectiveness of the price signal by reducing the costs or "disutility" associated with switching from single-car use to public transport (Transport for London 2008). And many firms—including large multinationals such as Hewlett Packard, Cisco, Clorox, and FedEx—are finding that embracing sustainability has improved the bottom line in part by promoting greater efficiency (Nidumolu and others 2009).

Third, *green policies stimulate innovation*. Study after study reports that well-designed environmental regulations stimulate innovation by firms, as measured by R&D spending or patents (see chapter 3). Surveys of firms in the European Union identify existing or future environmental regulation as the main driver for the adoption of incremental innovations. Similarly, international sustainability standards can help local firms to upgrade their environmental practices, a form of catch-up innovation. In developing countries, green policies can also encourage the adaptation and adoption of greener technologies that have been developed elsewhere.

Finally, *green policies also accrue non-growth gains to welfare*. They can reduce inequality through job creation and poverty alleviation, and they can reduce output volatility by increasing resilience to environmental and economic shocks, like natural disasters or spikes in commodity prices. A modeling exercise suggests that half of the cost of climate policies to limit greenhouse gas concentration at 550 ppm could be paid for by less vulnerability to oil scarcity (Rozenberg and others 2010).

(Ambec and others 2011). Further, where revenues from environmental taxes are used to reduce taxes on labor and income, the impact on GDP is likely to be neutral or positive, as found in an analysis of seven EU countries (Andersen and others 2007, cited in Ambec and others 2011).

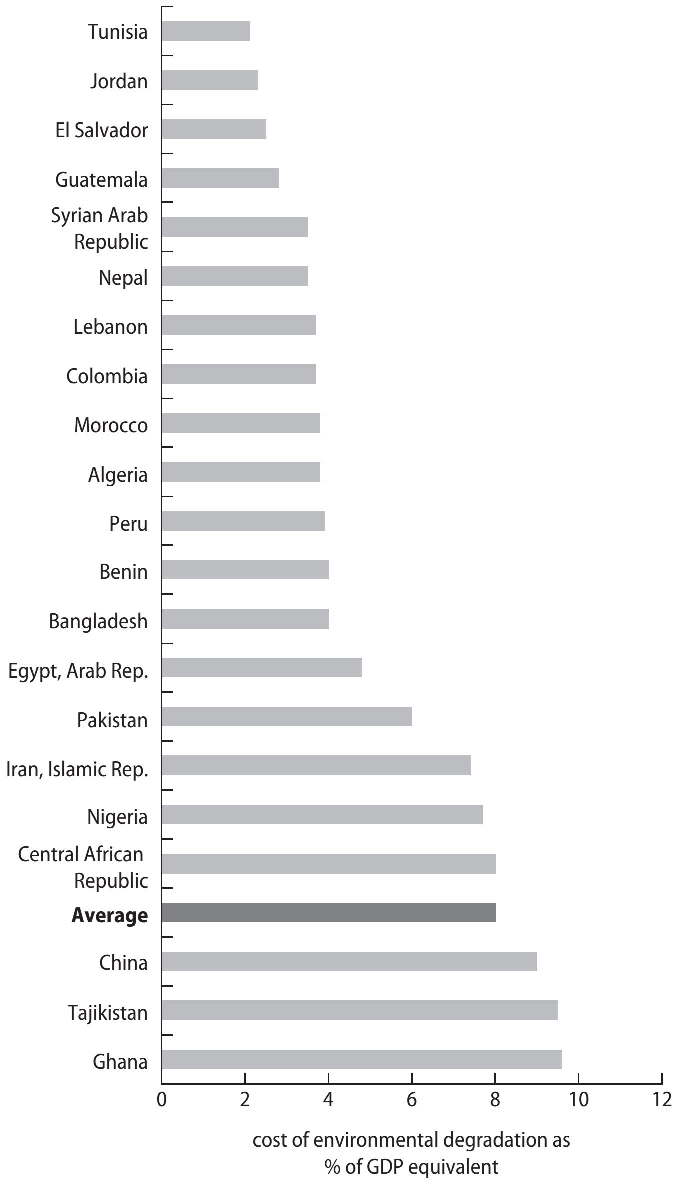
Other ex-post analyses confirm this conclusion. The EU Emissions Trading System has no negative impact on net imports in the aluminum, steel, and cement sectors (Ellerman and others 2010; Quirion 2011; Sartor 2012) or on the performance of German firms in general (Anger and Oberndorfer 2008). Meanwhile, the climate levy on U.K. firms seems to affect energy efficiency, but not economic performance and firm exit (Martin and others 2009).

Refineries located in Los Angeles significantly increased productivity in the late 1980s and early 1990s, a time of dramatically expanded regulation in California and decreasing refinery productivity in the rest of the United States. Interviews with plant managers suggest productivity increases resulted from a careful redesign of production processes to comply with the new regulations (Berman and Bui 2001 and others). Similarly, the productivity of the Mexican food-processing industry increased with stronger environmental regulations (Alpay and others 2002, cited in Ambec and others 2011).

Moreover, there is no evidence that environmental policies have led to an exodus of firms to "pollution havens" (locations with lax environmental policies). Tighter environmental regulation may cause firms to relocate, but they will choose locations that are more attractive overall, as pollution abatement costs represent a small share of production costs for most industries (Copeland

FIGURE O.6 Reducing environmental degradation would provide substantial economic benefits

(cost of enviromental degradation expressed as percentage of GDP equivalent)



Source: World Bank 2004, 2005a, 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2007a, 2007b, 2007c, 2008, 2009, 2010a, 2010b, 2010c, 2011a, World Bank and DRC 2012.

2012). Factors such as availability of capital, labor abundance, location, institutions, and agglomeration effects are more important than environmental policy in determining the location choice and competitiveness of firms.

But obstacles are plentiful, and green growth is no substitute for good inclusive growth policies

If green growth is necessary, efficient, and affordable, what is impeding it? Across countries and income levels, a mix of governance and market failures, complex political economy, entrenched interests and behaviors, and financing constraints are significant obstacles. Further, despite much rhetoric to the effect, green growth is no panacea and will not substitute for a good business environment and the reforms that are needed to promote growth and protect the poor.

When first-best recommendations meet second-best situations

Much of green growth is about good growth policies—addressing market failures and "getting the price right" by introducing environmental taxation, pricing environmental externalities (such as carbon pricing), creating tradable property rights, and reducing inappropriate subsidies. These measures are critical for enabling the private sector to undertake needed investments and innovations and for getting consumers to internalize the true costs of their behavior. But as with all good economic policy making, textbook policy recommendations, however appropriate, must be applied with insights into behaviors, political economy, and governance and market failures. This is an enormous challenge for a variety of reasons.

First, *getting prices right may be difficult because of political or social acceptability issues*. The benefits are usually diffuse and uncertain, while the costs (the burden of the price increase) are immediate, visible, and often concentrated on a vocal minority. This is why price changes can be achieved only when political economy issues are managed with appropriate complementary policies.

Second, *getting prices right may not be sufficient because other market imperfections can prevent prices from being the silver bullet of environmental policies*. These market imperfections include the following:

- *Low price elasticity.* The ability of prices to trigger changes in behavior and technology is sometimes limited by substitution possibilities: the responsiveness of drivers to higher fuel prices is low in the absence of alternative means of transportation. The ability of firms in the renewable energy sector to respond to incentives will depend on whether transmission lines are built between centers of consumption and production. In these cases, price-based policies may have to be complemented with direct infrastructure investments (such as public transportation and transmission lines) and other policy actions, like changes in urban planning or in norms and regulations. But if substitution capacity is limited by alternatives, their provision may increase the economy's efficiency and boost income or promote economic growth, making the price increase more politically acceptable.
- *Missing markets or institutions.* Specific institutional measures may be required to transform the "right price" into the right incentive. Where tenants are paying energy bills, for instance, owners and developers have little incentive to "build right" or to invest in more energy-efficient appliances unless they can recoup their investments through higher rents or sales price. This "principal-agent" problem can be tackled through information (such as energy efficiency labels for homes), specific schemes to finance investments in energy efficiency, or norms (such as compulsory retrofit when homes are sold).
- *Lack of credibility and predictability of price signals.* Governments cannot commit to maintaining environmental price instruments over the long term, which puts them in a poor position to encourage firms to undertake long-term, risky investments (notably in R&D and long-lived infrastructure).
- *Coordination failures and knowledge externalities.* Prices are ill-suited to address the "classic" market failures usually invoked to justify innovation and industrial policies. Think about electric cars whose development requires coordination between electricity providers, city planners, battery producers, and car manufacturers.

Third, *inertia and biases in behavior are such that many efficiency measures that might pay for themselves are not implemented.* Household responses to higher energy prices are often disappointing, and firms do not always exploit all opportunities to improve efficiency (Gillingham and others 2009; Allcott and Mullainathan 2010). Energy savings of 20–25 percent could be achieved through improved industrial processes in high-income and emerging economies (World Bank 2010d).

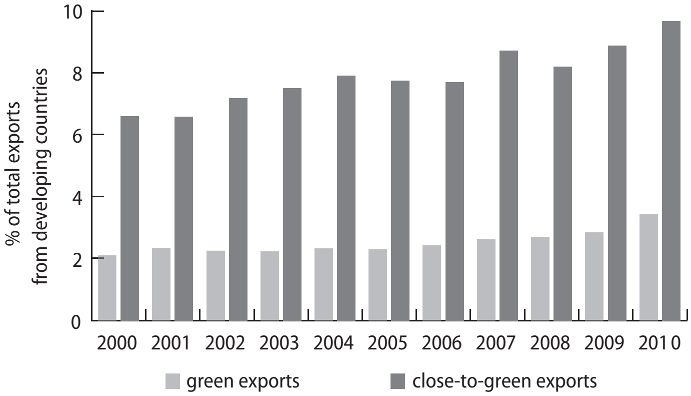
Fourth, *financing tools to tackle up-front investments are inadequate.* Take the case of solar, wind, or hydroelectric energy, which is characterized by much higher capital costs than fossil-based energy, but extremely low operating costs, or energy efficiency that requires up-front investments in new equipment or add-ons whose costs are then recouped over time through energy savings. Even with agriculture or fisheries, a shift to more sustainable practices typically results in lower returns and investments in early years that are then offset by higher returns in the future. The need for up-front financing can be a binding constraint for developing-country governments (especially local ones with limited access to capital markets and a small tax base) and the private sector (especially small and medium enterprises). Few countries have a well-developed banking sector, let alone energy service companies that specialize in financing investments in energy efficiency.

No substitute for good growth policy: The private sector needs an enabling environment

Green growth strategies are growth strategies with the additional goal of fostering a better environment. As such, they cannot substitute for good growth policies: environmental measures are unlikely to offset distorted labor markets, illiquid financial systems, or poor business environments.

FIGURE O.7 Developing countries may have substantial unexploited potential in green exports

(green and close-to-green exports as a share of total exports from developing countries, 2000–10)



Source: Dutz and Sharma 2012, based on data from the Commodity Trade Statistics database (COMTRADE) and a six-digit proximity matrix based on COMTRADE.
Note: Close-to-green exports are exports of goods that are not "green" but require similar skills—in the way growing apples requires the same set of skills as growing pears so that a country that is good at the former is likely to be good at the latter.

A case in point is "green jobs," a topic that has attracted substantial attention following the recent global financial crisis. Advocates stress that, in a situation of high unemployment, a green fiscal stimulus could effectively address recession-induced unemployment and set the stage for cleaner post-recession growth patterns. The argument is attractive: although green projects may not be the most labor intensive or "shovel ready," they have the added advantage of carrying environmental benefits. That said, a fiscal stimulus—green or not—is effective only if unemployment is linked to insufficient demand rather than to structural issues (such as lack of skilled workers or a poor investment climate).

Beyond stimulus effects, some countries—including Brazil, China, Germany, Japan, the Republic of Korea, and Morocco—are looking at green growth as a potential source of longer-term growth through which to create new markets. And even though not every country can become the world leader in solar panels or wind turbines, developing countries may have substantial unexploited potential in green exports (figure O.7). Many developing countries have natural endowments that create a potential comparative advantage in green activities (such as water resources and hydropower potential or insolation and solar power potential). Realizing this potential could generate jobs and exports, thereby boosting growth and output.

But green policies cannot address structural constraints to growth and employment creation, at least if deployed alone. They will not be effective at creating green jobs where labor markets are distorted and regulations discourage small business development. They will not offset an unattractive business environment. And where the labor force's skills are inappropriate for developing a competitive manufacturing sector, environmental policies can hardly replace education. Thus, a recent study of South Africa concludes that, while the idea of developing green industries (such as solar power) is appealing, it has little chance of succeeding unless structural problems such as regulatory obstacles to the creation of small enterprises and the lack of skilled workers are addressed (World Bank 2011b).

Skill shortages already appear to be impeding the greening of growth. In China and India, rural electrification programs are suffering from a lack of skilled workers. Reasons for these shortages include a scarcity of scientists and engineers, the poor reputation and limited attractiveness of some sectors important for the green transition such as waste management, and a limited number of teachers and trainers in environmental services (ILO and CEDEFOP 2011).

In countries where the business environment is not conducive to investment and growth, better economic policies must be the first step. Lessons from trade liberalization are telling: where labor mobility is limited by skills and regulations and where investments in the sectors that benefit from trade liberalization are impaired by inappropriate policies, both workers and the private sector take longer to adjust. The benefits from more trade take longer to materialize, and adjustment costs are much higher. Similarly, economic benefits from green policies are more likely to be large and immediate if economic policies are conducive to change and favor the development of more environmentally friendly and more productive activities.

The poor and vulnerable need social protection

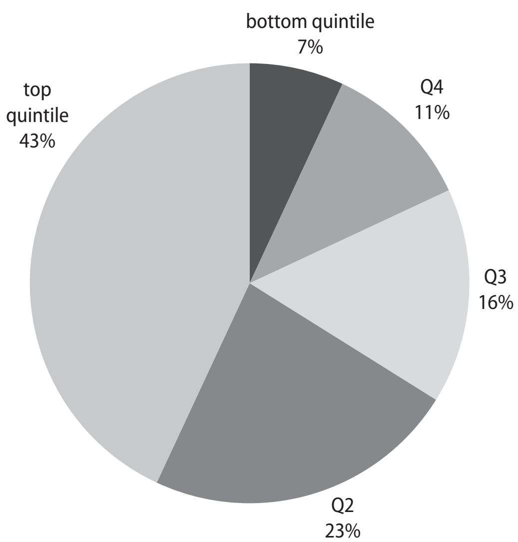
While there is a general presumption that the poor suffer most from environmental degradation and its impact, this need not imply that they would benefit automatically from green growth policies. For example, removing fossil fuel subsidies would clearly reduce the poor's purchasing power unless compensated for by other measures.

But subsidies are often regressive and can be replaced by better-targeted transfers at a fraction of the cost (figure O.8). By one estimate, the cost to the budget of transferring \$1 to the poorest 20 percent of the population via gasoline subsidies is \$33 (Arze del Granado and others 2010). Similarly, consumption subsidies for water and electricity can usefully be replaced by connection subsidies that are invariably better targeted, as the poor account for the majority of those without access to basic services.

In sum, hopes that green growth will singlehandedly solve countries' employment, competitiveness, or poverty problems are probably as unfounded as the fear that environmental policies will lead to massive loss of jobs or competitiveness. Adjustment costs may vary across industries because some sectors are inherently more innovative than others and tend to adapt better. Better regulation—particularly if supported by training, R&D support, and the recycling of environmental taxes into other tax cuts—will help to minimize these adjustment costs and maximize benefits. Also needed are steps to protect the poor from the potential downsides of green policies and to ensure that they benefit fully from the likely upsides.

FIGURE O.8 Fossil fuel subsidies benefit primarily the rich

(fossil fuel subsidy allocation, by income quintile, average across 20 countries, various years)



Source: Arze del Granado and others 2010.

The way forward: Good and inclusive growth policies tailored to real-world challenges

So greening growth requires good growth policies adapted to political economy realities and entrenched behaviors. It entails reforms in the patterns of pricing, regulation, and public investment that trigger resistance. It requires complex changes in behaviors and social norms because, even with efficiency gains and new technology, it is unlikely that middle-class consumers (whether in rich or in poor countries) can stick to current consumption patterns. And it requires knowing when to go for the politically expedient rather than the economically optimal, carefully deploying social marketing tools and making financial tools available.

Complicating matters is the fact that opportunities to green growth at a manageable cost are not evenly distributed over time. This creates urgency for some, though not all, green policies and is one of several arguments for why "grow dirty and clean up later" is not a good option even for poor countries (box O.3).

What follows is a three-prong strategy for tackling entrenched interests and behaviors, financing constraints, and the risk of lock-in.

BOX O.3 Why "grow dirty and clean up later" is misleading

Many argue that poor countries should focus on satisfying human needs before attending to nature, especially given their relatively small environmental footprint. This argument is misleading for several reasons.

First, not all environmental goods are superior goods whose share in total consumption increases with income. Individuals who struggle to feed and house themselves may not see biodiversity protection and climate change mitigation as priorities, but local environmental goods affect their daily lives, with significant impact on income and welfare. The lack of solid waste disposal, for example, is not merely an environmental issue. By clogging drains, it leads to health hazards and flooding, with serious economic and human consequences:

- In Haiti, poor solid waste disposal is to blame for the resurgence of diseases such as dengue and for vulnerability to storms.
- In India, better solid waste disposal systems were a principal recommendation of the fact-finding committee established to investigate the causes of the 2005 Mumbai floods, which caused almost \$2 billion in damages and killed an estimated 500 people.

Similarly, mismanaging water resources impairs people's ability to grow crops and feed their families. Where natural assets like soil quality, water, and standing forests serve as critical inputs into economic production, good environmental policies enhance income generation and poverty alleviation.

Second, it may be impossible or prohibitively expensive to clean up later. The loss of many environmental assets—most obviously biodiversity—is irreversible. This is also the case with climate. Because greenhouse gases reside in the atmosphere for a long time, each emitted molecule will influence the climate over decades (for methane), centuries (for CO_2), or longer. Irreversibility may also occur because of economic and technological lock-in. A lot of infrastructure is long lived, and today's choices will be hard to reverse. Urban forms are largely determined when city populations are increasing rapidly and most buildings and transport systems are being built. The consequences of development based on a low-density, individual-vehicle transportation model are largely irreversible, as evidenced by the current struggles of U.S. urban planners to densify and develop public transport systems.

Prong 1: Tailored strategies that maximize local and immediate benefits and avoid lock-in

Green growth policies require governments to do a better job of managing both market and governance failures. This is obvious in any discussion of green innovation or industrial policies, but also of the regulatory and market ("good growth") reforms that are needed, some of which are complex. Even sophisticated administrations may struggle with market-based instruments, as experience with the European Trading System has demonstrated (Betz and Sato 2006). Optimal solutions will differ across countries with varying degrees of institutional capacity, transparency, accountability, and civil society capacity. Therefore, green growth strategies need to be tailored to a country's circumstances, and "best practices" should be imported with caution.

Maximize local and immediate benefits. In addition to being tailored to local circumstances, strategies need to address the political economy of reform. Green growth strategies should aim to minimize transition costs by offsetting them to the extent possible, with visible and immediate benefits. This implies designing policies to maximize short-term, local benefits, such as increased efficiency and productivity, safety and resilience, job creation, and poverty alleviation.

Avoid lock-in. Governments cannot make all of the changes needed at once: they have limited resources and limited implementation capacity to devote to complex problems; they also have limited political capital to defend

TABLE O.1 Some guiding principles for establishing green growth strategies

		Local and immediate benefits	
		LOWER (Trade-offs exist between short-and long-term or local and global benefits)	**HIGHER** (Policies provide local and immediate benefits)
Inertia and/or risk of lock-in and irreversibility	**LOWER** (action is less urgent)	• Lower-carbon, higher-cost energy supply • Carbon pricing • Stricter wastewater regulation	• Drinking water and sanitation, solid waste management • Lower-carbon, lower-cost energy supply • Loss reduction in electricity supply • Energy demand management • Small-scale multipurpose water reservoirs
	HIGHER (action is urgent)	• Reduced deforestation • Coastal zone and natural area protection • Fisheries catch management	• Land use planning • Public urban transport • Family planning • Sustainable intensification in agriculture • Large-scale multipurpose water reservoirs

policies against interest groups and political opposition. A focus on the sectors and interventions that are most urgent—that is, those that can help to prevent irreversibility or reduce inertia—is thus called for.

Table O.1 illustrates the implications for priority setting of emphasizing local and immediate benefits and urgency. While lower-carbon energy from renewable sources is highly desirable, it is easier to build renewable plants later (even if this requires retiring thermal power plants) than to try and reverse poor land-use planning that has resulted in sprawling cities. Good land-use planning and urban public transport can provide short-term benefits—for instance, by reducing congestion and exposure to disasters and by favoring denser and more energy-efficient development. Table O.1 provides general statements on a few green policies; this analysis needs to be carried out at regional, national, and local scales to take into account specific contexts (see, for instance, an application to the Mediterranean countries in CMI 2012).

Developing countries (especially low-income countries) should prioritize policies that (a) have a negative or zero economic cost thanks to synergies with development (such as developing hydropower where appropriate, implementing effective urban plans, or scaling up family planning policies to manage population pressures and improve health and education outcomes), (b) have a positive economic cost but large direct welfare impacts (that is, when they target local environmental goods such as local air pollution or natural risks), or (c) are financed from external resources (including through carbon trading).

Actively manage the political economy of reform. Managing the political economy of reform also entails measures that target those segments of the population that would otherwise oppose reforms. For example, in 2010 the Islamic Republic of Iran increased domestic energy prices by up to 20 times, reducing fossil fuel subsidies by some \$50 billion–\$60 billion. It offset them with \$30 billion in cash transfers that benefited 80 percent of its population, thereby addressing the fact that opposition to the reform of such subsidies usually comes from the middle class. The combination of cash transfers with a well-orchestrated public relations campaign was critical to the success of the reform (Guillaume and others 2011).

Understanding the sources of resistance to a reform helps to design the reform process in a way that minimizes this resistance (box O.4). Sound information about winners and

BOX O.4 Morocco: The importance of political economy

A sound understanding of the winners and losers of possible green growth strategies helps policy makers find ways to address tough economic reforms—as Morocco has recently learned in its quest to overhaul a universal subsidy system that rewards fossil fuel consumption. By gaining insights into the political economy of reform, Morocco is now poised to reform its energy subsidy, which would sharply reduce fiscal costs and facilitate a greener growth path.

The problems with the energy subsidy are multiple. Its fiscal impact reached 5.5 percent of GDP in 2011, absorbing roughly 17 percent of the total investment budget. It undercuts Morocco's ambitious mitigation goals by keeping the price of fossil-based energy products low, thus making renewable and efficiency investments less competitive. And it is regressive, with the wealthy benefitting the most.

So why has Morocco hesitated to reform the subsidy? A big reason is that the subsidy reform was believed to be unpopular, although the government had never done a survey to ascertain just how unpopular, among which segments of society, and whether alternatives could motivate changes. For that reason, the World Bank offered to conduct such a poll in 2010 using a nationally representative sample of 1,600 households.

The results are astonishing: more than 70 percent of the population was unaware of the existence of energy subsidies. Thus, the vast majority of buyers of 12 liter cooking gas bottles—a product as widespread as bread—did not know that the real market price was more than DH 100 ($14) instead of the standard retail price of DH 40 ($5.6). In addition, a large majority opposed the idea of reducing subsidies—although this majority decreased once offered a well-targeted social program, and fell even further when the program was explained in detail. In the end, it was the wealthy that remained the group most opposed to reform.

This simple exercise in revealing political awareness and preferences helped the previous government develop a communication strategy over the medium term, starting from informing the population of the existence of the subsidy system and explaining its disadvantages. A communication campaign ensued in the first months of 2011, and the government elected in November 2011 now has energy subsidy reform at the top of its agenda.

Box text contributed by Andrea Liverani.

losers enables an information campaign to be tailored to potential critics.

One way of improving public decisions and determining priorities is to inform decision makers of the value of the services provided by natural ecosystems, so that this value can be compared directly with the economic costs and benefits of their decisions. Indeed, most environmental assets do not have widely accepted prices either for their intrinsic value or for the services they provide (such as flood protection). As a result, decisions that involve a trade-off between economic interests and natural assets (such as building a road through a rain forest) are difficult to assess.

Green accounting extends beyond the valuation of natural assets and focuses on a country's stock of natural and other assets (its wealth) rather than on a flow measure like GDP. By doing so, it helps to identify situations in which economic growth does not create wealth (because natural assets are consumed more rapidly than other assets are created) and is not sustainable. For instance, a green accounting exercise suggests that China's growth would be much lower than its official GDP growth of nearly 10 percent a year if environmental depletion and degradation were included. Indeed, calculations put China's adjusted net national income growth at about 5.5 percent a year (World Bank and DRC 2012).

Prong 2: Measures that promote and incentivize smart decision making

Even though the information provided by green accounting can help inform and balance the debates on political choices and public investments, it does not constitute an incentive for firms and individuals. To influence their behavior, additional measures are required, and it is here that governments can play a critical role by ensuring that market incentives promote green behavior on the part of firms and individuals.

Getting the prices right will influence consumer demand as well as firms' choice of production processes (for example, higher energy prices will make firms use more energy-efficient technologies to minimize their production costs) and products (to respond to consumer demand that changes with relative prices). But it will also make them innovate, develop, and implement new technologies and processes.

Getting prices right also has a central role in shaping the built-up structure of cities. Land developers respond to price signals so that higher land prices lead to higher density—enhancing productivity spillovers and the supply of affordable housing and managing demand for transport. When "official" land prices do not reflect demand and are depressed at the urban periphery, sprawl or suburbanization likely will be excessive.

But market incentives will not suffice. For green policies to succeed, governments will need all of the arrows in the public policy quiver.

Informing and nudging to influence individuals and address behavioral biases

Behavioral biases limit the impact of market incentives and complicate the design of environmental policies. For example, one explanation for the large unexploited potential that exists in energy efficiency springs from the "cognitive myopia" that prevents individuals from accurately weighing future benefits against immediate costs. Also, individuals measure gains and losses with respect to a reference point and weigh losses more than gains (Tversky and Kahneman 1992); as a result, they tend to consider the cost of new environmental policy as a loss and to disregard environmental damages avoided. People are biased toward the status quo, tend to choose the default option, and have an aversion to ambiguity, resulting in a tendency to delay decision making related to complex problems such as climate change (Tversky and Shafir 1992). At the same time, people like to "do the right thing" and are heavily influenced by social norms.

As a result, how messages are framed, what values are appealed to, and how the needed efforts are presented are critical. When given the choice of voluntarily paying for a carbon offset for an airline ticket, some 60 percent of Americans will do so regardless of political affiliation. When the offset is referred to as a carbon tax, support falls from 60 to 25 percent among Republicans (Hardisty and others 2010). More generally, framing green policies as a way to reach an ambitious and positive social goal (such as becoming carbon neutral by 2050 or becoming a leader in solar technologies) makes them more acceptable (and less prone to reversal at the next change of government) than if they are perceived as a constraint to economic development.

Another approach showing promising results is tweaking "choice architectures" to "nudge" people to make better decisions for the environment or other desirable outcomes without restricting their freedom of choice (Thaler and Sunstein 2008). To count as a nudge, the intervention must be easy and cheap, but not constitute a mandate. Changing the default options—without changing the options themselves—can be an efficient way to promote greener behaviors. In two cases where the default option offered by the electricity provider was a cleaner but more expensive one, fewer than 5 percent of customers requested a shift to a cheaper, but less green, source of electricity (Picherta and Katsikopoulos 2008).

Policies that unleash the power of the private sector

Firms have a major role to play in providing solutions to green growth. Through their capacity to innovate and adjust their production processes, firms are key to keeping the cost of green policy in check. This means that governments need to influence the behavior of firms by providing appropriate incentives and regulations in addition to the right economic incentives.

Use information. Besides prices, firms are subject to pressures from their customers, stakeholders, and investors, and this pressure can be used to green their behavior. Promoting transparency and access to information on environmental impacts can create social pressure to reduce these impacts. A 1996 amendment to the U.S. Safe Drinking Water Act requiring community drinking water systems to report regulatory violations publicly has been sufficient to reduce the incidence of subsequent violations, even in the absence of additional financial incentives.

In China, Indonesia, the Philippines, and Vietnam, performance evaluation and ratings programs that reported emissions data and assessed plants' environmental performance helped a large number of plants initially rated as "noncompliant" to rise to "compliant" (in contrast, plants rated as "flagrant violators" and "compliant" stayed in those categories). One reason these programs work is that they provide the information needed for civil society and legal and political systems to act to reduce pollution. But it also works because they attract the attention of managers to efficiency-increasing opportunities, which can be implemented at low or even negative cost.

Impose where it makes sense. Market and price instruments are sometimes difficult to implement or to enforce, they lack predictability and credibility over the long term, and they may be inefficient when economic actors do not take them fully into account, such as not fully valuing fuel economy when buying a car (Greene 2010). This is why it is sometimes easier to implement norms and regulations, as is done by Australia, Canada, China, the European Union, Japan, Korea, and the United States for car fuel efficiency standards (An and others 2007).

Use innovation and industrial policy, but with caution. Prices are notoriously limited instruments for transforming economies or triggering investments with long-term or uncertain payoffs. Since they depend on government actions, they have long-term credibility and predictability issues. They also cannot address the "classic" market failures that are usually invoked to justify innovation or industrial policies: increasing returns and knowledge externalities in new industries, information asymmetries, capital market imperfections, and the coordination needed across different sectors to permit a technological transition. As a result, most countries resort to some form of innovation and industrial policies in their growth strategies.

Such policies need to be used with care and tailored to the country context. Today, frontier innovation and basic R&D are highly concentrated in high-income countries and a few large emerging economies. High-income countries have a critical responsibility to step up their efforts on green innovation and its deployment as well as to take new technologies to scale through demand-side policies. Failure to do so will severely compromise the ability of developing countries to pursue green growth.

In lower-income countries, capacity is often not sufficient for frontier innovation; what is needed are policies to support the adaptation and dissemination of existing technologies. These technologies have been developed and tested in richer countries, making their support through trade, dissemination, and industrial policies less risky than the development of new technologies. The best way to accelerate technology diffusion is to reduce trade barriers. In China, photovoltaic panel fabrication technologies were introduced mainly through the import of manufacturing equipment from Europe. Also critical are policies to increase adaptation and adoption capacity through education and training as well as trade and industrial policies (such as local content requirements).

Moreover, several developing countries are pursuing green industrial policies—biofuels in Brazil and solar energy in China and Morocco. Lessons from past successes and failures of standard industrial policies are clear: governments should subject firms to competition, have clear sunset clauses, and focus on well-identified market failures, spillover, or latent comparative advantages (for example, solar potential in North Africa). But most green industries will require some type of policy support, making a market test more complex to design (is a technology not competitive because the government is not pricing the externality correctly or because the technology is not the most competitive available?) and making it even more imperative for government to navigate carefully the twin risks of policy and market failures. Typically, environmental policy (such as a carbon tax) should address the environmental externality, while the standard tools of innovation and industrial policies are used to address knowledge externalities and other market failures such as economies of scale and coordination failures.

Prong 3: Innovative financing tools that tackle higher up-front financing needs

Even when environmental or green infrastructure policies and investments pay for themselves, they can involve significant up-front costs and require specific financial tools. Innovative financing is therefore urgently needed, especially where gains from better environmental management cannot immediately be monetized.

Resources are available but remain small relative to need, so they need to be leveraged. With respect to climate change mitigation, recent estimates suggest that a package of public sources (including a redirection of subsidies currently destined for fossil fuels), multilateral development bank flows, and carbon offset flows could leverage some $200 billion to $400 billion in 2020 in additional private flows (MDB Working Group on Climate Finance 2011). This is close to the expected investment needed to reach a 550 ppm CO_2-eq target, but about half of what is needed to reach a 450 ppm CO_2-eq target. As for the biodiversity market, offset and compensation programs officially amount to some $2.4 billion to $4 billion per year, but may be much bigger, given that most of the existing markets are not transparent or analyzed enough to estimate their size (Madsen and others 2011).

Increasing the role of the private sector is critical. Many of the needed investments could benefit from public-private partnerships. Private participation in infrastructure has grown at a steady pace (13 percent a year) over the past 20 years but remains concentrated in a few middle-income countries and a few sectors, namely, telecom and, to a lesser extent, energy (World Bank and PPIAF 2012). New investments in renewable energy are largely private (some $143 billion of the $211 billion invested in renewables in 2010), but 82 percent of private renewable energy investments that take place in developing countries occur in Brazil, China, and India (UNEP and Bloomberg New Energy Finance 2011). Yet the need for innovation, efficiency, and "smart investments" (smart grids, smart transportation, and smart houses) makes the role of the private sector even more critical in green growth policies than it already is in traditional infrastructure finance.

Three weaknesses hold back private financing of infrastructure—green or not (MDB Working Group on Infrastructure 2011):

- The scarcity of resources to prepare projects and bring them to a stage at which they are "bankable" (that is, attractive to private sectors). Developing-country governments—at least those with limited experience with public-private partnerships—are often reluctant to borrow to prepare uncertain projects, while private investors are unwilling to invest in preparing a project they may have to bid for and not win.
- The mismatch between the tenor of the funds available, with the preference of investors for short-term funds and the needs of infrastructure for long-term funds (15–25 years). Few countries have well-developed capital markets or banking institutions able to transform short-term deposits into long-term products, and not enough refinancing tool options are available.
- The challenge of cost recovery. The ability to charge at full cost is behind the massive expansion in telecom services, but few other infrastructure sectors are able to do so, although where they have, investors have come, as they did in Colombia's water sector. Solutions include measures to price

infrastructure services close to cost recovery, while ensuring affordability for low-income households.

Another weakness springs from the additional policy risk created by the fact that the profitability of green investments is often dependent on public policies (such as feed-in tariffs or environmental taxation). Thus, Spain's retroactive reductions in solar feed-in tariffs, Germany's and France's decisions to reduce the amount of support for future projects, and the lack of progress on a U.S. energy bill all combined to depress the private sector's appetite for renewable energy investments in 2010. As a result, clean energy share prices dipped, reflecting investor concerns, despite continued strong government support for renewable energy in China (UNEP and Bloomberg New Energy Finance 2011).

Renewable energy and energy efficiency illustrate the need for innovative public financing instruments (World Bank forthcoming b). Renewable energy is capital intensive with a long payback period and may face the technology risks associated with emerging technologies (such as concentrated solar) or unique resource risks (drilling for geothermal). Energy efficiency suffers from the fact that most local banks rely on balance sheet financing, rather than project-based financing that is based on the cash flow generated by the investments. The result is that the customers most in need of financing (small businesses and households) are typically deemed not creditworthy. And energy efficiency investments tend to be small, with high transaction costs, so that banks may not find them attractive in the absence of dedicated credit lines to increase confidence and capacity and instruments to aggregate small deals.

Furthermore, access to financing is particularly problematic for small and medium enterprises (SMEs), which account for a large share (60 percent in many countries) of pollution and resource use. Some 65 to 72 percent of all SMEs (between 240 million and 315 million firms) lack access to credit, with a particularly daunting picture in Asia and Africa (Global Partnership for Financial Inclusion 2011). Even in the more sophisticated markets, most firms find it tough to get credit for investments aimed at business activities other than expansion.

How can these obstacles to green investments be overcome? The public sector, international financial institutions (IFIs), and bilateral donors can help by providing funds for project preparation as well as concessional elements for pioneer investments. Such support can go a long way toward changing risk-return profiles and giving investors more confidence in the long-term viability of their projects.

More generally, well-designed public finance mechanisms help to mobilize private investments in energy efficiency and renewable energy (World Bank forthcoming b). In the case of renewable energy and energy efficiency, the following tends to have the greatest leverage:

- Credit lines or guarantee instruments to engage private banks. The experience of the International Finance Corporation is telling: between 1997 and 2011 some $65 million in concessional funding, primarily for risk-sharing facilities, generated $680 million in sustainable energy finance investments (IFC 2011).
- "Fund of funds" under which the government invests a relatively small amount of long-term capital in a range of private, professionally managed funds that then invest in clean energy or energy efficiency
- Public funds to reduce interest rates for consumer financing, typically through financial institutions or utilities.

In addition, energy service companies (ESCOs), which provide clients with energy auditing, propose energy-savings measures, and financing, can help consolidate multiple small transactions. ESCOs as an industry often require public support to establish: in China, it took more than a decade of support by the government and the World Bank before the ESCOs grew to a $1 billion industry in 2007 (World Bank 2010d).

TABLE O.2 Financing mechanisms need to be tailored to the maturity of the local financial sector
(context-dependent financing tools for clean energy in East Asia and the Pacific)

Indicator	Level of financial sector development: Low	Medium	High
Country income level	Low income (e.g., Lao PDR)	Middle income (e.g., Thailand)	Upper middle income (e.g., Malaysia)
Banking services	Basic banks	Full-range banks	Universal banks
Non-bank financial services	None	• Government bonds • Equity	• Government and corporate bonds • Equity • Alternatives (private equity, venture capital)
Interest rate	Administrative setting	Largely market based	Fully market based
Access to finance for SMEs	Limited	Partial	Readily available
Availability of long-term financing	Limited (up to 1 year)	Partial (up to 7 years)	Full (up to 15 years)
Risk management	Weak	Adequate	Robust
Appropriate clean energy financing instruments	**• Lines of credit (liquidity support) • Concessional financing • Dedicated debt funds**	**• Lines of credit (demonstration) • Partial risk guarantee**	**• Lines of credit (demonstration) • Partial risk guarantee • Equity funds • Consumer financing**

Source: World Bank forthcoming b.

Overall, the relevant mix of financing instruments will depend on the market barriers (access to credit, transaction cost, or perception of risk), market segments (SMEs, large developers, or polluters), and local context (such as the maturity of the local financial sector) in which they seek to operate (table O.2).

In addition, payments for environmental services (PES)—whereby farmers and landowners are compensated for maintaining their land's ability to provide ecosystem services (such as the regulation of water flows, water purification, control of soil erosion, and habitats for wildlife)—are promising, but underutilized. Fortunately, efforts to develop REDD+ are helping to develop PES schemes.[4] In addition, in developing countries, policy makers have tried to design PES programs to benefit the poor. But whether these schemes in fact benefit the poor depends on the nature of the scheme. Brazil appears to have been successful in this regard, building on its experience in developing social safety nets for the poor (box O.5).

Conclusions

In sum, this report approaches green growth from a pragmatic point of view. The current model is not just unsustainable, it is inefficient. Improving it is good economics, so let's fix market failures, internalize externalities, assign property rights, improve governance, and influence behaviors. But making green growth happen and ensuring it is inclusive will also require an acute understanding of political economy and social psychology.

As such, this report speaks primarily to those who fear that greening growth may be too expensive, may be too ambitious at an early stage of development, or should concern only high-income countries. To them, the report makes a clear case that greening growth is neither unaffordable nor technically out of reach, there are plenty of

BOX O.5 "Green" cash transfers are helping poor communities in the Brazilian Amazon

An innovative addition to the Brazilian *Bolsa Família* (family allowance) conditional cash transfer program—the world's largest and one of the best regarded in terms of coverage and targeting—is being implemented for communities living inside protected areas in the Amazon region.

The *Bolsa Floresta* (forest allowance) rewards traditional communities for their commitment to stop deforestation by distributing payments for ecosystem services to families, communities, and family associations. In order to be eligible to receive the grants, families must enroll their children in school, sign a zero deforestation commitment, and attend a two-day training program on environmental awareness. Each eligible family receives a monthly stipend of R$50 ($30), paid to the mother. Community associations can also be eligible to receive payments of up to R$4,000 ($2,500) to support sustainable income generation activities, such as honey production, fish farming, and sustainable forest management.

Investments for administrative support to community associations make up 10 percent of the total paid to families during the year. *Bolsa Floresta* is being implemented by the State Government of Amazonas and the Fundação Amazônia Sustentável (Sustainable Amazonia Foundation). The funds are generated by the interest on an endowment initially established with contributions from the state government and private donors. Deforestation is monitored on a yearly basis by the Amazonas State Secretariat for the Environment and Sustainable Development through satellite imagery analyzed by independent institutions. The program currently benefits 7,614 families in 15 protected areas, covering around 10 million hectares of forests. The State of Amazonas has succeeded in halving the deforestation rate over the past five years.

Box text contributed by Adriana Moreira.

BOX O.6 Joining forces: A common platform to move forward on greening our economies and growth processes

How does the World Bank's definition of green growth as economic growth that is environmentally sustainable compare to those advocated in recent major reports on green growth? The OECD defines green growth as "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD 2011b). The United Nations Environment Programme (UNEP) defines a green economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011). Like the approach promoted in this report, these definitions are consistent with sustainable development as an ultimate objective and with green growth or a green economy as a means to reconcile its economic and environmental pillars, without ignoring social aspects.

So while the three reports differ in their focus and target audience, they are fully consistent in their broad vision and policy advice. This common vision is being developed further in the context of the Green Growth Knowledge Platform (GGKP), a partnership of the three institutions and the Global Green Growth Institute. The GGKP—launched in January 2012—is a global network of researchers and development experts seeking to identify and address major knowledge gaps in green growth theory and practice. Through widespread consultation and world-class research, the GGKP aims to provide practitioners and policy makers with better tools to foster economic growth and implement sustainable development (http://www.greengrowthknowledge.org).

immediate benefits and a poor country can reap economic benefit from better environmental management. And although high-income countries, which still account for 75 percent of global consumption and a disproportionate share of environmental degradation, absolutely have to implement ambitious environmental measures, all countries will gain from starting early.

Greening growth need not entail slower growth and is affordable. However, achieving a green economy overnight probably is not. The costs of greening growth will depend on the degree of ambition. Rapidly and dramatically decreasing our impact on the planet would be quite costly. So, too, would delaying action for too long. Dramatic shifts would entail much slower growth at least in the medium run, and avoiding a brutal transition is the main incentive to start acting as early as possible.

This report adds to the chorus started by the Organisation for Economic Co-operation and Development and United Nations Environment Programme (UNEP) in recent reports supporting the idea that inclusive green growth is good economics and good development policy (box O.6). While we are still far from being able to price ecosystem services properly, they clearly are valuable. As such, neglecting natural capital, like neglecting human and physical capital, is simply bad management, bad economics, and bad for growth.

Notes

1. The equivalent amount using purchasing power parity (PPP) that allows for better cross-country comparisons of purchasing power is \$6,000 PPP for all developing countries and \$1,300 PPP in low-income countries.
2. This section is based on World Bank (forthcoming a).
3. The fleet capacity index is the relationship between the capacity of a fishing fleet to catch a particular quantity of fish and the quantity of fish that it actually catches.
4. Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. REDD+ goes beyond deforestation and forest degradation and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (http://www.un-redd.org/).

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An Analytical Framework for Inclusive Green Growth

1

Key Messages

- It is inefficient either to pursue growth and only later worry about its environmental consequences, or to promote environmental sustainability and subsequently worry about its growth implications.
- The analytical case for green growth is strong: green policies can indeed contribute to economic growth over the short term, if they are designed in an appropriate framework.
- Green policies can contribute to growth through four effects: an input effect (increasing production factors), an efficiency effect (bringing production closer to the production frontier), a stimulus effect (stimulating the economy in times of crisis), and an innovation effect (accelerating development and adoption of technologies).
- Green policies can also contribute to welfare through direct environmental benefits, through distributional effects (including poverty reduction and job creation), and through increased resilience to shocks (including natural disasters and commodity price volatility). Welfare impacts will be greater if efforts are made to make green policies inclusive.

China grew at about 10 percent a year over the past 30 years, transforming it from a poor country to the world's second-largest economy. Yet, the Chinese government is now reconsidering the strategy that permitted this economic miracle in the hope of greening its development process (World Bank and DRC 2012). Two factors motivate this possible change in approach. First, the cost of environmental degradation, estimated at 9 percent of gross domestic product (GDP), is threatening both economic competitiveness and welfare. As a result, China's population is demanding a cleaner and safer environment. Second, China is looking for new sources of growth, supported by innovation and higher value added production, and wants to be an early

This chapter is based on Hallegatte and others (2011).

mover in the race toward greener production processes and products.

China is not the only such country. Brazil, Indonesia, Mexico, Morocco, and Tunisia are greening their growth process or looking to use green industries as sources of growth. Ethiopia is developing a green growth strategy. Kenya is investing heavily in geothermal power. And many other countries are hoping to better balance the environment and the economic imperative of rapid growth.

The reality is that the world needs green growth, and it needs it now. But what exactly does "green growth" mean? Green growth can be thought of as economic growth that is environmentally sustainable. More specifically, it aims to operationalize sustainable development by enabling developing countries to achieve robust growth without locking themselves into unsustainable patterns. The World Bank's environmental strategy defines green growth as growth that is efficient, clean, and resilient—efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters.

Importantly, green growth is not inherently inclusive. Its outcome will likely be good for the poor, but specific policies are needed to ensure that the poor are not excluded from benefits and are not harmed in the transition. The welfare impacts of green policies will be greater if efforts are made to make the policies inclusive.

Greening growth is essential to achieving sustainable development and its objectives of social, economic, and environmental sustainability (figure 1.1). Economic growth and social achievements are widely recognized as complementary, but growth and environmental sustainability are often perceived as antithetical. Greening growth would reconcile the need for environmental sustainability with that for economic growth and social improvement.

Fortunately, many policies provide both environmental and economic benefits. Informal settlements can pose economic, environmental, and social problems. Utilities often refuse to serve them and insecure property rights discourage residents from investing in establishing connections to water or electricity networks. Creating functioning land markets with secure land tenure helps informal settlers access solid waste removal, sanitation and drainage, and drinking water. It also increases welfare and labor productivity, both directly and indirectly, by giving such settlers greater access to credit and by allowing them to invest in small businesses, thereby increasing aggregate output. One example of the environmental benefits of a green growth policy is the World Bank–financed water quality and pollution control project around the Lake of Guarapiranga in Brazil. Urban renewal and slum upgrading were critical to improving water quality, which in turn provided a reliable water supply source for the city of São Paulo.

Most green growth policies are environmental policies in the sense that their primary objective is to preserve the environment. But not all of them are. Policies that improve energy security or reduce urban congestion, for example, may yield substantial environmental benefits even if doing so is not their primary objective.

Many observers have argued that environmental issues will "solve themselves" with economic development. This chapter examines the flaws in the "grow now, clean up later" argument and discusses what growth theory and evidence reveal about the compatibility of environmentally sustainable policies and growth. It investigates whether green growth is in fact feasible—beginning with the analytical case for green growth before reviewing the implications for welfare, the ultimate goal of economic policy—and explores how to identify trade-offs and synergies implied by a green growth strategy.

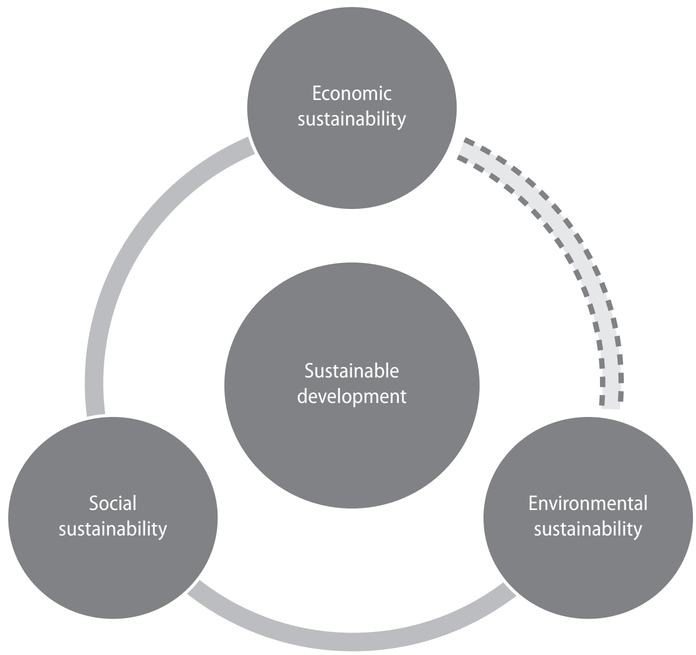
Why not grow now and clean up later?

The "grow now, clean up later" argument is based on the idea that environmental quality first deteriorates with growth and then improves—an environmental Kuznets curve.[1] In this framework, the environment eventually improves as national income rises because the environment is a "superior good" (a good whose consumption increases more than proportionately with income).[2] The framework implies that poor people care less about the environment than wealthier people, give priority to consumption over environmental quality, and act upon these preferences. Once basic needs have been met, this argument goes, people place greater weight on the environment, leading to investments in environmental protection and clean-up that increase environmental quality, assuming appropriate collective action proves possible. Economic growth will therefore automatically lead countries to environmental protection.

There are serious flaws in this argument. First, *a distinction needs to be made between environmental impacts that affect welfare through income and consumption and those that affect welfare through the amenity value of environmental assets*. In urban areas, poor households that struggle to feed and house themselves will indeed place a lower priority on the amenities provided by a park than wealthier households might. However, they care deeply about the absence of solid waste management and its results—dengue epidemics, clogged urban drains, and the destruction of their homes and small businesses by floods. In rural areas, protecting forests to prevent the extinction of rare animals may not be a priority for households that struggle to feed themselves (unless of course the poor can share in the benefits from wildlife protection). But the same households are likely to care about protecting soil quality and managing water flows, which allow them to grow crops.

Second, *even when poor communities care about the environment, they may not have the "voice" to make their concerns heard*. Policies implemented in developing countries may be more representative of the preferences of the elite than of the poor or may reflect institutional constraints, such as those imposed by poorly defined property rights (as in open access resources).

FIGURE 1.1 The three pillars of sustainable development



Note: Economic and social sustainability, on the one hand, and social and environmental sustainability, on the other, have been found to be not only compatible, but also largely complementary. Not so with economic and environmental sustainability, as growth has come largely at the expense of the environment—hence, the dotted line on this figure—which is why green growth aims to ensure that economic and environmental sustainability are compatible.

Third, *it is difficult to infer preferences about collective goods from individual behavior.* Cities offer many more jobs and opportunities than rural areas but also much higher levels of local pollution. The fact that people move from rural areas to cities does not mean they would not prefer slightly fewer opportunities and higher environmental quality. Their preferences are not completely revealed by the binary choice of "moving or not moving to the city," because they do not have a continuum of choices of increasing opportunities and decreasing environmental quality.

Fourth, *because the influence of environmental quality and welfare is often indirect, people may not link environmental problems (such as water or soil quality) to the health problems they confront.*[3] Better information, not just higher incomes, may be needed if individuals are to demand higher environmental quality at earlier stages of development. Even developed countries are only beginning to address the complex issue of the environmental damages of pesticides and chemicals.

Fifth, *although some dimensions of environmental quality improve with average income, many others do not*. Local environmental issues with short-term, highly visible manifestations (such as local air and some types of water pollution) are usually resolved spontaneously as countries develop. In contrast, global public goods with long-term consequences (such as climate change or biodiversity) and local environmental issues with complex and less visible consequences can keep getting worse (box 1.1).

The case of Costa Rica illustrates the contrast between local, visible pollutants and global ones. In 1978, when per capita GDP was about $2,200, emissions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) peaked, before leveling off and then declining slightly. Over the same period, however, carbon dioxide (CO_2) emissions continued to rise (figure 1.2).

Delaying action can be costly

Making the "grow now and clean up later" argument even less palatable is the fact that it may simply be too costly to do so. Indeed, it may be more economical to reduce or prevent pollution at an early stage of growth than to incur the higher clean-up costs at later stages, even when future costs and benefits are discounted. Acting early is critical when the choice of technology and infrastructure can "lock in" high-carbon or polluting lifestyles or economic structures. This issue is particularly relevant in developing countries, where most of the infrastructure will be built in the next few decades.

As for climate change, a variety of experts have studied the optimal timing of action (Nordhaus 1992; Wigley and others 1996). Prematurely depreciating investments can be costly if climate change turns out to be less threatening than expected or if the discount rate used to calculate future losses is too low. But early action may well result in savings. Lecocq and others (1998) find that in the absence of perfect foresight, specific policies regarding green infrastructure and long-lived capital must be adopted early to achieve mitigation objectives at a lower cost. Jaccard and Rivers (2007) show that early action is preferable in long-lived

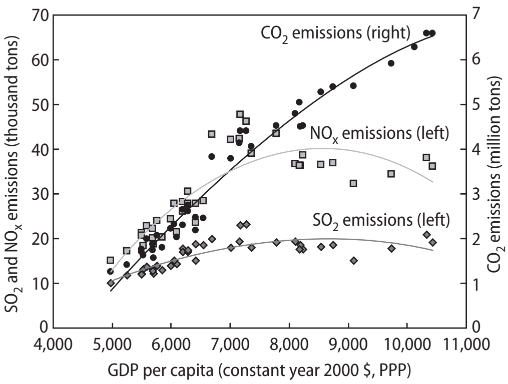
BOX 1.1 Persistent concerns about local pollution in high-income countries

Complex and "invisible" local environmental issues do not necessarily improve with income. In countries like France, efforts to understand the transfer of pesticides to the environment (mostly water bodies) began only some 20 years ago, under the pressure of a European Union Directive regulating drinking water (Aubertot and others 2005). Soil contamination is harder to monitor and can lead to severe long-term environmental and health hazards, as the example of the insecticide chlordecone illustrates.

Chlordecone, which was banned only recently, was used extensively in the French West Indies for more than 30 years, exposing the population to severe health hazards (Multignier and others 2010). The chemical remains in the soil for decades, polluting water and agricultural productions, and contains known carcinogenics (Aubertot and others 2005; Multignier and others 2010).

In the United States, the Safe Drinking Water Act regulates only 91 contaminants, despite the fact that more than 60,000 chemicals are used within the country's borders. Scientists have examined many of these chemicals and have identified hundreds associated with a risk of cancer and other diseases at small concentrations in drinking water, according to an analysis of government records by the *New York Times* (Duhigg 2009). The implication is that millions of Americans are exposed to water that does not meet safety standards meant to protect against cancer or other serious diseases.

FIGURE 1.2 Global pollutants and local, visible ones follow different paths
(relationship between GDP and emissions in Costa Rica, 1970–2009)



Source: Based on data from the International Energy Agency, the Joint Research Center, and World Development Indicators.

capital sectors, such as infrastructure and urbanization, even if marginal costs are higher there. Denser cities have lower CO_2 emissions from transportation (figure 1.3). But Gusdorf and others (2008) find that influencing the shape and density of cities ("changing urban forms") to make them less energy consuming is extremely costly. Developing countries would therefore do well to prevent their cities from growing in a low-density manner dependent on automobiles if their target for the end of the 21st century is to have high-density, energy-efficient cities.

One measure of the importance of early action is provided by Davis and others (2010), who estimate that without early scrapping, existing energy infrastructure commits us to warming of about 1.3°C above preindustrial temperatures. Introducing other types of infrastructure (including the capital that constrains the demand for transport, such as distant suburbs) and non-CO_2 gases, Guivarch and Hallegatte (2011) estimate this "commitment" at 1.7°C. These results imply that keeping the increase in global warming below 2°C (the internationally recognized objective of climate policies [World Bank 2009]) requires that almost all new infrastructure be designed with climate change in mind and that urgent action be taken on long-lived infrastructure. In the absence of such action, physical capital will have to be replaced earlier, at great cost.

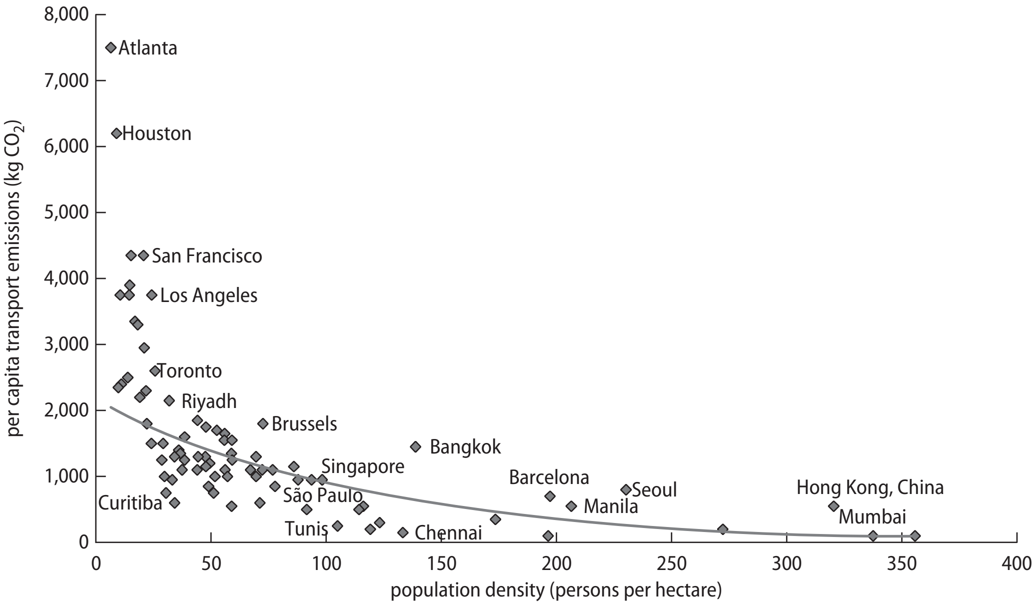
Another argument for early action has to do with the fact that the needed technologies will not become affordable unless there is sufficient demand to deploy them to scale. Countries or firms may be tempted to wait for better and less expensive technologies to become available. But these technologies will be developed only if serious commitments to pollution reduction are made (Goulder and Mathai 2000; Manne and Richels 2004; Sue Wing 2006). Early action is thus justified by the technological changes that action would induce. Developing these technologies is a critical role of high-income countries and the main reason why they need to act quickly on issues such as climate change.

And even worse, some damages cannot be reversed. In such cases, investments in environmental quality protection can be necessary in the short term. In Kenya, for example, traditional forests are being destroyed. Replanting can restore the country's water tower and other functions, but most biodiversity losses are probably irreversible (Chapin and others 2000).

Climate change itself may be irreversible. This irreversibility is a clear incentive for early action, as the consequences of warming exceeding 2°C are highly uncertain and potentially severe (Ambrosi and others 2003; Ha-Duong and others 1997; World Bank 2009). The 2°C objective, for example, is achievable only if significant emission reductions can be made before 2030 (Meinshausen and others 2009; O'Neill and others 2009).

If growing dirty now and cleaning up later is not an option, then what is needed are joint green and growth policies. It is inefficient to pursue growth and then worry about its environmental consequences or to promote environmental sustainability and then worry about its growth implications. But the possibility to green growth has been questioned. The next section provides a framework to investigate the potential for greening growth without slowing it.

FIGURE 1.3 The denser the city, the lower the transportation emissions
(relationship between urban density and per capita emissions)



Source: Kenworthy and Laube 2001.

Is green growth really possible? The analytical basis

Modern growth theory dates back to 1956, when Robert Solow put forward a formal model that suggested that growth in output—GDP—comes from increases in physical capital, labor, and productivity (box 1.2). In this model, physical capital increases thanks to investment. Labor increases as a result of population growth, greater labor force participation, and better health and education. And productivity increases thanks to technological change—which can stem from investments in education and research and development (R&D), economies of scale, and learning by doing.

What is missing in this model, however, is the notion that economic production depends directly on the stock of natural resources and the quality of the environment—that is, that the environment is a factor in the production function. This notion has been around at least since Malthus ([1798] 1965), but it was not until the early 1970s that classical growth theory was modified to embrace the environment—referred to as "natural capital"—as a factor of production (Dasgupta and Heal 1974; Nordhaus 1974; Solow 1974).[4] If the environment is considered as productive capital, it makes sense to invest in it, and environmental policies can be considered as investment.

In this "greener" framework, environmental policies increase economic output directly by improving environmental conditions (for example, better forestry management reduces soil erosion, leading to more productive agriculture). Failure to manage the environment results in the depreciation and destruction of natural capital, with direct adverse impacts on output. Cleaning up the environment also increases human well-being directly, by improving air and water quality and reducing exposure to natural hazards, although these benefits are not necessarily captured by conventional (GDP) statistics.

Whether investing in the environment increases only the level of production or also its rate of growth is likely to depend on the context in which the investment is made. Where credit constraints limit output growth, investing in the environment will accelerate

BOX 1.2 An economic framework for green growth

Classical growth theory (Solow 1956) assumes that output (Y) is produced using technology (A), physical capital (K), and labor (L). The relationship can be written as follows:

$$Y = f(A, K, L).$$

Growth in output results from increases in production factors (physical capital and labor) and productivity, which rises as a result of technological change, including changes in organization and practices. In this approach, the environment plays no productive role.

The idea that economic production depends directly on the stock of natural resources and the quality of the environment—that is, that the environment is an argument in the production function—has been around at least since Malthus (1798). It was further developed in the environmental economics literature that took off in the early 1970s. In this approach, the environment becomes "natural capital," an input in economic production and growth. The production function can thus be rewritten as follows:

$$Y = f(A, K, L, E),$$

where E represents the environment (natural capital).

To analyze the effect of green growth policies, however, growth models need to be modified to incorporate market failures and the fact that the economy is not at its optimal equilibrium. A first modification replaces the production function with the production frontier—the maximum production level possible with the available technology, physical capital, labor, and environment, assuming maximum efficiency. Actual production is given by

$$Y = \psi f(A, K, L, E),$$

where ψ (a value between 0 and 1) measures the efficiency of the production process.

A second modification introduces P_E, which can be thought of as the effort dedicated to environmental policies:

$$Y = \psi(P_E)\, f[A(P_E), K(P_E), L(P_E), E(P_E)].$$

In this case, environmental policies can create synergies with economic output by increasing productive capital (K, L, and E), improving efficiency ψ, and accelerating technological change by increasing A.

Ultimately, it is welfare that matters, not output. This means that the model needs to account for the impact of output on welfare (or utility, U). As investment does not increase welfare directly, utility can be modeled as depending only on the current level of consumption, C, plus the direct effect of the environment, E:

$$U = u(C, E).$$

In practice, environmental policies can affect utility directly (positively or negatively), with effects that are not mediated by aggregate consumption or the state of the environment such as distributional impacts or increased resilience. The utility function can thus be written as follows:

$$U = u(C, E, P_E).$$

Distribution (how total consumption is distributed across individuals) and volatility (how total consumption is distributed over time) affect welfare and can be influenced directly by environmental policies. Everything else equal, many people favor stable consumption patterns and lower consumption inequality; the utility function can thus include an aversion for risk and inequality.

Sources: Hallegatte and others 2011 and World Bank.

growth, because a higher production level increases income and savings. Where growth is limited by investment opportunities, it will fail to boost growth, because institutions are not in place to allow investors to benefit from their investment revenues. Where people are engaged in low-return activities, a limited increase in the production level may improve welfare but will not spur economic growth, because these economic activities do not generate sufficient returns to allow households to save and accumulate assets.

A key question in this framework is the extent to which production factors are complements or substitutes. If they are complements (or weak substitutes), protecting the environment is necessary to maintain economic production. If they are substitutes, in principle, increased investment in physical or human capital or technological change can compensate for damage to the environment. In fact, the ability to do so appears limited.[5] Food production requires soil and water, even if technology and increased labor intensity can reduce the quantities needed. The low elasticity of substitution between natural capital and other inputs implies that a small percentage increase in natural capital can free large percentage quantities of other inputs.[6]

While direct economic benefits from environmental policies occur mainly over the long term, green policies can also contribute to short-term economic growth because the world's economies perform far from their optimum levels. Indeed, many market failures hurt both the environment (by reducing the effective supply of natural capital) and the economy (by causing an extremely inefficient use of natural resources). Correcting these market failures, although sometimes costly, can increase efficiency and yield benefits that go beyond the environment. An example is urban congestion, which not only causes air pollution but also reduces the productivity and economies of scope cities provide. The reality is that the use and management of "natural capital" are plagued by extensive market failures, such as unpriced externalities and poorly defined property rights.

The problem for analysts is that models of economic growth usually fail to capture environmental contributions, partly because they generally ignore the role of natural capital and partly because they assume a world with no market failures. As the potential for green policies to accelerate income growth arises from market failures, such models cannot be used to assess the impact of such policies.

A real-world framework for green growth

To be useful for analyzing the effect of green growth policies, a broader framework is needed that is modified to account for market failures and other suboptimalities, such as the following:

- Knowledge spillovers and economies of scale that lead to underinvestment in R&D
- Underutilization of physical capital or labor, for temporary (crisis) or structural reasons
- Behavioral biases, such as the inability to make decisions about low-probability events (Camerer and Kunreuther 1989; Tversky and Shafir 1992)
- Other market failures, such as principal-agent issues, information asymmetry in capital markets, and coordination failures.

Actual economic output depends on the "production frontier" (the maximum production level possible with the available technology, physical capital, labor, and environment, assuming maximum efficiency) and on efficiency (how close the real-world production system actually is to the production frontier).

Green growth policies can thus be seen as policies that move the economy away from suboptimalities and increase efficiency—and hence contribute to short-term growth—while protecting the environment. Suboptimalities often persist because removing them is complex or requires large upfront investments. Assessing the possibility to correct these market failures requires devoting attention to their causes, to institutional and political obstacles, and to transaction costs.

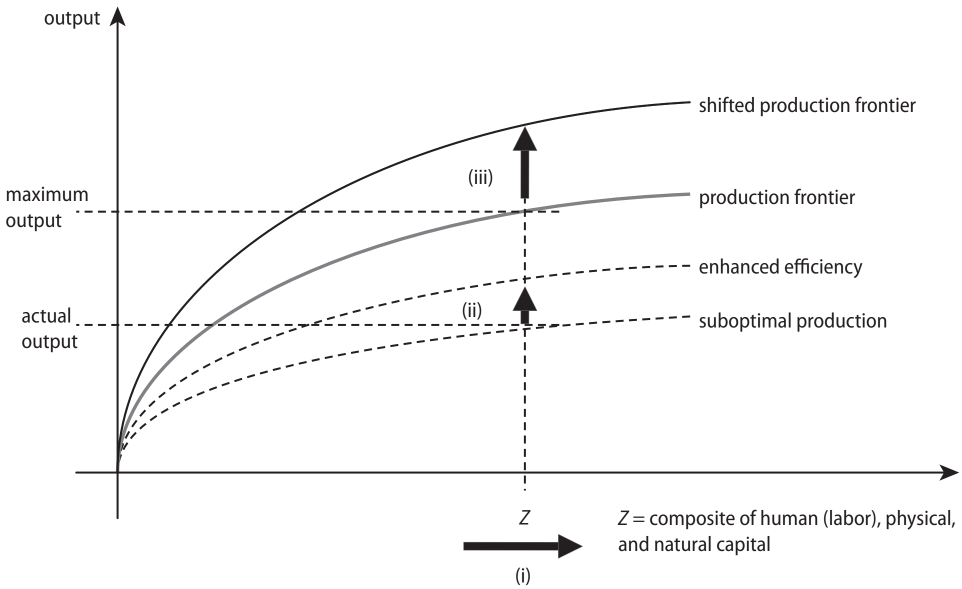
How do environmental policies increase conventionally measured GDP? They do so through four channels linked to input, efficiency, stimulus, and innovation effects. Figure 1.4 illustrates each of these effects.

Input effect

The input channel works by increasing the quantity of natural, human (labor), and physical capital (arrow i in figure 1.4). Specifically, green policies can achieve the following:

- Increase natural capital through better management of scarce resources. Individual transferable fishing quotas, for example,

FIGURE 1.4 Green policies hold the potential to sharply boost output



Note: Arrow (i) represents increase in factors of production. Arrow (ii) represents enhanced efficiency and stimulus effect. Arrow (iii) represents shift in production frontier.

help maintain and even increase fisheries and thus the economic activity that depends on them (box 1.3).

- Increase labor by improving health (Hanna 2011). Better environmental policies can decrease atmospheric pollution in cities, reduce the severity and incidence of respiratory diseases, increase labor effectiveness, and reduce days lost to illness. A study on the link between air pollution and labor productivity on farms in California shows that a decrease in ozone concentrations of 10 parts per billion (for an average value of 50 parts per billion) increased worker productivity by 4.2 percent (Graff Zivin and Neidell 2011).
- Increase physical capital by better managing natural risks, which in turn leads to lower capital losses from natural disasters (Hallegatte and others 2007). Protecting mangroves, for instance, not only protects biodiversity, it can also improve the resilience of coastal zones to hurricanes and storm surges, thereby reducing economic losses caused by coastal floods.

Efficiency effect

The efficiency channel works by increasing productivity, through correcting market failures and influencing behaviors, and by enhancing the efficiency of resource use (arrow ii in figure 1.4). One example is energy efficiency. Many firms and households fail to make cost-effective energy-efficiency investments—probably because of market failures and behavioral biases (Gillingham and others 2009). Improving the insulation of new buildings is often cost-effective, but firms and households often fail to do so because of a lack of information and the fact that building and housing prices do not adequately reflect differences in heating costs. Environmental policies that aim to reduce energy consumption and carbon emissions may correct these market

BOX 1.3 Using individual transferable quotas to revitalize fisheries

Lack of property rights in the sea has led to overfishing—in some cases with devastating results. The use of individual transferable quotas (ITQs) can correct this market failure, increasing both output and employment in the fishing industry.

ITQs operate by setting a cap on the total allowable catch (TAC). The cap is set at a level that is consistent with the long-term survival of the species (that is, less than the rate of growth of the fish stock). Once a TAC is set, it is divided into individual quotas, the amounts that particular boats or skippers can catch. Only quota owners are allowed to fish. If the TAC changes from year to year, the number of tons represented by the quota also changes, but the fraction of the TAC assigned to individuals does not. These quotas are transferable: they can be sold, given, or bequeathed to others. (A related approach is that of "catch shares," under which each boat or owner is entitled to a share of the TAC but the shares are not transferable.)

The value of the ITQ depends on the productivity of a fishery—1 percent of a thriving and productive fishery with large fish stocks is worth far more than 1 percent of an almost-extinct fishery. The ITQ system thus provides an incentive for quota owners (fishers) to invest in the long-run health of their fishery. The quotas generally represent a substantial share of fishers' wealth; if they overexploit the fishery, they thus risk impoverishing themselves. Under this system, they have an incentive to leave fish in the water to breed and generate future catch, an incentive they otherwise lack. ITQs align the interests of fishers and the fishery, generally improving both the health of the fishery and the profits of the men and women who depend on it.

Are ITQs making a difference? In studies of more than 11,000 fisheries, 121 of which had instituted ITQs, Costello and others (2008) and Heal and Schlenker (2008) find a substantial increase in catch within a few years of the implementation of ITQs and a significant decrease in the chance of a fishery collapsing once it is managed as an ITQ. On average, within 17 years of implementing an ITQ, the catch at fisheries with ITQs rose by a factor of five, with yields of some fisheries rising by a factor of 200. The institution of ITQs allows fisheries to prosper, generating better livelihoods for the people who work in them and more food for the world as a whole.

failures or influence these behaviors, leading to less environmental damage and to a more efficient economy, with a higher growth potential.

Stimulus effect

The stimulus channel can occur during an economic recession, when capacity utilization and employment are low (also arrow ii in figure 1.4). Large investments in green infrastructure increase demand, potentially increasing employment over the short term (Zenghelis 2011). Underemployment is not always related to demand, however; it can be structural, especially in developing countries.[7] In this case, a stimulus may prove costly and do little to increase employment.

Innovation effect

Environmental policies can shift the production frontier (increasing the potential output the economy can produce) by accelerating the development and dissemination of innovation and creating knowledge spillovers (arrow iii in figure 1.4).[8] Given that investments in knowledge tend to be lower than desirable in the absence of public intervention, policies that encourage green technologies can thus usefully increase R&D (Acemoglu and others 2012; Fischer and Newell 2008; Gerlagh 2006; Otto and Reilly 2008).[9] (The opposite effect is also possible, as research on green technologies could crowd out research on other productivity-increasing technologies [Popp and others 2009].) The innovation effect is illustrated by investments in R&D on photovoltaic power motivated by the desire to mitigate greenhouse gas emissions. Success could make photovoltaics competitive with fossil fuels, increase the supply of electric power, and reduce the cost of providing electric power to remote off-grid communities (see chapter 6).

At the same time, the costs associated with environmental efforts create a trade-off between environmental protection and economic production. For example, environmental efforts may have the following effects:

- Reduced productivity, by causing producers to use more expensive or less productive technologies or by crowding out R&D in nonenvironmental domains.
- Early retirement of physical capital based on polluting technologies (Grubb and others 1995; Jaccard and Rivers 2007). This effect can be represented as a decrease in capital or an increase in capital depreciation. In addition to the direct cost, the increase in investment needed to replace retired capital reduces consumption—and thus welfare—at least over the short term.
- Increases in the pricing of some goods and services, altering relative prices. By changing the structure of demand, environmental policies may reduce the ability of the structure of production to meet demand. For example, policies may reduce demand in some sectors that have a high production capacity (such as road transport) and may increase demand in sectors that have more limited production capacity (such as public transportation). This effect can be measured as lower efficiency.

These costs, and their assessment, depend on the definition of economic output. In a green accounting framework that includes valuation of ecosystem services, a reduction in economic productivity because of environmental regulations can be more than compensated for by a reduction in externalities—through, for example, the preservation of ecosystem services (a topic explored in chapter 2).

What about welfare?

Ultimately, however, what matters is welfare, not output. The next step, therefore, is to broaden the framework to take into account the impact of the environment on welfare (or utility), which can be positive or negative. Welfare can be assessed by viewing utility as depending on the current level of consumption and the direct effect of the environment (through its health effects and amenity value).

Welfare also depends on income distribution and employment. As such, analysts must take into account the fact that environmental policies may affect different social groups or regions differently. These policies may create jobs for some types of workers in some regions and eliminate jobs for other types of workers in other regions. Because women tend to be more dependent on common property resources and more vulnerable to the impacts of natural resource degradation than men (Foa 2009), environmental protection and green policies can also help improve gender equality, with many economic and social co-benefits. These distributive effects have both social and political economy implications that may require the implementation of complementary policies to compensate losers (see chapter 2). If compensatory financial transfers are possible at zero cost and labor markets are perfect, efficiency can be separated from equity. If such transfers are impossible or costly and labor markets are imperfect, it is necessary to pursue efficiency and equity simultaneously, which may require setting more modest goals (Goulder and Parry 2008).

Analysts must also factor in the fact that environmental policies can increase or decrease volatility. These policies can create shocks in the economy and can distort intertemporal trade-offs. But they can also reduce potential risks to growth by increasing resilience to environmental

BOX 1.4 Reducing vulnerability to oil shocks by increasing energy efficiency

The vulnerability of the world economy to oil shocks has diminished since the 1970s (Nordhaus 2007). Possible explanations for this decline include the decrease in the average oil intensity of world GDP; the increased flexibility of labor markets (in particular wages), so that pass-through inflation is less likely for a given monetary policy; a change in the nature of oil shocks (the 1973 and 1979 shocks followed supply disruptions; the 2008 shock resulted from increased demand from emerging markets); and improved confidence in monetary policy, which stabilized inflationary expectations as a result of nearly three decades of low and stable inflation (Blanchard and Gali 2010; Gregorio and others 2007).

Specific energy security policies drove the decrease in GDP oil intensity. In some countries, higher taxes on gasoline consumption reduced oil consumption. In others, norms and regulations reduced energy consumption by cars, industries, and the residential sector.

Over the longer term, climate policies may have similar results: by driving technological change and investment away from oil-intensive patterns, these policies reduce oil consumption and vulnerability to oil shocks (Rozenberg and others 2010). Climate policies can thus reduce vulnerability to oil scarcity and uncertainty over oil reserves. In particular, such policies might reduce the obsolescence of capital in case of large changes in energy prices. Cities that are denser, less dependent on individual vehicles, and less energy consuming are also less vulnerable to volatility in oil prices (Gusdorf and Hallegatte 2007). Climate policies and other policies aiming at higher efficiency in the use of natural resources can thus increase the security and resilience of the economy.

shocks (such as natural disasters) or economic shocks (such as oil shocks or spikes in commodity prices) (box 1.4).[10] In so doing, they can stabilize output and consumption, increasing welfare if risk aversion is accounted for.

Trade-offs and synergies between green policies and growth

Armed with this framework for green growth, how do policy makers weigh the trade-offs between the costs (possible reductions in investments, income, and consumption) and benefits (possible improvements on the environmental, social, and economic fronts)? Given that the net impact varies depending on the policy considered, the context, and the time horizon,[11] a start is classifying the potential benefits of green growth policies, as done in table 1.1. In a green growth context, any new policy should be examined for ways to maximize the potential for short-term benefits while minimizing the costs.

Measuring the net impacts of green growth policies also requires capturing suboptimal conditions caused by market or government failures or nonrational behaviors. Models based on first-best assumptions (perfect markets, rational expectations, and so forth) can assess the costs of these policies in a perfect world; they cannot be used to estimate their benefits.

The balance between costs and benefits will be affected by how they are defined. In a narrow economic framework, a policy to protect a mangrove forest has an economic opportunity cost (because it prevents shrimp farming or tourism development, for example) and no direct benefit. In contrast, in a framework that includes the valuation of ecosystem services, the policy also has economic benefits, including protection against coastal storms, the creation or maintenance of a breeding ground for fisheries, and the availability of wood for the local community. The "green accounting" approach incorporates the valuation of ecosystem services into national accounts, thereby providing a much

TABLE 1.1 Potential benefits of green growth policies

Type of benefit	Impact on welfare	Channels through which policy affects welfare
Environmental	Increases welfare directly	Improved environment
Economic	Increases welfare by raising income	Increase in factors of production (physical capital, human capital, and natural capital) Accelerated innovation, through correcting market failures in knowledge Enhanced efficiency, through correcting nonenvironmental market failures and influencing behaviors
Social	Increases welfare through distributional effects, reduced volatility, and other social indicators	Increased resilience to natural disasters, commodity price volatility, and economic crises Job creation and poverty reduction

better measure of trade-offs than traditional national income accounting. As such, it is central to green growth strategies.

In sum, although many observers fear that green policies require incurring large costs now for benefits that will materialize only in the long term, the reality is that many of the benefits can occur in the short and medium term. Moreover, green policies can contribute to growth. Action therefore needs to be taken now—at least on issues that carry a risk of lock-in and irreversibility—to minimize regret and avoid costly policy reversals. In the next two chapters, we look at the cross-cutting issues of market and governance, beginning with the range of tools that can be marshaled to change behavior with respect to environmental and natural resources—tools that aim to improve social welfare through greener growth.

Notes

1. Kuznets argued that as a country develops and national income rises, inequality increases, but once a certain national income level is reached, inequality then declines. His now disproved theory was extended to the environment, where it has also been rejected (Andreoni and Levinson 2001; Barbier 1997; Brock and Taylor 2010).
2. Another common interpretation is that the environmental Kuznets curve reflects structural transformation of an economy. As economies become more industrial, environmental quality deteriorates. But as economies shift from industry to services, environmental quality improves.
3. In some cases, even specialists debate the importance of these relationships.
4. Later efforts to explicitly model the environment into an endogenous growth framework include work by Smulders (1994) and Bovenberg and Smulders (1996); for a review, see Smulders (1999).
5. Few studies examine the potential for substituting other inputs for natural capital (Markandya and Pedroso-Galinato 2007).
6. It may be possible to compensate for the loss of natural capital with other types of capital in the short term but not the long term. An example would be increasing the use of fertilizer to compensate for soil degradation—a short-term solution that is not sustainable over the long term.
7. For an illustration of this point in the context of South Africa, see World Bank (2011).
8. This argument on the impact of green policies on productivity is the macro-scale equivalent of the Porter hypothesis (Porter and van der Linde 1995), which states that regulation can enhance innovation and business performance at the micro scale (for a review, see Ambec and others 2011).
9. A frequently asked question is whether public support of green innovation should target green innovation or general innovation. The opposite question—can green innovation policies accelerate innovation in general?—is posed here.
10. Hallegatte (2011) suggests that development can increase or decrease risk, depending

on its structure and pattern. Green growth strategies aim to make development risk decreasing, thereby increasing the resilience of the economic system.

11. For instance, the GDP losses associated with a carbon tax differ widely depending on how tax revenues are used (Goulder 1995).

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Influencing Firms, Consumers, and Policy Makers through Market and Nonmarket Mechanisms 2

Key Messages

- Because economic incentives promote efficient solutions, "getting the prices right" is key to greening growth without slowing it. Complementary policies will be needed to mitigate negative distributional impacts.
- Economic incentives cannot induce all of the changes needed to protect the environment, given market failures, behavioral biases, and political economy considerations.
- Other tools—such as information judiciously deployed to influence economic actors, and norms and regulations—are also needed.

The starting point in greening growth is an understanding of why so much of traditional economic growth has been "non-green"—that is, why the world is not using environmental assets efficiently, a reality that is harming economic growth and the environment.

For economists, achieving greener growth is fundamentally about changing the incentives that have led to environmental degradation and depletion—that is, "getting the prices right." The reasons markets are failing to appropriately price the environment and thus create incentives to encourage greener growth are many (Sterner 2003). They include institutional and policy failures; market failures, such as externalities, the public-good nature of many environmental goods; and missing or incomplete property rights (box 2.1). With a common pool resource like a fishery or a shared aquifer, for example, the lack of property rights (such as individual quotas) can lead to overexploitation and ultimately a collapse of the resource.

For psychologists, achieving greener growth is about compensating for behavioral biases, tailoring information and messages to the way people learn, and improving the way in which environmentalists and economists communicate the costs and benefits of greener behaviors. Examples include social marketing campaigns that changed social norms around water usage in Australia or

BOX 2.1 Institutional and market failures that help explain why growth is often environmentally unsustainable

Growth may be environmentally unsustainable because of *institutional and policy failure*. Institutions and governments may themselves face bad incentives, driven by political economy. Or they may lack information on the overall impact of the policies they promote. Subsidizing energy "to benefit the poor" is a classic example—the subsidy encourages energy consumption, thereby increasing emissions of local air pollutants that often disproportionately affect the health of the poor. Moreover, it is generally the nonpoor who benefit most from energy subsidies, because they can afford an energy-intensive lifestyle.

Alternatively, *market failures* may be to blame. Under some technical assumptions, competitive markets are an efficient means of allocating goods. But real markets deviate from the ideal in a multitude of ways that can have severe consequences for the environment and social welfare. Examples include the following:

- *Externalities*. These are uncompensated damages imposed by one economic agent on another. For example, a factory owner can maximize profits from production by releasing untreated effluents into a river rather than incurring the costs of treatment. But the resulting water pollution can damage the health of people drinking the water downstream. This health damage is external to the profit-maximizing decisions of the factory owner, with the result that the social benefits from production are less than private profits.
- *Public goods*. Many environmental assets have a public-good nature—they provide services, such as amenities or the regulation of water flow, that are nonrival (one person's enjoyment of the amenity does not decrease another person's enjoyment) and nonexcludable (there is no practical way to prevent people from enjoying an amenity such as a beautiful view). The result is that public goods are typically underprovided by private markets, because there is no way for private actors to appropriate all the benefits from providing the public good.
- *Information asymmetries and agency problems*. If different agents have different information, environmental impacts can result. Factory owners typically have much more information about pollutants, treatment measures, and treatment costs than environmental regulators, which can reduce the effectiveness of regulation. Landlord-tenant relationships lead to a type of agency problem with regard to energy efficiency: If the landlord pays the energy bills, the tenant has no incentive to conserve energy; if the landlord owns the furnace but the tenant pays the energy bills, the landlord has no incentive to invest in a more efficient furnace.
- *Missing or incomplete property rights*. For common pool resources (for example, a fishery or a shared aquifer), the lack of property rights (such as individual quotas) can lead to overexploitation and ultimately the collapse of the resource. From an economic perspective, overexploitation manifests itself as dissipation of resource rents: in the absence of quotas, exploitation efforts by users of the common pool drives up costs to the point at which economic profits drop to zero.

Source: Sterner 2003.

littering behavior in the United States. So for psychologists, incentives also matter but they must be tailored to how people process information and react to it.

Unfortunately, inappropriate incentives, or the lack of incentives, led to the current widespread inefficiency in the way natural resources are used. This chapter examines the range of tools that can be marshaled to increase efficiency by changing behavior with respect to the environment and natural resources—tools that aim to increase social welfare through greener growth. The tools fall into the following areas:

- Incentivizing: providing effective market signals to spur green growth
- Informing and nudging: using information and framing to influence economic actors
- Imposing: using rules and regulations.

Incentivizing, informing and nudging, or imposing—some combination of the three is likely to be needed. Determining the best mix requires a solid understanding of how individual decisions are made and framed. Behavioral economics and social psychology thus provide indispensable insights into how to green growth. Economists will ignore them at their peril.

Incentivizing: Providing effective market signals to spur green growth

Economic incentives promote efficient solutions

Economic incentives—traditional price and quantity instruments—are critical to promoting green outcomes, because they change behavior in a manner that typically leads to least-cost solutions. The intuition behind this approach can be seen in markets for tradable pollution emission rights. Because polluting firms use different technologies for production, their pollution abatement costs differ, often markedly. Firms with high marginal abatement costs therefore tend to prefer to pollute more and purchase permits from firms that have low marginal abatement costs and find it profitable to invest in less polluting processes and sell their pollution rights. This trade allows the market to minimize the overall cost of achieving a given pollution target.

Economists recommend a variety of incentive-based instruments to reduce environmental damage and depletion—such as taxes, tradable permits, subsidies, deposit-refund schemes, and refunded emission payments—that focus on either price or quantity. In the case of carbon dioxide (CO_2), for example, the debate has centered on emission taxes, subsidies, and tradable emission permits.

Price instruments. These instruments aim to change behavior by ensuring that the prices paid for goods and services reflect their full social costs, including externalities. To the extent that environmental taxes replace other distortive taxes (say, on labor), there can be a double dividend. Countries in the Organisation for Economic Co-operation and Development (OECD) have imposed some 375 environment-related taxes and about 250 environment-related fees and charges (OECD 2006). However, about 90 percent of revenues from these taxes comes from taxes on fuels and cars (OECD 2011). The majority of OECD countries also tax water usage in agriculture. Although they appear to have improved water efficiency, these price instruments still fall short of full cost recovery (OECD 2010, cited in OECD 2011).

In addition to reflecting social and environmental costs in prices through taxes, "full-cost pricing" implies the phasing out of harmful subsidies, such as subsidies on fossil fuels, fisheries, forestry, water use, land use, and agriculture. These subsidies not only encourage carbon emissions, resource depletion, and environmental degradation, they also distort trade and strain public finance. Reforming them should be a high priority, although it may not be easy.

Quantity instruments. Unlike pollution taxes and subsidy reforms, which affect existing markets, quantity instruments (such as tradable permit schemes) create new markets for pollution allowances by affecting the costs of production. Once these new markets reach equilibrium and the permit price is determined, the cost of acquiring pollution permits affects the costs of production in a manner equivalent to a pollution tax. Tradable permits or quotas have also shown good results in managing renewable environmental assets, notably fisheries.

"Cap and trade" schemes for pollution emissions have become the dominant market-based approach to controlling oxides of sulfur (SO_x) and nitrogen oxides (NO_x) in the United States, in the European Union's Emission Trading Scheme for CO_2, and in many other jurisdictions. The basic principle is that regulators determine the total allowable emissions per year (the cap) and allocate permits to polluters based on a variety of schemes (including "grandfathering" based on historical emissions or auctioning of all permits); firms are then free to trade permits. The evidence on the efficiency of the U.S. SO_x trading scheme is positive: markets have been liquid and permit prices (hence, total cost to firms) have been lower than originally estimated (Fullerton and others 1997). Moreover, international experience with CO_2 emission trading schemes suggests that they can be used to assign a price to polluting emissions from large sources, although implementation can be difficult (box 2.2).

Price versus quantity instruments. Although price schemes and cap and trade schemes are theoretically equivalent instruments, they have distinctive characteristics in practice (World Bank 2010). For example, permit systems create certainty regarding emission reductions but uncertainty about price; taxes provide certainty regarding price but uncertainly about emission reductions. They also differ regarding economic and administrative efficiency and their ability to generate revenues (theoretically both do, but in practice countries have tended to allocate permits free of charge). As such, many jurisdictions, particularly in Europe, have opted for hybrid schemes to control carbon emissions: tradable permits for large emitting sectors and taxes for smaller sectors characterized by many actors, such as transport.

But imperfect markets and political economy complicate matters

Although in theory, economic incentive–based instruments are the most effective, in practice, market imperfections and political economy mean that additional measures may be needed to make these instruments more efficient. One well-known case concerns innovation and long-lived investments, for which prices are not always efficient (see chapter 3). But there are other circumstances

BOX 2.2 Lessons from CO_2 emission trading schemes

A review of existing and proposed carbon trading schemes in Alberta, Australia; the European Union (EU); New Zealand; Switzerland; Tokyo; and the United States (both national and state-level schemes) shows that these schemes are complex to implement but can be used to create a price of carbon for large emitters. To implement them effectively, policy makers should keep in mind the following dos and don'ts:

- *Targets*. Ambitious long-run targets are needed if firms are to invest in reducing their carbon footprints.
- *Allocation*. Free allocation of permits to producers in the electricity generation sector should be avoided, because it leads to windfall profits at the expense of consumers (electric utilities are typically free to pass costs along to consumers). Free allocation to new entrants should also be avoided, because it risks locking in high-carbon footprints (by, in effect, subsidizing a new source of emissions). The EU Emission Trading Scheme is reducing the free allocation of permits.
- *Start-up*. Trading schemes have tended to overallocate permits in the initial phase, leading to a price collapse. Allowing permits to be banked—that is, allowing permits from one period to be used in subsequent periods—can overcome this problem, but this solution simply carries forward the surplus permits into the next phase. Other options include establishing a price floor, with cancellation of any unsold permits, or initially using a fixed price to aid the collection of data on emissions and abatement costs that can then be used to determine the subsequent allocation.
- *Offsets or links to other trading zones*. Trading outside the permit scheme can help reduce permit prices, but doing so runs counter to policy goals to reduce domestic emissions and provide incentives for innovation in achieving this reduction.
- *Support to carbon-intensive sectors*. Concerns about the competitive impacts on carbon-intensive sectors will lead to lobbying for financial support to these sectors. Any support should be time limited, and communicated as such, to reduce fiscal costs and provide incentives for firms to invest in less polluting technologies.

Source: IEA 2010.

in which narrow reliance on incentive-based instruments is misplaced. These include cases when:

Feasible alternatives are lacking. For pricing mechanisms to be successful in addressing environmental issues, feasible alternatives must be readily available or easily brought to market. One example is high fuel prices, which will be more effective at reducing individual car use if public transport is available or cities have been designed in such a way that walking or cycling are options. Another example is the emissions pricing scheme of the U.S. acid rain program, which successfully reduced SO_2 because the required technologies were available and well understood (Zysman and Huberty 2010). In this case, prices were a powerful incentive for adopting existing alternative technologies.

Market imperfections exist. Prices may be ineffective incentives because of market imperfections or imperfect contracts. For example, contracts may need to be designed in a particular way to address the principal-agent problem (the difficulty of motivating one party [the agent] to act on behalf of another [the principal]). An example is when building owners are responsible for insulation and heating systems but tenants pay energy bills; if owners cannot transfer the cost of higher energy efficiency through higher rents, they will under-invest in energy efficiency regardless of energy prices.

Another example is flood insurance if it is not "risk-based"—that is, if the premium is not calculated as a function of the risk level, which is itself based on the characteristics and location of the asset. Insurance that is not risk-based creates a moral hazard problem, as it reduces incentives to invest in prevention. Households or businesses investing in risk mitigation improvements (such as a reinforced roof or windows) are not rewarded fully for their investments. Moving toward a "risk-based" premium would encourage prudent behavior. However, this approach is difficult to implement with one-year insurance contracts, because investing in risk mitigation produces benefits over decades—meaning that a homeowner who sells his or her house may not be able to recoup the benefits from the investment. In this case, attaching a long-term insurance contract to the property rather than the owner could help create the right incentives (Kunreuther and Michel-Kerjan 2012).

Prices are difficult to change. The fact that so much pricing is currently inefficient suggests complex political economy considerations. Whether it takes the form of preferential access to land and credit or access to cheap energy and resources, every subsidy creates its own lobby. Large enterprises (both state owned and private) have political power and lobbying capacity. Energy-intensive export industries, for example, will lobby for subsidies to maintain their competitiveness. In emerging economies, industries that are likely to be most affected by climate change policies are export-based industries, which are also the most influential and most able to oppose environmental policies (Mattoo and others 2011; Victor 2011). Thus, governments need to focus on the wider social benefits of reforms and need to be willing to stand up to lobby groups (box 2.3).

In considering pricing reforms or the introduction of new taxes, policy makers need to consider social impacts. Increasing energy prices, for example, has far-reaching impacts, because energy is used pervasively in production and in households. And although energy subsidies almost invariably benefit the rich much more than the poor, their removal can have devastating impacts on the purchasing power of the poor (Arze del Granado and others 2010).[1]

To prevent this from happening, policy makers need to adopt complementary policies, such as the use of existing safety nets (where available), alternative short-term mitigation measures and subsidies, and energy-pricing solutions. In middle- and high-income countries, social safety nets can be used for compensation. In low-income countries, where safety nets are often lacking, ad hoc measures are frequently necessary. Information to target support is often not available, especially in urban areas, where geographic targeting is very inefficient (Kanbur 2010).

BOX 2.3 The political economy of subsidy reform

What lessons have been learned about subsidy reform? An analysis of the political economy of subsidy reform—which looks at the few attempts that have been successful—suggests the need for careful analysis of the likely social impact of the reform and implementation of a program of appropriate support for those affected (Nikoloski 2012). Other elements of success include political will and institutional capacity, as well as an effective communications and outreach strategy that explains the justification for the reform and the benefits to be derived from it. As for the timing and pace of the reform, there is no clear lesson as to whether "big bang" or gradual approaches are more successful.

Another study, which focuses on petroleum product subsidies, confirms the importance of addressing the political logic that led to subsidy creation and either compensating the political interest that would otherwise oppose reform or finding a way to insulate the reform from its opposition—advice that applies to any subsidy reform (Victor 2009). In addition, it is critical to ensure the transparency of the costs and purpose of the subsidy. Reforming a subsidy may be easier if all members of society are fully aware of the costs they are paying and the extent to which they or others are benefiting.

Moreover, the political economy of reform will likely require compensatory transfers to the middle class. In the Islamic Republic of Iran, for example, where the law that reformed fuel and food subsidies stipulated that 50 percent of the revenues raised had to be redistributed to households, the initial thought was to target the bottom 30–50 percent of the income scale. In the end, 80 percent of households received significant transfers (Guillaume and others 2011)—no doubt contributing to the success of the reform.

In the end, the redistributive impacts of a carbon price scheme depend on how revenues from the scheme are used. Compensatory measures can offset unwanted distributional effects. However, such schemes require the institutional capacity to manage the classical challenges of redistributive policies: political acceptability, imperfect information and targeting, and behavioral issues.

To be effective, incentives must reflect behaviors

Designing effective environmental policies requires a good understanding of how behaviors are determined and how they can be influenced.[2] The hypothesis of rational behavior—under which price-based instruments are optimal—is only a rough approximation of how people actually make decisions. In practice, individuals make decisions in a variety of ways: "by the head" (based on calculation), "by the heart" (based on emotion), and "by the book" (based on rules) (Weber and Lindemann 2007). Alternative or complementary policies and measures are therefore needed to address behavioral biases or changes in values and preferences.

Four types of behavioral biases are particularly important. First, "cognitive myopia" prevents people from accurately balancing future benefits and immediate costs and from assessing the desirability of reductions in immediate benefits in exchange for future gains (Ainslie 1975; Benartzi and Thaler 2004).

Second, individuals are inconsistent in their treatment of time (Ainslie 1975): they apply high discount rates to costs and benefits that will occur at some point in the future, discounting much less when both time points are in the future and one occurs later than the other, in a kind of "hyperbolic discounting." These biases explain why it is difficult to implement policies that entail immediate costs but future benefits even if the result is a net (discounted) gain. A classic example is the failure of consumers to buy more energy-efficient appliances even when future energy savings would more than compensate for higher up-front purchase costs (Gillingham and others 2009).

Third, individuals suffer from "loss aversion"—that is, they weigh losses more than gains, evaluating both relative to a reference point (Tversky and Kahneman 1992). If individuals use the current situation as the reference point, they will consider the cost of environmental policy as a loss and weigh it more heavily than the gain (averted environmental damages). If the reference point is the future, when the loss is the environmental destruction, they will weigh it more heavily than the gain (the averted cost of environmental policies). Weber and Johnson (2012, 16–17) make the following observation about farmers:

> Skillful insurance salespeople have long known that they need to move a farmer's reference point, away from its usual position at the status quo, down to the level of the possible large loss that could be incurred in case of drought. By focusing the insuree's attention on the severity of the possible loss and resulting consequences, all smaller losses (including the insurance premium) are to the right of this new reference point, making this a decision in the domain of (forgone) gains, where people are known to be risk averse and will choose the sure option of buying the insurance.

Fourth, individuals have an aversion to ambiguity, which causes them to delay making decisions (Tversky and Shafir 1992).[3] Aversion to ambiguity is particularly problematic for environmental issues, such as climate change, that involve huge uncertainties: while it disappears if decision makers regard themselves as expert in a domain (Heath and Tversky 1991), few people consider themselves experts in environmental policy.

Different behavioral changes can be triggered by different learning processes—such as learning by being hurt, being told, and observing and imitating (Weber and Johnson 2012).

Learning by being hurt. Learning by being hurt refers to learning from personal experience. Because recent events have a strong impact, which recedes over time (Hertwig and others 2004), reactions to low-probability, high-severity events often appear erratic. In particular, people usually overreact when a rare event eventually occurs (Weber and others 2004). For instance, extremely ambitious flood defense projects were designed after each big flood in New Orleans, but none has been completed so far, as public interest in the issue faded a few years after each event. This tendency to overreact to recent events and then forget needs to be taken into account in developing green growth strategies, especially for disaster risk management (Hallegatte 2011).

Learning by being told. Learning by being told involves the absorption of objective information. For instance, hydrometeorological data can be collected and analyzed to generate quantified risk assessments that help individuals make informed choices. But providing information will not be enough to induce appropriate risk management or environment-friendly behavior, because people treat abstract information on distant events differently from concrete, emotionally charged information linked with real-world experience (Trope and Liberman 2003). So what is needed is a combination of communication tools that accounts for this bias and practical information on what needs to be done—for instance, rules to save energy or water or how to react in case of disasters.

Learning by observing and imitating. Learning by observing and imitating has the concreteness that "being told" does not have, making action more likely. One way of encouraging learning by observing and imitating is to help individuals compare their behaviors with more environment-friendly ones and to provide them with feedback on their consumption and with tips on how to change their behaviors. In one experiment, an Internet-based tool that combined feedback on past consumption, energy saving tips, and goal setting was used to encourage households to reduce their energy consumption. Households with access to the tool reduced their direct energy consumption by 5 percent; household without access to the tool increased their consumption by

0.7 percent (Abrahamse and others 2007). Indicators are thus critical—even when they are imperfect—because they allow individuals to monitor their effort.

All of these biases vary with culture and education (Weber and Hsee 1998). For instance, individuals with greater ability to reason with numbers are more likely to rely on calculation-based processes to make their decisions (Peters and others 2006). This diversity means that policy makers may need to align their approaches with the cognitive biases present in a given country or population.[4]

Informing and nudging: Using information and framing to influence economic actors

Many motives other than price signals drive individuals' behavior. It is therefore critical that information on the environmental consequences of their actions go beyond price. Information needs to be framed in a manner that accounts for behavioral biases and the ways in which people learn and make decisions. Governments have a role to play to ensure that the required information is produced and disseminated effectively. Fortunately, they can rely on the experience gained from decades of public health campaigns. However, a vibrant civil society will be essential to ensure that action follows information.

Informing to influence policy makers: The role of green accounting

Environmental assets are seldom traded through markets and thus do not have readily identifiable prices. In such cases, development decisions (such as building a road through a rainforest) are often made with incomplete information. As a result, they may not maximize social benefits. Given that the outputs of environmental projects generally do have a readily identified economic value—a road may increase the access of farmers to markets and thus increase food production—it is vital that economic values for environmental assets be comparable to other economic values.

Environmental valuation can help in a number of ways:

- It estimates people's willingness to pay for environmental goods and services or willingness to accept compensation for the loss of an environmental asset (Bolt and others 2005; Ley and Tran 2011).
- It assesses the value of the services provided by natural ecosystems. Because ecosystem services are typically provided as externalities—for example, an upland forest provides water regulation services to lowland farmers—the natural systems providing these services may be at risk when decisions are made that ignore the flow of services from natural areas and their benefits to people.
- It establishes the schedule of marginal benefits associated with the provision of different quantities of environmental goods and services—such as changes in the volume of pollution emitted. This information is useful when setting tax rates on environmental "bads" or when determining total quota sizes, such as the number of pollution emission permits that will be issued in a given time period.
- It facilitates "green accounting" (box 2.4), which focuses on a country's stock of assets (its wealth) rather than relying on a flow measure such as GDP. As such, it promotes good economic management, identifies situations in which economic growth is not wealth creating (because the growth degrades natural resources faster than it creates wealth), and assesses whether a country's economic trajectory is sustainable. However, green accounting and environmental valuation are not substitutes for price signals, because they do not affect incentives faced by individuals and firms.

Informing and nudging to influence individuals: Tackling behavioral biases

Good design and careful interventions can help align individual preferences with social goals and address behavioral biases.

BOX 2.4 What is "green accounting"?

All accounts serve two purposes: a scorekeeping purpose, providing indicators on how well you are doing, and a management purpose, providing detailed statistics so that anybody who does not like the "score" has the information to understand and do something about it.

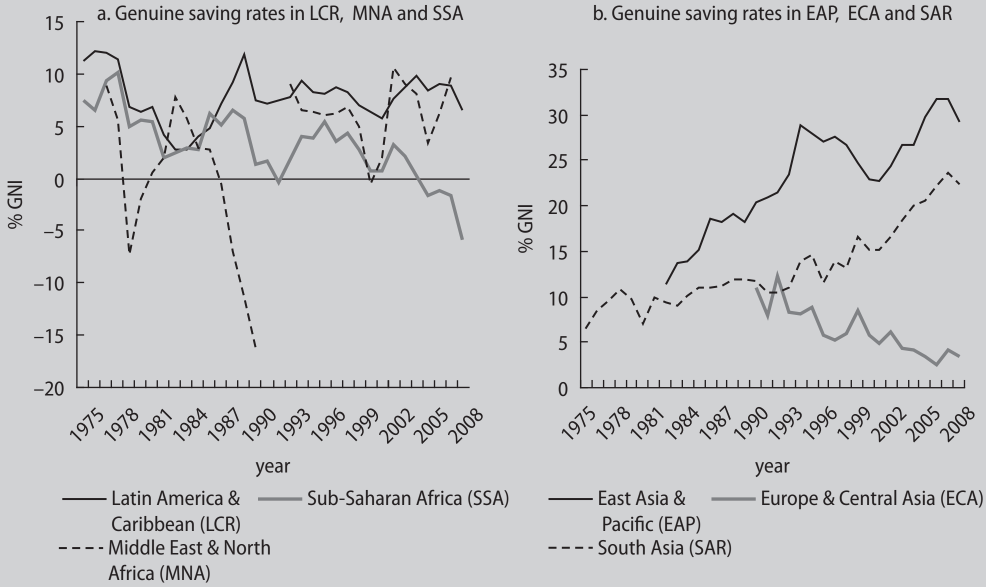
In standard national accounting, GDP is measured as the market value of all goods and services produced by a country within a specified time period. Changes in GDP indicate whether the economy is growing, but not whether this growth is sustainable. In particular, the use or misuse of natural capital is not taken into account.

Green accounting extends national accounts to include the value of the damage and depletion of the natural assets that underpin production and human well-being. In particular, net saving, adjusted for the depreciation of produced assets and the depletion and degradation of the environment, indicates whether well-being can be sustained into the future. Negative net saving indicates that it cannot, because the assets that support well-being are being depleted (Asheim and Weitzman 2001; Dasgupta and Mäler 2000; Hamilton and Clemens 1999).

At the regional level, East Asia and South Asia have exhibited strong wealth creation over more than a decade. In contrast, Sub-Saharan Africa, where the depletion of oil and minerals has been offsetting savings by the public and private sectors, displays a worrisome trend (figure B2.4.1). At the country level, China's near 10 percent annual GDP growth is being partly offset by environmental depletion and degradation, reducing its adjusted net national income growth to an estimated 5.5 percent (World Bank and DRC 2012).

With green accounting, the scorekeeping indicators (such as wealth accounts) can be used alongside GDP to better assess how well a country is doing for the long term. It also provides detailed accounts for management of natural capital, which many countries have adopted over the past 20 years—especially for water, energy, and pollution. However, few countries have adopted the revised macroeconomic indicators.

FIGURE B2.4.1 Some regions are doing better than others in wealth creation
(net saving by region, 1975–2008)



Source: World Bank 2011.
Note: GNI = gross national income.

(continued next page)

BOX 2.4 (continued)

A new partnership—Wealth Accounting and Valuing Ecosystem Services (WAVES)—is expanding efforts to account for ecological services. Botswana, a WAVES partner country, has defined one of its overarching objectives as to continue to grow while diversifying away from diamonds (which currently account for about 35 percent of national income) and eradicating poverty. Several natural resource–based sectors are being tapped to play a lead role in this development strategy, including nature-based tourism, mining (especially coal for export), and irrigated agriculture.

Water plays a critical role in Botswana's development, given its scarcity; the increasing reliance on shared, international water resources; and the water-intensive nature of sectors identified for economic growth and diversification. A key component of WAVES in Botswana will be the establishment of water accounts—physical supply and use accounts as well as monetary accounts (for supply costs, tariffs paid, and the value of water in different uses). Water accounts will enable Botswana to answer the following questions: Is there enough water in the right places to support the diversification strategy? What are the economic trade-offs among competing users? How can incentives for water efficiency be created? In the wake of the recent privatization of water under full cost recovery management, what will happen to poor households' access to water resources? The answers to these questions are critical for helping policy makers chart the best path forward.

Avoiding fear mongering. Given cognitive myopia and people's tendency to weigh emotion-filled consequences more heavily than abstract consequences, policy makers may be tempted to scare people into adopting environment-friendly behavior. Using "catastrophism" to make people change their behavior is ineffective, however, for two reasons. First, fear is only briefly effective. Once people get used to the problem, they revert back to their initial behavior (Weber 1997). For example, farmers informed about weather risks have a tendency to implement one mitigating measure (such as buying insurance), after which they consider their vulnerability problem solved, without considering how additional action may help.

Second, people have only a limited ability to worry; an increase in worry about one hazard decreases worry about other hazards (Weber 1997, 2006). This means that a policy based on fear leads to competition among hazards, and success in one area (for example, climate change) comes at the cost of failure in others (for example, water pollution).

Greening default options. An important behavioral bias that environmental policy makers can use to their advantage is the tendency of people to stick with the default option (box 2.5). In European countries, where organ donation is the default option, more than 85 percent of people are organ donors. In contrast, in neighboring countries where people must designate themselves as organ donors, less than 30 percent of people do so (Johnson and Goldstein 2003). In the United States, automatically enrolling employees in saving programs and requiring them to opt out if they preferred not to participate increased participation from 37 percent (under the opt-in design) to 86 percent (Madrian and Shea 2001).

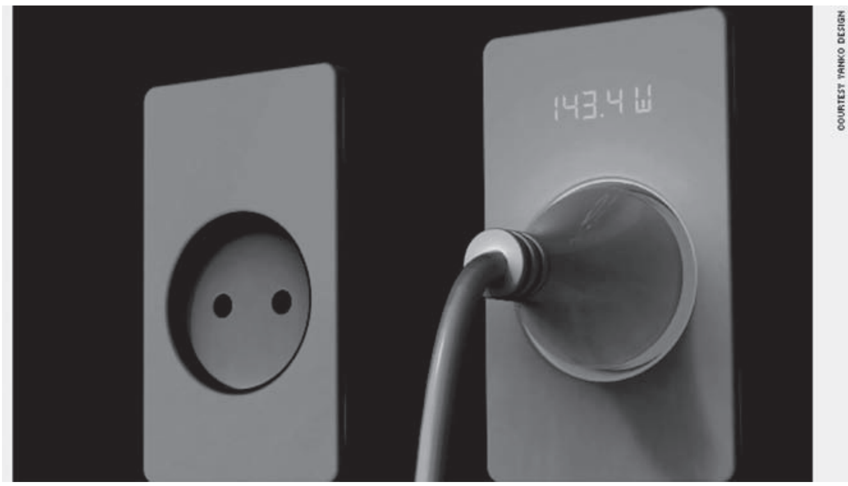
Using nudging. In recent years, behavioral economists and the behavior change community overall have stepped up their interest in the potential role of nudges to influence behaviors. This approach advocates tweaking "choice architectures" to nudge people to make better decisions about their health, the environment, or other desirable outcomes without restricting their freedom of choice (Thaler and Sunstein 2009). To count as a nudge, the intervention must be easy, inexpensive, and voluntary. Nudges are increasingly being used to stimulate green behaviors; studies show promising results. For example, an electrical outlet (designed by Muhyeon Kim) that displays how much power it is using makes people more conscious of their energy use (figure 2.1). The Danish Nudging

BOX 2.5 Changing the default option to spur the use of renewable energy

To spur, rather than coerce, the purchase of renewable energy, policy makers could rewrite the default electricity purchase contract to include a minimum share of electricity produced from renewable sources. Consumers would have to opt out to purchase their electricity without this constraint, at a lower cost.

A study of the impact of such "green default" in electricity provision provides support for this approach (Picherta and Katsikopoulos 2008). It looked at two cases in which electricity providers offered green options with more renewable energy and a higher price as the default option. In both cases, fewer than 5 percent of customers decided to shift to less expensive, less green options.

FIGURE 2.1 Energy-reporting electrical outlet



Source: Webster 2012.
Note: Designer Muhyeon Kim has designed a switch that displays how much power it is using. Research has found that people are more conscious of their energy use when they can see it in action.

Network even hosts a Web site, iNudgeYou.com, dedicated to sharing applications and study findings.

Framing decisions judiciously. The way economic actors react to policies depends on many factors, including how the policy is presented, or framed. Firms know this well, which is why they rely on marketing tools and branding in addition to price signals. By priming or framing personal behavior as part of a larger social goal, the public and private sectors can induce people to behave in more environment-friendly ways, particularly when they act as groups, as group decisions have been found to be made with less selfishness than individual decisions (Milch and others 2007). By framing environmental protection as a "social project," policy makers can make individuals think in terms of social and collective goals. For example, surveys show that many passengers are willing to pay more for flights to account for the environmental damage that flying causes. However, their willingness to do so depends partly on what the surcharge is called: simply relabeling a carbon "tax" as a carbon "offset" increases its acceptability (Hardisty and others 2010).

In addition, people are more likely to accept increases in energy prices if they perceive them as needed to reach an ambitious and positive social goal than if they perceive them as top-down government decisions to reduce oil imports or protect the climate. Germany presented its decision to gradually replace its nuclear plants with renewable energy sources as a collective national project that positions it as a leader in the transition toward a greener economy. This framing makes it more likely that the public will accept the resulting increases in the price of electricity. It also reduces the risk that the decision will be reversed by the next government. The certainty afforded by the decrease in the chance of policy reversal increases incentives for long-term investments in research and development and new technology.

It may be more efficient to change the values related to the emotional part of decisions than to count on prices and other policies to counteract emotion-based decisions. For instance, many consumers prefer big and inefficient cars for status-related reasons. As long as such cars provide status, raising their price may not reduce consumers' desire to own them. For this reason, price mechanisms may be less effective than efforts to make green and efficient cars a status symbol (Griskevicius and Tybur 2010). Ideally, price mechanisms and behavioral changes can reinforce each other, as recent trends in French car purchases show (box 2.6).

It may also be more efficient to influence consumer behavior through advertising than through price—witness the hundreds of billions of dollars firms spend every year to advertise consumer products (Bertrand and others 2009). What is true for commercial consumption choices is likely to be true for environmental behaviors.

Informing and nudging to influence firms: Enabling public pressure and focusing managers' attention

Information allows citizens or governments to put pressure on businesses—the goal of programs that collect and disseminate information about firms' environmental performance. This approach has been deemed the "third wave" in environmental regulation, after command-and-control and market-based approaches (Tietenberg 1998). Studies show that it is making significant inroads in terms of environmental benefits.

One type of disclosure program relies on emissions data without using them to rate or otherwise characterize environmental performance. Regulations requiring U.S. electric utilities to mail bill inserts to consumers reporting the extent of their reliance on fossil fuels led to a significant decrease in fossil fuel use (Delmas and others 2007). Another type of scheme involves reporting regulatory violations. A policy of publicly disclosing the identity of plants that are noncompliant or "of concern" spurred emissions reductions in a sample of pulp and paper plants in British Columbia (Foulon and others 2002).

Performance evaluation and ratings programs (PERPs) report emissions data and use them to rate plants' environmental performance. Examples include China's GreenWatch program; India's Green Rating Project (GRP); Indonesia's Program for Pollution Control, Evaluation, and Rating (PROPER); the Philippines' EcoWatch program; and Vietnam's Black and Green Books initiative (box 2.7). These programs—which require no enforcement capacity or even a well-defined set of environmental regulations but do require an active civil society, local activism, or both—are particularly helpful in developing countries, where weak formal institutions make traditional enforcement of environmental regulations difficult. Thanks to advances in information technology, the administrative cost of such programs (mainly data collection and dissemination) is falling (Dasgupta and others 2007).

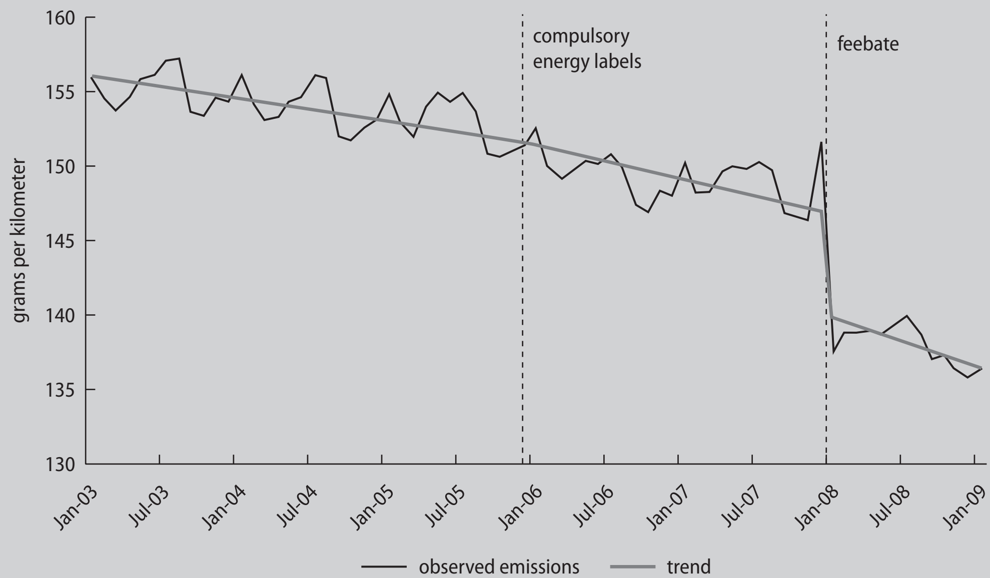
Public disclosure can improve environmental performance through a variety of channels. It can have the following effects (Powers and others 2011):

- Affect demand for firms' products (output market pressure).
- Affect demand for publicly traded companies' shares and the ability of such companies to hire and retain employees (input market pressure).
- Encourage private citizens to sue polluters (judicial pressure).

BOX 2.6 Modifying car buyer behavior in France

From 2003 to 2009, the average emissions of new cars in France decreased, dropping precipitously in 2008 when the government introduced a "feebate" that increased the price of high-energy and reduced the price of low-energy-consuming cars (figure B2.6.1). The average willingness to pay for a reduction of 10 grams of CO_2 per kilometer increased by €536 during the period. This shift in preferences accounts for 20 percent of the overall decrease in average CO_2 emissions of new cars—of which 34 percent is related to the type of cars on the market and 46 percent to price effects (gasoline prices and the feebate). The biggest preference changes occurred among young people and rich people.

FIGURE B2.6.1 A sudden shift to greener cars
(average CO_2 emission of new cars in France, 2003–09)



Source: Durrmeyer and others 2010.

BOX 2.7 How are PERPs faring in developing countries?

Performance evaluation and ratings programs (PERPs)—which are increasingly being used throughout the world—appear to generate environmental benefits. Indonesia's Program for Pollution Control, Evaluation, and Rating (PROPER) spurred significant emissions reductions in wastewater discharges (García and others 2007, 2009). A qualitative evaluation of PERPs in China, Indonesia, the Philippines, and Vietnam found that in all programs examined a large number of plants initially rated "noncompliant" rose to "compliant" over time (in contrast, plants rated "flagrant violators" and "compliant" tended to remain in these categories) (Dasgupta and others 2007). This evidence is consistent with the findings of other studies that concluded that performance ratings led to improvements among plants with moderately poor performance records but not among plants with either very bad or good records (García and others 2007; Powers and others 2011).

- Build support for new pollution control legislation or more stringent enforcement of existing legislation (regulatory pressure).
- Enhance pressure from community groups and nongovernmental organizations (community pressure).
- Provide new information to managers about their plants' discharges and options for reducing them (managerial information) (Blackman and others 2004; Tietenberg 1998).

The impact of information disclosure goes beyond its effect on environmentally conscious consumers. Even when environmental concerns are low and consumers are unlikely or unable to change their consumption patterns, disclosure can create an incentive for businesses to reduce their environmental impacts.

Imposing: Using rules and regulations

Price-based instruments such as taxes and polluting permits are generally considered preferable to norms and standards, under the simplifying assumptions of economic modeling (competitive industry, no enforcement cost, and so forth) (Baumol and Oates 1988; Morgenstern and others 1999). This may not be the case when additional complexities are considered (Helfland 1999).

When enforcement costs and political economy constraints (such as reaction against increases in fuel prices) are factored in, standards-based solutions may be more efficient than incentive-based solutions in some contexts. Moreover, introducing a new standard may prove easier, especially in sectors that are already regulated, than increasing (or introducing) prices. In such cases, existing institutions can be relied upon to enforce new norms, and complex policy making may not be necessary.

That said, the enforcement costs of norms and standards should not be underestimated. Enforcement of a norm on emissions or a trading scheme requires the establishment of emission measurement and reporting systems, which are costly to create and operate.

Norms and regulations can also have negative side effects, by favoring incumbent firms at the expense of new entrants, thereby reducing the ability of the economy to innovate and grow (Copeland 2012). To avoid such a risk, policy makers must design environmental regulation in a way that does not create additional barriers to entry into markets, especially for small firms, which are often innovative and create the most jobs.

Policy makers must also avoid the risk of a rebound effect. Promoting water conservation technologies may increase the acreage of crops requiring irrigation, resulting in an increase in total water consumption (Pfeiffer and Lin 2010). Improving the fuel efficiency of automobiles, by making it cheaper to drive, leads to an increase in car use, reducing by 30 percent any energy gain reaped by improved technology (Sorrel and others 2009) (box 2.8).

BOX 2.8 What is the best way to promote vehicle fuel economy?

Are incentive-based measures or norms and regulations more effective in increasing individual car fuel economy? Proponents of incentives argue that higher fuel prices are more efficient than stricter fuel efficiency standards. The latter, they contend, increase the costs of new vehicles, causing car owners (including organizations with fleets) to wait longer to replace their cars. The result is that fuel consumption remains the same rather than decreasing as owners continue to drive aging, and therefore less fuel-efficient, cars. In addition, when car owners do purchase more fuel-efficient cars with unchanged fuel price, their ability to drive more for the same price can result in rebound effects, thus reducing energy savings and leading to increased traffic congestion. In contrast, fuel taxes cause car owners to drive less, thereby not only decreasing local pollution but also reducing traffic congestion and accidents. In addition, by increasing

(continued next page)

BOX 2.8 (continued)

tax revenues, fuel taxes can potentially allow other, more distorting taxes to be reduced without affecting the budget.

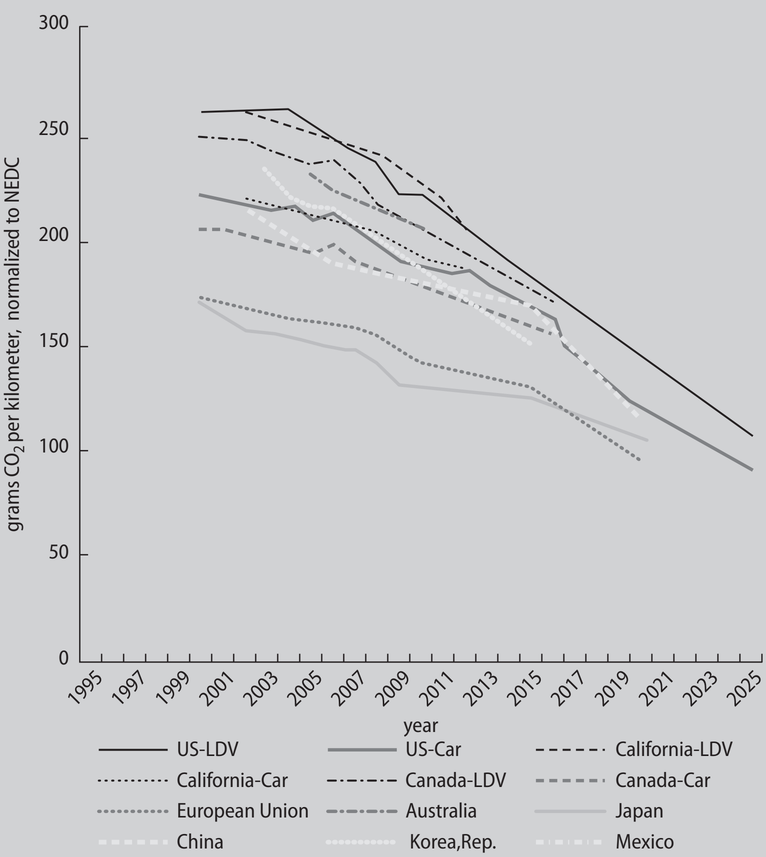
Proponents of fuel efficiency standards argue that consumers may not appropriately value fuel economy when buying a car (Greene 2010). If consumers undervalue fuel economy, fuel efficiency standards will improve welfare. They also argue that opposition to fuel taxes makes their imposition difficult politically.

The debate over which approach is better ultimately depends on the mitigation burden that should be borne by the automobile sector—that is, picking an appropriate carbon price as the basis for fuel taxes. The problem is that there is no consensus as to what could constitute an "appropriate" carbon price. Moreover, the carbon prices that have been implemented in the industrial sector (for example, the European Union's Emission Trading System) are not high enough to trigger manufacturer's investments in the technologies needed to dramatically reduce emissions (Vogt-Schilb and Hallegatte 2011).

In such a situation, fuel efficiency standards, like the ones implemented in Australia, Canada, China, the European Union, Japan, the Republic of Korea, and the United States (An and others 2007), are a reasonable second-best solution, particularly when they are announced early enough to let manufacturers adapt their investments plans accordingly (figure B2.8.1). Standards are best applied in combination with price increases to minimize the risk of rebound.

Figure B2.8.1 Fuel efficiency standards are key to reducing emissions from the transport sector

(historical fleet CO_2 emissions and current or proposed standards, 2000–25)



Sources: International Council on Clean Transportation; An and others (2007).
Note: The NEDC is a driving cycle used in Europe to assess car emissions. LDV = light duty vehicle.

The efficiency of market-based instruments is compromised by the existence of market failures that cannot be fixed. Emission intensity standards, for example—which are widely considered to be less effective than emission taxes—can be preferable in sectors where production has positive external consequences (for example, knowledge creation, transportation), because they generally have less of an impact on output. Emission intensity standards can also improve social welfare relative to emission taxes in the presence of market power (Holland 2009). The idea that a unique carbon price in the economy is the optimal policy has been challenged in situations in which future carbon prices are unpredictable (Vogt-Schilb and Hallegatte 2011); technologies exhibit lock-ins, making it difficult to disseminate new technological options (Kalkuhl and others 2011); or labor markets or revenue-raising taxes are distortionary (Richter and Schneider 2003).

Norms and standards are usually costly in economic terms. They should not be implemented without a detailed analysis of their costs and benefits—but predicting and measuring the economic cost of regulations and norms is difficult. For instance, a pollution regulation can increase production costs for industries and lead to reduced output and employment, but it can also favor more labor-intensive technologies and create jobs. A study of pulp and paper mills, plastic manufacturers, petroleum refiners, and iron and steel mills in the United States finds that the impact of regulation on employment is industry specific and the overall impact insignificant (Morgenstern and others 2002). When they target local public goods, regulations can even lead to net economic gains—by reducing health impacts from pollution, decreasing health costs, and increasing labor productivity, for instance.

In an analysis of U.S. environmental regulations, Morgenstern and others (1999) find that ex ante estimates of total (direct) costs tend to exceed actual costs, suggesting that environmental regulations may be less costly than usually predicted. The overestimation of total costs arises not from an overestimation of per unit abatement costs (how much it costs to reduce pollution by one unit) but from errors in the quantity of emission reductions achieved (how much pollution is reduced by a given regulation). This finding suggests that if regulation costs are often overestimated, so may their benefits.

In sum, rules and regulations are generally considered second-best solutions in situations with perfect markets (markets with perfect information and competitive industries). In the real world, where settings are imperfect, they can be a useful complement to price-based incentives. In the next chapter we look at the need to navigate between market and governance failures through the careful use of innovation and industrial policies.

Notes

1. In a review of energy subsidies across more than 30 countries, Arze del Granado and others (2010) estimate that it costs \$33 to transfer \$1 to poor households through a gasoline subsidy. The figure is high because the vast majority of gasoline is consumed by higher-income households.
2. Weber and Johnson (2012) provide a comprehensive review of this issue in a background paper for this report.
3. The Ellsberg paradox (Ellsberg 1961) shows that when faced with a choice between risk (which is represented by known probabilities) and uncertainty (in which probabilities are not available) decision makers display a preference for risk. This tendency is known as *ambiguity aversion*.
4. This is a different issue from cultural differences, which may make certain policies unacceptable (rather than ineffective) in particular countries. For example, London successfully adopted congestion charges, whereas such schemes are considered exclusionary in France, which explains why they have not been applied in Paris to date.

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Green Innovation and Industrial Policies 3

Key Messages

- Innovation and industrial policies are potentially useful tools to spur green growth, as they can correct market (environmental and nonenvironmental) failures, but they should be designed to minimize risks from capture and rent-seeking behaviors.
- More advanced countries need to invest in frontier innovation through research and development; lower-income countries (with more limited technological capacity) should focus on adapting and disseminating technologies already developed and demonstrated.
- Although green growth and trade interact, it is not through the much publicized but seldom observed “pollution haven” effects. Green policies create opportunities for developing exports of green products; meanwhile, imports facilitate the adoption of greener, more efficient technologies.

Brazil has supported the development of a biofuel industrial sector for decades. China is subsidizing research and development (R&D) and industrial production of photovoltaic (PV) panels, most of which it exports. Morocco is investing public resources in producing electricity from concentrated solar power and plans to sell renewable energy to Europe. In all three cases, the policy objective is both to produce environmental benefits and to create growth and jobs.

These countries are not alone in pursuing such approaches. Indeed, most countries tap these types of environmental policies—which really amount to green innovation policies and green industrial policies. Some commonly used policies include R&D subsidies for drought-resistant crops, national strategies for electric cars, and efforts to create new green industries such as China’s promotion of solar PV production.

Why are these policies even needed? Getting prices right is critical to addressing environmental externalities and providing the right signal for economic agents to modify their consumption, production, and investment patterns. But as chapter 2 showed, doing so is difficult because of behavioral quirks, political reasons, market or contract imperfections, and low price elasticities (how responsive quantities demanded or provided are to a certain price change).

And prices are notoriously limited instruments for transforming economies or triggering investments with long-term or uncertain payoffs. Indeed, they are ill-suited to address the "classic" market failures usually invoked to justify innovation and industrial policies: knowledge externalities, latent comparative advantage and increasing returns, information asymmetries, capital market imperfections, and the coordination needed across industries to permit a technological transition (box 3.1).

Further, for green growth, getting the price right requires pricing externalities, which requires government intervention. Future government policies (on carbon prices or pollution limits) determine the size and

BOX 3.1 Market failures that can justify innovation and industrial policies

Many market failures may justify the broad innovation policies and more targeted innovation and industrial policies that aim to support a specific green industry, firm, or technology:

- *Knowledge externalities and capital market imperfections.* Absent government intervention, knowledge spillovers create a gap between the private and social returns to producing knowledge that typically leads to under-provision of knowledge. And this is amplified by information asymmetry in capital markets. Competitive innovation projects may struggle to find financing, making it difficult for new businesses and activities to start. This is especially true because young businesses have more difficulty securing financing than large established companies, even though they may be very innovative.
- *Latent comparative advantages and increasing returns.* Latent comparative advantages—that is, future as opposed to current comparative advantages—are sometimes cited as a justification for industrial policies (Harrison and Rodríguez-Clare 2009; Khan 2009; Rodrik 2004). Industrial policies may be warranted if the advantage includes learning or increasing returns to scale, which require support at an early stage. When two or more technologies (some not even invented) are substitutes, profit-maximizing innovators may focus on improving the productivity of existing technologies ("building on the shoulders of giants") because the market for these technologies is large and the returns are higher. Support—through production subsidies or trade protection—can be provided to foster new technologies.
- *Coordination failures.* Industrial policies may be warranted to address coordination failures within and across industries (Murphy and others 1989; Okuno-Fujiwara 1988; Pack and Westphal 1986; Rodenstein-Rodan 1943; Trindade 2005). The idea is that developing a comparative advantage in an activity can depend on another activity in the region or country. (Morocco is hoping to develop a concentrated solar industry, which requires creating the demand, the needed transmission lines, and the domestic supply chain for those parts in which Morocco can develop a competitive advantage—such as mirrors.) An industrial policy through which the government acts as the precommitment mechanism can solve this problem (Rodrik 2004). The same argument holds for "soft" industrial policies—policies that support particular clusters by increasing the supply of skilled workers, encouraging technology adoption, and improving regulation and infrastructure (Harrison and Rodríguez-Clare 2009).
- *International rent shifting.* Some industries are characterized by fixed costs or indivisibilities limiting the number of entrants and creating oligopolies, with significant rents for installed businesses. A classic example is the competition between Airbus and Boeing (Baldwin and Krugman 1988; Helpman and Krugman 1989). Depending on the case, it can be welfare enhancing to either introduce specific taxes to capture and redistribute the rent or support new entrants to increase competition and reduce rents.

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BOX 3.1 (continued)

- *Spatial, redistributive, and political economy motivations*. Industrial policies are frequently used to promote regional balance and stimulate job growth and other economic activity where unemployment is worse, the population poorer, or a geopolitical reason exists to promote production in an area (such as Manaus in Brazil). Industrial policies are also used to smooth economic transitions—when, for example, structural change or trade liberalization leads to unemployment and workers find it difficult to shift from sunset to sunrise industries. In this case, an industrial policy can support a declining industry to mitigate transitional costs and allow time for retraining and shifting workers toward growing industries.

profitability of the future green market. But because they cannot credibly commit to future policies, governments create policy risks for green firms. It thus makes sense for governments to share risks through investment subsidies. To the extent that such subsidies reduce the future cost of green policies, they enable today's governments to influence future policies: it is more likely that carbon prices will be implemented in the future if inexpensive low-carbon alternatives are available (Karp and Stevenson 2012).

For these reasons most countries resort to some form of innovation and industrial policies in their growth strategies. But given the mixed record of these policies—rife with both successes and failures—green growth strategies must heed the lessons from innovation and industrial policies over the past decades.

This chapter explores the concepts of green innovation and industrial policies and identifies their main benefits and potential pitfalls. It finds that they represent potentially useful tools for facilitating green growth, provided that they are tailored to country contexts and that care is taken to navigate between the risks of market and governance failures.

Innovation policies: Tailoring mixes of instruments to a country's innovation potential

Green innovation, which includes both the creation and commercialization of new frontier technologies and the diffusion and adoption of green technologies new to the firm, is critical to greening growth processes.[1] Achieving greener growth requires both green innovation policies, supported sometimes by more targeted industrial policies, and environmental policies to create demand where the traditional environmental externalities are not fully reflected in market prices (box 3.2).

Green frontier innovation is growing fairly rapidly, albeit from a small base. But the lion's share of this growth is in high-income countries, raising concerns about the ability of developing countries to access and adapt new technologies tailored to their needs. A few large middle-income economies—Brazil, China, India—can become significant frontier green innovators; they are already leading in incremental process innovation in the wind, solar, and biofuel markets. Other countries need to rely on global frontier innovation efforts while developing the capacity to identify, adapt, and absorb relevant technologies that are new to their firms.

The challenge is to combine innovation and environmental policies to make them effective and ensure that they are suitably balanced among policies that support frontier innovation (relevant mostly for more technologically advanced countries); policies that promote catch-up innovation and the adoption and spread of suitably adapted technologies; and policies that improve domestic absorptive capacity, including strengthening local skills.

BOX 3.2 Shedding light on green innovation, technologies, and industrial policies

Green innovation is the development and commercialization of new ways to solve environmental problems through improvements in technology, with a wide interpretation of technology as encompassing product, process, organizational, and marketing improvements. In addition to frontier (new-to-the-world) innovations, this definition includes catch-up (new-to-the-firm) innovations—also known as *absorption*—which covers the diffusion (both across and within countries), adoption, adaptation (to local contexts), and use of green technologies.

Green technologies comprise many fundamentally different technologies to achieve more resource-efficient, clean, and resilient growth. They include technologies needed to achieve the following goals:

- Reduce pollution and achieve greater resource efficiency in buildings (thermal insulation and new materials, heating, energy-efficient lighting); production processes (new uses of waste and other by-products from firms); agriculture (from improved and resilient crop and livestock breeds, water management, and farming systems to mechanical irrigation and farming techniques); and infrastructure and urban design (such as land use zoning).
- Mitigate climate change through a cleaner energy supply (wind, solar, geothermal, marine energy, biomass, hydropower, waste-to-energy, hydrogen fuels); low-carbon end use (electric and hybrid vehicles, climate-friendly cement); and carbon capture and storage.
- Reduce vulnerability and adapt to climate change with tools for understanding climate risks, better early-warning systems, and climate-resistant technologies (sea-walls; drainage capacity; reductions in the environmental burden of disease; water, forest, and biodiversity management).
- Support wealth creation from the more productive and sustainable uses of biodiversity, including natural cosmetics, pharmaceutical products, other sustainable bioprospecting, nature-based tourism, more sustainable production of plants and livestock, and ecosystem protection.

Green innovation policies are policies seeking to trigger green innovation by encouraging innovation broadly (horizontal policies) or supporting a specific technology (vertical policies).

Green industrial policies are policies aiming to green the productive structure of the economy by targeting specific industries or firms. They include industry-specific research and development subsidies, capital subsidies, and tax-breaks; feed-in tariffs; and import protection. They do not include policies targeting demand (such as consumer mandates), which can be met by imports without changing local production.

In practice, green innovation and industrial policies can be difficult to separate. Brazil's support for biofuels relies on a range of policy tools from broad innovation to targeted industrial policies, with the ultimate goal of triggering innovation. Germany's support for solar photovoltaic power amounts to innovation policy using industrial policy tools. Both countries would likely consider these efforts as part of their environmental policies.

Source: Dutz and Sharma 2012 and World Bank.

Frontier innovation and catch-up innovation

Since the mid-1990s green frontier innovation has increased substantially worldwide, mostly in high-income countries (figure 3.1a). In recent years the gap between developed and developing countries for green patents—those based on key greenhouse gas–mitigation technologies—continued to widen, with the richer countries granted some 1,500 patents in the United States compared with only 100 patents granted to poorer countries. Within the developing world the East Asia and Pacific region has by far the largest number of patents; the Middle East and North Africa has the smallest number of patents (figure 3.1b). China, in 10th place globally in number of patents filed in more than one country, is the only emerging economy represented among the top 10 "high-quality" innovating countries (Dechezleprêtre and others 2011). The number and share of green patenting remains very small—less than 1 percent—in both developed and developing regions (figure 3.1c).

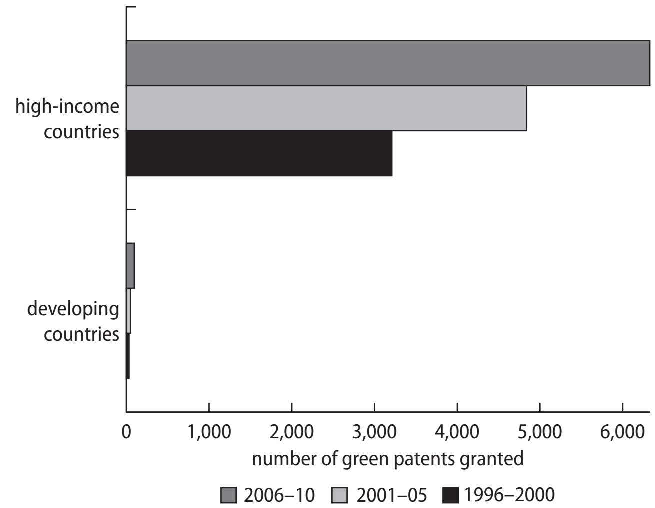
In the developing world a few technologically sophisticated countries are surfacing as significant innovators; appropriate green innovation policy in these countries is likely to differ from appropriate policy in other developing countries. A group of nine emerging economies (Argentina, Brazil, China, Hungary, India, Malaysia, Mexico, the Russian Federation, and South Africa) accounted for nearly 80 percent of all U.S. green patent grants to developing countries, over 2006–10.[2] And unlike the less technologically sophisticated countries, these "high flyer" economies display a sharp upward trend in green patenting, with their green patent grants more than doubling between 2000–05 (30 grants) and 2006–10 (more than 70 grants).

But even if there is little capacity for *frontier* green innovation in most developing countries, substantial capacity may exist for *catch-up* green innovation through the adoption and adaptation of green technologies as well as indigenous base-of-pyramid innovations, aimed at meeting the needs of poor consumers (box 3.3).

Trade data suggest that there is substantial potential for catch-up innovation. Environmental goods constitute a nontrivial and rising share of exports (3.4 percent in developing countries in 2010, 6 percent in high-income regions; figure 3.2). But, except for the East Asia and Pacific region, the share of green exports has not been rising, suggesting a need for greater diffusion of green technologies. The policy implication of this trend depends on the extent to which it reflects some underexploited comparative advantages in developing countries that account for lower levels of home production and export of green goods and services, whether driven by specific market or policy failures. Information on the extent to which weaker environmental regulations in many developing countries account for these differences could suggest appropriate policies.

FIGURE 3.1A Green frontier innovation occurs mostly in high-income countries…

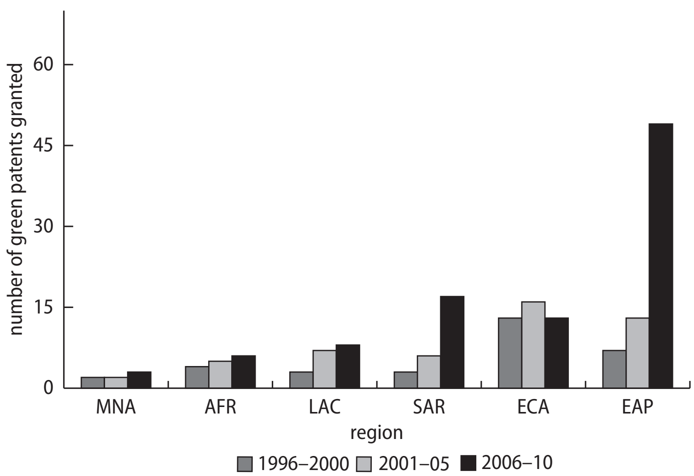
(number of green patents granted in the United States, developing versus high-income countries)



Source: Dutz and Sharma 2012, based on data from PATSTAT (the European Patent Office's Worldwide Patent Statistical Database).

FIGURE 3.1B . . . with East Asia leading the way in developing regions . . .

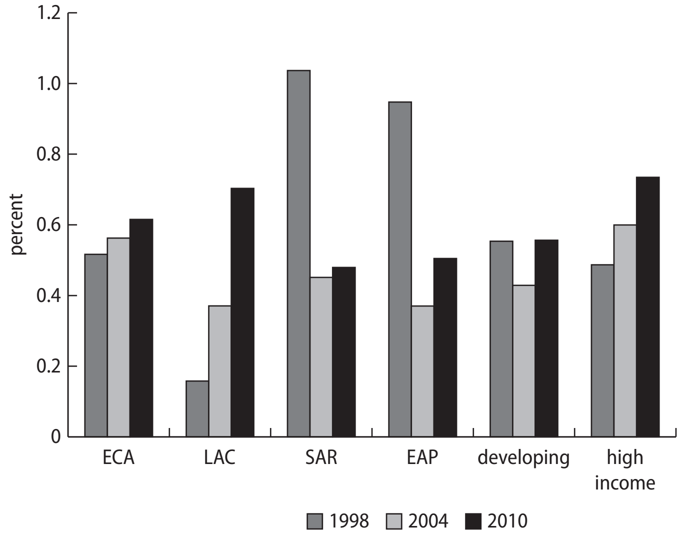
(number of green patents granted in the United States, by developing region)



Source: Dutz and Sharma 2012, based on data from PATSTAT (the European Patent Office's Worldwide Patent Statistical Database).
Notes: Total U.S. Patent Office grants in OECD green technology areas. Developing regions are AFR (Africa), EAP (East Asia and Pacific), ECA (Europe and Central Asia), LAC (Latin America and the Caribbean), MNA (Middle East and North Africa), and SAR (South Asia).

FIGURE 3.1C … but worldwide green patents remain low

(green patents granted as a percentage of all patent grants in the United States, by region)



Source: Dutz and Sharma 2012, based on data from PATSTAT (the European Patent Office's Worldwide Patent Statistical Database).
Note: Ratio of three-year moving averages of U.S. Patent Office grants in OECD green technology areas to all U.S. Patent Office grants.

Even if developing countries are not increasing their exports of green products, they could have substantial potential for moving into green industries to the extent that they are producing nongreen goods that use inputs or technologies similar to those used to produce green goods. The concept of "proximity" between products is useful for examining this broader capability for green exports.[3] For example, a country with the ability to export apples will probably have most of the conditions suitable for exporting pears but not necessarily the conditions for producing electronics. Indeed, trade in green and close-to-green goods is about three to five times that of green goods alone, with East Asia and Pacific and Latin America and the Caribbean countries on par with high-income countries (figure 3.3). This difference suggests a potential for developing exports in green products.

As for green imports, studies show that, as a share of all imports, they are as important

BOX 3.3 What are green base-of-pyramid innovations?

Base-of-pyramid innovations are defined as innovations that meet poor consumers' needs. They include formal innovations for the poor—namely, innovations by global and local formal private companies and public institutions, whether fully privately provided, supported by public subsidies, or produced through public-private partnerships (such as medicines for neglected diseases and seeds for "neglected" soil types and climates). They also include informal innovations by local grassroots inventors, largely through improvisation and experimentation. Often facilitated by co-creation with poor consumers themselves, the innovations typically seek to better meet the needs of poor households at dramatically lower costs per unit, aided by significant scale-up in volumes. They thus seek "to do more (products) with less (resources) for more (people)" (Prahalad and Mashelkar 2010). Three examples are described below.

Aakash Ganga ("river from sky"). In Rajasthan, India, ancient rainwater harvesting systems have been modernized to collect safe drinking water. This low-cost adaptation in arid regions has spurred additional innovations, generating many co-benefits for efficiency and inclusiveness:

- Automation of the traditional surveying system with satellite imaging, which shortens design time, minimizes earthwork, and reduces material costs.
- Creation of a numbering plan for reservoirs, which facilitates co-investments.
- Inducement of demand for stretchable roofs, which has spurred more innovation.
- Introduction of accounting transparency, which has spurred policy debate on broader inequities in water affordability.

Novel uses of rice husks. Rice husks are one of India's most common waste products. Husk Power

BOX 3.3 (continued)

Systems (HPS), winner of the 2011 Ashden Awards for sustainable energy, has adapted and converted a biomass gasification using diesel technology into a single-fuel rice husk gasifier for rural electrification. Households stop using dim kerosene lamps when they get HPS electricity, thereby saving on kerosene (and reducing CO_2 emissions) and facilitating evening studying and other productive activities. Tata Consulting Services sells a \$24 Swach ("clean" in Hindi) water filter that uses ash from rice milling to filter out bacteria. It is intended for rural households that lack electricity and running water.

Affordable green housing. In Mexico, Vinte specializes in building affordable, sustainable housing for low- and middle-income families. Its research and development in new technologies helped it introduce innovations such as home designs that reduce energy costs by 75 percent.

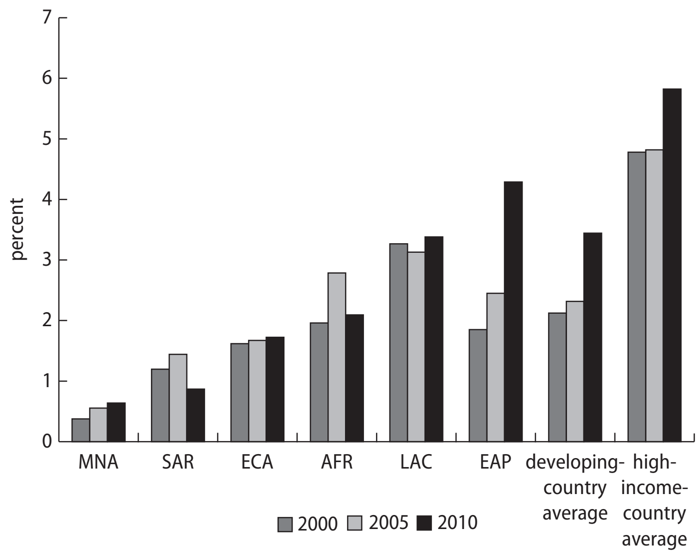
Source: Dutz and Sharma 2012.

in developing countries as they are in high-income countries, indicating the international transfer of green technology as embodied in green consumer products (figure 3.4). Inasmuch as some of these products are used as inputs, this also indicates the greening of the input mix, which may reflect adoption and adaptation of technologies by local firms. For instance, the purchase of manufacturing equipment in international markets is the main channel through which Chinese producers acquired the technologies and skills necessary to produce PV panels (de la Tour and others 2011). And the importing of green products may be a response to domestic demand-side green policies in developing countries. However, there has not been any significant upward trend in any region.

The dissemination of green technologies can be accelerated through policies that increase adaptation and adoption capacity (such as education in relevant disciplines, especially sciences and engineering) and through trade and industrial policies (such as local content requirements and technology transfers). A good example is the success of the high-speed train program initiated in the Republic of Korea in 1993 by the purchase of the French Alstom TGV (*train à grande vitesse*). The contract included technology transfers (partly through training Korean workers in France) and the localization of 50 percent of manufacturing in Korea (Lee and Moon 2005). Today, Korea is among the five top world competitors in exports of high-speed trains. In Morocco the contract for high-speed trains and the Casablanca tramway included a local factory (created by Alstom and Nexans) specializing in railway beam and wire production, which will produce for the local and international markets.

FIGURE 3.2 Green exports are growing, especially in the East Asia and Pacific region

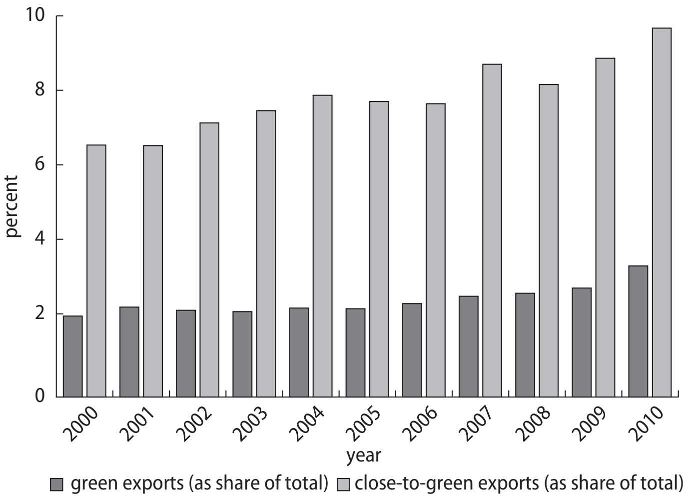
(export of green goods and services as a percentage of all exports, 2000, 2005, 2010)



Source: Dutz and Sharma 2012, based on data from COMTRADE + OECD list of environmental six-digit harmonized system categories.
Note: Developing regions are AFR (Africa), EAP (East Asia and Pacific), ECA (Europe and Central Asia), LAC (Latin America and the Caribbean), MNA (Middle East and North Africa), and SAR (South Asia).

FIGURE 3.3 Developing countries may have a substantial unrealized potential for producing green exports

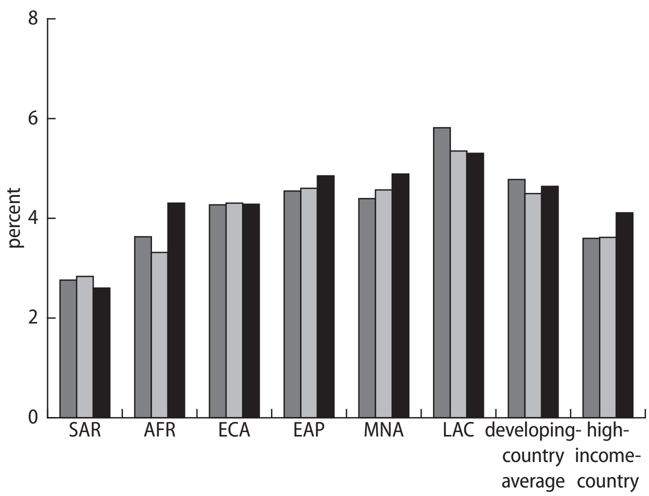
(export of green versus green plus close-to-green goods and services from developing regions, as a percentage of all exports from developing regions, 2000–10)



Source: Dutz and Sharma 2012, based on data from COMTRADE.

FIGURE 3.4 Green imports are vital worldwide

(imports of green goods and services, as a percentage of all imports, 2000, 2005, 2010)



Source: Dutz and Sharma 2012, based on data from COMTRADE and OECD List of environmental six-digit harmonized system categories.
Note: Developing regions are AFR (Africa), EAP (East Asia and Pacific), ECA (Europe and Central Asia), LAC (Latin America and the Caribbean), MNA (Middle East and North Africa), and SAR (South Asia).

Green imports from higher-income countries may not, however, meet the needs of poorer consumers in low-income countries. In principle, home-grown base-of-pyramid innovations can offer a complementary supply of relevant green technologies (box 3.3). But few green base-of-pyramid innovations have been sufficiently scaled up to date, suggesting the need for more focused policy efforts in this area.

The adaptation of green technologies to local conditions is also critical for developing countries. Using green technologies efficiently requires them to be more varied than nongreen technologies, given the significant variance of the underlying environment by locality. For instance, turbine designs need to be adapted to work efficiently in India, where wind speeds are lower than in Europe. Such adaptations can yield important co-benefits, including more sustainable corporate cultures (box 3.4).

Fostering innovation

The policy instruments relevant to promoting the development, dissemination, and adaptation of green technologies will differ depending on the maturity of the technologies and the market failures the policies seek to address. No single green bullet exists, so countries will need to employ a mix of instruments (figure 3.5).

Policies to foster innovation should aim to strengthen entrepreneurship and local firm absorptive capacity, support new knowledge creation and commercialization, and support diffusion and adaptation of existing knowledge to new local contexts. The importance of each and the modalities used depend on a country's level of technological sophistication and implementation capacity.

Strengthening entrepreneurship and absorptive capacity: The importance of skills and the broader business environment

For firms to understand and assimilate the discoveries of others as well as create new technologies, they need strong absorptive

BOX 3.4 Rapidly growing champions of "new sustainability"

In principle, the home-grown green ideas of companies to reduce costs, motivate workers, and shape their business environments by forging new relationships should make it easier for their peers in developing countries to emulate such approaches. Several examples are described below.

Century Energy (Colombia) develops small-scale hydroelectric power plants in Colombian river basins, diverting fast-rushing stream water without the need for reservoirs and thus avoiding displacement. In the next 5 years it plans to develop up to 10 facilities, adding 250 megawatts of capacity to Colombia.

Energy Development Corporation (the Philippines) pioneered the use of watershed management and recharge reinjection in its geothermal power plants as a way to extend the economic life of its facilities and reduce maintenance costs. These practices have since been mainstreamed across the industry and are now a regular part of industry regulation.

Equity Bank agricultural financial products (Nairobi, Kenya) worked with mobile telecom provider Safaricom to create a mobile banking system on its existing platform. The system offers credit for inputs and supports farmers throughout the value chain of production, transport, processing, and marketing. It has partnered with groups such as the International Fund for Agricultural Development to reduce its risks when lending to smallholders.

Jain Irrigation Systems (Jalgaon, India) adapted drip irrigation systems to meet the needs of smallholder farmers. The company works closely with customers to teach "precision farming" (optimizing the balance among fertilizers, pesticides, water, and energy to increase output) and uses dance and song to explain the benefits of drip irrigation to illiterate farmers.

Natura Organic Cosmetics (São Paulo, Brazil) worked transparently with rural communities and local governments to adapt its formal business practices to the local context. It tapped traditional knowledge about how to extract raw materials sustainably (receiving the Forest Stewardship Council certificate for these raw materials), and then educated suppliers in sustainable sourcing and production practices (such as reusing, refilling, and recycling packaging and adopting a new green plastic derived from sugar cane, which is eventually expected to reduce greenhouse gas emissions by more than 70 percent). The company also gives bonuses to workers who find ways to reduce the firm's impact on the environment.

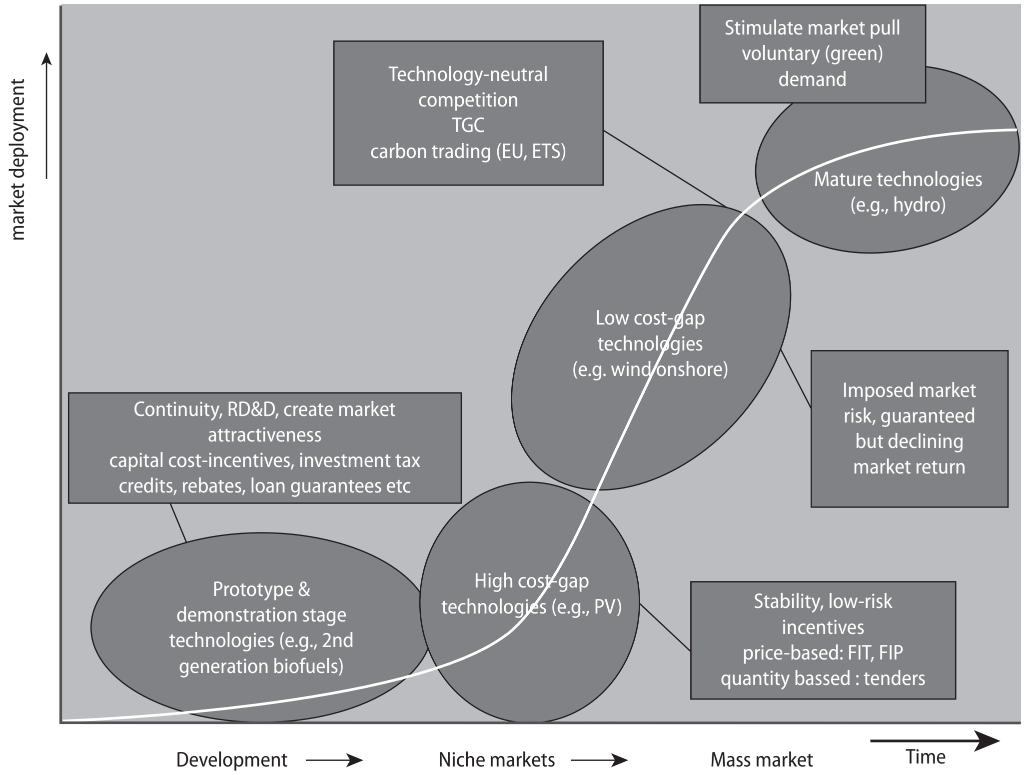
Source: IFC 2010; World Economic Forum 2011, cited in Dutz and Sharma 2012; and Russell Sturm (personal communication).

capacity. Absorption is a subset of innovation that focuses on the use of new-to-the-firm technologies rather than the creation and commercialization of new-to-the-world technologies. Absorption of existing technologies can be improved by tackling the cross-cutting business environment constraints that impede experimentation, global learning, and attracting and retaining talent, as well as enhancing human capital in the public and private sectors.

An important starting point is to ensure that the business environment does not constrain entrepreneurship and innovative behavior, whether green or complementary to green. Many cross-cutting policy measures are vital for creating a business environment that spurs and enables entrepreneurs and firms to create, commercialize, absorb, and adapt knowledge. They include the following:

- *Policies to overcome the stigma of failure and encourage opportunities for reentry and renewed experimentation.* Making it easier to wind up businesses is one of the best ways to get more people to try new ideas, even though doing so involves difficult legal reforms and changes in attitude toward debt. Closing a terminally ill business takes fewer than 10 months and allows more than 90 cents on the dollar to be recovered in Singapore, Tokyo, or Toronto. By contrast, in Mumbai it still takes on average 7 years to recover roughly 20 cents on the dollar (World Bank 2012). Other policies include publicizing

FIGURE 3.5 Snapshot of technology creation and diffusion



Source: IEA 2008 (*Deploying Renewables: Principles for Effective Policies* © OECD/International Energy Agency 2008, figure 1, page 25).
Note: FIT= feed-in tariffs; FIP = feed-in premiums; PV = photovoltaic; RD&D = research, development, and demonstration; TGC = tradable green certificate.

innovative role models (such as India's Tata Group's awarding of an annual prize for the best failed idea) and reducing the sunk costs of trying to commercialize an idea, such as removing impediments to deeper rental and resale markets.

- *Policies to facilitate global connectivity and learning.* Here the emphasis should be on linking up with international consortia and helping firms insert into global value chains. International mobility of workers was critical to the rapid development of wind energy capabilities in China and India. Suzlon, the leading Indian wind turbine manufacturer, established R&D facilities in Germany and the Netherlands to have its workers learn from European expertise. Goldwind, the leading Chinese manufacturer, sent employees abroad for training.[4] Learning networks were also critical in the development of China's PV panel industry.[5] Mexico's Green Supply Chains Program—a public-private partnership program—highlights a way to diffuse eco-efficiency techniques to small- and medium-size enterprises.[6]
- *Policies to increase the livability and "stickiness" of cities to attract and retain talent.* Dense urban-industrial agglomerations spur technological upgrading and productivity growth by opening up opportunities and stimulating supplies of capital and skills. China's establishment of special economic zones, followed by a range of support by national and local governments for further industrial deepening in its three major urban/industrial agglomerations and in a number of inland cities, highlights how

a mix of instruments can be used (Yusuf and others 2008).

In addition, green innovation, like innovation in general, depends on people who are able to generate and apply knowledge in the workplace and society at large. Required innovation skills include basic skills (reading, writing), technical skills (science, engineering), generic skills (problem solving, multicultural openness, leadership), managerial and entrepreneurial skills, and creativity and design skills.[7] The green economy requires greater emphasis on design and multidisciplinary teamwork, strategic leadership and adaptability, and knowledge of the sciences (CEDEFOP 2009; OECD 2011).

Even advanced developing countries are far behind high-income countries in the share of professionals engaged in creating knowledge and managing research projects. High-income countries like Denmark and Finland have about 15 researchers per 1,000 employees. By contrast, China, Mexico, and South Africa each has fewer than 2 researchers per 1,000 employees. And in developing countries the business sector plays a much smaller role in the national R&D system than the higher education and government sectors. In the United States, four of five researchers work in businesses. By contrast, in Chile, China, Mexico, Poland, the Slovak Republic, South Africa, and Turkey the number of researchers per 1,000 employees in industry is less than 1. Developing country firms need more individuals with research and related creativity skills in the workforce if they are to play a greater role in accessing green technologies and adapting them for local use.

Thus, policies are needed to strengthen market signals so that tertiary education institutions and technical and vocational education and training systems are better attuned to firm demands. These institutions should ensure that the costs of skills upgrading are shared by students, employers, and the government in line with benefits, and that periodic independent and transparent national assessments are adopted to ensure quality and consistency (OECD 2009). In West Africa an effort to better monitor monsoon variability and impacts illustrates solutions to build relevant skills in a developing-country setting (box 3.5). This case highlights the need to attract West African scientists trained in

BOX 3.5 African monsoon multidisciplinary analyses

West Africa is extremely vulnerable to weather and climate variability because of its dependence on rain-fed agriculture, on which 80 percent of the Sahel's population relies. The African Monsoon Multidisciplinary Analyses (AMMA) is a research project funded by agencies from Africa, the European Union, France, the United Kingdom, and the United States to better monitor West African monsoon variability and the impacts on society and the environment, including on climate. To do so, the AMMA community was created in 2002. It now comprises more than 600 people from 30 countries, including 250 in Africa, among them 80 African PhD students. The AMMA community has established local university research programs in climatology, agronomy, and related social science fields, and has convened functional research teams to build new capacity for improved early-warning systems. These teams and programs will continue to train cohorts of African specialists, thus cultivating a community whose mutual interest in AMMA–related issues will help ensure sustainability.

AMMA has done fairly well in building a partnership between the international community and Africans in phase one (2002–10). The main challenge for phase two (2010–20) is clarifying the needs of users (farmers, hydropower and flood managers, and health care professionals) and identifying what science can offer. Stronger user demand should increase political support for scientific resources.

Source: Thorncroft 2011.

better-equipped universities in high-income countries and the need to ensure enough local demand for established scientific and research facilities.

Promoting frontier innovation: Approaches depend on extent of local technological sophistication

Policies for frontier innovation include both supply-side "technology-push" elements (which reduce the costs of knowledge creation in advance of commercialization) and demand-side "market-pull" elements (which increase revenues from sales after commercialization). Key recommendations to guide the design of such policies include the following:

Limit local technology-push support to countries with enough technological capabilities. Government funding for early-stage and pre-commercialization technology is a vital element of many innovation systems, including direct funding of public labs and universities; grants, matching grants, and soft loans (which give the government control over what research is conducted); and indirect R&D tax subsidies (which allow firms to choose the most profitable research opportunities, switching some marginal projects from unprofitable to profitable). All these tools have their drawbacks. Grants allow coordination of research efforts with little or no duplication but may fail to integrate information from markets about what consumers want and are willing to pay for. They also run the risk of crowding out private R&D funding and need to be transparently allocated. Tax incentives may promote distorting tax avoidance rather than productive investment in countries with a weak tax enforcement system.

Despite these drawbacks, supply-push R&D support, through direct or indirect government funding, may generate new frontier innovations more effectively than demand-pull policies such as feed-in tariffs and regulations—at least where local technological capabilities and good governance mechanisms exist. For wind power, the marginal million dollars spent on public support to R&D in wind power technology generated 0.82 new inventions, whereas the same amount spent on demand-pull policies induced, at best, 0.06 new inventions (Dechezleprêtre and Glachant 2011).

Consider carefully structured public-private partnerships as only one of many measures to foster early-stage financing. Much of the investment needed for green growth will come from private business. Many of these investments face uncertain cash flows and require significant risk taking because they involve new technologies, including new business models. Once new ideas with commercial potential have progressed to the proof-of-concept stage, further financing and mentoring support for early-stage technology development (ESTD) are required.

The range of ESTD finance options includes both public and private resources. At this early stage, private sources are typically restricted to internal financing (personal savings and retained earnings), friends and family, angel investors (successful wealthy entrepreneurs), venture capital (VC), private equity, and private corporations (which fund ideas developed in-house, operate their own VC units, and acquire young start-up companies; see box 3.6). Among these sources, private equity and VC are uniquely suited to finance climate-friendly investments that are risky and fairly small. Although they will not provide more than a fraction of the resources needed, they can fill a key niche for driving green innovation.

However, developing the private equity and venture capital market for climate- and environment-friendly investments in emerging markets is hindered by capital market and carbon market barriers. These barriers include high management expenses, a shortage of good fund managers, long time horizons for investment returns and regulatory uncertainties, and the uncertainty of raising capital and having profitable exit opportunities for new technologies with no track record of historical returns. The public sector and international financial institutions can assist in capitalizing such

BOX 3.6 "Pinstripe greens": Private financiers making millions from clean-tech ventures

Although global venture capital investment in green energy declined with the 2008/09 recession and shares in clean-tech businesses have recently underperformed the wider market by a large margin, a world of U.S. solar titans, German wind moguls, Brazilian biofuel magnates, and Chinese battery tycoons has emerged over the past decade. One often hears that green energy could be the biggest economic opportunity of the 21st century. In 2010 the global clean energy sector (wind farms, solar parks, and related technologies) attracted a record $243 billion in new investment, nearly 5 times the volumes of 6 years earlier. Between 2000 and 2010 the global market for solar and wind power rose from $6.5 billion to $132 billion, the number of hybrid electric car models jumped from 2 to 30, and the number of certified green buildings grew from 3 to 8,138. Examples of private green financing include the following:

- *Khosla Ventures* is a venture capital firm founded by Vinod Khosla in 2004. Its clean-tech portfolio spans utility-scale and distributed generation, electrical and mechanical efficiency, batteries, building materials, plastics and chemicals, agriculture, cellulosic alcohol, and advanced hydrocarbons. The portfolio also includes investments in a low-emission engine (with Bill Gates) and two-bladed wind turbines (with Goldman Sachs).
- *Bloomberg New Energy Finance* is a provider of analysis, data, and news about clean-tech, including renewable energy, energy-smart technologies, carbon, carbon capture and storage, renewable energy certificates, nuclear, power markets, and water. The company, founded by Michael Liebreich in 2004, has generated more than $1 billion in profits in 2011.
- *Suntech* is a Chinese company founded in 2001 by Dr. Zhengrong Shi and floated on the New York Stock Exchange in 2005. It is the world's largest producer of solar panels, with solar modules installed in more than 80 countries (and a low-carbon museum in Wuxi, west of Shanghai, opened by Al Gore).

Source: Dutz and Sharma 2012.

funds by anchoring new funds, financing new fund development, supporting pioneer investments, and supporting improved carbon payments. Even more important will be helping with the structure, management, and exit routes for venture capital investments—for example, by providing equity contributions to increase potential returns or reduce potential risks, which would play a helpful demonstration role if there is enough deal flow.[8] But experience suggests that the government role should be restricted to that of financial backer, and not manager, with funds administered professionally, free of bureaucratic burdens, and independent of political interference (Lerner 2009).

But capital market–based, arms-length forms of finance that structure and price each transaction on its merits require deep financial markets, which most developing countries still lack. Moreover, a number of other factors—such as government R&D expenditures, the extent of patenting by entrepreneurial firms, and national environmental deployment policies designed with the long-term perspective of creating a market for environmental technologies—appear to be more important in affecting the amount of private financing of frontier innovation in the clean-tech sector.[9]

Provide global support for bottom-of-pyramid and neglected technologies. It is not advisable for countries with weak technological capabilities and no comparative advantage in creating frontier technologies to dedicate significant public resources to this objective. But given the global nature of benefits from many green innovations, stable, long-term global public spending on R&D should be increased and channeled into programs that facilitate the development and adoption of technologies applicable to developing countries.

Prize funds and advance market commitments—also called purchase guarantees—can be useful market-pull mechanisms for promoting R&D in neglected technologies.

- Prize funds are most appropriate when objectives can be well defined but the technologies are unknown. They may be particularly relevant for promoting more radical green innovations likely to be fostered not through the traditional linear R&D approach but rather through out-of-the-box new knowledge, involving co-creation and codesign by scientists, engineers, entrepreneurs, producers, and users from different disciplines.
- Advance market commitments work best when key characteristics of the desired technology are known and can be specified in a contract, typically for fairly homogeneous technologies rather than the more differentiated ones required for green growth. Although to date they have been used to provide affordable access to health care in low-income countries, they may help stimulate innovations and access to a few affordable green solutions—such as a nutrient-fortified staple food crop or improved storage technologies in contexts of land and water scarcity, climate change, and declining crop yields.

Promoting catch-up innovation: Facilitating technology access and stimulating technology adoption

Promoting green growth in developing countries is typically more about catch-up innovation and the diffusion and adaptation of already-existing technologies than about frontier innovation. Relevant policies need to facilitate access to existing technologies, as well as stimulate their uptake.

Policies to facilitate access to green technologies. The best way to facilitate access to green technologies is through openness to international trade, foreign direct investment, technology licensing, worker migration, and other forms of global connectedness. Many green technologies are embodied in technology licensing agreements and in equipment, machinery, and imported capital goods. Some are knowledge-based processes or business models that diffuse through movements of people attached to multinational corporations or from the diaspora. Some can be recreated by emulating imported final goods, copying lapsed patents, or studying and inventing around patents that are still in effect. Technology and skill transfer also occur through the purchase of manufacturing equipment on global markets, because suppliers usually provide worker training with their equipment. This channel was critical in the ability of Chinese producers to become world leaders in PV panel production (de la Tour and others 2011).

Other underused policies to boost access to existing technologies include patent buy-outs, compulsory licenses, patent pools, and open source approaches. A patent buy-out increases access to existing or future products that already benefit from adequate innovation incentives. Making it easier for countries to issue compulsory licenses under appropriate circumstances can help ensure more affordable access to patented green innovations by poorer households in low-income countries.[10]

Patent pools provide a one-stop voluntary licensing service that combines multiple patents and licenses them, with patent holders getting royalties on the sales of adapted, more affordable products, and generic manufacturers getting access to broader markets. An example is the Medicines Patent Pool, funded by the international drug-purchasing facility UNITAID, which increases access to HIV medicines in developing countries. In open source development, a body of original information is made available for anyone to use. Usually, any party using the original material must agree to make its enhancements publicly available. Open source projects are inherently royalty free. Both of these approaches could be used for neglected seeds for drought-prone, saline environments, or other green solutions for lower-income countries.

However, and perhaps most important, countries should avoid imposing tariffs on renewable energy technologies and subsidizing fossil fuels, given that most studies show that these tools do more than patent protection to limit the transfer of clean technologies (Barton 2007 and Copenhagen Economics 2009, as cited in Hall and Helmers 2010). A World Bank (2008) study finds that eliminating tariff and nontariff barriers in the top 18 developing countries ranked by greenhouse gas emissions would increase imports by 63 percent for energy-efficient lighting, 23 percent for wind power generation, 14 percent for solar power generation, and 4.6 percent for clean coal technologies.[11]

Policies to stimulate adoption of green technologies. Green technologies are often more costly for firms to adopt and are not always immediately more attractive to end-use customers. When feasible, ensuring that prices reflect the environmental externality and removing subsidies that favor brown technologies are the best tools with which to encourage the adoption and spread of green innovation.

When prices cannot be adjusted, demand-pull technology-deployment innovation policies (standards, regulations, public procurement) are needed. Demand-side policies include guaranteed feed-in tariffs for renewables, taxes and tradable permits for emissions pollution, tax credits and rebates for consumers of new technologies (compact fluorescent light bulbs), comparison labeling (to inform consumers about the relative efficiency of products), endorsement labeling ("CFC–free"), government regulations (limits to polluting emissions from industrial plants), and industry-driven standards (home and office building insulation). In contrast with radical innovation, demand-side policies appear to be effective in spurring firms to introduce incremental environmental innovations and adopt existing technologies.

Indeed, European Union surveys show that firms in most countries identify existing or future environmental regulations, followed by market demand from customers, as the main driver behind adopting incremental processes (Dutz and Sharma 2012). In high-income countries as a whole, most studies report that well-designed environmental regulations stimulate innovation by firms, as measured by R&D spending or patents. That said, the induced innovation may not be enough to fully overcome the added costs of regulation (Ambec and others 2011). As for designing environmental regulations, studies emphasize the need for stability, predictability, and a focus on end results rather than means—allowing firms to choose the most cost-effective approach to meet the end result.

Voluntary sustainability standards for products and processes can help local firms upgrade environmental practices, a form of catch-up innovation for business practices. Roundtables and other multi-stakeholder initiatives provide new ways to manage natural resources more sustainably and efficiently. The best-known are international initiatives that group together producers, processors, traders, and other actors in a commodity's supply chain with banks and civil society groups concerned about the harmful impacts of agriculture and aquaculture expansion. They aim at building consensus and setting voluntary standards on what constitutes responsible production and processing, along with promoting proven management practices to reach the set targets. Linking local firms to the global value chains of multinational corporations that have adopted sustainability standards helps leverage international market pressures (box 3.7).

Finally, a better financial infrastructure could significantly boost green technology absorption. In a study on adopting efficient stoves, small biogas plants, and efficient tobacco barns for commercial farmers in Malawi, Rwanda, and Tanzania, financing emerged as the main stumbling block for all projects because of high start-up costs (Barry and others 2011). A study of low-income countries finds that higher financial intermediation significantly helps non-hydroelectric renewable energy generation per capita, because investment in renewable energy is constrained in environments where access to long-term loans is limited (Brunschweiler 2010). Regarding China, a study cites access

BOX 3.7 Voluntary standards support the sustainable management of South African deep-sea fishing and Indonesian palm oil

A highly visible and credible certification that deep-sea hake fishing was sustainably managed by the international nongovernmental standards organization (the Marine Stewardship Council) constrained local regulators in South Africa from allowing excessive new entry of fishers, which would have depleted stocks. It also led to restructuring of the equity structures of companies to meet the country's Black Economic Empowerment goals.

For palm oil there was no comprehensive, agreed-upon sustainability standard that producers could adopt, despite the crop's impact on deforestation and biodiversity loss. On top of environmental and social risks, this uncertainty raised the cost of World Bank loan preparation and monitoring and added potential reputation risk issues, affecting the availability and pricing of Bank financing. Thanks to guidelines issued by the Roundtable on Sustainable Palm Oil (RSPO)—supported by the Indonesia Palm Oil Producers Association, Unilever, the Hong Kong and Shanghai Banking Corporation, the World Wildlife Federation, Oxfam, the International Finance Corporation, and other key members—the share of RSPO-certified palm oil has risen to 11 percent of the total market. To raise this share to the next level, broader government support in the consuming countries is needed to complement achievements driven by consumer activism.

Source: Levy and others 2011; IFC 2010; RSPO 2012.

to financial credit and quality of after-sales service as key barriers to adopting solar home systems (D'Agostino and others 2011). And a study on Europe's reconstruction after World War II emphasizes that the largely bank-based, relationship-based financial systems provided vital support for lower-risk technology absorption by firms (Wolf 2011).

Green industrial policies: Ensuring that the standard caveats apply

Many countries include green industrial policies that target industries, firms, or technology-specific innovation and production in their environmental policy mix, from feed-in tariffs for PV solar energy to tax breaks for innovative firms in specific environmental industries and green procurement (box 3.8). But given that this approach is vulnerable to powerful lobbies, rent-seeking behavior, and costly mistakes caused by information asymmetries, there is no consensus on whether it is desirable.

Moreover, while industrial policies can transform an economy's structure, the debate over whether they are effective instruments for accelerating growth continues. Some argue that industrial policies played a key role in the rise of Japan and other Asian countries (Chang 2006); others consider this catch-up a consequence of large investments (and a catch-up in capital intensity) in countries with high levels of education and institutional capacity (Krugman 1994). Whatever the case, it is critical to not blindly apply the lessons from East Asia to countries with very different characteristics, including low education levels and weaker institutions.

Whether even Asia's industrial policies would have passed a cost-benefit analysis is unclear (Harrison and Rodríguez-Clare 2009; Noland and Pack 2003). But because green industrial policies offer environmental benefits, they could be desirable even with no net positive impact on growth or job creation. For instance, whether or not Brazil's ethanol policy accelerated economic growth or created jobs, there is little doubt that it led to the creation of a dynamic biofuel sector that would, in the absence of that policy, probably not exist (or would at least be much smaller; Karp and Stevenson 2012). For their part, the biofuel policies of Europe and the United States can be considered examples of green industrial policies that failed to generate even an environmental benefit, as they are generally considered to have harmed the environment.

BOX 3.8 The role of green procurement

When governments look for ways to influence the economy to achieve greener growth, public procurement stands out as a viable tool. For this reason, both industrial and developing countries are now pursuing green public procurement. In recent years many countries—Brazil, China, the Republic of Korea, Turkey—have implemented green initiatives to protect the environment and mitigate emissions (OECD 2010; Thomson and Jackson 2007). Green procurement is estimated to have accounted for 6 percent (Korea) to 60 percent (Sweden) of total public procurement in 2005 (OECD 2007).

The preferences of governments for green products in the early stages can help firms reduce production costs. They can also have dynamic effects in relevant markets. New companies can be motivated to enter the market, leading to further market development. If the market evolves rapidly, private users of similar products will also be educated to use greener products. In addition, the dynamic market development may lead to significant economic competitiveness in such technological domains. For instance, a French company that invested in R&D to develop an environment-friendly paint for public road signs also developed other paint products that now lead the market (OECD 2007).

Governments can take advantage of standard-raising demonstration effects and the provision of a guaranteed demand to foster markets of green products, change technological standards, generate green jobs, adapt public assets (such as buildings and infrastructure), and take a lead in educating consumers and firms to engage in more sustainable consumption and production. From a global welfare and climate change perspective, such procurement should not discriminate against foreign suppliers.

Whether green environmental policies are desirable, many countries, mostly middle and high income, are actively engaged in policies that support specific industries. Some of these policies aim to provide direct environmental benefits (biofuel production in Brazil, concentrated solar power in Morocco). Others aim to produce related upstream goods and services (solar PV panels in China, high-speed trains in Europe). It is worth exploring the motivations for green industrial policies and the lessons from past experience with standard industrial policies.

What role for green industrial policies?

Green industrial policies can be implemented for multiple reasons. All these reasons are linked to different market failure or policy objectives.

Compensate for the uncertainty in future environmental policy and promote new industries and technologies. Most countries that adopt green industrial policies claim to do so to take advantage of a latent comparative advantage, create jobs, and pursue new sources of growth. The underlying argument is that prices are not enough to address the standard market failures that hamper new industries (such as increasing returns, coordination failures, and underdeveloped financial markets).

Even if prices were to fully reflect the environmental externality, current and new green industries would face many challenges. Pricing policies are politically vulnerable, and the lack of credible long-term commitments and regulatory uncertainty discourages the private sector from making long-term investments in green industries. Witness the European carbon emission trading scheme, which effectively created a carbon price but did little for environmental innovation (Borghesi and others 2012; Rogge and others 2011). When long-term innovation, deployment, and production scale-up is needed, pricing policies may need to be complemented by innovation and more targeted industrial policies (Vogt-Schilb and Hallegatte 2011), as with PV solar energy in Germany and China (box 3.9).

Level the playing field. The risk of pollution leakage from countries with strict environmental regulations to laxer countries has been used to justify green trade-based industrial policies.[12] The fear is that

BOX 3.9 Comparison of photovoltaic support policies in Germany and China

Germany and China are emerging as leaders in the global photovoltaic (PV) market, thanks to developing a dual industry composed of vertically integrated firms and segment specialists (Grau and others 2011). Public support aims to trigger cost reductions through economies of scale and additional technological innovation. It is directed at three activities:

- *Direct R&D to support innovation.* Both China and Germany provide support to R&D, especially to promote radical innovation that is not the usual focus of the private sector. But this support remains limited, with only 1 percent (in China) and 3 percent (in Germany) of the total support these countries provide to PV panel production (Grau and others 2011).
- *Standard environmental policies to support deployment.* Both China and Germany are using feed-in tariffs to support the large-scale deployment of PV modules. The German example points to the inherent risks resulting from a stable, long-term commitment to buy electricity from PV. When the price of PV modules dropped in 2009, the sudden surge in profitability led to a rush to install PV modules, inflating the total cost of the program and jeopardizing its existence.
- *Investment to support manufacturing plants.* Investment to support manufacturing plants embraces direct subsidies, reduced taxes, public guarantees, and reduced-interest loans. Neither China nor Germany links investment support to specific innovation requirements.

Striking the right balance among the three forms of support is critical for reducing costs. But support schemes are further complicated by information asymmetries between the industry and the government and by market power exerted by different actors in the industry.

Has public support made a big difference? There is little doubt that it helped achieve the large reduction in solar panel costs, which yielded global benefits. But there are growing concerns that this support is increasingly focused on the interests of domestic producers rather than global welfare objectives.

In Germany the issue is whether hefty feed-in tariffs mainly benefit Chinese PV manufacturers who export to Germany. But Chinese producers are concentrated in the downstream segments of the PV panel supply chain, which are highly labor-intensive and are where the country has a comparative advantage (de la Tour and others 2011). These downstream segments have limited margins and small profits compared with upstream segments, such as silicon production, where industrial countries, including Germany, still dominate. (Germany also manufactures some of the machinery used in China for PV production.) In China the issue is whether the policy leads to the import of mature technology, thus preventing the takeoff of an internal innovation capacity for more radical technology changes.

stricter environmental regulations in one country may cause "dirty" industries to move to pollution havens rather than adopt cleaner processes. There is little support for this argument in the current context. Pollution abatement costs represent only a small fraction of production costs for most industries. And while environmental regulation may cause firms to move from a particular location, the destination location chosen likely has other draws (skilled labor, good business environment, and a well-developed financial sector).

And studies show that the impact of current environmental regulations on firm competitiveness remains limited. Quirion and Hourcade (2004) calculate that in the European Union, a €20-per-ton CO_2 tax has a lower impact on marginal cost than interannual exchange rate variations, even in energy-intensive industries and without tax revenue recycling. Econometric studies found no negative impact of the EU Emissions Trading System (ETS) on net imports in the aluminum, steel, and cement industries (Ellerman and others 2010; Quirion 2011; Sartor 2012). Anger and Oberndorfer (2008) reach the same conclusion on German firms and the EU ETS. Panel data from the U.K. production census suggest that the climate change levy (an energy tax) had a significant impact on energy intensity but no detectable effects on economic performance or on plant exit (Martin and others 2009).

Empirical evidence fails to support the notion of "pollution havens" (Copeland 2012), though this could change if environmental policies, such as carbon taxes, become much stricter. Should this happen, trade policies may become an important complement to environmental policies: specific trade policies—from bilateral and multilateral agreements on environmental regulation to border tax adjustments, with or without revenue transfers to the exporting country—can help level the competitiveness playing field.

Smooth the transition. Countries may opt to use industrial policies to support ailing industries to facilitate the political economy of a green transition. Japan supported declining traditional industries to make the transition toward high-productivity, high-skill industries more acceptable for the population. In the same manner a green strategy may need to include some transitional support to (declining) energy-intensive industries. This component of the green growth package can be a requirement for its political acceptability, despite its cost. The aim of such support would be to smooth the transition, help businesses adjust their production technologies, and help workers adapt by moving to other industries—while ensuring that any public support remains transitory, with clear sunset clauses.

Heeding the lessons of the past

The desirability of innovation and industrial policies—green or not—cannot be assessed without analyzing a country's economic situation, the benefits it can expect from these policies, and its ability to avoid capture by vested interests. Experiences around the world with these policies show that the following six lessons are key.

First, the relevant policy intervention depends on what market failure needs addressing (Baldwin 1969). Designing industrial policies requires that the government be able to identify and analyze market failures (Pack and Saggi 2006). To do so, the government may need information on which firms and industries generate knowledge spillovers or benefit from economies of scale and dynamics effects (for example, learning by doing). Without a clear understanding of the market failures that need to be corrected, innovation and industrial policies will be inefficient or detrimental, particularly if they are used as a substitute for an enabling business environment.

Second, horizontal (or output-based) policies should be favored over vertical policies ("picking winners" or at least the winning technology) when possible. Vertical policies should be contemplated only when technologies or solutions have been demonstrated in other contexts or are justified by industry or technology-specific characteristics.

But applying this recommendation to green growth policies may be challenging. For example, absolute technology neutrality hardly applies as a guiding principle of climate policy (Azar and Sanden 2011). An example is feed-in tariffs (payments of a cost-based rate to energy producers for the electricity they generate from renewable resources), which can be designed to offer the same premium for any low-carbon electricity, thereby freeing electricity producers to choose the technology. But in the presence of learning-by-doing, a higher feed-in tariff may be desirable for the technology whose potential is estimated to be larger (del Rio Gonzalez 2008; Johnstone and others 2010).

In the early 2000s, advocates of feed-in tariffs to support PV electricity production (rather than other carbon-free technologies, such as wind power) pointed to the large potential of this technology, its fairly high initial cost, and the improvements expected from learning-by-doing, which made it unlikely to be picked up under horizontal support to any carbon-free electricity production technology.

Fortunately, picking winning technologies may be less risky for developing countries implementing green growth, as they may be able to choose environmental technologies already developed and tested in high-income countries. This fact may partly explain why developing countries adopt environmental regulations at earlier stages of development and at lower cost than developed countries (Lovely and Popp 2011). Examples include technologies with large potential for economies of scale (such as solar PV) and technologies broadly used in industrial countries (such as low-sulfur fuels or wastewater treatment technologies). Technology support may also be less risky when a latent (that is, future rather than current) comparative advantage can be observed in an objective manner—for instance, renewable energies that depend on natural endowments, such as the potential for solar energy in North Africa and hydropower in Central Africa.

Third, the desirability of innovation and industrial policies depends on the balance between market failure and government failure. These policies need strong institutions, because they are vulnerable to capture and rent seeking and to inefficient micromanagement of the innovation and investment process (Laffont 1999; Rodrik 2005). In climate policy, rent-seeking behavior is likely to influence policies even in countries with high institutional capacity and appropriate "checks and balances" (Anthoff and Hahn 2010; Helm 2010). Neven and Röller (2000) identify factors that make such problems more likely: sharply partisan political systems, weak governments, and absence of transparency. But rent capture remains possible even in the most efficient, balanced, and transparent country, because industrial lobbies are powerful actors in any economy (box 3.10).

Fourth, successfully using innovation and industrial policies requires the capacity to remove support when it is no longer justified, especially if one technology proves less promising than expected. Regardless of their ability to "pick the winner," there are plenty of political economy reasons to explain why governments find it difficult to interrupt support when a project or business fails. One option is to make support conditional on some market test. East Asian countries used export competitiveness, an indicator difficult to manipulate by local firms. They were fairly ruthless in terminating support to underperformers and made continued protection in the domestic market contingent on export performance (World Bank 1993).

Subjecting green policies to a market test is more challenging than with standard industrial policies (Karp and Stevenson 2012). When the market does not price the environmental externality—that is, in the absence of complementary price policies—a market test cannot be used to decide whether the supported technology is the appropriate one. For instance, R&D subsidies or feed-in tariffs that help the solar panel industry reach scale and technology maturity may need to be permanent to make the industry competitive in the absence of a carbon price. The profitability of the low-sulfur refining industry will depend on permanent subsidies in the absence of regulations on vehicle sulfur emissions. Contrary to classical industrial policies, which are supposed to be temporary because they correct temporary market failures (such as increasing returns to scale), green industrial policies may need to be permanent if they are supposed to correct permanent market failures (such as an environmental externality). To avoid this issue it is preferable to use price-based instruments to correct permanent environmental externalities and industrial policies to cope with transient externalities.

Fifth, the benefits from innovation and industrial policies vary depending on the scale of assessment. When these policies make it possible to create a domestic industry with significant market share, local benefits can be large in terms of jobs and income. But the assessment can be completely different at the global scale if market shares are gained thanks to public support at the expense of more efficient foreign producers. The desirability of these policies should be evaluated in view of trade-offs, especially if ambitious

BOX 3.10 Lessons from a "green" industrial policy: U.S. biofuels

In recent decades, concerns about national energy security, dwindling reserves of easily recoverable petroleum (and oil price hikes), and health and safety have prompted many industrial countries to look for renewable energy alternatives, including biofuels. The U.S. biofuels program offers useful lessons on green industrial policies—two of which appear particularly relevant for developing-country policy makers.

First, biofuel industrial policies have mixed consequences for competition among technologies. The relationship between first-generation (ethanol, primarily from corn and sugar) and second-generation (or cellulosic) biofuels, which are being developed to prevent higher food prices and land use changes, has long been viewed as a cooperative process. By developing an infrastructure for handling large volumes of biomass and constraining fuel refiners to blend increasing quantities of biofuels in fossil fuels, producers of first-generation biofuels would naturally pave the way for a new generation of biofuels. But a recent study suggests that first-generation biofuels would be a tough competitor for the nascent industry of next-generation biofuels (Babcock and others 2011). And the difficulty of the nascent technology is heightened by the fact that "declining industries are generally more successful in forming lobby groups and securing policy concessions from governments" (Damania 2002).

Second, the reversibility of a policy (and thus the risk from capture) depends on the instrument used. Producers of biofuels used to be supported through subsidies (or, equivalently, tax breaks). In the United States the corn-based ethanol tax credit has been complemented by an import tariff on all sources of ethanol, with the tax credit working with federally mandated blending minimums to ensure a domestic market for ethanol. U.S. ethanol subsidies are estimated to have cost taxpayers $6 billion in 2009 (Karp and Stevenson 2012). They likely imposed significant costs on developing-country suppliers that are more efficient—such as Brazil, which uses sugar cane as a feedstock (though in 2009/10, Brazil imported small amounts of ethanol from the United States due to high food demand for sugar and competing crops worldwide). The subsidies sharply pushed up corn prices, though part of that increase could have been avoided if the U.S. market had been open.

The phasing out of the U.S. tax credit (and tariff) at the end of 2011 marked the end of the taxpayer's support to biofuels. But the support by the consumer still remains, through the blending requirement of increasing amounts of ethanol. What is worrisome is that the consumption mandates appear far more difficult to reverse than direct subsidies—which were subject to annual review by legislative bodies in the United States and in most European Union member states. With consumption mandates, biofuel policies are less susceptible to public finance pressure. Although the amounts at stake are substantial, the fact that the burden is spread across millions of consumers reduces the political pressure to relieve it. Indeed, substantial coordination would be needed on the consumer side to stand up against the mandates if warranted from a cost-benefit perspective.

policies in a few countries lead to escalating support globally, beyond what is justified by market failures.

Sixth, green growth is about synergies between economic growth and environmental protection. And more targeted innovation and industrial policies represent a way to capture these synergies. Indeed, if and where these policies can promote growth cost-effectively and provide environmental benefits, it is possible that they can be developed to generate synergies between economic and environmental objectives.

In sum, a balanced view of costs, potential benefits, side-effects, and risks is needed to analyze the desirability of green innovation and industrial policies. The fact that these policies have influenced the structure of several economies suggests that they are options for transforming economies and bringing them toward more environment-friendly patterns. But the potential for costly failure and waste of scarce public resources always needs to be factored into any policy decision. In the following three chapters, we explore the three key inputs in a greener production function—human, natural, and physical capital—beginning with labor markets and whether green growth creates jobs.

Notes

1. This section is based on Dutz and Sharma (2012), a background paper produced for this report.
2. Indicators of technological sophistication (R&D personnel per capita) as well as the scale of the R&D sector (total R&D personnel) were considered in making this distinction.
3. Hausmann and Klinger (2006) show that as countries change their export mix, there is a strong tendency to move toward related goods rather than to goods that are farther away, where "relatedness" or "proximity" of products is defined at the global level.
4. See Popp (2012), who highlights the work of Lewis (2007) documenting how both countries went from having no wind turbine manufacturing capacity to having almost complete local production in fewer than 10 years. Sauter and Watson (2008) highlight this as a case study of "environmental leapfrogging," explaining how the adoption of cutting-edge technologies was facilitated by the creation of learning networks.
5. See Popp (2012), who highlights international mobility of workers as a more important source of information than foreign direct investment or licensing, and de la Tour and others (2011) for the underlying analysis.
6. The initiative, led by the Commission for Environmental Cooperation, established by the North American Free Trade Agreement, included the environmental authority of the state of Queretaro and the Global Environmental Management Initiative, a nonprofit organization of leading U.S. multinational corporations focused on environmental sustainability. It is a 10-week eco-efficiency educational training program emphasizing learning-by-doing with a commitment by participating small and medium-size enterprises to generate and implement pollution prevention projects, with recommendations for change made by the participants themselves. Investments related to the implementation of the improvement projects were provided by individual participants, who became convinced of their value. Lyon and van Hoof (2010) find that the average participant generated a project with a net present value of more than $150,000, saved 1,900 cubic meters of water and 42,000 Kwh per year of electricity a year, reduced CO_2 emissions by 61 tons a year, and cut waste disposal by 1,455 tons.
7. Chapter 4 addresses the labor market–related questions concerning skills.
8. See chapter 4 of Zhang and others (2009) for an overview and recommendations of policies to strengthen the ecosystem for the venture capital industry in China, and see chapter 7 of Dutz (2007) for India.
9. Regression results (based on comprehensive deal-level data on high-growth financing and enterprises seeking investment in the clean-tech sector over 2005–10 in 26 countries including Brazil, China, the Czech Republic, and India) suggest that deployment policies such as feed-in tariffs and tradable certificates, government R&D, and firm-level patenting are associated with higher levels of investment in clean-tech industries than short-term fiscal policies such as tax incentives and rebates. No significant correlation is found between public investment loans or public financing of venture capital and the amount of private financing of innovative ventures (Criscuolo and Menon 2012).
10. Henry and Stiglitz (2010) document how the United States used the threat of a compulsory license to manufacture Cipro during the anthrax scare following September 11, 2001.
11. The assessment is based on first-round approximations rather than full general equilibrium effects.
12. This is a different issue from the rise in imported emissions to high-income countries from developing countries, which is associated with their general deindustrialization. In 2008, China emitted about 1,400 $MtCO_2$ through its production of exported goods; the United States imported goods amounting to about 600 $MtCO_2$ of emissions.

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Human Capital: Implications of Green Growth Policies for Labor Markets and Job Creation 4

Key Messages

- Green growth cannot substitute for good growth policies, and employment is no exception: shortcomings in labor markets will not disappear with the adoption of environmental policies.
- But even if green jobs will not be a panacea, environmental regulation need not kill jobs either, and the net balance can be positive.
- To smooth the impacts on labor markets of the transition to green growth, policy makers need to tackle potential skill shortages and impediments to worker mobility—both of which have constituted barriers to other types of economic adjustment, such as trade liberalization.

For many countries the promise of new sources of growth and job creation is what lies behind the attractiveness of green growth. They look at Brazil, China, Denmark, India, and Japan—world leaders in exports of green products, who created entirely new industries in wind, solar, and biofuels. They hear about the promised double dividend of a green fiscal stimulus that can create jobs in the short run while laying the foundations for a more sustainable future.

For others the fear of diminished competitiveness and job losses remains one of the main barriers to pursuing green growth. They worry that tightening environmental policies could lead to industries relocating in countries with laxer environmental policies (so-called “pollution havens”)—and that these policies will lead to trade wars.

Yet, to some extent, this is an old debate—one that centers on the complex relationships between environmental regulation and competitiveness, and the ensuing job impacts. The topic of “green jobs” is just the latest round, prompted by global economic worries.

This chapter is based on Bowen (2012), except section “. . . and Learn from the Lessons of Trade Adjustment,” which draws from Porto (2012).

Does green growth create jobs? The supporters argue that green policies are "a new engine of growth" and "a net generator of decent jobs" (UNEP 2011). The recent global economic downturn triggered many proposals for "green" fiscal stimuli to promote growth and job creation (Pollin and others 2008). The Organisation for Economic Co-operation and Development (OECD) also suggested that investing in green activities has substantial potential to create jobs (OECD 2011b). Chinese analysts estimate that measures to save energy, protect the environment, and replace polluting industries with high-tech firms would lead to the net creation of some 10 million jobs over the next 5–10 years, and that exports of green goods could create some 4–8 million jobs (CCICED 2011, cited in World Bank and DRC 2012).

But the critics claim that the potential is overestimated and that environmental policies may actually hurt labor markets (Michaels and Murphy 2009; Morriss and others 2009). A recent study of South Africa finds that while developing green industries is appealing, it has little chance of succeeding unless structural problems (regulatory obstacles to creating small enterprises, a lack of skilled workers) are addressed (World Bank 2011a). Similarly, investments to promote research and development (R&D) in green industries will do little if educational and financial systems produce few skilled workers and little risk capital.

To shed light on this debate, this chapter explores the net impact of green job creation—that is, whether more jobs will be created than lost—and the relationship between labor markets and green growth policies. It first discusses what exactly green jobs are, then moves to the factors that influence whether green growth policies lead to job creation, and finishes with measures needed to smooth the transition to greener growth paths for labor markets.

The key finding is that environmental policies will lead to substantial job creation only if other inefficiencies—including those of labor markets—are tackled. In other words, green growth policies are no substitute for good growth policies. But while green growth may not be the answer to chronic unemployment and low competitiveness, fears that environmental regulations would result in job losses and lower competitiveness are misplaced—indeed, odds are that the impacts will be quite moderate. Meanwhile, better regulations (particularly those supported by training) support for R&D, and tax recycling (that is, using revenues from environmental taxes to reduce other taxes) will help minimize the risks posed by green growth policies and maximize co-benefits.

Green policies may create jobs, but are no substitute for sound labor markets

A first hurdle in framing the debate is that there is no agreement on how to define "green" jobs, even among economists. This lack of definition matters because it complicates the debate on the desirability of green policies.

Defining green jobs…

As "employment in 'green' industries"

Some definitions of green jobs are fairly narrow, including only jobs with an identifiable environmental focus or employment in industries (or specific projects) whose products are deemed to be of environmental benefit. This would include employment in renewable energy, energy efficiency, and environmental services or in developing less carbon-intensive products (such as building railways).

For the United Nations Environment Programme (UNEP), job content, as well as the characteristics of industry goods and services, also matters (UNEP 2008). UNEP defines green jobs as

> work in agricultural, manufacturing, R&D, administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce

energy, materials, and water consumption through high-efficiency strategies; decarbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution (UNEP 2008).[1]

This definition takes a broad industry perspective, extending beyond employment in narrowly defined environmental services. In principle it embraces employment in producing any goods and services that have smaller adverse environmental impacts than close substitutes.

Some definitions focus on industries producing environmentally desirable outputs. The OECD/Eurostat defines the environmental goods and services industry as "activities that produce goods and services to measure, prevent, limit, minimize, or correct environmental damage to water, air, and soil, as well as problems related to waste, noise, and ecosystems. This includes technologies, products, and services that reduce environmental risk and minimize pollution and resources" (OECD 1999). For example, air and resource pollution management would qualify.

Using the OECD's definition, green jobs constitute a small but significant share of total employment—about 1.7 percent of total paid employment in Europe (European Commission 2007). That is probably a higher fraction than a global estimate along UNEP lines would suggest; as UNEP notes, much of the documented growth in green jobs has so far been in developed countries.[2] Employees in many jobs might find that their jobs are not counted as "green" despite the nature of the goods and services that they help produce. For example, jobs in the car industry are excluded, even though some may be devoted to developing low-carbon vehicles.

As "the employment consequence of green policies"

Some definitions of green jobs follow a different track, focusing on what happens when public policies to correct environmental externalities are introduced—opening the possibility of including jobs created and destroyed across the whole economy. In effect they try to answer the question, "What are the employment consequences of introducing green policies (such as cap and trade) relative to a baseline case?" This approach requires implicit or explicit economic modeling of the policies.

Some studies in this vein count only jobs directly created by the policies—that is, *"direct" employment effects*. They focus on the specific labor requirements of technologies ("bottom-up" estimates, using simple spreadsheet-based analytical models in conjunction with engineering estimates).[3] An important issue is the timing and duration of job creation. There is a key distinction between construction, manufacture, and installation—where jobs may be fairly short-lived—and ongoing operation, maintenance, and fuel processing—where the length of jobs depends on the durability of the relevant plant.

Other studies include both jobs created and jobs destroyed in sectors disadvantaged by green policies—that is, *indirect and net employment effects*. This net concept of employment change is crucial for evaluating the overall labor market impacts of environmental policies. It can be done through input-output tables or general equilibrium modeling. They include jobs created by the aggregate demand generated by the extra direct and indirect employment ("induced" employment effects). This approach allows jobs to be counted as green if they are created by green policies, even if they are in sectors with no obvious direct relationship to environmental objectives (such as communication) or with only a secondary relationship (such as financial services). It also includes other economic feedbacks and mechanisms triggered by environmental policies, thus hopefully capturing jobs lost owing to higher prices and lower real wages, lower final demand, and lower investment. But many studies do not follow through with this netting-out process.

Another approach considers *different time horizons*—the further the time horizon, the more economic variables can be adjusted.

For example, a study of the impact of carbon price policies on U.S. industry considers outcomes along four time scales (Ho and others 2008):

- The very short run, where firms cannot adjust prices and profits fall accordingly.
- The short run, where firms can raise prices to reflect the higher energy costs, with a corresponding decline in sales as a result of product or import substitution.
- The medium run, when in addition to the changes in output prices, the mix of inputs may also change, but capital remains in place, and economy-wide effects are considered.
- The long run, when capital may be reallocated and replaced with more energy-efficient technologies.

It concludes that employment consequences of green policies differ strongly, depending on the time horizon. Short-term employment losses mirror output declines and are substantial in energy-intensive sectors, but gains in other industries would fully offset those losses in the longer term.

But few studies account for labor market rigidities and other obstacles to job creation, and yet they may impair any positive effect of green policies. As the World Bank study on South Africa (World Bank 2011a) noted, green policies cannot correct all the problems holding back job creation—such as skill mismatches and the dualism (insider-outsider) of the job market. Thus, the scope for green job creation is limited in the absence of parallel economic policy changes.

Evaluating the impact of green policies on jobs: Gross versus net job creation

What is the overall job creation impact of green policies in developing countries? Few studies have explicitly focused on this, and those that have suffer from many definitional issues, making comparisons difficult.[4] They also fail to look at economy-wide effects. That said, the few that do exist suggest that climate-change policies in general and renewable energy policies in particular can generate considerable extra employment:

- In South Africa, a study finds that an "energy revolution" scenario—that is, a scenario with a strong transition toward renewable energy—creates 27 percent more jobs than the International Energy Agency's business-as-usual scenario and 5 percent more than the growth-without-constraints scenario (Rutovitz 2010).
- In India, a study finds that low-carbon employment is one of the key co-benefits of promoting the renewables sector. It notes that solar power is more labor-intensive than wind power and better able to meet India's requirements for small-scale, off-grid power. Biomass, green transport, and public works in water and forest management are also attractive ways of achieving both employment and environmental objectives (GCN 2010).
- In China, a study emphasizes the possible employment losses from the planned sharp reduction in the energy intensity of Chinese industry, but notes that this could be outweighed by increased employment in renewables and—quantitatively, much more important—the shift of the Chinese economy toward services and away from heavy industry (GCN 2010).
- In Brazil, a study argues that renewable energy sources have a stronger potential in Brazil than is envisioned in official studies and government policies, both in contributing to CO_2 mitigation and generating jobs (GCN 2010).

What is the record of green fiscal stimuli on job creation in developing countries? The evidence is scant, but a few studies do show some job creation, with substantial variation in jobs created per dollars spent.

- In the Republic of Korea, forest restoration generated nearly eight times as many jobs per dollar as the least labor-intensive green objective, "vehicles and clean energy" (Barbier 2009).
- In China, biomass spending was found to be nearly 30 times more effective in generating jobs per dollar than wind

power (UNEP 2008). That suggests that the focus on renewable energy and low-carbon manufacturing prevalent in studies for Europe and the United States may miss the opportunities for employment creation from changes in land management and agriculture in developing countries, where these economic sectors are fairly more important.

- In Latin America, water network rehabilitation and expansion in Honduras is much more effective (by a factor of more than 10) in creating jobs than hydroelectric schemes in Brazil, with rural electrification in Peru falling in between (Schwartz and others 2009).

While useful, these studies have limitations. They do not discuss the capital constraints that may hamper the (public or private) investments needed to create the green jobs. They assume people will move seamlessly from one sector to another and ignore labor market rigidities. They tend to focus narrowly on the energy sector when green growth options (even when limited to climate change concerns) exist in other sectors that may be more labor-intensive. And they do not always distinguish between substitution (using more labor and less capital, energy, and other inputs) and lower productivity (using more inputs to produce the same amount of output). This distinction matters because capital-labor substitution is desirable, at least for countries with excess labor supply, large unemployment, and limited access to capital; lower productivity is not.

Another question worth asking is whether green spending is a good way of creating short-term employment during a crisis. The argument in favor of green fiscal stimuli is that they can both create jobs and lay the foundations for more sustainable growth. But experience suggests the need to look across the range of possible green works (from renewable energy to reforestation) as not all are equally labor-intensive and "shovel-ready."

To begin with, if employment creation is the objective, higher spending in sectors with lower capital intensities than either conventional or renewable energy—such as reforestation programs or even education and health services—may be more effective. But there may be tradeoffs between rapid employment creation and "greenness." Road building, for example, is fairly labor-intensive and can help to provide valuable infrastructure, but it is not particularly green. And some sectors, such as energy, will not top the list for sustainable rapid job creation, given that they require a long lead time for replacing capital.

And programs that yield larger employment effects tend to lead to more employment gains for largely lower skilled workers, so that the long-term growth effects are fairly small. Long-term development, including sustainable development, requires more of a focus on growth-enhancing infrastructure investment, which is not necessarily labor-intensive.

More analysis is needed of how global markets will affect job creation—leakages of green jobs and spending to other countries depend on endowments of skills, existing industry structure, the nature of the technologies newly deployed, and the ways that comparative advantage is exploited (GCN 2010).

The last point is a useful reminder that general equilibrium effects matter. Yet these are largely ignored in the green jobs literature. That may be particularly misleading for developing countries, as the next section discusses.

The effect of green policies on employment depends on labor market structure and the specific policy considered

The problem with studies that discuss job markets is that they tend to either model them as perfectly competitive, and thus adapting instantly to all shocks with no involuntary unemployment (the neoclassical model)—or as having involuntary unemployment that could be cleared with a fiscal stimulus (the Keynesian model). The first set of assumptions implies that green jobs are likely to displace as many jobs elsewhere in the economy.[5] The second, that there will be no crowding out of jobs by green fiscal stimuli.

Neither approach is realistic. Most developing countries have surplus labor economies, so estimates limited to direct employment creation in the green jobs literature might be less misleading for developing countries than for industrial economies closer to full employment. But it is more complicated in "dual" economies with modern and traditional sectors or in three-sector economies with a traditional rural sector and both formal and informal urban sectors characteristic of many developing countries (Harris and Todaro 1970; Mazumdar 1976). In that case the (skilled) formal urban labor market is often very shallow and green job creations can have crowding-out effects on other activities.

So knowing how best to model how the aggregate labor market works—and, indeed, how the macroeconomy as a whole works—is crucial to properly assess overall (net) job creation. Babiker and Eckaus (2007) illustrate the value of the implicit or explicit macroeconomic framework, showing how climate policy could increase unemployment in the presence of real wage rigidities or barriers to the sectoral reallocation of labor. Guivarch and others (2011) highlight that climate policy costs depend significantly on labor market rigidities and that policy cost estimates are much higher in models with imperfect labor markets. Overall, labor market impacts can also be influenced by how the revenues from other environmental taxes are used, as the literature on the "double dividend" from environmental taxation shows (Fullerton and Metcalf 1997; Sartzetakis and Tsigaris 2007). Studies tend to show that if tax revenues are used to reduce payroll tax—a tax on labor supply—employment will fall by less or even increase.

The key point is that the overall effects of green policies on employment depend on the characteristics of the economy's labor markets and the nature of the policy interventions, including their funding, not just the input requirements of rival energy technologies. Indeed, underemployment can have multiple causes, and the consequences of green policies will differ depending on these causes. It thus helps to consider the implications of a wider range of theories of underemployment and labor market adjustment in different types of economy (box 4.1).

But environmental regulation need not kill jobs either

A major fear being voiced in the green jobs debate is that environmental regulation—needed to price externalities and encourage firms to change their production processes—will destroy jobs.

A tale of two antithetical hypotheses: the "pollution haven" and "Porter" hypotheses

For the past 20 years the debate on the implications of environmental policies on competitiveness (and jobs) has revolved around two antithetical hypotheses: the "pessimistic" pollution haven hypothesis, which contends that firms will flee locations with strong environmental regulations; and the "optimistic" Porter hypothesis, which argues that environmental regulation will lead to innovation (Porter and van der Linde 1995). In the latter, innovation reduces the cost of regulation (weak Porter hypothesis) and may lead to increased competitiveness and profitability (strong Porter hypothesis).

What is the latest thinking on this issue? As chapter 3 reported, there is no evidence that environmental policies have systematically led to job losses because of an exodus of firms to pollution havens. Tighter environmental regulation may cause firms to relocate, but they will choose locations that are more attractive overall, as pollution abatement costs represent a small share of production costs for most industries (Copeland 2012). Factors such as availability of capital, exchange rates, labor abundance, location, institutions, and agglomeration effects are more important than environmental policy in determining firm location and competitiveness. Empirical evidence from existing

BOX 4.1 A framework to estimate the impacts of green policies on jobs

How can policy makers determine if green policies will create jobs? The following provides a framework to assess labor market consequences, exploring what would happen in an economy with two sectors: a clean one and a dirty one. The products are imperfect substitutes that are produced with many inputs, including labor. The first two cases explore the impact of green growth policies that focus on the demand side, and the rest deal with policies that focus on the supply side.

Case 1. Demand deficit and a green stimulus

In this case the economy is typified by "Keynesian" unemployment—that is, with insufficient overall demand. The green policy involves a fiscal stimulus with spending focused on the clean sector. What would happen? Greater demand for the clean sector's product would stimulate greater employment in the clean sector, in turn pushing up wages in this sector, and thus increasing final demand. Increased demand in the labor market would put upward pressure on wages throughout the economy, possibly causing a slight decline in employment in the dirty sector. Overall, employment would be expected to rise as long as job creation in the clean sector outweighs the (indirect) job losses elsewhere, facilitating a virtuous outcome.

Case 2. A green paradox: demand deficit and a green stimulus meet a skills deficit

Here again we have a Keynesian economy, but there is a skills deficit in the clean sector. The green policy involves a fiscal stimulus with spending focused on the clean sector. Higher demand for the clean sector's products would feed into higher wages across the economy, because employment in the clean sector cannot expand, but overall employment levels would not expand much, and may even decline. Thus, the green fiscal stimulus would be largely ineffectual, generate higher wages, and create little (if any) additional employment. (In an open economy the green stimulus may trigger imports, in which case it would have little impact on employment.)

Case 3. Pollution regulation with virtuous initial conditions

Now the green policy involves a pollution tax to correct a pollution externality in the dirty sector, and there are no wage or price rigidities in the economy. Faced with an emissions tax, the optimum response would be a contraction of output and an investment in pollution abatement. What would happen? The regulations would be expected to destroy jobs in the dirty sector, given that the tax raises production costs with the dirty technology and the price of these goods rises. As a result, demand for the clean substitute good rises and employment in the clean sector increases—imparting incentives to reduce the externality either through new production techniques or end-of-pipe abatement, which would boost jobs in pollution abatement.

This scenario suggests that overall employment would increase when there exists a close and clean substitute produced with more labor-intensive technology or when abatement is feasible and more labor-intensive than dirty production (on the margin). This situation might apply to economies such as Japan's or the Republic of Korea's that are well endowed with labor skills and technology for cleaning up.

Case 4. Pollution regulation with immiserizing initial conditions

This is similar to the previous case but with two key differences: no clean substitute for the dirty good, and pollution abatement is either far too costly or unavailable, or is highly capital intensive. Production and employment in the dirty sector would decline, with little or no offsetting increase in cleaner jobs. This situation most likely applies to economies reliant on extractive industries—such as artisanal mining, where pollution abatement is typically far too costly for the small producers and there is no clean substitute available for the mineral.

Case 5. Renewable resource regulations—restore rents but not necessarily jobs

Here we have a classic open-access common-property resource such as a fishery. Entry occurs until the payoffs from harvesting decline to zero (or to the opportunity cost). If there is a tax or restriction on harvesting, this would lower employment but increase resource stocks and the payoffs. Thus, while employment may decline, economic returns increase and environmental benefits accrue. Conversely, if the policy were accompanied by expenditure on ecosystem restoration, there would be offsetting changes in employment, with ambiguous net impacts.

The bottom line is that the labor market consequences of green policies depend on the policy under consideration, technological parameters, and the state of the economy. There are cases where a given policy can create jobs, and other circumstances when it can destroy jobs.

Box text contributed by Richard Damania.

regulation or environmental taxes confirms this result (Anger and Oberndorfer 2008; Ellerman and others 2010; Martin and others 2011; Morgenstern and others 2002; Quirion 2011; Sartor 2012). But this evidence is based mostly on existing regulations in developed countries, and future research needs to ascertain whether these results extend to developing countries and to more ambitious environmental policies than have been applied to date.

For sectors intensive in natural capital—with which many developing countries are well endowed—the pollution haven hypothesis is even less likely. After all, without sound environmental policies, the increased pressures coming from trade could rapidly deplete natural capital, and then the short-term benefits from increased trade would be wiped out by the subsequent collapse of the resource base of the activity (Copeland 2012).

The reality is that stringent environmental provisions are essential for guaranteeing the long-term sustainability of the economic activities (and jobs) that depend on natural capital. If a natural resource base is well managed, it can be used to create jobs (moving up the value chain by creating a downstream processing sector, for instance) and seize opportunities in global markets.

At the firm level, studies show that the impact of more stringent environmental regulation on productivity and competitiveness is modest and sometimes even positive, thanks to innovation (Ambec and others 2011). The large body of literature triggered by the seminal paper by Porter and van der Linde (1995) supports the weak version of the Porter hypothesis: innovation does reduce costs.

Further, recent studies have found an increasing number of cases where environmental regulation had positive impacts on profits (Ambec and others 2011). This may be due to the fact that regulators have become better at designing smart regulatory policies, as well as that the models used to assess the effects of environmental regulation on innovation and competitiveness were refined to account for the lagged structure of innovation (essentially they wait a few more years to evaluate the impact, giving the firm more time to adapt).

Thus, the overall effect of environmental regulations on jobs is likely to be limited. In the United States, an econometric study of highly regulated industries finds that the impact of stringent environmental regulations on U.S. jobs was negligible in most cases—across all industries, 1.5 jobs were created per $1 million spent in additional environmental spending, with a standard error of 2.2 jobs (Morgenstern and others 2002).

Types of adjustment needed across countries

There is much variation across developing countries in the likely ease of transition to a low-carbon growth pathway. Chapter 3 shows that developing a comparative advantage in the production of equipment for low-carbon electricity depends on the manufacturing base of the country and on whether there are scale and learning economies in the technology. Some countries have a comparative advantage in particular renewable energy sources because of natural endowments. Brazil has the right climatic conditions and soils to give it a substantial cost advantage in biofuels, though other characteristics of the Brazilian economy also help, in addition to being very well endowed in hydroelectric potential (Kojima and Johnson 2005).

Developing countries that produce a high level of greenhouse gas emissions per unit of GDP face a more difficult challenge of structural adjustment. They are the ones in which more labor is likely to have to be reallocated from greenhouse gas–intensive activities, either by switching technologies within an industry or by moving labor between industry sectors. Given the importance of CO_2 emissions from energy production, energy-intensive economies will compose a large part of this group.

Endowments of fossil fuels combined with industrial development strategies that have favored carbon-intensive industry make a transition to low carbon much more challenging (EBRD 2011). If such economies impose a carbon tax, the standard economic policy instrument to internalize the greenhouse gas externality, the relative returns to different factors of production are likely to change. The few empirical studies focusing on how carbon taxation might affect factor returns suggest that the incidence of a carbon tax is likely to be regressive when emission abatement measures are capital-intensive, requiring complementary policies (Fullerton and Heutel 2007, 2010). Countries such as Kazakhstan and Mongolia, with a much larger-than-average proportion of the labor force in mining and energy supply, are more likely to suffer as a result of this adjustment and also from the difficulties of reallocating displaced labor to other sectors. Chapter 3 discusses how industrial and other sector-specific policies can facilitate this transition.

Smoothing the transition to greener growth paths for the labor market

Policy makers need to worry about skills that can limit job creation…

To what extent are the skills needed in the labor force for greener growth being altered? This matters because if the skills required are unavailable, that could place a major obstacle in the way of the transition to green growth.

Overall, "green restructuring" brings with it the usual challenges to policy makers trying to facilitate restructuring and reduce the labor market adjustment costs, including those from a changing skill mix. Many of the expanding industries are likely to be using new products and processes, reflecting the transition to low-carbon technologies, so the generic skill requirements of many of the newly created jobs are likely to be higher than average, as they have to allow for assimilation of unfamiliar tasks and working methods and "learning-by-doing." But a larger proportion of jobs in the renewable energy sector and in energy efficiency are lower skilled than in the fossil fuel energy sector (Pollin and others 2009). Contrary to the coal industry—which employs many low-skill workers in developing countries—the oil and gas industries tend to have fairly well-paid workers and a large proportion of highly qualified engineers and technicians.

Perhaps the most thorough study of green growth and skills so far is ILO/CEDEFOP (2011), which reports and synthesizes the results of 21 country reviews. It notes that the demand for skills is being affected in three ways by the transition to green growth:

1. Induced structural change across industries increases the demand for skills specific to expanding industries such as renewable energy and reduces the demand for skills such as those for coal mining.
2. Some new occupations are emerging—such as photovoltaic (PV) fitters and carbon-footprint assessors—though there appear to be fairly few unique green skills.
3. The content of many jobs in current industries is changing, as companies focus on achieving better energy efficiency, switching from fossil fuel sources to renewable energy, and producing capital equipment for expanding green industries. In agriculture, low- and no-till agriculture and reduced use of fertilizers and pesticides will entail changes in farmers' practices, as will increased production of biofuel crops and efforts to increase forest cover—a development likely to have the most pervasive effects on labor markets, particularly in developing countries.

What is worrisome is that skill shortages may already be impeding the transition to green growth (box 4.2). In 2011 the OECD (2011a) drew attention to widespread skill shortages in energy-efficient construction and retrofitting, renewable energy, energy and resource efficiency, and environmental services. Many countries have reported specific bottlenecks, such as the shortage of skilled PV workers in Germany and the lack of design engineers for smart grids in the United Kingdom. Karp and Stevenson (2012) identify similar shortages in developing countries. In India, maintaining and operating the

BOX 4.2 Shortage of skills and inadequate training provisions can undermine green programs

The problems that can arise when training provision is not up to the challenge of the induced structural change are illustrated by Australia's experience with a new Home Insulation Program introduced in February 2009 as a key part of the government's fiscal stimulus.

The program was designed partly to generate jobs for lower skilled workers in the housing and construction industries. At the start of the program only supervisors were required to satisfy one of three minimum competences—prior experience in the insulation industry, qualifications in an approved trade, or insulation-specific training. The program proved popular. At its peak, demand was running at almost 2.5 times the anticipated level and some 1.1 million roofs of 2.7 million eligible were insulated. But fires, fitters' deaths, and reports of fraud undermined public confidence, and the program was canceled in February 2010. A subsequent sample of inspections revealed that nearly 30 percent of installations had some level of deficiency. Investigations showed that low skill levels in the industry, inadequate provision of training, and poor management of the program were among the factors responsible.

The importance of competent project management and national policy making in this case is a reminder of the key role of higher level management and planning skills in a policy-induced transition to green growth that is likely to take sustained effort and policy credibility over a long period.

Source: Australian National Audit Office 2010.

renewable energy systems deployed by the Remote Village Electrification is complicated by the lack of skilled workers (IEA 2010).

In 2001 China started the Township Electrification Program to bring electricity to rural communities using solar PV, small hydro, and wind. While installation appears to be working well, there are problems with maintenance and operation, partly because of a lack of qualified electricians. Reasons for these reported shortages include the underestimation of the growth of certain green sectors, the general shortage of scientists and engineers, the low reputation and attractiveness of some sectors important for the green transition such as waste management, and a shortage of teachers and trainers in environmental service (ILO/CEDEFOP 2011).

Many of the skill shortages already reported in connection with green growth strategies appear to result from generic failings in education and training. And they reflect long-standing issues such as the lack of functioning universities and research centers, the mismatch between students' choices of discipline and the needed skills, the lack of incentives for employers to invest in developing the transferable skills of their workforces, the lack of access for the disadvantaged to time and finance for training, and the stickiness of relative pay rates.

Fortunately, there is a potential for synergies between green policies aimed at skill development and growth policies aimed at increasing labor capital, worker education, and labor productivity. Figure 4.1 shows that many developing countries need to increase their enrollment in technical tertiary education. Such an increase would accelerate growth and help with skill limitations created by green policies.

…and learn from the lessons of trade adjustment

Green growth is about transforming our production and consumption processes from a dirty, environmentally unsustainable model to a sustainable one. Like any structural transition it inevitably entails transition costs, which green growth policies must seek to minimize. As such, the trade literature, which has extensively documented adjustment costs associated with trade liberalization, offers interesting insights.

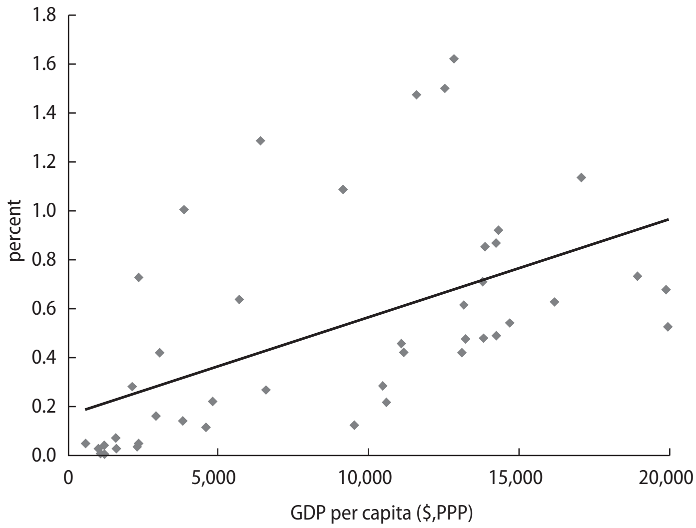
Adjustment costs, whether stemming from trade shocks or a transition to green growth, are fundamentally driven by factor immobility—sluggishness in capital or labor market adjustments.[6] These costs would be zero were workers able to adjust instantly to the changing demand for skills (moving instantly from one industry to another) and were firms able to instantly modify their fixed capital following changes in carbon prices or pollution standards.

In the real world, labor markets are sluggish, as experience with trade liberalization shows. Trade liberalization creates and destroys jobs within industries. But the flow of labor across sectors—from shrinking to expanding ones—is slow. In Brazil it took several years for workers displaced from deprotected industries to be absorbed by sectors with comparative advantages (Muendler 2010). In addition, large wage differences persist among workers with similar qualifications and status across industries, suggesting limited mobility of workers across industries (if workers were mobile, they would switch to the highest paying industry until wages equalized). This "industry-effect" explains a large fraction of wage differences across workers, and prevails in both developed and developing countries, for skilled and unskilled workers (Krueger and Summers 1989).

What does this sluggishness stem from? Slow labor market adjustments reflect demand-side (industries requiring specific skills) and supply-side (worker characteristics) factors. Whether sector-specific knowledge and training are a bigger impediment to mobility than labor market frictions (the time and costs associated with search and matching) depends on the extent to which worker experience is specific to each sector (Cosar 2010; Dix-Carneiro 2010). And there appears to be significant variation in the mobility of different types of workers, with lower adjustment costs for younger workers and skilled workers. The policies needed to help transition may thus differ by country (depending on the nature of the adjustment) or by affected worker categories (depending on age, skill, and so on).

FIGURE 4.1 Many developing countries need to increase their enrollment in technical tertiary education

(enrollment in engineering, manufacturing, and construction in tertiary education as a percentage of the total population, 2009)



Source: Authors based on UNESCO Institute for Statistics, http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx (accessed March 18, 2012); World Bank 2011b.
Note: PPP = purchasing power parity.

As for capital stocks, a shift toward greener production processes is likely to require substantial changes, as firms may need to invest in new product lines, machines, and equipment. Yet, as experience with trade adjustment shows, the process may be quite costly—for example, following Argentina's trade reform, the required capital adjustment averaged 14.5 percent of firms' capital stock (Bet and others 2011). Thus, the capacity of economies to adjust to green policies may be limited by capital constraints, which could affect labor demand.

Because adjustment costs are a direct function of factor immobility, efforts to increase labor or capital mobility will be critical. And support policies should be targeted to facilitating the transition rather than cushioning potential losses. Simple unemployment insurance tends to hamper reallocation and skill formation. But employment subsidies can be useful if made conditional on working in the export-oriented (or green) sector (a form of industrial policy; see chapter 3).

Ultimately, the cost of the transition will depend on the overall economic policy framework and the extent to which it facilitates the emergence and growth of new sectors and firms. So the ability to carry out and reap the benefits of a green growth policy will depend on good economic policy.

In sum, fears that environmental regulations will lead to massive job losses or loss of competitiveness are probably as unfounded as the hope that green jobs will single-handedly solve countries' employment problems. That said, it is vital to invest in human capital to accelerate growth and to green growth. This is one of the inputs to economic production. Natural capital is another critical input, and the next chapter will look at why it is important to invest in this domain, too.

Notes

1. UNEP also includes a provision that "green jobs need to be decent jobs" (UNEP 2008).
2. At the same time developed countries are responsible for, by far, the largest share of the stock of greenhouse gases in the atmosphere. They have also probably made a disproportionate contribution to long-lived solid waste. So some of the green jobs reflect the unsustainability of developed-country economies.
3. See Kammen and others (2004) and Wei and others (2010) for a review.
4. Further, studies use a range of methods, reflecting the different definitions of green job creation discussed above, differ in coverage of countries and sectors and as to whether they include gross or net effects and whole value chain effects, and make varying assumptions concerning economic growth and business-as-usual scenarios (Bacon and Kojima 2011; Fankhauser and others 2008; GCN 2010; GHK 2009; Kammen and others 2004; Wei and others 2010). The few studies of developing countries conclude to significant job creation, but offer no analysis of the net impact (see box 4.2).
5. In such models implementing carbon pricing will tend to both redistribute labor to low-carbon activities and reduce overall labor supply due to the higher relative price of carbon-intensive goods and services. There can be net job destruction, depending on how the revenues from carbon pricing are used as in a study of the potential implications of a cap-and-trade system for the United States, which found significant reductions in labor input in 29 of 35 U.S. industries without revenue recycling (Goettle and Fawcett 2009).
6. For instance, Guivarch and others (2011) model economic transaction costs due to a climate policy with different levels of rigidity in the labor market, finding that mitigation costs are much larger when labor market imperfections are considered.

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Natural Capital: Managing Resources for Sustainable Growth 5

Key Messages

- Sustainable management of natural capital underlies green growth in key sectors—such as agriculture, manufacturing, and energy—and is vital for resilience and welfare gains.
- Different resources require different types of policies. For extractable but renewable resources, policy should center on defining property rights and helping firms move up the value chain. For cultivated renewable resources, policy should focus on innovation, efficiency gains, sustainable intensification, and "integrated landscape" approaches.
- The elements of natural capital cannot be regarded in isolation. Integrated landscape approaches can increase production of both "regulating" and "provisioning" services of natural capital.
- In some cases, growth and green outcomes—such as cleaner air, cleaner water, less solid waste, and more biodiversity—will involve tradeoffs. But not all of these tradeoffs are inevitable: innovation, which can be supported through smart subsidies, can help minimize or eliminate some of them.

Meeting peoples' needs for food, fuel, and fiber depends on sound management of the natural capital—agricultural lands, forests, water, fisheries—on which production of these goods depends. Manufactured goods also depend on sustained production from natural capital, such as subsoil assets.

But what exactly is natural capital? The term refers to the stock of natural resources that provides flows of valuable goods and services. Major types of natural capital include agricultural lands; subsoil assets (oil, gas, coal, and minerals); forests; water; fisheries; and the atmosphere.[1] Goods and services provided by natural capital underpin conventionally measured economic growth by providing inputs to agriculture, manufacturing, and services and by increasing the productivity of agriculture and the reliability of infrastructure services through climate control.

Complementing natural capital with human, physical, and social capital greatly increases its productive capacity. But the extent to which other forms of capital can substitute for natural capital is bounded, because people require water, food, and air to live, and demand for water and food will increase as population and incomes rise.

How can better management of natural capital lead to green growth? Sustainable management of capture fisheries can increase economic returns. Restoration and enhancement of watershed services can enhance agricultural productivity. Conservation of biodiversity can generate economic returns through nature-based tourism and bioprospecting. Rents accrued from mineral extraction can be invested in infrastructure and human capital, thus generating economic returns.

But achieving these outcomes is not easy, given the myriad market and institutional failures at play. What is needed, therefore, is a package of measures encompassing both price and nonprice interventions to enhance the management of natural capital. Reaping higher economic returns from natural forests, for example, requires aligning policies, incentives, capacity, and governance. Reaping higher returns from mineral extraction requires policies that increase production efficiency, fiscal policies that are fair to both the government and investors, and public expenditure policies that encourage the reinvestment of income for broader development gains.

This chapter explores how better managing natural capital can promote green growth. It looks at four broad categories: (1) extractable renewable resources (capture fisheries, natural forests, soil, and water); (2) cultivated renewable resources (crops, livestock, aquaculture, and forest plantations; (3) nonrenewable resources (oil, gas, coal, and minerals); and (4) ecosystems that provide regulating services (watershed management, climate regulating services, and nature-based tourism). The first three categories provide "provisioning" services (those that directly produce goods and services, such as food and water); the fourth embraces "nonprovisioning" services (those that provide regulating services, supporting services, and cultural services).[2]

The key finding is that sustainable management of natural capital is essential for green growth in key sectors—such as agriculture, manufacturing, and energy—and is vital for resilience and welfare gains. The type of measure (both price and nonprice) needed will vary with the type of resource being targeted:

- For extractable but renewable resources, policy should center on defining property rights and helping firms move up the value chain.
- For cultivated renewable resources, policy should center on innovation, efficiency gains, sustainable intensification, and "integrated landscape" approaches that can lead to productivity gains without damaging the environment.[3]
- For nonprovisioning services, efforts should concentrate on increasing knowledge of the economic value of these services and incorporating these values in policy decisions.
- For nonrenewable resources, the focus should be on minimizing environmental damage and recovering and reinvesting rent optimally for broader economic development.

Second, the elements of natural capital cannot be regarded in isolation. Integrated landscape approaches can increase production of both "regulating" and "provisioning" services of natural capital—for example, by integrating the production of crops, trees, and livestock on the same land area or by managing animal waste to enhance soil fertility and produce energy rather than contributing to pollution. But solutions need to be adapted to local circumstances and need to include the right policy measures to provide incentives for innovation and adoption.

Third, in some cases, growth and green outcomes—such as cleaner air, cleaner water, less solid waste, and more biodiversity—will involve tradeoffs. These tradeoffs are most common in current cultivation practices in agriculture, livestock, aquaculture, and plantation forests. But not all of these tradeoffs are inevitable: innovation, which can be supported through smart subsidies, can help minimize or eliminate some of them.

Extractable renewable resources: Defining property rights and moving up the value chain

Extractable renewable resources (capture fisheries, natural forests, soil, and water) are often, though not always, common property resources—goods from which it is difficult to exclude potential users, whose consumption precludes consumption by others. The inability to exclude users often leads these resources to be managed under open access property rights regimes, under which no economic returns or rents accrue to the scarce natural capital. Under such a scenario, more factors of production are employed in the extraction of the resource than is efficient, and more of the resource is extracted, accelerating its depletion.

If property rights were established, total output would increase (perhaps after a lag during which the resource regenerates itself), and rents would accrue to the scarce natural resource. Some factors of production, such as labor, could, however, be worse off once property rights were established, unless the rents were redistributed (Weitzman 1974). The fact that establishment of property rights can reduce the returns to labor may explain the resistance to introducing such rights. These potential losses should be weighed against enhanced productivity, which can improve overall economic welfare and, with a supportive policy environment, can enhance opportunities for moving up the value chain (by shifting from extraction alone to downstream processing), providing new job opportunities.

Capture fisheries

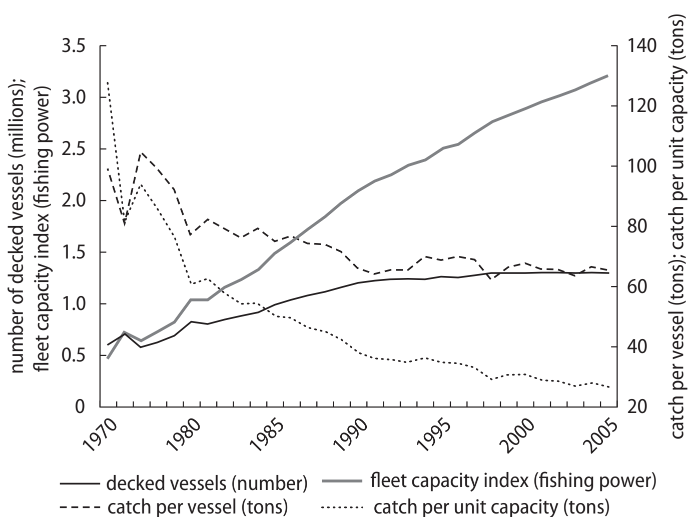
Globally, capture fisheries added $80 billion in gross value and provided direct and indirect employment to more than 120 million people in 2004 (World Bank and FAO 2009). But because fish are mobile, marine capture fisheries are very difficult to manage: only a handful of fisheries are being managed reasonably efficiently.

The open access nature of capture fisheries has led to overcapitalization, rent loss, and overexploitation. Because of a shrinking resource base, the growing number of fishers and fishing overcapacity, the catch per fisher and per vessel has been declining globally—despite significant technological change and investments in vessel capacity (figure 5.1). The prevalence of subsidies has reduced the cost of fishing below its economic cost and has contributed both to overfishing and resource depletion and to the economic waste associated with overcapacity (World Bank and FAO 2009).

The good news is that well-managed fisheries could accrue rents as high as $50 billion (World Bank and FAO 2009), which could be used to build wealth or increase productivity. Establishing property rights would help unlock the potential economic value of fisheries. But defining and enforcing these rights remains a challenge. High-sea capture fisheries (beyond the exclusive economic zone) are dominated by large commercial vessels, which are often largely unregulated, overcapitalized through subsidies, or both.[4]

For their part, inshore capture fisheries have long been used as a safety net

FIGURE 5.1 Current fishery practices are not sustainable
(productivity of global fishing fleet, 1970–2005)



Source: World Bank and FAO 2009.
Note: The fleet capacity index is the relationship between the capacity of a fishing fleet to catch a particular quantity of fish and the quantity of fish it actually catches.

for the rural unemployed; for this reason, policy makers resist altering the status quo. Success stories suggest that policy interventions that directly address the job loss associated with defining property rights can make green growth politically feasible (box 5.1). In addition, moving up the value chain can help create jobs that are more productive. However, such "industrial" policies may not reflect the country's comparative advantage and would need to be justified on a case-by-case basis (Hausmann and others 2008).

Natural (including managed) forests

Natural forests (including natural forests that are actively managed) provide a range of extractable commodities (from timber to wood fuel to various nontimber forest products) and a range of ecosystem services (from regulation of soil, water, and the climate to sequestration of carbon and provision of habitats). In Africa alone, forests account for 65 percent of the total primary energy supply. Nontimber forest products (fruit, nuts, medicinal plants, and game) are an important source of rural livelihoods.

Global demand for industrial wood was about 1.8 billion cubic meters in 2010, and it is projected to rise to 2.6 billion cubic meters by 2030, with most of the increase coming from Asia and Eastern Europe (FAO 2011).[5]

How will this growing demand be met given that natural forests are often not well managed? The global rate of deforestation remains high, especially in tropical regions, with deforestation averaging about 1 percent a year in Latin America and Africa over the 1990–2010 period. The encouraging news is that the rate of deforestation has been declining since 2000 (FAO 2011), with impressive declines in some key countries such as Brazil. Moreover, some areas—such as temperate and boreal zones and some emerging economies—have witnessed increases in forest area through both natural forest recovery and reforestation. Indeed, more than 80 percent of traded timber is produced in temperate countries.

A problem for the world's forests—80 percent of which are publicly owned—is poorly defined property rights. In many developing countries, forests are often treated as de facto open access areas. Significant progress has been made in recent years toward devolving full or partial forest management to local communities to deal with the problems associated with open access

BOX 5.1 Job creation and revenue generation from off-shore capture fisheries in Namibia

Soon after gaining independence from South Africa in 1990, the new Namibian government declared an extended economic zone, established a coherent fisheries policy, and enacted comprehensive fisheries legislation based on long-term fishing rights (rights-based management) and payments for these rights. At the same time, it focused on the "Namibianization" of the processing sector. Before independence, all fish were exported (or transshipped at sea) whole and frozen for later processing into value-added products abroad. By investing in local processing capacity, Namibia created many jobs and increased the industry's value added (although it also created considerable processing overcapacity).

With an average catch of 500,000–800,000 tons a year (in 2003 the total catch was about 636,000 tons), the fisheries sector's contribution to gross domestic product rose from about 4 percent at independence to 10.1 percent in 1998. About 95 percent of Namibia's total fish production is exported, yielding about $375 million in foreign exchange in 2005. About 14,000 people were employed in the fisheries sector in Namibia in 2003, about half of them in onshore processing.

Source: http://www.fao.org/fishery/countrysector/FI-CP_NA/en.

BOX 5.2 Reform of forest tenure in Albania and China

In Albania serious degradation of the forests and pastures was observed in the early transition years. To address the problem, the government reformed and decentralized national institutions and increased support to pasture and forest management at the local level. Reforms transferred management rights of forests and pastures to local communities. To deal with fire management and control illegal logging, the government adopted a cross-sectoral approach. It provided local investment support for the restoration of watersheds, forests, and pasture land using participatory planning approaches. This support included small-scale investments in the planting of forests and orchards in degraded lands, the thinning and cleaning of degraded forests and pastures, and measures to control erosion and grazing. This mix of policy, social, and natural capital investments enhanced resilience (erosion control and soil restoration), yielded environmental benefits (carbon sequestration), increased efficiency (greater pasture and forest productivity), created jobs, and reduced poverty.

In China, the government has made substantial investments in tree planting across the country over the past 25 years to restore environmental balance and secure supplies of raw materials. It has also reformed forest user rights to collective forests (forests under the control of provinces and other subnational authorities). Like reforms to property rights of agricultural lands, these reforms sought to harness the productive energies of rural households and communities. They amount to the largest transfer of forest wealth ever recorded. Most reforms involve provisions that offer individual households a large degree of economic autonomy and independence to manage the forests, with households and farmers' groups receiving certificates of use rights.

Source: World Bank 2010b, 2010c.

regimes (box 5.2). But there have been few assessments of the impact of changes in forests management regimes on the rate of deforestation or the productivity of forests. A review of 42 studies on community forest management concludes that little is known about the effect of community forest management on improving the productivity of forests or reducing poverty (Bowler and others 2010).

Another problem is that assessments of the economic value of forests are rare, especially in developing countries, particularly when it comes to valuing the economic contribution of nontimber forest products. These products are undervalued because, in many countries, they are not reflected in national accounts systems, in part because they are produced informally. For example, in Europe, where these products are economically marginal, they were valued at $7 billion in 2010. In contrast, in Africa, where they are much more important economically, they totaled only an estimated $0.5 billion (FAO 2011).

Where these assessments do exist, they suggest that a number of factors limit the value added from these resources. A meta-study of 61 case studies of production of and trade in nontimber forest products in Africa, Asia, and Latin America finds that, by and large, commercialization has not helped reduce poverty, for four reasons:

- Resources are often collected under open access regimes, where overexploitation is common, leading to rent dissipation.
- Access to markets tends to be poor, limiting economic returns.
- Fluctuations in quantity and quality make commercialization of nontimber forest products difficult.
- Middlemen often capture the bulk of added value (Belcher and others 2005).

As with capture fisheries, increasing the economic returns from natural forests sustainably requires a package of measures that includes strengthening property rights; assessing the economic value of forests; and adopting measures, such as better market access and improved product quality, that increase economic returns and reflect the full value of the service.

Soil

Soil quality reflects how well a soil performs the functions of maintaining biodiversity and productivity, supporting plants and other structures, and providing a slew of other nonprovisioning ecosystem services. Land degradation includes deterioration of soil quality, vegetation, and water resources (Nkonya and others 2011). It is a process that affects all agroecological zones, potentially reducing GDP (table 5.1). A quarter of the world's agricultural land is estimated to be seriously degraded (Bai and others 2008).

Factors leading to land degradation include poor agricultural and grazing practices and forest degradation as well as factors outside the renewable natural resource sector, including poorly designed infrastructure and mining activities. Land degradation can, in turn, affect the operation of infrastructure installations by silting up key facilities such as ports and hydroelectric power generation facilities.

Land users need to be given the right economic incentives to invest in preventing or mitigating land degradation. The strength of these incentives depends on the nature of land tenure regimes (Deininger and Feder 2001; López 2002) and on the way costs and benefits are shared. Costs, for example, are often borne only by the farmer, whereas environmental benefits accrue to society as a whole.

TABLE 5.1 Poor soil quality and land degradation hurt economic growth

Country	Type of degradation	Percentage of GDP lost
Central African Republic	Cropland and soil	1.0
Colombia	Land	0.8
Egypt, Arab Rep.	Soil	1.2
Ghana	Agricultural soils, forests, and savanna woodlands	5.3
Pakistan	Soil salinity and erosion	1.2
Tajikistan	Land, including soil erosion and salinity	3.7

Source: Country Environmental Analyses conducted by the World Bank (World Bank 2005a, 2006a, 2006b, 2007c, 2008b, 2010a).

Well-defined, transparent, and secure land tenure systems are essential if farmers are to undertake the long-term conservation that underpins agricultural production and investments to improve natural capital and productivity. In Rwanda, for example, land tenure reform led to a rapid doubling of investment in soil conservation, with even larger increases for plots managed by female farmers (Ali and others 2011). Secure land tenure also leads to the development of land markets, which improves overall allocative efficiency and the possibility of using land as collateral in formal credit markets. That said, land registration and tenure systems must be adapted to local conditions and customs (Deininger and Feder 2001). In Africa, approaches to land use rights increasingly recognize that customary and modern systems may exist side by side.

On-site approaches, such as conservation agriculture, can be tapped to foster natural ecological processes to increase agricultural yields and sustainability. This approach, which dates back to the 1930s, is based on three main principles: continuous minimum mechanical soil disturbance; permanent organic soil cover; and diversification of crop species grown in sequences, associations, or both (FAO 2001). Its use yields environmental benefits (decreased nutrient pollution of waterways, increased carbon sequestration in soils), increases the efficiency of production (through the use of lower levels of energy inputs), increases resilience (through frequent crop rotation), and increases long-run agricultural productivity (through decreased erosion and enhanced soil structure). Local conditions should dictate the technology (box 5.3).

Conservation agriculture tends to involve up-front costs (for new machinery necessary for direct seeding or for tree seedlings in

BOX 5.3 Conservation agriculture in Brazil and Zambia

Conservation agriculture first emerged in the 1930s during the severe dust storms in the United States. It has been gaining momentum worldwide since the 1990s, when it was employed to deal with soil erosion crises in southern Brazil. Its use is now widespread globally. By 2007, for example, zero-tillage practices were in use on about 43 percent of arable land in Latin America (World Bank 2007a).

In Brazil, conservation agriculture relies on a variety of technologies, depending on the region. One approach supports a mixed livestock and crop system, rotating pastures with crops. The zero-tillage system supplies residual nutrients for cheap pasture, thereby reducing pests, weeds, and diseases. The most common rotations are soybeans, cotton, and maize, followed by 1–3 years of pasture. These practices have increased pasture stocking rates and have reduced soil degradation and water runoff.

In Zambia, five basic conservation farming technologies are being used: retaining crop residues, concentrating tillage and fertilizer application in a permanent grid of planting basins or series of planting rows, completing land preparation in the dry season, weeding aggressively to reduce plant competition, and intercropping or rotating nitrogen-fixing legumes on up to 30 percent of cultivated area.

Many farmers also incorporate nitrogen-fixing trees, which provide fodder and fuelwood. As of 2010, Zambia had restored 300,000 hectares in an effort that involved more than 160,000 households. Conservation agriculture practices doubled maize yields over those achieved with conventional plowing systems, and increased cotton yields 60 percent. A recent study finds returns of $104 per hectare for plots under conservation agriculture in Zambia—5.5 times the $19 per hectare of plots under conventional tillage (FAO 2010a).

Source: Landers 2005; FAO 2010a; Scherr and others 2011.

agroforestry systems) and short-term yield reductions as farm systems are changed. Benefits may materialize only in the medium to long run. Smart subsidies and access to long-term financial markets can help cover short-run costs and increase adoption.

Focusing public support measures on soil fertility can yield impressive results. In Brazil—where state support of agriculture is just 5 percent of aggregated gross farm receipts compared with an average of 18 percent in Organisation for Economic Co-operation and Development (OECD) countries in 2010 (OECD 2011)—the government has concentrated on investments in soil fertility enhancement, land and water management systems, and crop and livestock breeding for varieties adapted to Brazil's climate and ecosystems. Brazil's public support of research and soil fertility has paid off handsomely, helping transform the country from a net food importer into a global food exporter.

Water

The sustainable management of water resources is becoming more urgent than ever as several global trends collide.[6] In developing countries, growing populations are increasing demand for water to produce essential commodities like food and energy. Higher rates of urbanization fuel demand for water for domestic and industrial uses, putting stress on existing raw water sources. Exacerbating matters, climate change increases the risks of greater water variability.

One big worry is water scarcity. Developing countries account for 71 percent of global water withdrawals, and their demand is expected to increase by 27 percent by 2025 (from 2010). In 2010, about 44 percent of the world population lived in areas of high water stress, and projections indicate that an additional 1 billion people will be living in areas with severe water stress by 2030 (OECD 2008). And many countries in Asia and North Africa are exhibiting moderate or extreme scarcity, which is expected to increase in the future.

Another worry is poor water quality, which sets back growth because it degrades ecosystems; causes health-related diseases; constrains economic activities (such as agriculture, industrial production, and tourism); reduces the value of property and assets; and boosts wastewater treatment costs. For example, the annual costs of poor water quality stand at 0.6 percent of GDP in Tunisia and 2.8 percent of GDP in the Islamic Republic of Iran (World Bank 2007b).

Yet another worry is natural hazards—the vast majority of which involve water—which affect almost everyone and retard growth. Kenya, for example, was hit by several disasters over a 3-year period that undid years of economic growth (an extreme flood cost its economy 16 percent of GDP, and extreme drought 11 percent of GDP) (World Bank 2004). And when these natural hazards strike, it is the poor who suffer most, because of their locations, low incomes, insufficient infrastructure, and greater reliance on climate-sensitive sectors like agriculture.

What can policy makers do to better manage water resources? Four green growth water policies—none of them easy to design or implement—can be adopted:

- *Correct distortions in water allocation decisions*. New mechanisms for allocating water resources should embrace economic principles of allocative efficiency to correct for market failures and imperfections. These failures are compounded by the sector's political economy and the fact that more efficient water pricing boosts costs for some elements of society more than others. Decision makers need to devise efficient and flexible ways to allocate water among competing quantity and quality demands for human use (energy, agriculture, fisheries, and urban consumption) and ecosystems health (forests and wetlands) (World Bank 2010d). A study of China finds that improving water allocation could increase per capita income by 1.5 percent a year between 2000 and 2060 (Fang and others 2006).
- *Expand the use of water pricing mechanisms to manage demand*. The price of most water services does not include investment, operation, and maintenance costs or the scarcity value of the resources. Pricing could be used as an effective instrument to ensure the resource's optimal allocation. Most countries fail to use it because of the political and social sensitivities of water management, particularly the need to ensure affordability for the poorest communities. Most countries allocate surface and groundwater by assigning fixed quotas to major sectors and activities. Although far from effective, these quotas have been politically and socially acceptable. In the short term, they seem to be a more realistic option than full cost pricing.
- *Create new markets*. Tradable water rights are an effective water management instrument in the long term but have proven difficult to implement in the short term in most developing countries—partly because success depends greatly on sound design and partly because it takes a long time to establish the necessary institutions (World Bank 2010d). Thus, in the short term, it is imperative to ensure that the proper institutional arrangements and capacities are in place.
- *Strengthen the framework for analyzing the relationship between growth and water*. There have been few attempts to analyze and quantify the relationship between water and economic growth and development because of the complex spatial and temporal dimensions of water and its management. There is a need to strengthen this analytical framework by examining regional differences in growth within a country or group of countries. This information would allow more informed decision-making processes by providing a clear understanding of the economic tradeoffs of policies in different sectors (such as energy, agriculture, urban, land use, environment, and health).

Cultivated renewable resources: Innovation, sustainable intensification, and integrated landscape approaches

Food production will need to increase by 75 percent between 2010 and 2050 to cope with rising demand caused by population and income growth and changes in the structure of demand. As incomes increase, demand for higher-value horticultural and livestock products is likely to increase by more than direct demand for staples; demand for livestock products will likely increase 85 percent between 2010 and 2030 (Foresight 2011). Yet hunger remains a challenge: 800 million people in the world remain food insecure. Improving agricultural productivity and access to food remain core elements of an inclusive growth agenda.

For cultivated renewable resources, the main policy challenges are to support sustainable increases in productivity and resource-efficient production by focusing on innovation, increasing efficiency in input use, regulating pollution, and ensuring that smallholder farming more fully realizes its potential, especially in lower-income developing countries. In the future, a larger share of fish and wood products is likely to come from aquaculture and plantation forestry than from natural forests or wild fisheries, further increasing the importance of sustainable management of cultivated renewable resources in meeting green growth objectives.

Agriculture, including livestock

Agricultural production is strongly affected by how natural capital—especially energy, land, water, forest, marine, and coastal systems—is managed. Agriculture, including livestock, accounts for 70 percent of fresh water consumption and 40 percent of land area. Many agricultural systems depend heavily on fossil fuels for nitrogen fertilizer, crop husbandry, harvesting, transport, and pumping water for irrigation. Thus, food and fossil fuel energy prices are closely linked. There are synergies and tradeoffs between maximizing production of food at low cost and conserving the environment. These synergies need to be maximized and the tradeoffs managed.

Strategies in support of a green growth agenda for agriculture need to differentiate between agriculture-dependent, transitioning, and urbanized economies and between land and water–dependent and land and water–abundant ecosystems and countries. In agriculture-dependent countries, agricultural productivity and inclusive growth are closely related: GDP growth in these sectors is estimated to benefit the poor two to four times as much as GDP growth in other sectors (World Bank 2007a). Four elements may be considered in a green growth strategy for agriculture.

Increasing productivity while improving land and water management. Intensification—producing more with less—has been responsible for the dramatic rise in global cereal yields in recent decades. From 1960 to 2010, rice yields rose 250 percent (from 1.8 to nearly 4.5 tons per hectare [Dobermann and others 2008; International Rice Research Institute data]), while between 1965 and 2000 cultivated land area increased by just 20 percent (from 125 million to 150 million hectares [Khush and Virk 2005]). Attaining the same production increase with no growth in yields would have required increasing the area planted with rice to 300 million hectares, reducing further land availability for wetland or watershed protection functions. Extensive, poorly managed agricultural and grazing systems, often related to poverty and lack of access to finance or knowledge, contribute to the land degradation and loss of soil fertility described above. Sustainable intensification can protect biodiversity, reduce deforestation, save water, and reduce greenhouse gas emissions. By integrating improved land, soil, and water management measures into production systems, such intensive systems can also increase productivity while maintaining and even enhancing the value of natural capital.

In a number of agricultural systems intensification has been accompanied by negative environmental consequences. Excessive and poorly managed fertilizer and agrochemical use has polluted water bodies and soils; run-off has created "dead zones" in coastal areas that cover about 245,000 square kilometers worldwide, mostly in OECD countries.[7] Agricultural run-off from intensive farming is the single greatest water polluter in China and other intensively farmed countries, including Denmark, the Netherlands, and the United States (Chinese National Census of Pollution 2010; Scheierling 1996).

Similar tradeoffs are linked to livestock production. In the United States, for example, production efficiency in the dairy industry soared over the past 60 years. In 2007, producing 1 billion kilograms of milk required just 10 percent of the land, 21 percent of the animals, 23 percent of the feed, and 35 percent of the water used to do so in 1944. But there were plenty of negatives, including the geographical concentration of livestock waste, increased water and air pollution, and reduced animal welfare. These problems could be avoided with the right mix of incentives and regulation to protect water bodies and manage waste. Productivity increases, innovation, and genetic improvements are a "low-hanging fruit": in India, average milk yields are only 3.4 kilograms per day compared with the world average of 6.3 kilograms, and only 20 percent of animals are cross-bred; doubling productivity would halve greenhouse emissions per cow.

But in Colombia, a mix of policies has supported sustainable productivity increases for livestock by encouraging landscape-based, mixed agro-sylvi-pastoral systems. The aim is to introduce trees and better pasture in grazing lands, provide improved fodder and shade, and reduce heat stress for animals and soil degradation. The results are impressive—including increased meat and milk yields as well as improved water infiltration, increased bird populations, reduced methane generation, and improved carbon capture (López 2012). This livestock policy is part of a broader land use policy intended to support sustainable intensification together with forest and landscape restoration. These approaches have helped achieve "triple wins" of increased productivity, enhanced resilience to climate variability, and reduced carbon emissions ("climate-smart agriculture").

Some agricultural subsidies exacerbate the negative effects of intensification. In land-scarce, intensely farmed agricultural systems with already high levels of inputs, subsidization of inorganic fertilizer encourages over-use, with deleterious effects on the environment (box 5.4). However, in countries with low-input/low-output systems, a fertilizer subsidy may initially be justified to increase yields and enhance vegetative growth and soil carbon.

BOX 5.4 The use and misuse of agricultural input subsidies in India

In India, fertilizer and other input subsidies contributed to rapid development of irrigation and more intensive farming methods, resulting in increases in yields and food security: by 2010, irrigated wheat yields in some provinces averaged 4.5 tons per hectare, up from 1.5 tons per hectare in 1975. However, subsidized energy is now contributing to excess groundwater withdrawals (about 75 percent of groundwater used in Punjab and Harayana originates from overexploited aquifers), requiring pumping water from ever-deeper aquifers and salinization of aquifers in some areas. In addition, the fertilizer subsidy—which cost the government $30 billion (2 percent of GDP) in 2008—is contributing to excessive use of nitrogen compared with phosphorus and potassium, exacerbating nitrate pollution of rivers and aquifers.

Source: Prince's Charities' International Sustainability Unit 2011.

Increasing efficiency and reducing waste. Reducing food waste involves some of the same issues encountered in increasing energy efficiency: even where the saving potential is huge, many barriers, including transactions costs, prevent efficiency-increasing investments from being made. The problem has been recognized for decades, but limited progress has been made. In both agriculture-dependent and OECD countries, up to one-third of food is lost or wasted. The reasons for this waste—and the solutions to the problem—vary with the settings (Foresight 2011).

In agriculture-dependent countries, where food accounts for a large share of household expenditure (46 percent in Pakistan), there is little household waste, despite lack of refrigeration at home. But 15–30 percent of food produced is lost before it reaches markets, because of postharvest losses caused by poor storage and inefficient transport systems. The problem is compounded by food quality and food safety issues, which may preclude poor farmers from participating in value chains (Gómez and others 2011). For low-income countries, the following strategies could reduce food waste:

- Diffusing existing knowledge and technology in storage and investing in transport infrastructure.
- Investing in new technologies to reduce postharvest waste.
- Using information and communication technology to improve market information, helping match supply and demand in local markets.
- Investing in capacity building, infrastructure, and regulatory improvements in food quality and food safety.

OECD countries have developed efficient supply chains from farm to market, with low spoilage rates and effective transport systems. But about one-third of food supplied is nevertheless wasted through losses in supermarkets (food thrown away because it is not sold by the sell-by date), losses in homes (food discarded before it is used), and plate waste (food that is served but not consumed). Because food accounts for a relatively small proportion of household expenditure in OECD countries (11 percent in Germany, 7 percent in the United States), there is little price incentive to avoid waste. However, new technologies, such as enhanced sensor technologies to monitor the edibility of food, could help reduce wastage. The main challenge is changing consumer behavior.

Harnessing technology. Technological innovation plays a key role in green growth strategies for agriculture. It can be used to increase input efficiency, as is the case in irrigation water management, where advances in the use of remote sensing technologies permit estimation of crop evapo-transpiration (the sum of evaporation and plant transpiration to the atmosphere) on farmers' fields and facilitate improvement of water accounting at the regional and basin-wide levels. China is adopting this approach with its Xinjiang Turpan Water Conservation Program, in an arid part of the country (World Bank 2010c). This program monitors basin-wide evapo-transpiration with remote sensing and supports a combination of engineering, agronomic, and irrigation management measures to increase agricultural productivity measured in terms of evapo-transpiration. Innovation includes developing agricultural products that feature improved characteristics, such as being drought resistant, requiring less fertilizer, and being resistant to common pests and diseases (which reduces the need for pesticides)—as India is doing with better backyard chickens (box 5.5).

Innovation can also be used to increase access to weather and climate information services for farmers, which improves resilience, increases efficiency, and raises income. In Florida, a timing tool helps farmers reduce the quantity of fungicide they use, reducing the harmful effects on the ecosystem and saving them money (Pavan and others 2010). But in many developing countries and transition economies, investment and expenditure in the classic public goods of weather and climate information generation and services is far too low (World Bank 2008a). A 2010 study by NetHope in Kenya indicates that farmers gain access to information through a

BOX 5.5 Producing a better backyard chicken in India

Kegg Farms in India has bred a robust and improved dual-purpose backyard chicken. The "Kuroiler" lays 100–150 eggs a year (many more than the 40 eggs a year the Desi chicken lays) and grows to 2.5 kilograms in about half the time a Desi chicken reaches 1 kilogram. The chickens typically command a premium of about Rs 60 per kilogram over other broiler chickens, because the meat is darker and more flavorsome.

Kegg Farms produces about 16 million day-old chicks a year, which it sells to 1,500 small enterprises that raise the chicks for about two weeks before inoculating them and selling them to about 6,500 bicycle salespeople, who sell them to some 800,000 farmers, most of them women, many located in some of the remotest parts of the country. The turnover in sales of chicks is about $5 million a year, with another $5 million turnover by the thousands of small, rurally based businesses that grow and sell the chicks.

An independent assessment indicates that the average gross revenue generated per Kuroiler chick (as eggs and meat) is $3.10. With some 16 million chicks distributed annually, total output is about $50 million, with a net profit of about $10 million. Profits from the Kuroiler are significantly higher than profits from the Desi bird. The Kuroiler birds contribute significantly to household cash flow. Women have maintained control over their chicken-growing enterprises as the business has become more commercial.

The success of Kegg Farms reflects several factors. Its chickens are more robust than other chickens, are better able to scavenge food, and have higher food conversion ratios. The company's business model features a devolved, rural-based distribution system with in-built incentives.

Source: Isenberg 2006.

range of methods, including SMS (cell phone messaging), radio, newspapers, and extension officers.[8]

Changing the structure of support policies. Changes in the structure of support policies can also help manage potential tradeoffs. In the European Union (EU)—and to a lesser extent the United States—the past 20 years have been characterized by a shift away from highly distortive price and quantity instruments (target prices, export subsidies, and quotas) toward lump-sum payments. The policy change has weakened the incentives for farmers to use polluting inputs, such as fertilizers and pesticides. Between 1991 and 2006 fertilizer use decreased in most EU member countries, though it increased in new member countries (Eurostat 2011). Moreover, as agricultural transfers became decoupled from production, they became increasingly subject to environmental provisions.[9]

Aquaculture

In 2009, humans consumed 117 million tons of fish—almost half of which was produced on farms (FAO 2010b). By 2030, this figure is expected to rise to 140 million tons. Capture fisheries are not expected to support the higher demand, leaving aquaculture to meet shortfalls in supply.

As in the livestock industry, competition, economies of scale, and economies of agglomeration have increased productivity but have pushed some systems into potentially damaging environmental practices. Farms tend to concentrate where there is expertise, good land, water resources, and marketing infrastructure. This crowding has sometimes led to overuse of ecosystems services, pollution, and massive fish kills. Agglomeration in the Norwegian salmon farming industry, for example, has reportedly improved the transfer of knowledge and increased the supply of specialized production factors, but it has also helped spread fish disease (Tveteras and Battese 2006).

There are two approaches to greening aquaculture. The first is zoning—that is, leaving adequate space between farms and interspersing a variety of aquaculture systems (including a mixture of species at the farm or watershed level) and water uses between major centers of production. This approach would hinder disease transmission, moderate negative impacts on wild fish populations, and reduce the contribution of aquaculture to water eutrophication.

The second approach is creating synergies with other economic activities in the watershed. The farming of aquatic plants (such as seaweed) and the filter feeding of detritivorous organisms (such as mussels, clams, and sea cucumbers, which together represent about 40 percent of total global aquaculture) reduce nutrient loading from livestock, agriculture, and other sources. Fish production in cages or culture-based fisheries can be conducted in reservoirs and irrigation systems to amortize costs, improve water quality, reduce weeds, and replace wild catch where dams have destroyed indigenous fish stocks. Mixed fish and rice production systems are widespread in low-lying areas and flood plains, taking advantage of synergies between the water and land management approaches.

Although dispersing fish farms is good for the environment, it does raise costs, in part because of the losses from agglomeration. Thus, green growth strategies will require practical financial and market incentives to support spatial dispersing, technical guidelines on green technology, and government policies that encourage investors to avoid the traditional practice of copying successful production/ market models and instead explore new partnerships at the watershed level.

Plantation forests

Afforestation—the planting of forests in areas that were not forested in recent times—is expected to meet an increasing share of the demand for wood and fiber, possibly reducing pressure on primary and natural forests. In 2010, the global area under plantation forests (forested areas artificially created by planting or seeding) accounted for 7 percent of total forest area and 40 percent of industrial timber production (FAO 2011). Plantation forests provide a growing share of industrial timber, both because the area under plantation forests has increased and because productivity has risen. Areas under bamboo and rubber plantation are also increasingly being used to provide timber products, providing an important source of income for rural households. Reforestation and restoration of degraded woodlands also play a role in plantation forestry.

Whether plantation forests help or hurt the environment depends on the land use systems they replace. In China, for example, bamboo plantations have helped control soil erosion by replacing agriculture on steep slopes. But in some provinces, where plantations have replaced natural forests in areas not well suited to bamboo, soil erosion has increased. The Chinese government has tried to address these negative environmental effects by establishing environmental regulations, but these regulations have been resisted in some cases (Ruiz-Perez and others 2001). More recently, China has supported programs with species better adapted to local ecosystems (World Bank 2010c).

Agroforestry systems, in which trees are incorporated into the broader production landscape, are widespread in some areas. They can yield the "triple wins" of climate-smart agriculture by enhancing productivity, resilience, and carbon sequestration, as they have in Kenya and the Sahel (Liniger and others 2011).

Nonprovisioning services: Creating knowledge and markets for economic valuation

In addition to ecosystems that provide food and water ("provisioning services") are ecosystems that regulate, support, and offer cultural services ("nonprovisioning" services). This group includes nature-based tourism supported by biodiversity, watershed services, and climate-regulating services. The main challenge in this area is to create markets for these services so that they become part of the visible economy and are efficiently provided.

Another challenge is coping with the timing of benefits. Although efforts to reduce the loss of ecosystem services are likely to boost growth in the near term, efforts to restore these services take a long time and are unlikely to do so in the near term (Vincent 2012).

Biodiversity

Biodiversity refers to the degree of variation of life forms, including all animals, plants, habitats, and genes. It matters because genetic diversity provides the basis for new breeding programs, improved crops, enhanced agricultural production, and food security. When species become extinct or habitats are threatened, biodiversity is reduced; according to the International Union for Conservation of Nature, 875 species went extinct (or extinct in the wild) in 2008. Ecosystem fragmentation can contribute to species loss, especially for large predators, leading to a cycle of habitat degradation.

Tropical, temperate, and boreal forests (forests in northerly latitudes) are home to the vast majority of the world's terrestrial species. They play a major role in biodiversity and provide cultural, recreational, and other supporting services, such as soil and water conservation. For this reason, 12 percent of the world's forests are designated for the conservation of biodiversity—an increase of more than 20 percent since the 1990s (FAO 2010a).

A key reason why the world has experienced such a dramatic loss in biodiversity is the difficulty of valuing it, given knowledge, time, and spatial asymmetries. Building a road around, rather than through, a fragile ecosystem increases its cost by a known amount, payable immediately; the benefit of protecting the ecosystem and its inherent biodiversity is much more difficult to value and accrues only over time. At the global level, many efforts are under way to protect biodiversity, dating back to the 1992 Convention on Biological Diversity. At the local level, the incentive could come in part from the economic returns that biodiversity can generate through nature-based tourism and bioprospecting.

Nature-based tourism. Nature-based tourism (or ecotourism) is defined by the International Ecotourism Society as "responsible travel to natural areas that conserves the environment and sustains the well-being of local people." It is one of the fastest-growing sectors in the tourism industry, with annual growth rates of 10–12 percent (TIES 2006). Nature-based tourism aims to combine stringent environmental provisions with the generation of local economic revenues, thus concurrently triggering positive development impacts and incentives to conserve natural capital.

Nature-based tourism can be a significant source of employment, economic growth, and revenue (including foreign exchange) (Aylward and others 1996; Wunder 2000). A study of nature-based tourism in Zambia estimates that ecotourism generated 3.1 percent of GDP in 2005 (agriculture contributed 6.5 percent, mining 8.6 percent, and manufacturing 10.6 percent) (World Bank 2007d). Potential tradeoffs between rural livelihoods and nature-based tourism need to be managed by involving local communities. Indeed, the success of a nature-based tourism initiative is often linked to such involvement, which requires establishing incentives for local people to effectively protect their community's natural capital (box 5.6). Tourism revenues are only a partial solution, however, as many important ecosystems have only limited appeal for tourists.

Bioprospecting. Bioprospecting is the search for genetic material from plants or animal species that can be used to develop valuable pharmaceutical (or other) products. It represents a second example of how the creation of a market can provide incentives to protect biodiversity, although in practice it is hard to achieve (Polasky and others 2005). Returns to bioprospecting are often too low to provide sufficient incentives to conserve biodiversity, and disputes arise over the distribution of rents resulting from discoveries. The Access and Benefit Sharing provisions of the Convention on Biological Diversity may help alleviate this problem.[10]

BOX 5.6 Involving local communities in nature-based tourism in Indonesia

The Komodo National Park is a protected marine area in the Lesser Sunda Islands of Indonesia. This World Heritage Site was established in 1980 to protect the habitat of the Komodo dragon. Since then, its goals have expanded to include protection of the area's many coral species and nearly 1,000 fish species.

In 2005, a nonprofit joint venture, Putri Naga Komodo (PNK)—comprising The Nature Conservancy, a local tourism company, and the International Finance Corporation—was set up to run the area. The aim is to protect biodiversity and enable local communities to benefit from the park in a sustainable way—through carefully managed nature-based tourism, alternative livelihoods for local people, and collaborative protection strategies, such as antipoaching patrols. All proceeds go toward stewarding biodiversity and developing alternative and sustainable livelihoods for the local communities.

PNK, which is the exclusive manager of the venture, has invested $1 million in helping people in the park develop new activities, such as woodcarving and textile weaving. It has also provided them with technical assistance to develop sustainable seaweed farms, as well as facilitate the breeding of high-value reef fish to substitute for threatened wild fish. These efforts notwithstanding, a recent evaluation report (Agardy and others 2011), while acknowledging the project's positive impacts, raises concerns about the sustainability of the results, given the difficulties encountered in making this public-private partnership work.

Source: The Nature Conservancy website (http://www.nature.org/); Catherine Cruveillier-Cassagne (personal communication).

Watershed services

Watersheds—that is, the area of land where all of the water that is under it or drains off it goes into the same place—provide a range of ecosystem services, supplying water and hydroelectric power, regulating water flows and floods,[11] controlling soil erosion, and creating habitats for wildlife. Because of spatial tradeoffs—and in some cases open access regimes—the market often underprovides these services, creating the need for public intervention. To correct this market failure, governments have been investing directly in the restoration and enhancement of watershed services through initiatives such as watershed development programs. Payments for such environmental services are a recent policy innovation to create markets and provide incentives to conserve or generate these services.

Support for investments in soil and water conservation. Investments in soil and water conservation normally include support for a mix of measures adapted to local conditions, including landscape restoration, erosion control, grazing management, water harvesting, and agricultural productivity support measures. At lower altitudes in irrigated landscapes, they often include support for improved irrigation water management, drainage, and salinity control. Such integrated programs have been supported to scale in a number of countries and include a mix of private and public investment measures.

In Turkey, better land management practices—promoted through investments in watershed rehabilitation and landscape restoration and reforestation programs, as well as profound changes in agricultural policy—have led to greening in the interior of the country, despite declining rainfall and increased temperatures in these areas. However, it is unclear whether this "regreening" also led to increases in rural incomes and employment.

In India, where several watershed development programs have been tried in semiarid rain-fed regions of the country, the verdict is still out. These programs seek to increase agricultural productivity by controlling soil erosion, preventing siltation of water bodies, and improving the reliability of water resources. They also hope to provide employment opportunities and improve the availability of drinking water, particularly during the summer. Between 1996 and 2004, the government of India spent more than $6 billion on watershed development (WRI 2005), but no systematic, large-scale assessment of the impact of these programs has been conducted (Joshi and others 2004).

There are nevertheless some positive results for integrated landscape approaches. In Kazakhstan, the Syr Darya/Northern Aral Sea Control program in the lower Syr Darya watershed supported innovations in water management, combining "soft" and "hard" infrastructure solutions and flood management, which helped restore river functions and the Northern Aral Sea, leading to recovery of grazing lands, ecosystems, and fisheries (World Bank 2011b). In Rwanda, the land husbandry, water harvesting, and hillside irrigation programs have already increased yields and incomes and have reduced soil losses (World Bank 2011a).

Payments for ecosystem services. The Pago por Servicios Ambientales (PSA) program, implemented in Costa Rica in 1997, was one of the first schemes to pay people to provide ecosystem services. Under this program, private landowners and communities receive payments for conserving the forest and helping protect water quality downstream. Financing for the scheme comes from donor grants, earmarked taxes, and buyers of ecosystem services, including municipal utilities. Other examples of payments for ecosystem services include schemes established to eliminate or reduce animal waste and agricultural chemical residues to protect water reservoirs, payments to landowners to encourage conservation, and REDD+ schemes, under which payments will be made for carbon sequestration services and to provide an incentive to reduce deforestation and forest degradation.[12]

In some developing countries, policy makers have tried to design payment for ecosystem services programs to benefit the poor, but the evidence on both the environmental and the poverty reduction effects of payment programs is thin (Pattanayak and others 2010). In China's Sloping Land Conversion Program, average household incomes remained unchanged, although incomes increased for some households and decreased for others. In addition, increased availability of fodder to improve income from livestock rearing, and extension services to improve agricultural productivity have helped compensate households for the loss of agricultural incomes from the conversion to forests. In Ecuador, Costa Rica, and Mexico, large-scale payment for ecosystem services schemes (table 5.2) may have benefited the poor, although assessments remain to be done.

Whether the poor are helped will no doubt depend on the scheme's design. Those based on land diversion (from current use to a use that is more oriented toward the provision of environmental services) are likely to benefit the landed, some of whom are poor—although they could also hurt poor households, especially the landless, by reducing access to key natural resources. Those based on working lands are likely to increase the demand for labor and may thereby benefit the poor. However, schemes expected to meet poverty reduction goals may be less effective in meeting environmental goals (Jack and others 2008). Where the poverty reduction impacts are likely to be small, it may be better to design schemes to be as effective as possible in achieving environmental goals and draw on other instruments to reduce poverty (Bond and Mayers 2009; Wunder 2008).

Climate-regulating services

Natural capital—including the oceans, land, and their living organisms—plays a key role in climate regulation.[13] However, the value of these key regulating services is not adequately captured through markets, and valuing them is difficult.

One of the most important services that forests, soils, and water provide is storing carbon. Indeed, out of the 9 gigatons (Gt), or billion tons, of CO_2 emissions released in 2007, the

TABLE 5.2 Impacts of payment for ecosystem services schemes on poverty reduction

Country/study	Scheme	Seller characteristics/results	Payment	Impact on income
China/Bennett (2008)	Sloping land conversion program	Tens of millions of rural households; 9 million ha of marginal sloping lands converted from agriculture to forests, 4.92 million ha of degraded lands reforested	Annual in-kind payment of grain (1,500–2,250 kg per ha), cash subsidy ($36 per ha), and free seedlings. Length of subsidy depends on type of forests. Income from forests and grasslands tax free	Mixed results: in Gansu, 50% of participants lost 8% of 1999 household net income; in Sichuan, 30% lost 11% of net income; in Shaanxi, 7% lost 33% of net income; estimates do not include net present value of future income from trees and grasses
Costa Rica/ Pagiola (2008)	Payments for environmental services	Private landowners, indigenous communities; 270,000 ha enrolled in 2005	$64 per ha per year for forest conservation and $816 per ha for 10 years for timber plantation (15% of which goes toward transactions fees)	Bulk of benefits goes to larger and better off farmers, but no assessment of impact on poverty reduction
Ecuador/Wunder and Albán (2008)	PROFAFOR	109 private landowners (50- ha minimum contract size), 43 communities.	$100–$200 per ha to cover plantation costs; 70–100% value of harvested wood, 100% of nontimber forest products	Upfront payment of $60–$635 per household (6–50% of household expenditure); income of $7–$2,481 per household from harvesting

oceans absorbed about 2Gt and terrestrial ecosystems about 2.7Gt. The remaining half remained in the atmosphere, increasing the concentration of CO_2 and contributing to global warming (World Bank 2010d). Maintaining and, where possible, increasing the sequestration capacity of terrestrial, coastal, and marine ecosystems thus plays an important role in mitigating climate change.

Healthy ecosystems that sequester carbon also function better in flood and erosion management, increasing the adaptive capacity of ecosystem services such as agriculture, forestry, and fisheries in the following ways:

- Coastal ecosystems (including mangroves and wetlands) reduce erosion and flooding and provide spawning grounds for marine species.
- Freshwater wetlands and floodplains maintain water flow and quality, acting as floodwater reservoirs and water storage facilities in times of drought; they also provide grazing land for livestock and aquatic habitats.
- Forests and vegetation stabilize slopes, control erosion and flash floods, and conserve soil fertility for agriculture.
- Integration of trees into agricultural production systems builds climate resilience.

However, ecosystem losses reduce their effectiveness as carbon sinks and their role in adaptation. Under current management regimes, land-based ecosystems in some countries contribute significantly to greenhouse gas emissions: emissions from agriculture, land use change, and forestry (deforestation, degradation, and fires) account for more than 30 percent of greenhouse gas emissions (forests account for about 17 percent and agriculture another 14 percent) (UNFCCC 2007).

Overall, more progress has been made in recognizing the importance of terrestrial ecosystems in climate regulation than in marine ecosystems, and more progress has been made in recognizing the role of forests in climate mitigation than of soils (UNEP and others 2009). Total carbon stocks in vegetation and in the top meter of soils are estimated at 466Gt (vegetation) and 2,011Gt (soil) (Ravindrah and Ostwald 2008; Watson and others 2000). The top meter of soil is important because annual crops depend on its quality and organic content for growth. For tropical forests, nearly half of the 428Gt of carbon stocks is from above-ground vegetation; in tropical savannahs, 80 percent of the 330Gt of carbon stocks is from soil.

Much work remains to be done to incorporate agricultural and grazing land and soils into climate change regimes. Only one pilot program in Africa, the Agricultural Soil Carbon Project, has benefited from financial support from carbon finance through the BioCarbon Fund.[14] The project supports increased agricultural productivity, agroforestry, and sustainable land management practices on more than 65,000 hectares in western Kenya; farmers benefit from selling carbon sequestered both in and above the soil as a result of improved farming practices (World Bank 2011a). The Clean Development Mechanism recognizes emissions from livestock and paddy rice as major sources of emission, especially in more intensive farming systems in East Asia and OECD countries.[15]

Lessons can be learned from the progress made on forests, including the work on REDD+. As countries prepare REDD+ strategies, they must address carbon monitoring, reporting, and verification as well as challenges regarding tenure rights to carbon stored or sequestered, potential tradeoffs between conservation and development, the rights of indigenous people and forest-dependent communities, and the tradeoffs between carbon sequestration and other ecosystem services, such as biodiversity.

Increasingly, countries are weighing co-benefits from adaptation and local income generation as they develop REDD+ strategies (box 5.7). However, given the modest development of international carbon markets, it is important to manage expectations regarding potential revenues from these sources over the next few years (FAO 2010a).

The role of marine ecosystems in adaptation and mitigation has received relatively little attention, partly because of their complexity, their status as an international common property resource, and the absence of robust mitigation metrics. Focusing first on coastal ecosystems in relatively shallow waters, where restoration approaches are well known, would be a low-risk, shorter-term strategy that could restore their capacity in oxygenating coastal waters, provide nurseries for fish stocks, and shelter coastal settlements

BOX 5.7 Scoring a triple win in Ethiopia by restoring the landscape

The overexploitation of forest resources in Ethiopia has left less than 3 percent of the country's native forests untouched. In Humbo, near Ethiopia's Great Rift Valley, deforestation threatens groundwater reserves that provide 65,000 people with potable water. It has caused severe erosion, resulting in floods and mudslides. With a population that depends heavily on agriculture, exacerbation of droughts and floods creates poverty traps for many households, thwarting efforts to build up their assets and invest in a better future.

Under the Humbo Assisted Natural Regeneration Project (implemented with the help of World Vision), farmer-managed regeneration of the natural forest encourages new growth from felled tree stumps that are still living. The regeneration of nearly 3,000 hectares has resulted in increased production of wood and tree products, such as honey and fruit, which has increased household revenues. Improved land management has also stimulated grass growth, providing fodder for livestock that can be sold as an additional source of income. Regeneration of the native forest is expected to provide an important habitat for many local species and reduce soil erosion and flooding.

The forest now acts as a carbon sink, absorbing and storing nearly 0.9 million tons of CO_2 over the project life. The project is the first large-scale reforestation project in Africa to be registered with the United Nations Framework Convention on Climate Change. The operation is regarded as a model for scaling up under a broader green growth and landscape restoration strategy for Ethiopia.

Source: Brown and others 2011.

from storms while additional scientific work is undertaken on assessing technical strategies for using oceans as potential carbon sinks (UNEP and others 2009).

Nonrenewable resources: Promoting rent recovery and reinvestment

Economic growth in countries with nonrenewable resources is a process of extracting resources efficiently and investing revenues from these resources in other forms of productive capital that can continue to produce income after the nonrenewable resources are depleted. Only in this way can these resources be used to promote sustainable development.

Some nonrenewable resources are essential for green growth. The generation of solar power uses silicon; devices that control vehicle exhaust and refining processes for cleaning fuels require precious metals to act as catalysts; wind turbines, semiconductors used in smart grids and other computer applications, and batteries for hybrid vehicles require rare earths; and almost all processes require steel, which is made from iron, carbon, and alloying elements. Natural gas is a relatively clean fuel; because it can readily generate power on demand, it complements solar and wind power well.

Avoiding the natural resource curse

One major problem for countries with abundant natural resources is what is known as the natural resource curse. This phenomenon refers to the economic observation that countries rich in natural assets—particularly oil, gas, and minerals—often fail to use these resources as a platform for sustainable growth and actually grow less rapidly than similar countries without such assets. These countries—such as the Democratic Republic of Congo, Guinea, Nigeria, and República Bolivariana de Venezuela—fail to transform natural capital into other types of capital, such as human capital and infrastructure.

Early explanations of the resource curse focused on economic factors, such as the difficulty of managing revenue volatility or the negative impact of exchange rate appreciation on the more technologically sophisticated manufacturing sector (Dutch disease). Such analysis left open the question of why some countries were able to overcome these economic hurdles.

The current consensus is that the resource curse is the result of weak governance (institutional capital) and human capital (Gelb and Grasmann 2010). Concentrated resources, coupled with very large investments, are easily subject to capture. Instead of directing their energies toward productive activities and the development of the institutions needed in a market-oriented economy, political and economic elites engage in "rent seeking," using their proceeds to reward their supporters and stifle dissent by potential reformers. During downturns, the government finds it difficult to adjust to lower levels of spending, because the survival of the regime may depend on rent allocation. In short, resource rents are used not to develop other forms of productive capital but to perpetuate the political regime and its inefficient economic policies. Once trapped in the resource curse, it is difficult to escape, because the elite have little incentive to do so. In the extreme case, the resource curse can lead to armed conflicts as a way to determine access to the rents.

Not all resource-rich countries get trapped by the resource curse. Some (like Australia, Botswana, Canada, Chile, and Kazakhstan) have managed to avoid it altogether. Others (like Ghana, Peru, and Zambia) suffered the resource curse earlier in their development but went on to enjoy steady growth in the past 10–15 years. Moreover, many of the fastest-growing countries in the world in the past decade have been mineral-rich countries, some of which were once victims of resource curse, although the sustainability of such growth has not been tested by a significant drop in resource prices or production.

Given that most of the fastest-growing countries in Africa since 2000 have large extractive industries—with major investments ongoing or planned—it is particularly important that these countries act now to avoid the resource curse. History shows that countries that have successfully managed concentrated natural resources for economic development have tended to have a cadre of strong technocrats, pointing to the importance of developing human capital. Countries that have recently become resource abundant, such as Mongolia and Mozambique, need to be as transparent with their rents as possible (through the Extractive Industries Transparency Initiative and other means); set up a means of smoothing volatile revenue, such as a fiscal stabilization fund; and focus on policies and programs to build human capital and competitive industries.

Even where growth has been rapid, the presence of nonrenewable resources can skew income distribution in undesirable ways. In Equatorial Guinea, for example, one of the richest and most resource-dependent countries in Africa, 77 percent of the population lives on less than $2 per day (Goldman 2011). Institutional innovations can help countries avoid this outcome. Botswana and Norway, which have strong institutional capacity, have managed their resource rents well. That even countries with a history of political instability—such as Chile, Indonesia, and Malaysia—have used resource rents effectively for economic development suggests what can be achieved (Gelb and Grasmann 2010).[16]

Managing resource revenues

How can policy makers promote efficient production, rent recovery, and rent reinvestment in ways that support broader economic growth? First, they can adopt saving mechanisms, such as fiscal stabilization funds and saving funds, which help smooth expenditure and ensure that funds are used only when the country has the capacity to absorb the new investment. Second, they can use the nonrenewable resource rents to help overcome market failures or deficiencies—such as inadequate skills, poor health and social protection, lack of infrastructure (especially electricity), and high business transactions costs. Third, they can avoid using these rents to promote industries in which their country has no or little comparative advantage.

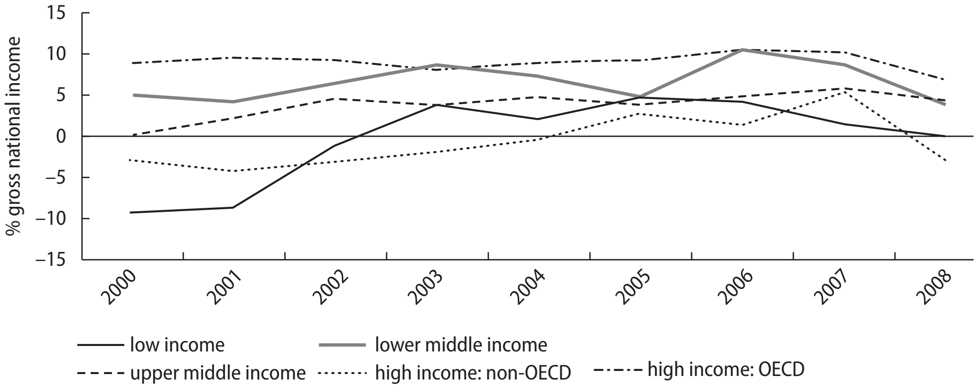
The World Bank's comprehensive wealth accounts—notably, its adjusted net savings (ANS) indicator—assess whether countries rich in subsoil assets are using their natural capital to support sustainable development through rent capture and reinvestment (World Bank 2005b, 2010b). These accounts can help countries assess whether they are on a sustainable development path. Unlike national accounts, which measure gross savings and depreciation of produced capital but do not record changes in the stocks of human and natural capital, ANS measures the change in a country's national wealth. Since 2000, many low-income, resource-rich countries have failed to leverage their nonrenewable resources for broader development. In fact, their ANS indicators were negative for several years and were relatively low when positive, suggesting that they may be running down their total wealth (figure 5.2). High-income non-OECD countries are also exhausting their natural resource wealth. The Wealth and Valuation of Ecosystem Services Initiative is being used to pilot incorporation of natural resource depletion or restoration, including renewable natural resources, into national accounts in a number of OECD and developing countries.

Practicing sustainability in mining

The largest source of employment in nonrenewable industries comes from artisanal and small-scale mining. This sector contributes to livelihood development, creating tens of thousands of jobs in many countries and hundreds of thousands in several countries (including the Democratic Republic of

FIGURE 5.2 Not enough wealth creation from natural capital

(adjusted net savings of resource-rich countries, by income group, 2000–08)



Source: World Bank 2010b.
Note: Adjusted net savings (ANS) measures the change in a country's national wealth. A positive ANS indicates that the country is adding to its wealth; a negative ANS indicates that the country is running down its capital stocks.

Congo and Ghana). But for the sector to be sustainable, there needs to be a long-term commitment by the government and strong local institutions.

Artisanal and small-scale mining is often a highly destructive industry that causes significant environmental damage, including mercury pollution and extensive riverbed destruction. The struggle to obtain control of the resources in remote, largely lawless areas also creates social tensions. Although continuation of the current mode of artisanal and small-scale mining is damaging, prohibiting it would immediately throw many miners and their families into poverty. For this reason, there is a consensus that the way forward is to recognize the role of this type of mining in development and to support improved management and livelihood development through formalization of the sector, registration of both miners and traders, adoption of technological good practice, strengthened health and safety standards and their enforcement, economic diversification, and adequate protection for female and child labor.

For medium- and large-scale mining projects, foundations and financial sureties are increasingly being used to deliver sustainable benefits to communities. These two instruments help mining contribute to broader economic development while providing environmental protection (box 5.8).

Sustainable management of natural capital underlies green growth in other sectors, including agriculture and manufacturing. It is also key to resilience and welfare gains. Well-managed, nonrenewable natural capital can provide both jobs and revenues for investment in human capital and infrastructure. Well-managed, renewable natural capital protects people and key infrastructure from floods and drought, provides key productive and cultural services, and is the basis for important tourism-based activities. Innovation, efficiency gains, and enhanced human and physical capital all play roles in achieving natural capital outcomes that are consistent with green growth. In turn, as the next chapter illustrates, the infrastructure agenda and investments in physical capital can support or undermine green growth, depending on management, policy, and investment choices.

BOX 5.8 How the mining sector is investing in communities

Medium- and large-scale mining projects typically leave a large environmental footprint, resulting in the destruction of land, loss of natural habitats, damage to ecosystems, and the reduction of water and air quality. To reduce these negative externalities and produce sustainable benefits for the community, mining companies are increasingly establishing foundations—there are now more than 60 worldwide—and financial sureties (a sum of money or a guarantee by a third party that a financial liability will be met).

Foundations

Mining companies often set up foundations for larger mining operations; a few countries, including Canada and South Africa, require that they be established. These entities increase the benefits of mining by developing skills (for mining-related jobs and alternative livelihoods) and providing funds that can provide a benefit stream once a mine is closed. They are usually funded by one or more mining operations, which contribute 0.25–1.0 percent of their gross revenues. The funds are used to deliver community investment programs for companies, facilitate the use of government payments to local areas, and manage compensation funds. A critical condition for success is adaptation to the local context, which should be subject to extensive social assessment to define the foundation's vision, beneficiaries, and project types. The foundation's complexity should be proportionate to the funding and capacity of the operating environment, and its operations should be integrated with local and regional development plans.

Financial sureties

Over the past 20 years, it has become the norm for mining companies to be legally obligated to set up financial sureties. These instruments reduce the negative externalities associated with mining by ensuring that there will be sufficient funds to pay for site rehabilitation and postclosure monitoring and maintenance at any stage of a mining project, including early or temporary closure. Funding should be based on a cash accrual system or a financial guarantee provided by a reputable financial institution. Mine closure requirements should be reviewed annually and the closure funding arrangements adjusted to reflect any changes. Financial sureties should not be regarded as a surrogate for a company's legal liability for clean-up but rather as a buffer against the public having to shoulder costs for which the operator is liable. Closure costs vary enormously but tend to range from \$5–\$15 million for medium-size open pit mines to more than \$50 million for large operations. Some sureties include socioeconomic obligations, making their goals similar to those of foundations.

Source: Sassoon 2009; Wall and Pelon 2011.

Notes

1. By and large, natural capital is the form of capital that is not created by deliberate investment, although investments may be needed to restore it (by removing pollutants or reversing soil erosion, for example) or enhance it (by building water storage structures to enhance the water retention services of watersheds, for example). This chapter considers the role of natural capital as a factor of production. Its role as a sink and the relationship to growth is covered in other chapters.
2. Following the Millenium Ecosystem Assessment (2003), ecosystem services can be classified into "provisioning services" (services that produce goods and services, such as water, food, fuel, fiber, and fodder) and "nonprovisioning services." Nonprovisioning services include services that provide regulating services (such as watershed management and climate regulation), supporting services (such as nutrient cycling and soil formation), and cultural services (including services that embody recreational and spiritual values). The report states that biodiversity and ecosystems are closely related concepts. Biodiversity is the

variability of living organisms from all types of ecosystems.

3. Landscape approaches integrate management of land, agriculture, forests, fisheries and water at local, watershed and regional scales to ensure that synergies are captured.
4. Exclusive economic zones—referred to in the preamble to the United Nations Convention on the Law of the Sea Treaty (1982)—are defined as waters that are 200 nautical miles or less from the coastline of a sovereign state. Within these areas, the state has exclusive economic rights concerning management of all natural resources.
5. Projections vary widely, depending on assumptions about recycling and the move from paper to electronic communication formats.
6. In the case of aquifers, in which the actual recharge rate is negligible, water can be considered as a nonrenewable resource. A study of China estimates the annual environmental cost of the depletion of nonrechargeable groundwater in deep freshwater aquifers to be on the order of 50 billion yuan (World Bank 2007b).
7. Dead zones are areas in which oxygen concentrations are less than 0.5 millimeters per liter of water. These conditions usually lead to mass mortality of sea organisms.
8. Nethope is a Kenya-based organization that brings together 33 nongovernmental organizations, with the mission of improving connectivity and access to information.
9. EU farmers receiving direct payments must respect mandatory cross-compliance provisions, which require them to fulfill the requirements of 19 European legislative acts related to the environment, public and animal health, pesticides, and animal welfare. Farmers who do not comply face partial or total withdrawal of their Single Farm Payment. Beneficiaries of direct payments must also keep their land in good agricultural and environmental condition.
10. The Nagoya Protocol on Access and Benefit-Sharing is an international treaty that aims to develop greater legal certainty as well as transparency for providers and users of genetic resources. The protocol covers the use of genetic resources (covered by the Convention on Biological Diversity) and the traditional knowledge that is associated with it. Its objective is for both parties to acknowledge and respect their reciprocal obligations.
11. The evidence on the role of forests in regulating water flows and floods is mixed, as Vincent (2012) notes. The evidence that forests mitigate large floods is scant, and it appears that their effect on low flows can go in either direction, depending on the balance between infiltration and evapo-transpiration.
12. REDD stands for "reducing emissions from deforestation and forest degradation." To this, REDD+ adds conservation, sustainable management of forests, and enhancement of forest carbon stocks.
13. This section does not address nonrenewable natural capital from subsoil assets (fossil fuels), which are dealt with in other chapters.
14. The BioCarbon Fund, housed within the World Bank's Carbon Finance Unit, is a public-private initiative mobilizing resources for pioneering projects that sequester or conserve carbon in forest and agro-ecosystems, mitigating climate change and improving rural livelihoods.
15. The mechanism, defined in Article 12 of the Kyoto Protocol on Climate Change, allows a country with an emission-reduction or emission-limitation commitment under the 1997 Kyoto Protocol (mostly high-income countries) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction credits, each equivalent to one tonne of CO_2, which can be counted toward meeting Kyoto targets.
16. Chile had the highest human development index of all South American countries in 2010 (UNDP 2010).

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Physical Capital: The Role of Infrastructure in Green Growth Strategies 6

Key Messages

- Infrastructure policies are central to green growth strategies, because of the huge potential for regret (given the massive infrastructure investments required and the inertia they create) and substantial potential for co-benefits (given the current gap in infrastructure service provision).
- The infrastructure gap offers opportunities to "build right" and leapfrog; but huge unmet needs also can imply difficult trade-offs between "building right" and "building more," particularly given financing and fiscal constraints.
- A framework for green infrastructure must build on efforts to address overall constraints on infrastructure finance (including cost recovery issues) and must develop strategies to both minimize the potential for regrets and maximize short-term co-benefits to address social and political acceptability constraints.

Getting infrastructure "right" is at the heart of green growth. It is critical because infrastructure choices have long-lived and difficult-to-reverse impacts on the carbon, land, and water intensity of future patterns of development. Infrastructure also offers substantial co-benefits: many investments needed for growth and improved living conditions are also good for the environment.

The challenges and opportunities of greening infrastructure in developing countries must be understood in the context of the huge unsatisfied needs that remain: the fact that much remains to be built creates an opportunity to build right; the fact that needs are so large implies important trade-offs between "building right" and "building more." While the additional costs of building green are relatively modest, they occur in a context of frequently binding financing and fiscal constraints. Complicating matters is the dramatic rise in population and growing urbanization. As such, a framework for green infrastructure needs to offer strategies to minimize the potential for regrets and maximize short-term local benefits; and it must build on efforts to address overall constraints on infrastructure finance.

This chapter focuses on long-lived infrastructure systems such as energy, water, sanitation and transport infrastructure, although it recognizes other infrastructure—for example, buildings—also play a key role in driving the demand for infrastructure services (irrigation is covered in chapter 5).

Infrastructure as the heart of green growth

Infrastructure policies are central to green growth strategies because of their unique characteristics, namely the large potential for regret (linked with the large inertia embodied in infrastructure investments) and the substantial potential for co-benefits (linked to the current gap in infrastructure service provision).

A massive potential for regret

Infrastructure decisions are long-lived (table 6.1). They influence the purchase of consumer durables and the location choices of households and firms. As such, they create substantial inertia in socioeconomic systems. Because the economic system reorganizes itself around infrastructure, this inertia can even exceed the physical lifetime of specific infrastructure investments. A delay in greening investments may therefore prove extremely costly if it results in a lock-in into technologies that turn out to no longer be appropriate (because of their excessive carbon, land, or water intensity) or settlement patterns that prove vulnerable to changing climatic conditions. The infrastructure already in place now will raise global temperatures by 1.3°C–1.7°C unless it is retrofitted or retired before the end of its useful life (Davis and others 2010; Guivarch and Hallegatte 2011).

Inertia is particularly evident in urban policies and the transport-related decisions that shape cities. The consequences of these decisions are illustrated by the contrast between Atlanta and Barcelona, two cities with roughly the same population and income but dramatically different densities and, hence, dramatically different options in terms of urban transportation and housing (figure 6.1). Once a city is developed, it is difficult to change its form. This irreversibility makes the idea of "growing dirty and cleaning up later" inapplicable in this domain (box 6.1).

The consequence of the inertia in infrastructure development is an enormous potential for regret if decisions are made without adequate consideration of how conditions—socioeconomic, environmental, and technological—will change over time. The potential for regret has always been a challenge for infrastructure policy; it is made much more complex by climate change, which introduces deep uncertainty about future climatic conditions, technologies, and environmental standards and prices.

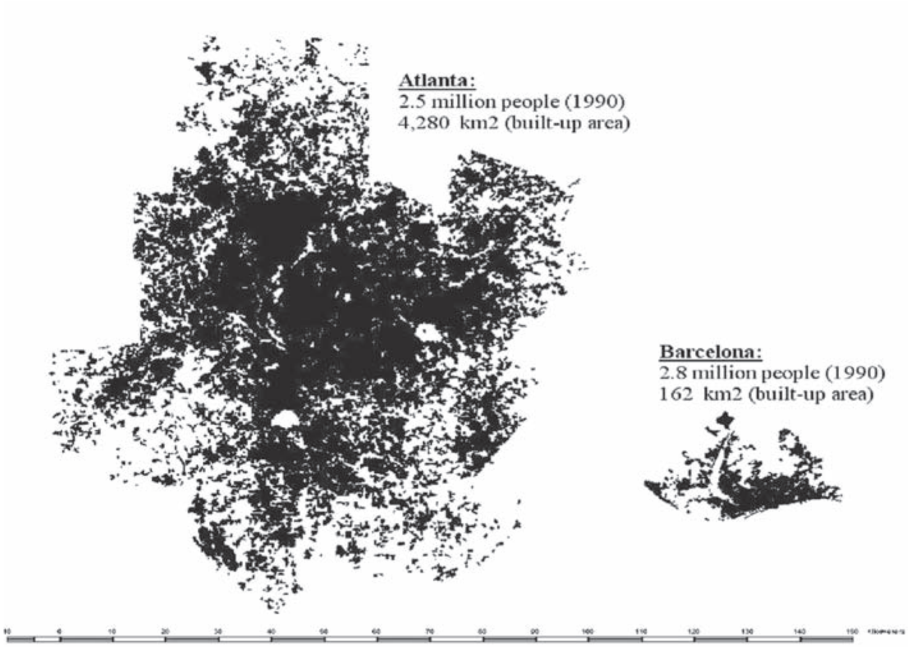
Uncertainty about future climatic conditions. This complicates decision making, given the importance of weather and climate conditions for infrastructure design and performance (Hallegatte 2009). In the energy sector, weather directly affects demand (which varies with temperature) and supply. Water availability affects electricity production from hydropower and thermal plants (because of cooling needs), and wind and nebulosity determine wind and solar power. Electricity networks are also highly vulnerable to extreme events

TABLE 6.1 Sectors in which inertia and sensitivity to climate conditions are great

Sector	Example	Time scale (years)
Water	Dams, reservoirs	30–200
Land-use planning	New development in flood plain or coastal areas	>100
Coastal and flood defenses	Dikes, sea walls	>50
Building and housing	Insulation, windows	30–150
Transportation	Port infrastructure, bridge, roads, railways	30–200
Urbanism	Urban density, parks	>100
Energy production	Coal-fire plants	20–70

Source: Hallegatte 2009.

FIGURE 6.1 Urban densities determine cities' options for greening
(built-up areas of Atlanta and Barcelona, represented at the same scale)



Source: Bertaud 2003.

(such as strong winds and snowstorms, as illustrated by the January 2008 snowstorm that left millions of people stranded across China or the repeated power outages caused by heavy snow in the United States). Transport infrastructure, which affects urban development and land use, including in flood-prone areas, must also account for long-term climate changes.

Uncertainty about how technologies evolve. This has a particularly important effect on cities. With current technologies, low-density single-home suburban developments lead to high carbon emissions. But they may become sustainable in terms of emissions (albeit maybe not in terms of water and land consumption) with efficient electric vehicles, decarbonized electricity production and low-energy-consumption houses (box 6.2). Uncertainty about the evolution of energy technology costs complicates the design of energy policy (Kalkuhl and others 2011). Anecdotal evidence suggests that uncertainty is also leading investors to postpone investments for fear of being stuck with an older and uncompetitive technology.

Uncertainty about environmental policies and prices for energy, oil, or carbon. Energy-intensive development may create deep vulnerabilities and loss of competitiveness in a future with high carbon or energy prices (Rozenberg and others 2010; World Bank 2010). Dense cities are less vulnerable to shocks in energy—hence transportation—prices (Gusdorf and Hallegatte 2007).

The combination of sensitivity to uncertain parameters and the high level of inertia creates a high risk of lock-ins into situations that will be undesirable in the future. Avoiding these lock-ins—and the corresponding regret or retrofitting costs—should be a priority for decision making on infrastructure (see chapter 7).

The vast potential for co-benefits

The second reason why infrastructure will play a key role in green growth strategy is that

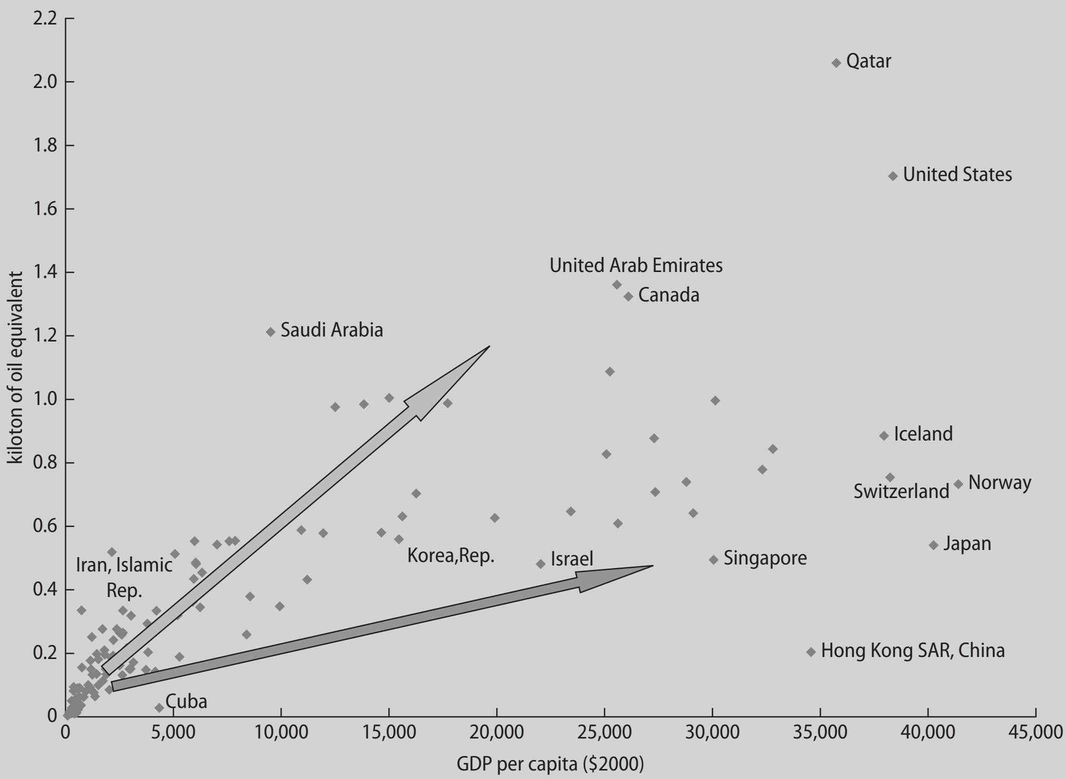
BOX 6.1 The case for immediate action in the transport sector

Transport is a major contributor to CO_2 emissions. It is also one of the fastest-growing sources of emissions. Not surprisingly given the 1 billion cars already on the road, road transport accounts for about two-thirds of total transport emissions.

Developing countries, which still face a huge transport infrastructure gap, have the opportunity to choose their transport development path: low-emission transport or car-dependent transport (box figure B6.1.1). Experience suggests that demand for car ownership increases dramatically at annual household incomes of $6,000–$8,000. If history repeats itself, an additional 2.3 billion cars will be added by 2050, mostly in developing countries, given expected economic growth and past patterns of motorization (Chamon and others 2008). Without policies to encourage high-density urbanization and public transport, high reliance on individual car transport will ensue.

If public transport is included as a major part of modal structure in urban transport, there is no conflict between a low emission transport sector and rapid growth or high income. In fact, economies with some of the lowest ratios of energy consumption to gross domestic product (GDP) in the world—including Japan, Singapore, and Hong Kong SAR, China—have experienced extraordinary development over the past few decades.

FIGURE B6.1.1 As income rises, will countries choose low energy consumption in road transport?
(relationship between per capita income and energy consumption from the road sector)



Source: World Bank 2011d.

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BOX 6.2 The impact of technologies on transport policies—not enough?

Given the significance of emissions from road transport, the green growth path of transport depends on how rapidly vehicle technologies develop. If low- or zero-emission vehicles become available in the near future, relatively small changes in existing transport infrastructure stock would be required. People could continue relying on individual cars without harming the climate. But this may not be realistic.

Technical standards in transport can also help reduce emissions in the sector. Emissions per kilometer of new cars have historically been reduced through better gasoline and diesel internal combustion engines, better lighting and air conditioning, and better tires. The aviation fleet has also reduced emissions in accord with international efficiency agreements. There is also an opportunity to reduce emissions levels through Intelligent Transport Systems—for instance, by allowing drivers to access timely traffic reports, identify available parking spots, and optimize routing.

But technical standards are unlikely to lead to massive reductions in emissions, so barring the rapid emergence and global adoption of low-carbon engine technologies, modal shifts will be needed. An average bus emits only half as much CO_2 equivalent per passenger kilometer as a small car. For travel between distant cities, railways are even more eco-friendly than buses: emissions from light-rail transit can be as much as half of average bus emissions. But the efficiency and feasibility of modal shifts depend on urban forms, with mass transit requiring minimum levels of density, and on tackling market structure and coordination failures.

Modal shifts will also imply addressing consumer preferences, and here the "nudging" and social marketing campaigns discussed in chapter 2 are an important complement to price incentives and supply-side interventions. In a world in which major automobile companies spent some $21 billion worldwide on advertising in 2009—an increasing percentage of which is aimed at emerging markets—public transport agencies across Africa, Europe, and North and South America are beginning to apply to public transportation the same marketing approaches used by the auto industry to bolster sales to shift demand for public transportation (Weber and others 2011).

infrastructure is a domain in which substantial synergies exist between economic growth and the environment. Infrastructure systems are indeed designed to provide welfare-improving and productivity-enhancing services, which are critical for development, but they also often provide environmental benefits.

Providing service to the unserved—who usually pay a higher price for water and energy than connected households—provides both social and environmental benefits (box 6.3). Universal access to water and sanitation is good not only for welfare and economic growth—with impacts on health and human capital, especially for the poor—but also for the environment. (For instance, providing sanitation services to the slums surrounding the Guarapiranga Lake helped slum dwellers but also preserved the water source of 25 percent of São Paulo's 18 million inhabitants in the early 1990s.) This is also true for energy. When reliable network electricity is available, pollution is reduced and competitiveness increases, as firms no longer need to rely on expensive back-up diesel generators. Photovoltaic (PV) solar systems are optimal solutions for isolated, low-density areas; hydroelectricity is the cheapest and most reliable energy source for some countries (box 6.4). Better public urban transport reduces congestion and air pollution, with large economic and health impacts.[1]

An additional source of co-benefits is linked to distributional effects. Infrastructure consumption subsidies are both regressive and bad for the environment (Komives and others 2005). Subsidies not only distort demand, with financial and environmental consequences, they also often fail to reach the very poor they are supposed to help (see chapter 2). The poor do not own cars and often are not served by utilities; if they do, they consume

BOX 6.3 Benefits from using photovoltaic electricity in rural areas

Power grids in Africa are available only in cities and high-density areas. In most rural areas, kerosene and candles are the main source of lighting, while dry cell batteries are used to power radios. All are expensive (1 liter of kerosene can cost more than $0.80 and provides about 20 hours of light). PV systems are superior solutions. For example, a solar home system may be sized to power a refrigerator and television (costing $1,000); a large television and three lamps (for $250); a small television, three lamps, and a radio (for $100); or a lamp, radio, and cell phone charger (for as low as $50—about the same cost as a cell phone).

Africa offers a huge market for modern, energy-efficient lighting products. Although the market has a low profit margin, its strength is in the high number of clients (if the right product for the right price can be offered). The GTZ-sponsored pico-PV program and the World Bank Group's Lighting Africa are examples of two initiatives that aim to transform the lighting market from fuel-based products to clean, safe, and efficient modern lighting appliances.

Source: ESMAP 2009.

BOX 6.4 Hydropower as a green choice for lower-income countries

For lower-income countries, sustainable hydropower represents an important clean energy source—and one that will assume a larger share of the world's energy production as these countries develop further. Africa is exploiting only 7 percent of its hydropower potential; if the region developed it to the same extent that Canada has, its electricity supply would be multiplied by a factor of 8.

The reality, however, is that hydropower projects are complex—with impacts on agriculture, water management, irrigation, food production, climate change, and the sustainability of communities. They require detailed planning and studies before a shovel breaks the ground. Social and environmental impacts have to be assessed and addressed, consultations must be held, and regulations need to be developed. In some cases, new institutions have to be created and made viable. None of this is easy or cheap, but it is essential, because well-managed hydro projects can generate an array of benefits, including flood control, drought management, provision of water supply, and environmental benefits.

Storage facilities for hydropower are essential to adapt to changes in the hydrological cycle that are expected to occur as a result of climate change. With increasing water scarcity in some regions, there is a need to develop multiyear storage that is economically, environmentally, and socially feasible. Where the intensity and frequency of floods increases, storage is required to manage flows. Multipurpose storage facilities can also provide water services to agriculture, water supply, and environmental flows.

Box text contributed by Diego Rodriguez.

small quantities of water and electricity or transport fuel. The lion's share of consumption subsidies benefits wealthier segments of the population (Arze del Granado and others 2010). The urban poor may enjoy some spillovers, but the rural poor seldom do.

There are also trade-offs between infrastructure development and the environment. A first trade-off is related to infrastructure's direct environmental footprint. Building the infrastructure that is needed for development will have detrimental impacts on natural areas, biodiversity, and the environment (Geneletti 2003). Another trade-off is linked to the fact that building better (cleaner, more resilient, or both) can be more expensive. This trade-off raises the fear that countries faced with severe financing constraints may need to chose between "building right" (which may make both economic and environmental sense) and "building more" (which may be what is required socially).

But the additional cost of building greener infrastructure should not be overstated. In some sectors, green infrastructure is more expensive—where electricity grids are present, solar or wind energy is more expensive than electricity produced from coal, for example. But thanks to innovation and economies of scale, the difference in cost is narrowing rapidly, and green energies are now competitive in some contexts (where the hydropower endowment is large, where electricity is produced off-grid, or where carbon is priced). In the transport sector, providing public transport is more expensive than building roads, but public and individual transports are imperfect substitutes: in highly congested cities, public transportation becomes necessary for economic reasons, and the environmental benefits can be reaped with no or little additional cost. In the construction sector, the additional cost to build lower-energy buildings—thanks to better insulation and more efficient heating systems—may not exceed 5 percent, and this additional investment cost is rapidly recouped by reduced energy bills.

One case in which additional costs may create trade-offs is the retrofit of existing buildings. Indeed, retrofitting the lowest-efficiency buildings into average-efficiency buildings costs €500 per square meter in France (Giraudet and others 2011). However, energy savings can pay back upfront costs in many instances. The main constraint is thus one of access to capital rather than financial or economic viability, as many green investments pay for themselves over the medium to long term.

Recognizing the need for efficiency: Meeting large unsatisfied infrastructure needs within tight fiscal constraints

Developing countries are characterized by large unsatisfied needs, including needs met by infrastructure such as drinking water and reliable electricity (table 6.2). The scale of unmet needs is particularly great in Sub-Saharan Africa, where less than a third of households have access to electricity. Connectivity also remains low in the developing world, particularly in rural areas, where only 70 percent of the population has access to an all-weather road (33 percent in Africa). Access to water has increased, but 780 million people still lack access to an improved water source (WHO-UNICEF 2012).

Globally, the challenge is greater for sanitation than for water supply. The percentage of the population with adequate access to potable water increased from 74 percent in 1990 to 89 percent in 2010. Sanitation figures are much lower, having increased from 44 percent in 1990 to just 63 percent in 2010 (WHO-UNICEF 2012). The difference partly reflects the greater "public good" and "externality" element of sanitation and sewerage—that is, individuals feel the welfare impacts of inadequate access to water, whereas other sectors and members of society feel the effects of inadequate sanitation (through impacts on water quality and corresponding health and productivity impacts). Estimates of the costs of inadequate water and sanitation in the Middle East and North Africa are about 1 percent of GDP in the Arab Republic of Egypt and 2.8 percent in the Islamic Republic of Iran (Hussein 2007). With 2.5 billion people lacking access to improved sanitation, the achievement of the Millennium Development Goal (MDG) on sanitation is unlikely.[2]

TABLE 6.2 Gaps in access to infrastructure in developing countries remain large, particularly in Africa

	All developing countries	Africa
Percentage of households with access to electricity	75	31
Improved water source	89	61
Improved sanitation facilities	63	31
Percentage of rural population with access to an all-weather road	70	33
Telecom: mobile and fixed lines per 100 inhabitants	85	46

Source: Roberts and others 2006 for roads; World Bank 2011d for telecom; IEA 2011 for electricity; and WHO-UNICEF 2012.
Note: Road access data are for 2005 or the latest year available up to that date; telecoms, for 2010; water and sanitation data are for 2010. Averages are weighted by country population. The road access indicator measures the share of the rural population that lives within 2 kilometers of an all-season road.

Filling the infrastructure gaps in developing countries—to address household needs and expanding infrastructure so that firms have access to the kind of energy and transport services they need to compete—will cost an estimated $1.0–$1.5 trillion a year, or 7 percent of developing-country GDP (Fay and others 2010).[3] Developing countries are currently investing about half that amount, although the amount varies dramatically by region and income level. In Africa, infrastructure needs were projected to reach 15 percent of the region's GDP in 2008, about twice the level actually spent (Foster and Briceño-Garmendia 2010). Moreover, given the constraints on poor households' budgets, increases in infrastructure services need to be provided in a way that is affordable.

In the energy sector, the challenge is to provide all people with modern energy to meet their basic needs at affordable costs while ensuring the sustainable growth path of energy consumption (through conservation and greater energy efficiency) and making energy sources more environmentally sustainable (box 6.5). Thus, the goals of the

BOX 6.5 The energy challenge: Expanding access and increasing supply in an efficient, clean, and cost-effective manner

How will countries meet the goal of the United Nations Sustainable Energy for All initiative of providing universal energy access at affordable costs while ensuring environmental sustainability through improved efficiency and an increased role for renewables? The answer is through a portfolio of technologies (World Bank 2010).

To achieve universal access to electricity by 2030, countries need to develop not only grid systems but also off- and mini-grid power systems, at least as a transition solution. The International Energy Agency estimates that about 45 percent of electricity will come from national grids, 36 percent from mini-grid solutions, and the remaining 20 percent from isolated off-grid solutions serving remote and low-density areas. Off- and mini-grid technologies can be complemented by other solutions at the end-user level. For instance, the Lighting Africa initiative lowers entry barriers to the off-grid lighting market by establishing quality standards, developing a good investment climate, and supporting product development while educating consumers on the benefits of solar lighting products. In 2010, more than 134,000 solar portable lamps that had passed Lighting Africa quality tests were sold in Africa, providing more than 672,000 people with cleaner, safer, better lighting and improved energy access.

Energy-efficiency policies could potentially contribute a quarter to a third of averted greenhouse gas emissions by 2050 (World Bank 2010). Technologies that increase energy efficiency are typically not costly or innovative: existing technologies alone could reduce energy consumption 30–40 percent across many sectors and countries. For instance, 70 percent of lighting (which consumes 20 percent of total global electricity consumption) can save 50 percent of energy use just by using current technologies alone. A problem is that the transaction costs for energy-efficiency projects tend to be high, compared with their relatively small amount of investment. Relatively long pay-back periods may still be a considerable barrier to financing these projects (World Bank forthcoming).

Among renewable sources of energy, large-scale hydropower tends to be the least expensive. It can be competitive with conventional thermal generation. Geothermal energy can also be cost competitive, making it another suitable candidate. Both types of energy involve large upfront costs and long lead-times for development, however. At the opposite end of the spectrum, solar energy is more expensive, but it may still be the least-cost option in remote, isolated areas.

One challenge in developing renewables is the temporal variation in the availability of electricity. Demand for electricity varies continuously, with large fluctuations during the day and even larger variation from season to season. Rapid variability of some renewables can add to the challenge of maintaining a balance between supply and demand at all times. A proper mix of generation technologies with varied output control characteristics (for example, hydropower with storage and fast-responding gas units), well-developed transmission systems, and improved forecast and grid operations capacity will help cushion the effects of variability.

United Nations Sustainable Energy for All (UN SE4ALL) initiative are to achieve universal access to modern energy, doubling the global rate of improvement of energy efficiency, and doubling the global share of renewable energy.

And providing modern energy services to all does not need to be done at the expense of the environment—in fact, the environmental impacts are likely to be modest to positive, even when using brown technologies. This is because the poor consume little even when they are connected to modern infrastructure services, particularly in comparison to the rich. For instance, the additional emissions produced by providing electricity using standard technologies to the 1.3 billion people who currently lack service could be offset by a switch of the U.S. vehicle fleet to European standards (World Bank 2010). Greening, infrastructure does not need to come at the expense of universal access—in fact, universal access is likely to be good for the environment.

In the water sector, developing countries will need to invest an estimated $72 billion a year to reach the MDG targets on improved water supply and sanitation, 75 percent of which is needed just to maintain existing facilities (Hutton and Bartram 2008).

Meeting infrastructure needs, protecting the environment

Even with significant synergies between infrastructure service development and environmental consideration, greening growth will increase investment needs in the infrastructure sector. As an illustration, an analysis of mitigation scenarios from four models suggests that the global energy investment needed to achieve a greenhouse gas concentration of 450 ppm CO_2-eq (parts per million CO_2 equivalent) could amount to $350 billion–$1.1 trillion a year by 2030 (figure 6.2). A 550 ppm target appears much easier to achieve, requiring $50–$200 billion of additional annual investments. (These figures are gross investment costs; they do not take into account the benefits from higher energy efficiency and reduced operating costs.) These additional investment needs are significant, but they remain a small share of total world investments, at least for the 550 ppm target. They do not include the cost of adapting infrastructure to a changed climate, which could cost developing countries an additional $15–$30 billion a year by 2050 (World Bank 2010).

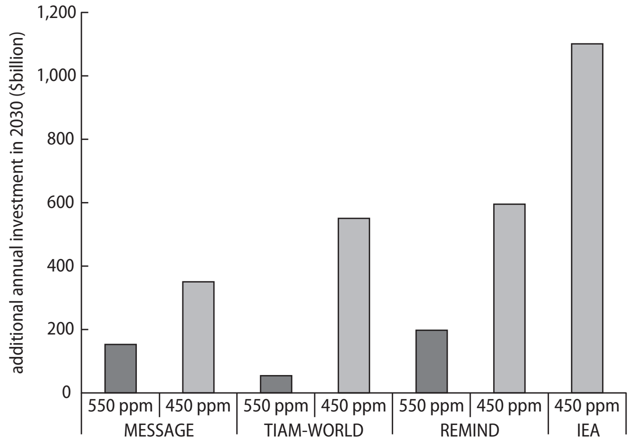
Financing infrastructure: Efficiency and cost recovery to improve access and sustainability

Investment in infrastructure in the developing world is inadequate partly because infrastructure is expensive and "lumpy"—capacity can be increased only in large increments, not through a continuous process. In addition, when investments require public funding, the financing gap is linked to limits to the borrowing capacity. Even when a project is economically beneficial and will generate sufficient tax revenues to pay back the upfront cost, it is difficult to mobilize private finance because of information asymmetry, long return on investments, and political risks. Doing so would require shifting the risk-adjusted return upward, by increasing returns or reducing risks, so that proposed projects can compete with other categories of investment.

Another reason for the insufficiency of investment in infrastructure is that economic and fiscal sustainability has long been a major challenge in the infrastructure sector. Full-cost pricing continues to be an elusive goal, and infrastructure often involves significant technical and nontechnical inefficiency. Colombia grappled with both issues successfully (box 6.6). In Africa, quasi-fiscal deficits caused by underpricing, technical losses, and nonpayment amount to about 2 percent of GDP. Eliminating these problems could offset about a third of the financing gap (Briceño-Garmendia and others 2008). In South Asia, more than 20 percent of electricity produced is lost because of technical and nontechnical reasons, including illegal connections (World Bank 2011d); 30–45 percent of water

FIGURE 6.2 Upfront investment costs for energy supply and greater energy efficiency could be substantial

(additional investment needs in the energy sector projected by four global models and for two climate objectives)



Source: Authors' compilation based on following sources: MESSAGE: van Vliet and others 2012; REMIND: Luderer and others forthcoming; TIAM-World: Loulou and Labriet 2008; IEA: IEA 2011.
Note: The targets 450 ppm and 550 ppm are in CO_2-eq (parts per million CO_2 equivalent) which measures the concentration of all greenhouse gases using the functionally equivalent amount or concentration of CO_2 as the reference; 450 ppm CO_2-eq is the concentration is needed to maintain a 50 percent chance of not exceeding global warming of more than 2°C above preindustrial temperatures. IEA 2011 does not provide estimates for a 550 ppm scenario.

is leaked from the network or not accounted for (IBNET 2011).

What can be done? Addressing these inefficiencies would help improve both infrastructure coverage and the greening of infrastructure. Strengthening cost recovery would not only contribute to the financial sustainability of energy sector development, it would also encourage consumers to use energy wisely. Efficient management of metering, billing, and collection would improve the financial performance of service providers. New metering technologies based on information and communications technology are facilitating this activity in many places, including small, off-grid private service providers and large publicly owned distribution utilities. And more efficient management of utilities would eliminate waste and reduce environmental impacts.

In addition, incentive mechanisms should be tightened at the utility and end-user levels. The biggest hurdles to doing so are accountability and enforceability in implementing tariff setting and collection. The cost of energy imports and power generation can be volatile; it needs to be passed on to consumer prices, although smoothing mechanisms may be required. Adjusting tariffs will greatly improve the financial sustainability of utilities. But utilities will also have to take measures against illegal connections and nonpayers.

Chapter 2 discusses the difficulties in eliminating subsidies to infrastructure services. It suggests complementary actions to mitigate undesirable distributive impacts of these measures (such as connection subsidies or targeted cash transfers).

Another measure in the arsenal may be cross-country collaboration. Because infrastructure exhibits significant economies of scale and scope, cross-country collaboration—for instance, through regional power pools—is generally helpful, particularly for small countries.

In Africa, where many countries are too small to build national power plants at an efficient scale, $2 billion of energy investment could be saved if trade in power trade was fully exploited (Foster and Briceño-Garmendia 2010). Regional power pools (for example, in West and East Africa) can help capture benefits from economies of scale and smooth the intermittency of solar and wind energy. Trade and cross-country coordination also help countries manage natural resources (such as shared water resources) and improve reliability.

Hydro-meteorological services also benefit from cross-country collaboration. An analysis of South Eastern Europe estimates that the financing needed to strengthen national hydro-meteorological services in seven countries without regional cooperation and coordination would be about €90 million (ISDR and others 2011). With deeper cooperation, the cost would be 30 percent lower.

Managing demand

Improving the delivery of infrastructure services is critical. But in infrastructure, increased supply often translates into

BOX 6.6 Pairing cost recovery with deregulation in Colombia

In 1964, only 50 percent of people in Bogota and other large cities had access to electricity, water, and sanitation. And coverage rates were even worse in smaller cities (about 40 percent for water and electricity and 20 percent for sanitation). Today, Colombia has almost universal access to basic services in cities of all sizes. But achieving convergence took more than 40 years (box figure B6.6.1).

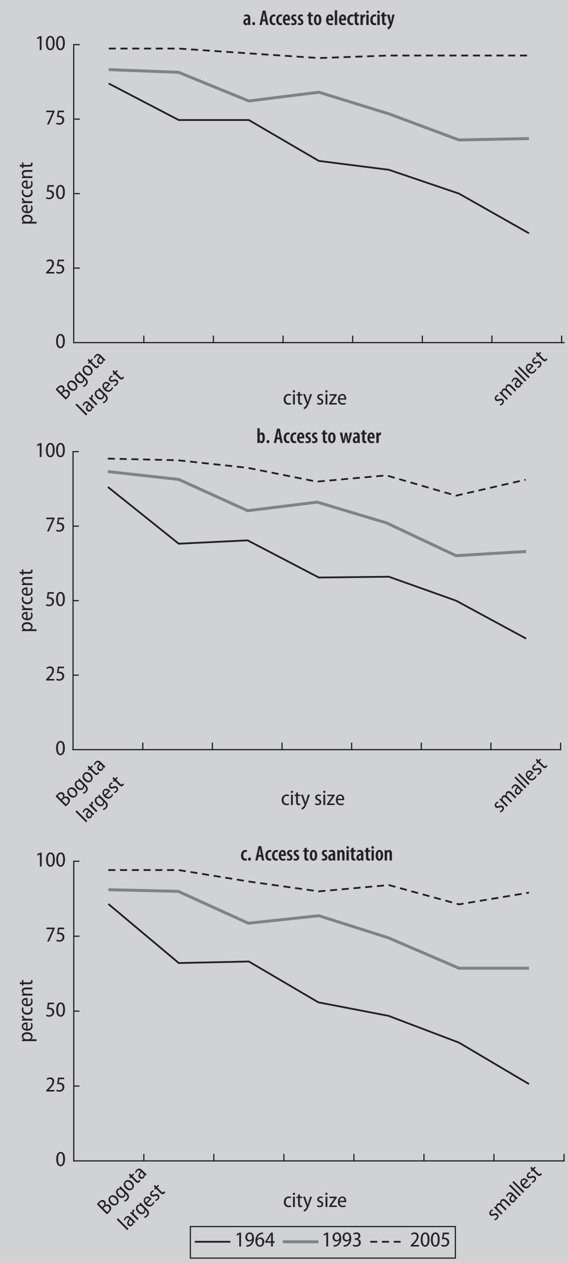
How did Colombia achieve near universal coverage? The key was a series of policy reforms in the 1990s that brought tariffs toward cost recovery levels. In the water sector, average residential tariffs per cubic meter were increased from $0.33 in 1990 to $0.78 in 2001 (World Bank 2004). With almost 90 percent of households having metered connections, the price increase triggered a decrease in household water consumption from 34 to 19 cubic meters per month over the same period—in the process reducing the need for major new infrastructure. But even with higher prices, water remains relatively affordable for the average household. The tariff structure allows the Colombian government to cross-subsidize the poorest consumers from richer households and industrial users. As a result, the average poor household spends less than 5 percent of its income on utility services.

In the electricity sector, in the 1990s the rules on who gets to generate and sell electricity were changed. After two major blackout periods (1983 and 1992/93), the government grappled with increasing capacity or increasing efficiency. Given severe financial constraints, increasing capacity was not an option. Deregulation was therefore undertaken to improve the efficiency of existing capacity (Larsen and others 2004). As part of the reforms, electricity was unbundled into generation, transmission, distribution, and commercialization. In the 1990s, the electricity sector represented a third of Colombia's public debt stock. By 2004, this had fallen to less than 5 percent and Colombia had become a net exporter of electricity.

Box text contributed by Somik Lall.

FIGURE B6.6.1 Access to basic infrastructure services has risen dramatically in Colombia

(access to services, by city size, 1964–2005)



Source: Based on data from the Colombia's National Administrative Department of Statistics (DANE) census 1964, 1993, and 2005.

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increased demand, making a supply-side-only approach both costly and ineffective. For instance, building new roads is often ineffective in reducing congestion because it incentivizes the use of individual vehicles, leaving congestion unchanged. For this reason, action is also needed to manage demand. Policy makers can chose from an array of tools that includes price instruments, regulation, and integrated planning of supply and demand.

Prices: Important but hampered by low elasticity

Price elasticity—that is, the percentage change in quantity demanded in response to a change in price—is relatively low in the transportation sector, at least in the short term. This is, in part, because consumers may be slow in responding to price signals. But it is also because the real cost of transport (sometimes referred to as the generalized cost) includes both the monetary cost of transport and the cost of the time spent in transportation. And sometimes the cost of time is larger than the monetary cost of transportation. Elasticity is greater in the long run, because individuals can adjust their choice of where to live, means of transportation, or lifestyle. For instance, the price elasticity of automobile fuel demand ranges from −0.1 to −0.4 in the short run and −0.6 to −1.1 in the long run (Chamon and others 2008).

This low elasticity explains why the rebound effect (whereby people may increase their driving when the cost of car use decreases as a result of improved efficiency) is relatively limited, even though it may be greater at lower income levels. Sorrel (2007) finds that this effect should remain below 30 percent (that is, less than 30 percent of the gain in efficiency will be “taken back” by the increase in demand). Greene and others (1999) find that the rebound effect for individual transport in the United States is about 20 percent.

Various price instruments have proven efficient. Singapore’s Area Licensing Scheme—the first-ever comprehensive road pricing scheme in the world—required drivers to pay an area license fee of S$3 ($1.25) a day to enter the central business district during peak hours. The number of vehicles entering the restricted zone declined by 73 percent, and average speeds increased by an estimated 10–20 percent (Federal Highway Administration 2008). Modal shift can improve the efficiency of such price-based transport policies and help mitigate their negative consequences (such as the significant spatial inequality they can create) (see Gusdorf and others 2008). But it requires investments in public transport multimodal coordination (such as creating parking lots next to train stations), and urban planning (to maximize access to public transit and ensure that passenger density is high enough to justify the required investments).

In the water sector, different uses have different elasticities. Residential use has a low price elasticity, estimated at about −0.1 to −0.3 (Nauges and van den Berg 2009; Nieswiadomy and Molina 1989). Agricultural use has a higher elasticity, and subsidies (whether to water or to the electricity needed for pumping) in this sector can thus create distorted incentives, favoring activities with high water consumption. And disincentives to water conservation are greatest where the resource is scarcest (Frederick and Schwarz 2000). Removing subsidies and raising prices can thus be efficient in this sector.

Demand-side actions, standards, and regulations: Critical complements to prices

Price-based instruments can be made more efficient if complemented with appropriate demand-management actions. Large quantities of water can be saved in India through better irrigation technologies, obviating the need to exploit new raw water sources. In China, industrial water reuse systems can save water, reducing the need to build expensive water conveyance systems. Many of the technologies that can make a difference already exist and are in use in developed countries. Further application needs to be supported by institutions and promoted by sector leaders. India’s Total Sanitation campaign is a successful example of using noneconomic incentives to promote greener options (box 6.7).

Standards and regulations may also be useful where price elasticity is limited or the political economy of price reform is complex. Examples of such instruments include renewable portfolio standards, in which regulators require utilities to include a given percentage or an absolute quantity of renewable energy capacity in their energy mix.

In transport, fuel economy standards are common for new vehicles (see chapter 2). In 1995, Japan introduced fuel economy standards to reduce new car fuel consumption by 19 percent, achieving the target by 2004. A new target, set in 2006, aims for another 23.5 percent reduction (An and others 2007). In Europe, improvements in fuel economy occurred largely as a side effect of air pollutant regulations, although automobile manufacturers agreed with the European Commission on a voluntary fleet average emission target of 140 grams of CO_2 per kilometer for new passenger cars. Governments can also create automobile restricted zones to limit passenger car traffic in urban areas, as Denmark did in the city of Aalborg.

Promoting clean cooking and heating solutions is another case in which standards and public investments are likely to be more helpful than pricing instruments. Replacing traditional three-stone cooking fires with advanced stoves could significantly reduce emissions and health risks (World Bank 2011b). Without drastic interventions, 2.7 billion people may still lack clean cooking facilities in 2030 (IEA 2011).

Integrated market development, including technology standards, is needed to promote the use of clean and efficient solutions at the household level. The Global Alliance for Clean Cookstoves, launched in September 2010, aims to enable 100 million households to adopt clean and efficient stoves and fuels by 2020. The alliance works with public, private, and nonprofit partners to help overcome the market barriers that impede the production, deployment, and use of clean cookstoves in the developing world.

Green infrastructure requires planning and strong institutions

Because infrastructure is lumpy, infrastructure systems cannot be grown incrementally and continuously, and they need to be planned in a holistic manner. A road or train line cannot be designed without considering other parts of the transport system, land use regulations, and urban planning.

Moreover, different infrastructure systems interact across sectors and cannot be designed in isolation. Water availability affects electricity generation, and electricity is critical in water management (for groundwater pumping, for example). Transportation and energy interact closely: energy production often requires transport infrastructure, and different transport modes have different energy needs (from liquid fuel transport to electricity grids for electrified cars). Smart use of information and communication technologies can green the urban environment and improve the efficiency of other infrastructure systems (box 6.8). Thus, much can be gained from

BOX 6.7 Using noneconomic incentives to reduce the demand for water and sanitation

India's Total Sanitation Campaign, launched in 1999, focused on communication, education, community mobilization, and the provision of toilets in government schools, mother/child centers, and low-income households (World Bank 2011c). There was little government contribution to the capital cost of sanitation facilities. Instead, the focus was on private investment and private behavior change.

Part of the effort involved the Clean Village Award Program—awards to local councils that achieved the status of "Open-Defecation Free and Fully Sanitized Uni." The awards—inspired by a program initially introduced in Maharastra (the "Sant Gadge Baba")—helped increase reported sanitation coverage from 21 percent in 2001 to 57 percent in 2008.

BOX 6.8 Harnessing smart information and communication technologies to shape a green future

The smart application of information and communication technologies can facilitate green growth, both by reducing emissions of greenhouse gases and by creating new market opportunities, such as smart grids and Intelligent Transport Systems (ITS). To date, most of these mitigation opportunities have been applied in high- and middle-income countries. But it is arguably in the megacities of the developing world where the impact could be greatest. Application of ITS in Bangkok or Manila, where there are few substitution opportunities for private road traffic in the form of mass-transit system, would have a much more beneficial impact than in, say Hong Kong SAR, China, or Singapore. Asian countries committed to introducing ITS—such as electronic fare and road-user charging systems, transport control centers, and real-time user information—in Goal 11 of the Bangkok Declaration on Sustainable Transport Goals for 2010–20.

a planning system that can integrate various objectives and infrastructure systems at both the country and regional level to significantly reduce infrastructure costs.

Developing cities: Managing rapid expansion to tap the potential for efficiency gains

Rapid urbanization is both a driver and a feature of economic development, with serious consequences for infrastructure design (World Bank 2009). In many developing countries—particularly countries transitioning from low- to middle-income status—the next few decades will see a dramatic increase in the share of people living in cities. In fact, the number of people living in urban areas in developing countries is expected to double, from 2 billion to 4 billion, between 2000 and 2030. And this massive increase is expected to triple the physical footprint of urbanized areas from 200,000 to 600,000 square kilometers. The public policy and investment challenges of managing the social and environmental implications while promoting cities that are economic drivers of the economy are substantial. Fortunately, practical options exist to efficiently green the urbanization process.

The first priority is designing policies and institutions that can help anticipate future urbanization. These policies should enable existing urban areas to be redeveloped and should prepare the peri-urban fringe to accommodate new settlements. For this to work, land markets need to be functional. Urban land markets mediate demand and supply and enable the efficient use of land and optimal development of constructed floor area, both of which shape a city's spatial structure. Developed countries typically rely on market data from transactions and property attributes to reveal land and property prices. In contrast, most developing countries lack the basic institutional machinery to value and price land.

Higher land prices routinely lead to higher density—which enhances productivity spillovers, potentially increases the supply of affordable housing, and helps manage the demand for transport. But this mechanism is sometimes impaired by land regulations—in many Indian cities the floor-space index is limited to 1 (as opposed to 5–15 in other Asian cities). As a result, high land prices coexist with low density and sprawl, creating both housing affordability and transportation issues.

Also, when "official" land prices do not reflect demand and are depressed at the urban periphery, it is likely that sprawl or suburbanization will be excessive. How the peri-urban expansion is managed will be a critical determinant of whether cities can harness agglomeration economies and induce efficient resource allocation. The absence of a functioning land market creates a major urban governance challenge, as the scale at which urban and metropolitan economies now operate often does not coincide with their physical and administrative boundaries. The institutional arrangements that can enhance coordination across these entities is likely to be context specific, but significant efforts are needed to make them emerge.

The second priority is redeveloping older, obsolescent areas to promote more efficient development and achieve higher densities. Older areas typically share several common traits. Their network of streets and alleys is often irregular and highly granular—limiting the ability of developers to build modern high-rise buildings. An alternative is to redesign these areas to accommodate higher densities. Doing so typically requires assembling small plots into larger and more efficient parcels and ensuring that the redeveloped area has adequate infrastructure (particularly transport, water, electricity, broadband Internet, and public services) to support higher population densities. These actions should be designed using consultations with the local population, to make sure they benefit. For instance, rehabilitation projects need to account for the fact that slum dwellers often gain more from slum upgrading than from relocation (World Bank 2006).

The third priority is integrating land policy with urban mobility and transportation (Viguié and Hallegatte 2012). Options for urban transportation are closely tied to urban land development and can create both positive and negative externalities as cities grow. Problems arise when there are inconsistencies between new developments and mass transit investment—as in Hanoi, where new dense urban development projects are not being located near the planned transit network. This kind of planning creates a double risk of having too few users of a public transit system, threatening the financial and social return on investment, and increasing the number of cars on the roads, with consequences on congestion and air pollution.

Urban transport is best addressed as part of integrated urban strategies that can address the interests of multiple user groups and anticipate long-term needs for which no one is yet advocating but that will become critical in the future. Although public transport tends to be more sustainable than personal motor vehicles, it is often unviable in low-density agglomerations (table 6.3).

Although planning and developing public transit is likely to generate co-benefits for economic integration and manage demand for private modes of motorized transport, these strategies should not come at the expense of allowing a wider range of transport options that can enhance the poor's mobility. Surveys show that many people cannot afford public transport. In Sub-Saharan African cities, walking represents between 5 percent (in Kigali) and 80 percent (in Conakry) of all urban trips, with public transportation ranging from 10 percent to 90 percent (World Bank 2008). A significant share of households

TABLE 6.3 Effect of land use and density on use of public transport

Population density	Typical region	Modal model split (%) Motorized private	Public transport	Non-motorized	Automobile use (km/person/yr)	Public transport use (trips/person/yr)	Petrol consumption for transport (MJ/person/yr)
Low (25 people per ha)	North America and Australia	80	10	10	>10,000	<50	>55,000
Medium (50–100 people per ha)	Europe	50	25	25	—	—	—
High (more than 250 people per ha)	Asia	25	50	25	<5,000	>250	<15,000

Source: Gomez-Ibañez 2012.
Note: —=not available.

2012-08-054_000000000000534

reports no public transport expenditure, but the average share of income spent in public transport ranges from 3 percent (in Addis Ababa) to 14 percent (in Lagos), reaching about $12–$16 a month in most cities. This implies that at low-income levels, the wider availability of different service levels and modes at different prices is a necessary strategy for providing urban transport services. In particular, improving sidewalks, streetlights, and other measures to protect pedestrian users should be parts of an urban transport strategy.

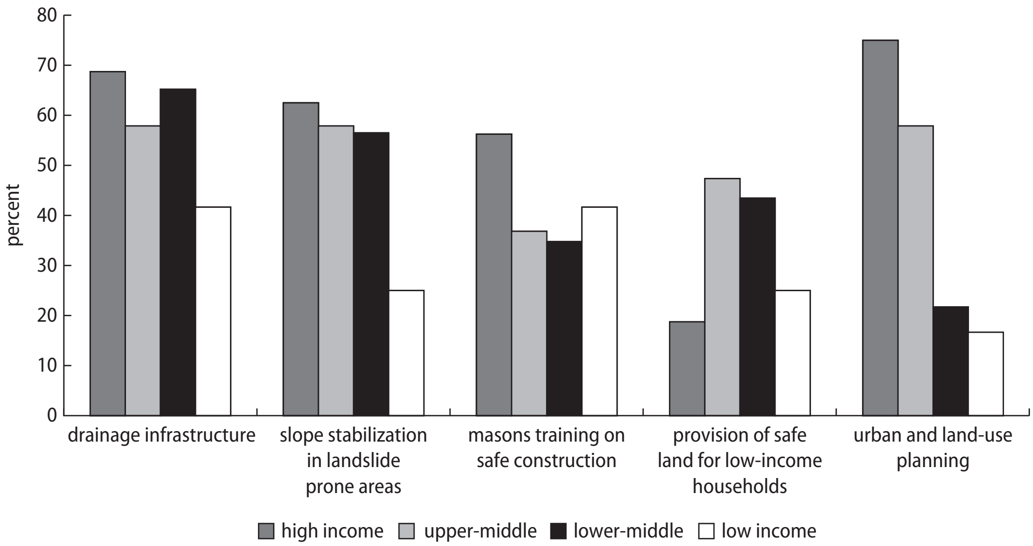
Urban transport also plays a key role in spatially integrating urban labor markets. As cities around the world expand their spatial footprints, the limited reach of walking trips may exacerbate slum formation, as many people trade off housing quality to be close to jobs. It can also severely limit labor market opportunities for people who live farther away from economic centers. Bovenberg and Goulder (1996) suggest that higher commuting costs can decrease labor supply. Graham (2005) finds that productive firms are located in accessible and densely populated places.

A fourth priority is integrating urban planning with natural risk management—still rare, especially in low-income countries. In 2005, the global community adopted the Hyogo Framework for Action, a 10-year plan to make the world safe from natural disasters. To date, 70 percent of high-income countries are carrying out urban and land-use planning under the framework, but only about 15 percent of low-income countries are doing so (figure 6.3). This low participation matters because cities are increasingly vulnerable to natural hazards, including floods that are becoming more destructive in many parts of the world. And considering the limited protection offered by dikes and sea walls, only risk-sensitive land-use planning can mitigate flood losses over the long term (Hallegatte 2011).

Given the role of urbanization in development, a green policy able to develop cities without increasing risks and negative environmental outcomes would help maintain or increase cities' attractiveness and produce economic benefits (World Bank 2009). It is an open question as to how cities can

FIGURE 6.3 Too few countries are implementing plans to mitigate against natural disasters

(percentage of countries that implemented risk management policies under the 2005 UN Hyogo Framework for Action)



Source: UN 2011.

accommodate the huge increase in urban population that is expected in many regions without experiencing a hike in disaster losses (World Bank 2010). That said, a recent World Bank study uses Alexandria, Casablanca, Rabat, and Tunis to illustrate how flood risks and climate change can be integrated in urban planning (World Bank 2011a). Transportation infrastructure has a key role to play to make it possible for the population to live in safe locations while retaining access to jobs and services (Hallegatte 2011).

Infrastructure robustness and redundancy are critical to maintaining the functions of the economic system after disasters, especially in urban environments, where the failure of one component (such as electricity, transport, water, or sanitation) can paralyze activity. In many cases, indirect disaster impacts caused by the loss of lifeline and essential infrastructure services are of similar magnitude to direct disaster losses (Hallegatte 2008; Tierney 1997). However, increasing robustness and redundancy is costly, creating trade-offs between the resilience of the economic system and its efficiency in normal conditions (Henriet and others 2012).

Minimizing the potential for regrets and maximizing short-term benefits

Some infrastructure investments that are required from a development and economic perspective and useful from an environmental point of view cannot be implemented because of financial, institutional, or planning constraints. Given these constraints, a green growth policy should seek to minimize the risk from regret and maximize short-term benefits.

To do so, one needs first to identify what investments made today can lead to irreversibility that will cause regret in the future. An example is urban planning and urban form, which are being decided on now in many countries and cannot be easily reversed in the future. Next, one needs to identify what policies (such as removing subsidies or imposing an environmental tax) or additional investments in infrastructure (such as sanitation systems) can yield large co-benefits and synergies between economic and environmental objectives. An example is the provision of urban public transport in crowded cities with high congestion and air pollution levels, where public transport can increase economic efficiency and improve environmental conditions. Sometimes the synergy is between the environment and welfare, without being uniquely mediated by economic efficiency (an example is sanitation infrastructure, which improves water quality and thus population health).

Previous chapters have shown that many actions and policies can green growth and capture synergies between environmental protection and development. Designing a green growth strategy requires policy makers to choose among these options, based on what is most important and urgent. The next chapter proposes a methodology to identify priority actions, as a function of the inertia and irreversibility they imply and of the trade-offs and synergies they create.

Notes

1. Transport externalities in the United States are estimated at $0.11 per mile (Parry and others 2007). Traffic congestion not only increases emissions, it also increases local pollutants and noise.
2. WHO-UNICEF (2012) projects that by 2015 the share of people without improved water will have fallen to 8 percent, exceeding the target of 12 percent. In contrast, about 33 percent of the world's population is projected to lack access to improved sanitation, far from the 23 percent target.
3. Investment needs is a relative concept, as it depends on what the target level of coverage and quality is. No firm data exist on how much countries invest in infrastructure, although efforts have been made to collect information for Africa and for private investments in infrastructure (see Fay and others 2010; MDB Working Group on Infrastructure 2011).

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Crafting a Green Growth Strategy

7

Key Messages

- The design of green growth policies must balance predictability against flexibility and relevance against enforceability.
- Step-by-step guidelines, including a checklist, can help analysts and decision makers structure the process of crafting green growth strategies.
- The suggested approach identifies priorities along two dimensions: synergy (the existence of local and immediate co-benefits) and urgency (inertia and the risk of irreversibility and lock-in).
- A green growth strategy needs to be designed before individual projects are assessed and selected. Project assessments need to account for uncertainty and diverging world views.

A good green growth strategy can increase welfare by providing both environmental and economic benefits. It is not a panacea to a country's economic ills: if economic growth is insufficient because of institutional or policy problems, green growth will not boost it in the absence of other structural changes.

Many green policies impose economic costs in the short term, such as higher investment or operational costs. But over the longer term, they are designed to yield economic benefits and contribute to long-term sustainable growth. Even so, short-term costs can create trade-offs between environmental protection and short-term economic growth.

For this reason, political and social acceptability require that green growth policies be designed with the specific goals of mitigating trade-offs across both space and time and offsetting costs by maximizing synergies and short-term economic benefits (such as job creation, poverty alleviation, and increased efficiency).

Traditional economic analysis of policies and projects can be complemented with a screening exercise that helps design policies that provide short-term economic benefits and are thus easier to implement. Not all green growth policies can yield such synergies, and trade-offs will be unavoidable. It is nevertheless useful to scrutinize policy designs for opportunities to achieve more co-benefits, if necessary by combining several policy interventions.

This chapter does not provide a one-size-fits-all green strategy, because the appropriate measures and policies are highly dependent on the context, especially on the most pressing environmental and economic issues. Countries at different income levels will necessarily have different priorities; the lowest-income countries are more likely to delay the implementation of environmental policies that imply trade-offs with short-term productivity. Instead, this chapter provides a step-by-step approach to designing a strategy that is appropriate in a given context.

The challenges of developing a green growth strategy

Much can be gained from framing environmental policies as national strategies with positive long-term goals. Doing so increases the acceptability of immediate costs by the population and the private sector. It also improves consistency among policies and fosters policy certainty—which creates a friendlier climate for investments, making it more likely that private resources will be invested in long-term projects. But building a national strategy creates some challenges of its own, including the need for interagency coordination, private sector engagement, and the definition of relevant long-term goals and indicators.

Balancing predictability and flexibility

Promoting a transition toward a more environment-friendly growth pathway requires balancing the credibility and predictability of long-term objectives on the one hand and the flexibility of the selected strategy on the other. Credible and predictable long-term objectives are necessary to help coordinate economic actors and promote investments: businesses will not invest heavily in research on low-energy or water-saving technologies if they cannot be sure that a market will exist over the long term for innovations in these domains. Their willingness to invest in green technologies and infrastructure depends on their trust in and projections of future environmental goals.

But environmental policies themselves need to evolve over time, in response to new information (such as technology or scientific facts) and to the actions undertaken by other countries or regions. Thus, the ability to adjust course is essential—even if it can occur only at the expense of predictability.

Getting around the commitment problem. What factors might reduce predictability? Certainly, changes in the political landscape, scientific uncertainty, and differences in interpretations of scientific results or future technological potentials will arise—as will questions about the government's ability to commit (Dixit and Lambertini 2003; Kydland and Prescott 1977). The fact that governments lack the ability (or credibility) to make long-term commitments has led to the transfer of monetary policy to independent central banks in many countries. On the fiscal front, independent fiscal councils (such as the Office of Management and Budget in the United States) have been created to monitor government policies and inform policy makers from a technical and nonpartisan perspective.

This commitment problem exists in the environmental domain as well. Innovative solutions will have to be found to combine political legitimacy with the ability to commit. A process needs to be established that allows long-term objectives to be monitored by a body other than the government in place at a given point in time. There may be a role for an "independent environmental council" that monitors environmental policies for consistency with agreed-upon long-term objectives.

Building consensus. How a national strategy is developed and implemented strongly influences its sustainability, credibility, and predictability. National strategies help bring together diverse groups of stakeholders (businesses, worker unions, and civil society) to build connections, exchange viewpoints, raise awareness, and build a sustained political commitment. This approach signals to society that significant and durable efforts will be dedicated to environmental protection.

Local authorities play a vital role, given that it is at the local level that citizens experience the destructive impact of environmental degradation (such as atmospheric pollution) and government is often empowered to take corrective action (through land-use planning or the regulation of economic activity). Local authorities have proved to be willing innovators, offering opportunities to test policies and build consensus before scaling up.

Some countries, such as Brazil and France, have tried to build consensus through open and participatory approaches involving political parties and civil society. Ahead of the preparation of its National Plan on Climate Change, Brazil created the Brazilian Forum on Climate Change, which brought together representatives from government, civil society, business, universities, and nongovernmental organizations to mobilize society around a climate plan of action. Public participation took the form of a national conference on the environment and sector dialogues.

Approaches that feature iterative, multistakeholder involvement and extensive consultation with the private sector and civil society create the transparency and political buy-in to make commitments to green growth sustainable. Extensive consultation can also help address some of the governance risks inherent in climate change—which is characterized by complexity, uncertainty, and asymmetries in information. It is particularly important to ensure opportunities for the indigenous and poor communities to voice their concerns and priorities (Transparency International 2011).

Jointly setting economic and environmental goals. At the strategic level, integrating environmental concerns with broader government activity involves systematically evaluating government policies through an environmental lens and creating new coordinating mechanisms to ensure that environmental concerns are mainstreamed in government activity. Poverty reduction strategies, economic development plans, disaster risk reduction strategies, and climate strategies provide opportunities for this to happen.

Consider the case of climate strategies. One way for countries to balance climate policy and development objectives is through national climate plans and low-emission development strategies. Already, more than 47 countries have low-emission development strategies supported by bilateral or multilateral bodies; many more have issued climate change–related strategies on their own (World Bank 2011b).

For instance, India's National Action Plan on Climate Change defines eight national "missions," including policy programs for energy efficiency, a sustainable habitat, and sustainable agriculture. Bangladesh's 2009 Climate Change Strategy and Action Plan requires reviewing and revising existing government policies to ensure that they take climate change impacts into account. Climate change "focal points" within all line ministries are to work in coordination with a climate change unit housed within the Ministry of Environment and Forests (Government of Bangladesh 2009). Other country strategies outline a central interministerial body to coordinate climate activities, including with key economic ministries (table 7.1).

Another way to integrate economic and environmental goals is to require that the environment be brought into core government operations. A logical place for this to occur is through the budget, as the budget process is the central means of ensuring that expenditures are aligned with policy goals and that proper consideration is given to the trade-offs involved when climate-related concerns and growth objectives clash. For example, carbon pricing schemes, subsidy reform, and energy and infrastructure investment decisions all affect the fiscal balance (as discussed in chapter 2). As a result, finance ministries and other core government and development planning actors must be key players

TABLE 7.1 Inter-ministerial arrangements for coordinating on climate change strategy in selected countries

Country	Arrangement
Bangladesh	National Steering Committee on Climate Change headed by the Minister of Environment and Forests oversees the work of the Ministry of Environment and Forests' climate change unit, which works with climate change focal points in each line ministry.
Brazil	Inter-ministerial Commission on Climate Change is chaired by Ministry of Science and Technology and includes the Ministry of Planning, Budget, and Management, and the Ministry of Finance, among others.
India	Advisory Council on Climate Change, led by the prime minister, oversees climate policy. Coordinating unit within the Ministry of Environment and Forests implements the National Action Plan on Climate Change. Ad hoc inter-ministerial commissions will address the eight national "missions" identified in the National Action Plan.
Indonesia	National Committee for Climate Change includes representatives of all departments with responsibilities related to mitigation or adaptation.
Mexico	Inter-secretarial Commission on Climate Change, led by the Secretary of Environment and Natural Resources and including the Secretary of the Economy as well as other line ministries and agencies, is charged with promoting and coordinating the national plan and associated activities.
South Africa	Inter-ministerial Committee on Climate Change coordinates government climate change actions and aligns climate policy with existing legislation and policy.
Vietnam	National Steering Committee headed by the prime minister and representing all major line ministries oversees the work of a unit within the Ministry of Natural Resources and Environment that is to coordinate implementation of the National Target Program to Respond to Climate Change.

Source: Governments of Bangladesh 2009; Brazil 2010; India 2008; Indonesia 2009; Mexico 2009; South Africa 2010; and Vietnam 2008.

in developing and implementing green policies. The Republic of Korea's national green growth strategy (box 7.1) and many national climate strategies have already begun to reflect this reality.

- The Indonesian Ministry of Finance has taken a leading role in national climate policy. In 2009, it issued a green paper outlining actions to support the country's agenda on climate change (Government of Indonesia 2009). It was the lead national partner for a World Bank country study on low-carbon growth.
- Ministries of finance in Morocco and the Philippines, among others, are undertaking climate change public expenditure reviews to help align spending with climate change and development objectives.
- As part of Niger's participation in the Pilot Program for Climate Resilience—which provides assistance for integrating climate resilience into national development planning—the Ministry of Economy and Finance will house a strategic unit to coordinate actions taken under the country's climate resilience program (PPCR 2010).

Balancing relevance and enforceability

Key dimensions of the needed balancing act between relevance and enforceability of environmental objectives include the choice of indicators with which to measure progress toward objectives; the time horizon over which environmental objectives should be selected; and the scale (national, local, or sectoral) at which environmental objectives are set.[1]

The choice of indicators. Potentially accurate indicators may be difficult to set or enforce, and easier-to-implement indicators may be less relevant. For climate change, a natural indicator for measuring mitigation is a "long-term carbon budget," which measures global carbon emissions over the course of a given period of time, say, a century (Matthews and others 2009; Meinshausen and others 2009). But carbon budget commitments are difficult to introduce and enforce. Indeed, there is an incentive for decision makers to delay investments and efforts beyond their mandate.

Another possibility is to define emission targets at one or several points in time—such as the European objective of reducing

BOX 7.1 Implementing a green growth strategy in the Republic of Korea

Korea has moved assertively to become a leader in implementing green growth policies and defining a global green growth agenda. Its two-tier strategy focuses on a short-term response to the current global economic crisis and a long-term transition toward green growth through export-focused green-tech research and development. In acting as a resolute first mover, Korea has exposed itself to both risks and potentially high payoffs.

Policy makers in Korea are seeking transformation, not marginal adjustment, of the economy, seeking to move it away from its current heavy reliance on energy-intensive industries (which doubled its greenhouse gas emissions during the 1990s) and massive energy imports (which account for two-thirds of imports). In pursuing green growth, they are combining three complementary and mutually reinforcing objectives: responding to the economic crisis, reducing the country's energy dependency, and rebalancing the economy toward green sectors over the long term.

Korea's $30.7 billion stimulus package, adopted in 2009, was the greenest of any country, with 80 percent of all funds going toward environment-friendly projects (World Bank 2010). Investments initially targeted infrastructure as a short-term response to the crisis. Projects funded included the development of renewable energy sources, energy-efficient buildings, and low-carbon vehicles; the expansion of railways; and the management of water and waste. Most of the green investment funded three initiatives: river restoration, expansion of mass transit and railroads, and energy conservation in villages and schools. Together, the three projects were projected to create 500,000 jobs (World Bank 2010).

Source: http://www.greengrowth.go.kr.

greenhouse gas emissions by 20 percent by 2020. This type of objective is easier to enforce, but setting an objective for a particular point in time removes some flexibility as to when and how to act, leading to higher costs.

The time horizon over which environmental objectives are set. Relevance would favor setting very long-term objectives, but doing so risks encouraging policy makers and economic actors to delay action. Shorter-term goals are needed to ensure that action is taken. Shorter-term milestones are also useful because there is less uncertainty surrounding technologies and economic conditions over the short term, making it easier to define relevant targets. It thus makes sense to combine a long-term objective (such as limiting global warming to less than 2°C) with shorter-term objectives (such as reducing emissions by 20 percent by 2020).

Short-term goals complement rather than replace long-term goals. If a short-term goal is an end in itself, it may make sense to implement the least expensive solution. But in this case, there is a risk that the solutions selected to meet the short-term goal may lock in technology and infrastructure, making it impossible to reach longer-term objectives (Vogt-Shilb and Hallegatte 2011). To meet an ambitious long-term objective, a short-term target may need to be achieved by implementing options that have greater potential (or suffer from greater risks of lock-in or irreversibility). Urban policies such as land use planning or mass transportation may not be required to reach short-term targets (for instance, in terms of emissions by 2020). But considering the timescale of such policies, they need to be implemented without delay if longer-term (2050), more ambitious targets are to be met.

The scale (national, local, or sectoral) at which environmental objectives are set. Where objectives are economy wide (such as a carbon tax), the economic system has full flexibility to reach the objective by taking action where it is least expensive to do so. Given the information asymmetry between governments and economic agents, it makes sense to let market-based mechanisms determine where it is most cost-effective to act

(Laffont 1999). But the government cannot set credible and predictable signals over the very long term, and economic agents do not anticipate changes that occur over decades. As a result, there is underinvestment in land-use planning, resilient infrastructure, research, and other interventions critical to greening growth but whose benefits take time to materialize.

Given these constraints, action at the sector level may make sense in sectors with significant potential for both lock-in and green impacts (Vogt-Schilb and Hallegatte 2011; chapter 3). Overlapping sectoral objectives—such as the 20 percent renewable energy target in Europe, fuel-economy standards in the automobile industry, and changes in urban planning, building norms, and infrastructure design—may thus be part of an efficient mitigation policy.

However, sectoral policies are vulnerable to regulation capture, rent seeking, and inefficient micromanagement (Laffont 1996; Rodrik 2005). Rent-seeking behavior is likely to affect policies even in countries with strong institutional capacity and appropriate checks and balances (Anthoff and Hahn 2010; Helm 2010). Systematic appraisal of policies, using cost-benefit analysis where feasible, can mitigate these risks (see a discussion on such analysis below). It is also important for national authorities to ensure that sector policies are developed through a transparent process that provides opportunities for all stakeholders to contribute.

A step-by-step process for crafting a green growth strategy

How should policy makers design a green growth strategy that fits the country's requirements? This section proposes a series of steps to follow. A key principle is that individual projects need to be assessed with respect to a strategy rather than in an abstract and isolated way. For instance, building coal-powered electricity plants can be a useful short-term component of a strategy to green electricity over the long term, if doing so helps reduce reliance on diesel generators and is combined with demand-side action and measures to transition to cleaner sources of energy. Similarly, building coastal dikes can be part of a long-term land-use strategy to manage risks—although if it is not combined with appropriate maintenance and land use regulations, it can increase vulnerability. Given these kinds of consequences, a green growth strategy needs to be designed before individual projects are evaluated and selected.

Step 1: Identify economic and social objectives and key obstacles

Step 1 is to identify the key economic and social objectives in terms of the growth and welfare channels noted in the green growth framework presented in chapter 1 (the first three bullets relate to growth; the last two, to welfare):

- Increase production factors (human, natural, and physical capital).
- Enhance efficiency, by correcting market failures to move closer to the production function (the maximum production level possible with the available technology, physical capital, labor, and environment, assuming maximum efficiency).
- Push out the production frontier, by correcting innovation and dissemination market failures in order to be able to produce more with less.
- Increase economic resilience and reduce vulnerability to natural hazards and commodity price volatility.
- Increase the job content and poverty reduction of growth (that is, move toward "inclusive growth").

In addition, policy makers need to take other important policy goals—such as maintaining a balance in regional and local development, which may also offer a potential source of synergy—into account.

Once the objectives have been identified, the next step is to identify the market or institutional failures that retard growth and limit well-being (table 7.2). Hausmann and others (2008) claim that different countries

TABLE 7.2 Channels through which green policies could contribute to growth

Channel	Questions	Possible priorities
Increase in production factors (human, natural, and physical capital)	Which categories of capital (physical, natural, human) are important in limiting economic growth or in reducing population welfare?	Increasing transportation (and export) capacity, improving secondary education and population health
Enhanced efficiency (correcting market failures to move closer to the production frontier)	What are the greatest inefficiencies in the economic systems?	Reducing urban congestion and energy costs, increasing energy supply reliability, increasing employment of young qualified workers
Outward movement in the production frontier (correcting innovation and dissemination market failures to be able to produce more with less)	What are the obstacles to innovation and to innovation adaptation and dissemination?	Improving worker skills and property right protection, reducing entry costs for innovative firms, improving access to capital
Increases in economic resilience	Is the economy particularly vulnerable to exogenous shocks such as commodity price volatility, natural disasters, or competitor innovations?	Diversifying the economy, reducing energy intensity and dependency on imported energy, reducing vulnerability to large-scale disasters, improving food security
Increases in the job content and poverty reduction of growth (moving toward "inclusive growth")	What are the major problems in the labor market and poverty reduction, and why have they persisted up to now?	Reducing rural or urban poverty, mitigating ethnic segregation, fighting poverty traps, improving access to capital for the poor

face different obstacles to growth and that growth-enhancing policies need to be targeted to address the specific obstacles. A study by the Organisation for Economic Co-operation and Development (OECD 2011a) proposes that green growth strategies be developed by first identifying specific obstacles to growth.

Step 2: Identify environmental objectives and lock-in risks

Step 2 is to identify (1) the environmental improvements that are most likely to increase welfare and (2) the risks of irreversibility in both the environmental and economic domains. The idea is to focus on welfare-improving environmental objectives that preclude a "grow dirty, clean up later" pathway. Examples include improving water quality, reducing air pollution and flood losses, protecting soils, and avoiding irreversible destruction of coral reefs. Here (as in Step 1), the analysis should combine scientific and economic information from reports, local knowledge, and widely agreed priorities. It should rely on broad consultations to ensure consistency with population goals, objectives, and preferences and to avoid conflicts between the green growth strategy and other planning initiatives.

Step 3: Consider six types of interventions and identify synergies

Step 3 is to determine which types of policy interventions would help a country reach its environmental goals while also improving economic growth and social welfare. This report singles out six types of interventions.

Pricing and fiscal policies: taxes, subsidies, or subsidy removal (chapter 2). Fiscal policies can be used to guide economic behavior and create environmental and economic benefits. Governments need to assess fiscal policies as a whole, taking account of the trade-offs between alternative ways to source and apply funds. Reallocating resources from fuel subsidies to spending on education, health, and infrastructure will help reach environmental objectives and increase economic growth. Reallocating these funds to services that are accessible to the poor will also help reduce poverty. Oil dependency, and thus vulnerability to oil price volatility, can be mitigated by imposing an energy tax, to favor energy-efficient technologies and equipments. Such policies would provide environmental benefits and enhance economic resilience.

Political economy considerations will play an important part in determining the feasibility of a realignment of fiscal policies with green growth objectives. Interest groups will resist the withdrawal of subsidies and tax incentives. Nonetheless, as recent efforts by the Islamic Republic of Iran to reduce fuel subsidies illustrate, progress can be made. A phased approach supported by communication and complementary policies that reallocate resources to the poor can help build constituencies for reforms. In some cases, resources may need to be allocated temporarily to compensate losers, even if they are not the poor or needy. Building in sunset clauses to such compensatory programs may help prevent temporary relief becoming another permanent subsidy.

Institutions, norms and regulations, and behavior-based policies (chapter 2). Economic incentives can be usefully complemented with other types of instruments. For instance, where low building energy efficiency contributes to high energy imports, introducing regulations or creating new mechanisms to make dwelling owners invest in insulation and efficient appliances could yield a double dividend, strengthening the economy and protecting the environment.

Policy makers must consider how environmental policies affect businesses and individuals, taking into account their decision-making biases and the noneconomic incentives that affect behaviors. A strategy that takes these aspects into account—by, for instance, framing policy changes within a positive collective project and providing individuals with feedback on how they behave with respect to the project—will be more efficient than one based on an economic argument alone. Information disclosure programs that require firms to publish their level of pollutant emissions can be as efficient as and less costly than a norm.

Innovation and industrial policies (chapter 3). The greening of the economy requires growing new industries, along with developing and disseminating new technologies. This process can be eased with specific policies that target (1) the development and dissemination of technologies and innovations, by correcting the effect of a knowledge spillover, and (2) the development of new industries and sectors, by correcting the effect of nonenvironmental market failures (such as coordination failures and capital market imperfections).

Green industrial policies can help disseminate new technologies (especially when they have been tested and demonstrated in developed countries) and develop new competitive sectors. Examples of green industrial policies that have been used include feed-in tariffs for solar electricity, or subsidies to research and development (R&D) in renewable energy. Countries with a latent competitive advantage in renewable energy (such as North Africa with solar energy) may want to pursue this advantage with the hope of creating a viable and competitive industry. However, support must carefully balance market failures and government failures given the risks of policy capture and rent-seeking, especially where institutions and civil society are weak (chapter 3).

Education and labor markets policies (chapter 4). Green transitions are likely to involve structural change away from some industries and toward new ones. Experience with trade liberalization offers valuable lessons as to how to reduce the cost and length of such structural changes. In particular, policies that facilitate the movement of workers from one sector to another can accelerate the transition and reduce adjustment costs. Where such movement is impeded by skill issues, training programs can help—for example by training construction employees to efficiently retrofit buildings.

Natural capital, agriculture, and ecosystem services management (chapter 5). An excellent way of greening agricultural production is through conservation agriculture, which simultaneously yields environmental benefits (by reducing pollution of waterways from nutrients and increasing carbon sequestration in soils); increases the efficiency of production (by reducing the use of energy inputs); increases resilience (by frequently rotating crops); and increases agricultural productivity in the long run (by reducing erosion and enhancing soil structure).

But for this to work, there needs to be better information underlying decision making and better access to this information. For example, greater access to weather and climate information services for farmers can improve resilience in the agricultural system and the overall value chain, including production, post-harvesting, storage, and market access. It can also help innovations to succeed (such as in weather-based risk products).

Infrastructure, building, urbanism, transport, and energy (chapter 6). Green sectoral interventions can help increase factors of production, push out the production frontier, enhance efficiency, improve resilience, create jobs, and reduce poverty. In some countries, urban congestion and the lack of efficient transportation reduce well-being and hold back economic growth, on top of causing negative environmental effects. Investments in public transit and changes in land-use plans to favor a more compact urban area could reduce air pollution and spur growth (thanks to the benefits from urbanization and concentration). Multiple benefits can also be reaped from multipurpose infrastructure such as water reservoirs that produce hydroelectricity, mitigate floods, and ensure minimum river flow during drought. And regional integration in infrastructure design and investments can improve the efficiency of the system, for instance by increasing the reliability of electricity generation and allowing for a greater penetration of renewable energy.

Step 4: Define priorities

Policy makers face limitations in terms of the capacity and resources to design and implement reforms and the political and social capital to launch several reforms simultaneously. They therefore need to define priorities based on urgency (to avoid lock-in and irreversibility) and synergies (the existence of local and immediate benefits that will help diminish political and social resistance).

Priorities can be defined by examining the policy options identified in step 3 through the lens of political and social acceptability and lock-in risk, as done in table 7.3. Columns

TABLE 7.3 Some guiding principles for establishing green growth strategies

		Local and immediate benefits	
		LOWER **(Trade-offs exist between short-and long-term or local and global benefits)**	**HIGHER** **(Policies provide local and immediate benefits)**
Inertia and/or risk of lock-in and irreversibility	**LOWER** **(action is less urgent)**	• Lower-carbon, higher-cost energy supply • Carbon pricing • Stricter wastewater regulation	• Drinking water and sanitation, solid waste management • Lower-carbon, lower-cost energy supply • Loss reduction in electricity supply • Energy demand management • Small-scale multipurpose water reservoirs
	HIGHER **(action is urgent)**	• Reduced deforestation • Coastal zone and natural area protection • Fisheries catch management	• Land use planning • Public urban transport • Family planning • Sustainable intensification in agriculture • Large-scale multipurpose water reservoirs

organize policies for the extent of local and immediate benefits they offer. Some policies provide immediate synergies between the economy and the environment (such as reducing leaks in water networks), whereas others involve trade-offs, at least in the short term (restricting development in coastal areas, for example). Rows classify interventions for the extent to which they prevent irreversibility and lock-in. Policies may need to be implemented more urgently even where they imply trade-offs, simply because acting later would be more costly or even impossible. Other policies can be postponed because they do not involve significant inertia.

In designing a green growth strategy, priority should go to policies that are high in terms of local and immediate benefits and more urgent (such as public urban transport and sustainable intensification in agriculture). Policies that provide local and immediate benefits, even if they are not urgent, can be implemented at any level of income.

It is more difficult to implement policies that are urgent but involve significant trade-offs (such as reduced deforestation). But these policies would be more costly—or even impossible—to implement later. For this reason, these policies require international cooperation, especially when they affect global challenges, such as climate change.

Developing countries (especially low-income countries) should focus on environmental policies that have a negative or zero economic cost thanks to synergies with development (such as developing hydropower where appropriate, or implementing specific urban plans); have a positive economic cost but large direct welfare impacts, that is, when they target *local* environment goods such as local air pollution or natural risks; and whose cost can be offset with external resources (such as carbon trading).

Step 5: Conduct a systematic analysis of the policies and projects included in the green growth strategy

Step 5 is to thoroughly review each policy and project as a function of the selected priorities and strategic choices. Such a review should rely on a multicriteria analysis, given the limitations of cost-benefit analysis.

The limitations of cost-benefit analysis. The standard cost-benefit analysis—which is commonly used to evaluate public policies or investment projects—is necessary but needs to be supplemented by other approaches for green growth policies. The reason is that cost-benefit analysis encounters three major difficulties when applied to environmental or green growth policies.

First, some of the benefits (or costs) are difficult to assess and measure. Environmental benefits are often problematic to quantify and value, beyond the assessment of health impacts. But some economic benefits, like innovation-related or resilience-related ones, are also difficult to assess and are thus often left out of the analysis. For instance, the innovation benefit of a demonstration project cannot usually be quantified. More generally, benefit-cost ratios consider only one project at a time and often cannot take into account the integration within a broader, longer-term strategy and the consistency with priorities and strategic choices.

Second, different stakeholders often assign very different weights to different types of consequences, and differences in world views and priorities translate into different preferences for design and targets of policies. Cost-benefit analysis requires agreeing on values—something that can be very difficult to achieve.

Third, many of the tools and policies that can be part of a green growth strategy involve significant uncertainties. For instance, reducing vulnerability to oil shocks is a clear economic benefit, but is difficult to quantify in the absence of reliable probabilistic estimates of future oil volatility. This uncertainty arises from many sources, including technological change, climate change, and policy efficiency and enforcement. Cost-benefit analysis can capture uncertainty when it can be translated into probabilities for different outcomes. Where policies and projects involve deep uncertainty, however—as green growth policies often do—it is very difficult to estimate probabilities or reconcile different stakeholders' world views.

Differing world views, diverging priorities, and the use of multicriteria analysis. A green/wealth accounting system would allow the consequences of green policies to be aggregated and policies compared. However, as noted in chapter 2, aggregation is difficult, because many prices are missing; aggregation also raises ethical and philosophical issues on which there is little consensus. In the absence of such an accounting system, many policies will involve difficult trade-offs between improving the environment and traditionally measured growth.[2] Thus, it is useful to complement the cost-benefit analysis with decision-making methods that facilitate capturing—if only qualitatively—the full costs and benefits and the corresponding uncertainty.

For these reasons, multicriteria analysis can be useful, at least as a first screening tool. It does not provide an objective ranking of all possible actions, but it allows decision makers to include a full range of social, environmental, technical, and economic criteria and policy goals in a balanced manner—mainly by quantifying and highlighting trade-offs between conflicting objectives that are difficult to compare directly and agree on.

Multicriteria analysis is widely applied to environmental issues, including disaster risk reduction and climate change adaptation assessments. In the past several years, it has been applied to urban flood risk in France (Viguie and Hallegatte 2012) and Germany (Kubal and others 2009); to adaptation options for climate change in the Netherlands (Brouwer and van Ek 2004; De Bruin and others 2009); to climate change–related health risks (Ebi and Burton 2008); and to adaptation planning in Canada (Qin and others 2008). Older examples include identifying vulnerability in the agricultural sector and assessing alternative crop options (Julius and Scheraga 2000), and prioritizing climate change adaptation options in Africa (Smith and Lenhart 1996).

In 2002, the United Nations Framework Convention on Climate Change developed guidelines for using the adaptation assessment process in low-income countries. The guidelines suggest using multicriteria analysis to prioritize adaptation measures (UNFCCC 2002).[3] In 2011, the United Nations Environment Programme proposed a multicriteria decision-making tool for climate policies in its Multi-Criteria Analysis for Climate (MCA4Climate) project (box 7.2). The project lists the various benefits, co-benefits, costs, and co-costs of a set of environmental policies to ensure that coeffects are included.

This multicriteria approach is particularly appropriate for green growth, because it allows analysts to identify trade-offs and synergies and present decision makers with the information they need to capture the potential for co-benefits from green policies. A variety of indicators can be used to measure the potential benefits from green growth policies. Each of the channels shown in table 7.4 could be further broken down (for example, improved environment could be split into biodiversity, air pollution, and climate). Many institutions—including the OECD (2011b), World Bank (2011a), and the United Nations Statistical Division that created the System of Environmental and Economic Accounting—have proposed indicators for this purpose.

Applying such a process would ensure that the real motives for implementing a project are taken into account. For example, a demonstration of new technology that depends on economies of scale to be efficient would not be expected to pass a cost-benefit analysis (or to reach the classically required return on investment) that does not take this demonstrator status into account. These benefits can be made explicit by simply identifying the projects' contribution to a set of policy objectives, as Morocco did for a solar power project (box 7.3).

Of course, no methodology provides a purely objective way of making decisions; it can communicate only trade-offs

BOX 7.2 MCA4Climate: A practical framework for planning pro-development climate policies

Climate change is a pervasive and complex problem, with uncertainty surrounding its multifaceted impacts. Setting priorities is hampered by the lack of a systematic and comprehensive description of the issues concerned, the links among them, and the trade-offs involved. Structured guidance is needed to underpin long-term policy planning in this area—guidance that systematically considers the direct and indirect economic, social, environmental, and institutional costs and impacts.

The goal of the MCA4Climate initiative is to help fill this gap by developing practical guidance that enables governments to identify low-cost, environmentally effective, and pro-poor climate mitigation and adaptation policy choices. The multicriteria framework offers a useful planning tool for prioritizing and populating with concrete measures, including Nationally Appropriate Mitigation Actions, National Adaptation Programs of Action, and other broad, economy-wide climate strategies.

MCA4Climate rests on three main principles:

- Climate change policy has multidimensional implications for human societies and the environment, affecting multiple interests and a wide range of values and priorities.
- If formulated appropriately, policy responses to climate change can help meet country-specific development objectives.
- Nonmonetary values, uncertainty, and the long-term dynamics of environmental, socioeconomic, and technological systems are inherent to climate change. They should be considered in the development of any policy response to it.

Source: UNEP 2011.

TABLE 7.4 Framework for measuring potential benefits from green growth policies

Type of benefit	Channels	Examples of indicators
Environmental	Improved environment	Indicators specifically developed for the domain in question (for example, reduction in greenhouse gas emissions, natural area protected from development, air or water quality)
Economic	Increase in factors of production (physical capital, human capital, and natural capital)	Measured by the additional production from increased capital (potentially measured by the value of ecosystems or renewable resources), or by the value of additional capital
	Accelerated innovation, through correction of market failures in knowledge	Measured by productivity indicators (for example, efficiency of photovoltaic panels used to produce electricity) or dissemination indicators (for example, the fraction of the population with access to photovoltaic electricity)
	Enhanced efficiency, through correction of non-environmental market failures	Measured by indicators for resource efficiency (for example, the material or energy intensity of production, reduction in the value of time lost from congestion), or by additional production
Social	Increased resilience to natural disasters, commodity price volatility, and economic crises	Measured by metrics related to the project, from avoided disaster losses (in monetary terms) or number of people at risk from floods to a measure of the vulnerability to oil price volatility
	Job creation and poverty reduction	Measured by the number of jobs created or an indicator of the impact on the poor (for example, reduction in the number of people without access to drinking water and sanitation)

BOX 7.3 Using a policy framework to analyze the benefits of Morocco's Ouarzazate concentrated solar power project

Through a public-private partnership, the World Bank is helping finance the first phase of a 500 megawatt Ouarzazate solar power plant in Morocco. The project's goal is to increase power generation from solar power, along with mitigating greenhouse gas emissions and the deleterious effects of power production on the local environment.

The project illustrates the limits of a cost-benefit analysis when a project has nonmonetary objectives and is part of a broader national strategy. Both cost-effectiveness analysis and cost-benefit analysis indicate that the project is not economically justified under prevailing economic conditions. However, a simple listing of policy objectives and the project's contributions to these goals can help identify co-benefits that would otherwise be ignored.

- The project seeks to help develop a globally available noncarbon power generation technology and to reduce the cost of concentrated solar power worldwide (a global public goods benefit).
- It will contribute to Morocco's energy and climate change objectives of security of supply, energy diversification, and reductions in CO_2 emissions, as well as other economic and social objectives, such as helping start a new green industry, developing interior regions of the country, and creating jobs.
- It will test the use of storage technology in concentrated solar plants, create a precedent for the use of the public-private partnership business model to develop concentrated solar power plants in Morocco and elsewhere, and contribute to regional integration of the electricity market in the Mediterranean.

These co-benefits can be identified using the six rubrics shown in table B7.3.1. The multicriteria analysis is thus useful for decision makers, even though it should not replace the cost-benefit analysis, which provides invaluable information.

TABLE B7.3.1 Co-benefits of the Ouarzazate concentrated solar power project

Type of benefit	Channels	Examples of indicators
Environmental	Climate change mitigation	Reduced greenhouse gas emissions
Economic	Increase in factors of production (physical capital, human capital, and natural capital)	Added electricity production capacity Local learning on solar technologies
	Accelerated innovation, through correction of market failures in knowledge	Demonstrate technology that has market potential in region, given likely latent competitive advantage and capacity to export solar resources to Europe Institutional innovation through the development of PPP Reduce cost of concentrated solar power globally
	Enhanced efficiency, through correction of non-environmental market failures	None
Social	Increased resilience to natural disasters, commodity price volatility, and economic crises	Diversifying energy in Morocco
	Job creation and poverty reduction	Creating jobs and new industries Spurring economic activity in interior regions of the country

Source: Based on the "Ouarzazate Concentrated Solar Power Project for Morocco" Project Appraisal Document.

to decision makers. For instance, a cost-benefit analysis will provide different answers if different aggregation methods are used (how to aggregate losers and winners) or if different valuation methods are used (how to measure ecosystem losses in monetary terms).

Uncertainty and the need for robust decision making

Assessing the costs and benefits of a green growth strategy is extremely difficult, especially when the future is difficult to project or even describe using probabilities.[4]

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Uncertainty surrounding green growth strategies stems from at least three sources:

- Many factors of success are not controlled by national decision makers. Such factors include the availability of technologies from abroad; the price of internationally traded goods such as oil, minerals, and food; economic growth and imports and exports from other countries; and green or trade policies in other countries.
- There are many implementation obstacles, and it is difficult to predict how efficient innovation policies will be or how quickly production costs will fall when production volumes increase.
- Scientific uncertainty is high. No one can project future changes in local climates with certainty, complicating decisions about land-use planning, water management, and electricity production.

Green growth strategies need to be robust with respect to these uncertainties. Kalkulh and others (2012) highlight how the optimal policy in the presence of perfect knowledge on technology potentials and market failures differs from the optimal policy in the presence of deep uncertainty. Disregarding uncertainty and basing actions on the most likely scenario is dangerous and may lead to undesirable outcomes (box 7.4).

Cost-benefit analyses can be extended to consider multiple states, each with a probability of occurrence. These probabilities are sometimes determined by a frequency-based method (How often did the event occur in the past?) or by belief-based analysis, such as

BOX 7.4 Incorporating uncertainty in protecting Ho Chi Minh City

Ho Chi Minh City already experiences extensive routine flooding; increased precipitation and rising sea levels in the coming decades could permanently inundate a large portion of the city, placing the poor at particular risk and threatening new economic development in low-lying areas.

In response to these challenges, Ho Chi Minh City has developed plans for, and started implementing numerous infrastructure projects to mitigate flood risks. Over the years, its multibillion dollar investment plans in sewerage and drainage infrastructure have included 6,000 kilometers of canals and pipes covering 650 square kilometers in the city to upgrade the discharge capacity of the storm sewer system and address land up-filling; roughly 172 kilometers of dikes and river barriers, mainly to control tides; and a tide control plan that uses at least 12 gates and 170 kilometers of dikes to create a polder system.

These plans were based on the best predictions of future climate and development available at the time they were made. Recent analysis suggests, however, that climate change and urbanization will be greater than expected. In fact, some variables already exceed the maximum values considered in the design phase. These surprises require significant revisions to the plans. The canals and pipes built principally to upgrade the discharge capacity of the storm sewer system and address land up-filling may not be able to handle increased flows. Increases in precipitation and tide levels observed over the past decade already exceed those projected and may top dikes and barriers. Future saline intrusion and rainfall intensity may be more severe than anticipated, potentially rendering the poldering plans obsolete before they are approved.

In addition, unforeseen effects may cause significant harm and increase risk in Ho Chi Minh City. Since the plan was created, the city has experienced unprojected urbanization in low-density areas, perhaps because of the illusion of safety associated with the presence of flood prevention infrastructure there. The city's Steering Committee for Flood Control is concerned that the insufficiency of the planned infrastructure may exacerbate flooding in some areas. If it does, the legacy of the intervention will have been to increase vulnerability.

The Steering Committee is now preparing an integrated flood management strategy to harmonize

(continued next page)

BOX 7.4 (continued)

the master plans for the storm sewer system, flood control system, and urban development. Aware of the consequences of underestimating uncertainty, they have chosen a robust approach to address concerns that their earlier approaches to planning consistently under- or misestimated uncertainties; that plans proved brittle to assumptions that proved inaccurate, leading to costly realignment; and that it was often difficult to reach consensus among diverse actors and agendas. Through an integrated, robust approach, the Steering Committee is accepting the role of persistent, deep uncertainties as a new component in its planning process.

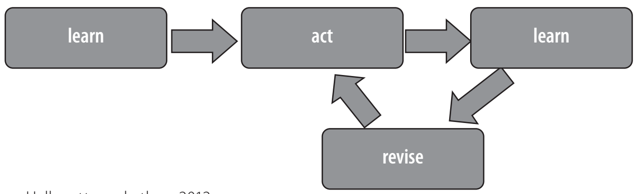
Maximizing the robustness of strategies may require changes in decision-making approaches. Traditional decision-making processes address quantifiable uncertainty (risk) by predicting a future state and designing a plan or project for the conditions of that state. This approach produces optimal results for the intended future, but its application may be increasingly limited when faced with larger uncertainties.

Source: Hallegatte and others 2012.

Bayesian analysis (What are the odds of the event? How much do I trust my model?).

But as uncertainty grows, it becomes more difficult to characterize the probability of an event's occurrence, particularly when multiple stakeholders with differing values and expectations are involved. In such a situation, the optimal solution may be designed for a world whose existence is uncertain; that solution may perform poorly in other plausible, yet unanalyzed, worlds. In such a context, solutions should be adopted that are more robust—often achieved by making them flexible and allowing for adjustment over time, as new information becomes available. Learning and action are thus conducted in parallel, in an iterative process that includes learning and monitoring as a major component (figure 7.1). "Waiting for more information" is never an option: information has to be created, through experimentation, monitoring, and analysis. If information is not sufficient to make an investment decision, a learning plan is required.

FIGURE 7.1 Schematic for crafting solutions in the presence of deep uncertainty



Source: Hallegatte and others 2012.

The robust decision-making approach helps design strategies able to cope with deep uncertainty (Lempert and others 2003). It starts with analyzing a candidate strategy to determine its vulnerability to surprise and uncertainty. It then tries to reduce this vulnerability, thereby increasing the overall resilience of the strategy. In practice, this is done through a stakeholder consultation process that identifies the available strategies or "policy levers," then determines the criteria for appraising these strategies and the range of uncertainties to consider. Next, decision makers proceed through an iterative process, identifying the vulnerabilities that different scenarios expose and how these can be addressed until the vulnerabilities are reduced to an appropriate level. This robust decision-making approach can be managed through a consultative process or supported by sophisticated modeling (box 7.5).

This approach is particularly relevant when multiple policy goals and world views coexist, because it allows for a flexible definition of success and failure. A cost-benefit analysis requires a consensual objective function that is able to rank all potential outcomes. In contrast, the robust decision-

BOX 7.5 Using robust decision making in water planning in southern California water

Planners have traditionally used historical stream flow data and weather patterns to develop seasonal water forecasts. But because climate change is expected to change weather patterns, air temperature, and precipitation patterns in an as yet unpredictable fashion at the local scale, planners are now seeking methods to incorporate the impacts of climate change into their planning processes.

In 2006, the RAND Corporation worked with the Inland Empire Utility Agency (IEUA), in Chino Hills, California, to test its robust decision-making framework. In 2005, IEUA released its Regional Urban Water Management Plan (UWMP), in response to a projected population increase of 800,000 to 1.2 million people by 2030. The document outlined a plan to meet future water demands by improving water use efficiency and developing local resources.

The robust decision-making analysis took the UWMP as its initial strategy, used climate information from the National Center for Atmospheric Research, and employed a planning system from the Stockholm Environment Institute to assess how different policy levers would perform under a variety of possible futures.

The first run of the model evaluated the proposed management plan under four climate scenarios. Its findings generally indicated that if the impacts of climate change were minimal, the UWMP would meet its supply goals for 2030. However, if climate change were to cause significant warming and drying, the UWMP could perform poorly and miss many of its goals, causing economic losses.

Additional runs of the model, using more than 200 scenarios and 8 additional management strategies, were then performed. In 120 of the scenarios, cost was 20 percent higher than expected. The analysis revealed that UWMP was particularly vulnerable when future conditions were drier, access to imported water more limited, and natural percolation of the groundwater basin lower. Strategies ranged from increasing water use efficiency, recycling storm water to replenish groundwater, and developing the region's water recycling program. In all cases, augmenting the UWMP with additional management strategies reduced both costs and vulnerability.

The analysis concluded that local solutions should not be overlooked when developing ways to mitigate the impacts of climate change. Local policies and management opportunities may be more cost effective, reliable, and feasible than other options.

Under the robust decision-making analysis, the best management plan was found to be adaptive and to include near-term implementation of more water use efficiency techniques. Presented with these results, water managers expressed increased confidence that they could plan for the effects of climate change despite the uncertainty of forecasts.

Source: For more information, see http://www.cakex.org/case-studies/1029.

making approach makes it possible to combine different performance criteria. It is thus useful for the design of green growth policies, which are based largely on the identification of synergies across policy goals.

Both robust and optimal techniques are necessary elements in a decision-making process involving significant uncertainties. Analyses focused on optimality are vulnerable to overconfidence bias. Robust approaches dwell on consequences and eschew risky behavior. Managed risk-taking, however, is an essential part of development and inseparable from innovation.

One critique of robust approaches is their sensitivity to the worst-case scenario. This tendency is not an artifact of the methodology; rather, it reflects the reality of some choices; in other cases, decision makers can judge that hedging about a worst-case scenario is too expensive and not worth it. Robust processes deal with this issue through stakeholder participation and exchanges with experts. The choice of the worst-case scenario is thus a negotiated, participatory process that plays a key role in determining which policy options will eventually be implemented.

This type of approach is particularly appropriate in the context of green growth, because it allows analysts to identify the policies and measures that are necessary to avoid getting locked into patterns that will be extremely difficult to change in the future. Robust decision making thus helps identify measures that are needed over both the short and medium terms.

Moreover, the deep uncertainty surrounding environmental issues affects the type of solutions that need to be implemented. As any good solution must be context specific, the application of "best practices" is difficult. Two general rules can be proffered, however. First, solutions that allow greater flexibility should be favored over those that create lock-in; and where choices that could lead to irreversible consequences must be considered, they should be evaluated very carefully (Hallegatte 2009). Second, given the difficulty in projecting the consequences of all policies, implementation should be based on experimentation, monitoring, and generalization of successful methods.

Developing green growth strategies and responding to climate change entail an investment in planning. One option is for governments to develop specific green growth strategies alongside their core planning instruments. An alternative—possibly more in line with the goals of integrating climate change, growth, and poverty reduction policy objectives—is to incorporate green growth strategies in core planning instruments (such as national development plans). This approach highlights the trade-offs that governments will have to weigh: between predictability and flexibility, between relevance and enforceability, and among the various policy objectives. The step-by-step process proposed here helps them resolve these trade-offs, identify synergies and cobenefits, and formulate a comprehensive green growth strategy that incorporates the range of policies available, while taking into account the deep uncertainty that characterizes climate change. The process is equally applicable at the national, local, and sectoral levels.

Notes

1. This section draws heavily on Vogt-Schilb and Hallegatte (2011).
2. With widely accepted prices (and an agreed upon discount rate), all the components of future welfare can be summarized in a single number (which can be referred to as "wealth"). In this case, a policy is "good" (it increases wealth) or "bad" (it decreases wealth).
3. For an example of standardized multicriteria analysis scoring for a variety of adaptation actions, see Republic of Burundi (2007).
4. This section relies extensively on Hallegatte and others (2012).

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Inclusive Green Growth

As the global population heads toward 9 billion by 2050, decisions made today will lock countries into growth patterns that may or may not be sustainable in the future. Care must be taken to ensure that cities and roads, factories and farms are designed, managed, and regulated as efficiently as possible to wisely use natural resources while supporting the robust growth developing countries still need. Economic development during the next two decades cannot mirror the previous two: poverty reduction remains urgent but growth and equity can be pursued without relying on policies and practices that foul the air, water, and land.

Inclusive Green Growth: The Pathway to Sustainable Development makes the case that greening growth is necessary, efficient, and affordable. Yet spurring growth without ensuring equity will thwart efforts to reduce poverty and improve access to health, education, and infrastructure services. Countries must make strategic investments and farsighted policy changes that acknowledge natural resource constraints and enable the world's poorest and most vulnerable to benefit from efficient, clean, and resilient growth. Like other forms of capital, natural assets are limited and require accounting, investment, and maintenance in order to be properly harnessed and deployed. By maximizing co-benefits and avoiding lock-in, by promoting smarter decisions in industry and society, and by developing innovative financing tools for green investment, we can afford to do the things we must.

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OVERVIEW OF THE REPUBLIC OF KOREA'S NATIONAL STRATEGY FOR GREEN GROWTH

April 2010

Prepared by the United Nations Environment Programme as part of its Green Economy Initiative

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CONTENTS

Figures

Tables

Boxes

Annexes

Overview of the Republic of Korea's National Strategy for Green Growth

Purpose of this report

This report is produced by the United Nations Environment Programme (UNEP) as part of its Green Economy Initiative. The purpose of this report is to present an overview of the Republic of Korea's strategies and policy goals set under National Strategy for Green Growth announced in August 2008. The report also examines Korea's Green New Deal launched in January 2009 along with the Five-Year Plan for Green Growth released in July 2009.

The objectives of the review are:

1) to analyze the change in strategic thinking and economic policy in the Republic of Korea, towards green growth;

2) to outline the plans that the Republic of Korea has put in place to achieve this vision;

3) to discuss the general approach and elements of the Republic of Korea's National Strategy for Green Growth relative to the issues outlined in UNEP's publication "Global Green New Deal: A Policy Brief", published in March 2009.

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Preparation of this report was directed by Pavan Sukhdev, Special Advisor and Head, UNEP Green Economy Initiative. Sylvie Lemmet, Director of UNEP's Division for Technology, Industry and Economics; Khalida Bouzar, Deputy-Director, of UNEP's Division for Technology, Industry and Economics, Steven Stone, Chief, Economics and Trade Branch and Young-Woo Park, Director, UNEP Regional Office for Asia and the Pacific provided guidance. The report was coordinated by Moustapha Kamal Gueye. Nidal Salim, Director, Global Institute for Water, Environment and Health contributed to the drafting.

Foreword

On 15 August 2008, at a national address on the 60th anniversary of the Republic of Korea, President Lee Myung-Bak announced a “low-carbon, green growth” strategy as a new vision to guide the nation’s long-term development. Six months later, in January 2009, the Government of the Republic of Korea responded to the deepening recession with an economic stimulus package equivalent to US$ 38.1 billion of which 80 per cent (the highest ratio among comparable packages from other G20 governments) was allocated to more efficient use of resources such as fresh-water, waste, energy-efficient buildings, renewable energies, low-carbon vehicles, and the rail network.

Meanwhile, in March 2009, UNEP released a Policy Brief on a Global Green New Deal, encouraging governments to use the opportunity presented by the massive fiscal response to the financial and economic crisis to direct public spending and private investment in green sectors such as energy efficient construction, renewable energies, low carbon transport, sustainable agriculture, and restoring ecological infrastructure, especially forests and freshwater bodies. The UNEP Policy Brief argued that an investment of 1 per cent of global GDP over the next two years could provide the critical mass of green investment needed to reduce carbon dependency and to seed a significant greening of the global economy. UNEP observed that the Republic of Korea’s Green New Deal stimulus package provided a model for its allocation of stimulus towards green infrastructure and lowering carbon dependency.

More recently, on 6 July 2009, the Republic of Korea announced a Five-Year Plan for Green Growth to serve as a medium-term plan for implementing the National Strategy for Green Growth over the period 2009-2013. With total funding of US$ 83.6 billion, representing 2 per cent of GDP, this Five-Year Plan intends to turn the strategy into concrete and operational policy initiatives towards achieving green growth. Indeed, one of the interesting, but least reported, aspects of the current economic recovery efforts is that over two-thirds of global green stimulus has in fact been committed in Asia, led by China, the Republic of Korea, Japan, and Australia.

By extending the Green New Deal into a full five-year development plan, the Republic of Korea has signalled that it believes that green growth is a strategy well beyond current economic recovery efforts, and that it wants to create a green economic future for the Republic of Korea. The Republic of Korea has committed itself to moving away from the traditional "brown economy" growth-at-any-cost model to a "green economy" model where long-term prosperity and sustainability are the key objectives. This commitment by the Republic of Korea has the potential of creating a domino effect on the other major Asian economies.

This report shows that the Republic of Korea is more vulnerable than average to the effects of climate change, and more exposed than most to fossil fuel dependence. During 1912-2008, average surface temperatures in the Republic of Korea rose 1.74°C, which is above the world average. The Republic of Korea has shown the seriousness of its resolve on mitigation by announcing, unilaterally and, despite being a non-Annex I Party to the United Nations Framework Convention on Climate Change/Kyoto Protocol (i.e. not required to take on emissions reductions), a voluntary emission reduction targets. The Republic of Korea is 97 per cent dependent on fossil-fuel imports out of their total energy demand, and thus highly exposed to oil price shocks, as well as any secular rise in oil prices due to the observed peaking of oil. In their new strategy, the share of renewable energy in total energy supply is planned to go up from 2.7 per cent (2009) to 3.78 per cent (2013), and more than doubling to 6.08 per cent (2020). UNEP encourages an even more aggressive target to improve the Republic of Korea's future energy security and to further support its strategy and plans for green growth.

Freshwater scarcity has long been, and still is, a critical challenge facing Korea. With global warming likely to continue, the levels of flooding and drought are expected to worsen. The large investment (22.2 trillion Korean won (US$ 17.3 billion)) in the Four Major Rivers Restoration Project has, among its five key objectives, securing sufficient water resources against water scarcity, implementing comprehensive flood control measures, and improving water quality whilst restoring the river-basin ecosystems. UNEP encourages the stepping up of investment in ecological restoration, to address this key ecological scarcity as well as to prepare effective and cheap adaptation strategies for the onset of climate change reducing recurrent costs associated with periodic flooding.

The overview presented in UNEP's earlier "Interim Report" has been incorporated into this "Final Report" submitted by UNEP to the Government of the Republic of Korea. These reports were prepared to further UNEP's strategy of supporting the Republic of Korea and other governments to engender deep change which targets a "Green Economy": an economy of permanence, one which generates wealth and well-being, increases employment, reduces poverty and inequality, and does so without exhausting natural capital or creating ecological scarcities and climate risks.

Pavan Sukhdev
Special Advisor and Head UNEP Green Economy Initiative

Executive Summary

Transforming the global economy away from dependence on fossil fuels and unsustainable use of the Earth's limited resources and achieving a transition towards a Green Economy[1] is not an option; it is a fundamental requirement for the survival of our economic and social systems in the 21st century.

The Republic of Korea's National Strategy and Five-Year Plan for Green Growth represent a major attempt to fundamentally transform the country's growth paradigm from "quantitative growth" to low-carbon, "qualitative growth". The green growth strategy contains encouraging policy goals and targets to tackle climate change and enhance energy security, create new engines of growth through investment in environmental sectors, and develop ecological infrastructure. The commitment to spend 2 per cent of gross domestic product (GDP) over the next five years, for investment in areas such as green technologies, resource and material efficiency, renewable energies, sustainable transport, green buildings, and ecosystem restoration, is a remarkable effort to reorient and refocus investment in the environment.

The Republic of Korea responded to the economic crisis with a stimulus package that included a significant portion of green spending. In fact, it has been particularly efficient in the actual disbursement of its fiscal stimulus, with almost 20 per cent of funds disbursed at the end of the first half of 2009, compared to 3 per cent for most countries.

Beyond its policies at the national level, the Republic of Korea is demonstrating engagement and leadership at the international level by boosting global efforts towards achieving a green economy. The Republic of Korea was instrumental in the adoption of a Declaration on Green Growth by the Ministerial Council Meeting of member countries of the Organisation for Economic Cooperation and Development (OECD) on 25 June 2009. It is also playing a key role in promoting an East Asia Climate Partnership.

The bullet points below summarise the key action areas contained in the Korean Green Growth Strategy, the outcome of the review done by UNEP, and the main recommendations.

Climate Change

- Korean carbon emissions have been growing fast and are expected to grow much faster than the average for the OECD countries. Under the International Energy Agency's (IEA) reference scenario, which assumes that the level of growth in carbon emissions continues from the 2002 level, the Republic of Korea would increase its emissions by close to 35 per cent in 2025, compared to less than 15 per cent for the whole of the OECD countries. In the IEA's low-emissions scenario, carbon emissions would grow by slightly less than 25 per cent in 2025, compared to 5 per cent for the whole of the OECD countries.

- This makes is critical and urgent for the country to address the challenges posed by the level and pace of growth of carbon emissions and their consequences. Moreover, achieving a low-carbon green growth will require an effort to reduce the carbon intensity of the Korean economy.

- Given its status as a non-Annex I Party to the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the Republic of Korea's announcement, in a voluntary and independent manner, of a national mid-term target to reduce its greenhouse gas (GHG) emissions by 30 per cent by 2020 from its otherwise projected growth is very encouraging. This is the highest reduction level that the IPCC has recommended for developing nations.

- The creation of a carbon emission trading scheme in Korea can be an important step forward. But to be successful it should involve effective caps on emissions, a proper coverage of high-emission sectors, and mechanisms for allocation of emission permits that encourage mitigation efforts. It is also important to design new systems to work in harmonious ways with the existing ones.

- The Republic of Korea could enhance its capacity to respond and adapt to climate change impacts such as sea level rise, flooding, and heavy rains and reduced forest density by carefully assessing the capacity of measures proposed under the green growth plan to achieve such objectives.

- In particular, UNEP encourages ecosystem-based adaptation strategies, including ecological restoration and riparian reforestation. Forests and wetlands that are prevalent in a large part of the Korean peninsula, if properly conserved and made more resilient, could play important roles in climate change adaptation, as natural defences against increasing hazards associated with climate change, such as storms, cyclones, flooding and sea-level rise, thereby alleviating future expenditures associated with disaster recovery.

Energy Efficiency

- Enhancing energy efficiency is particularly important given that manufacturing and energy-intensive industries remain predominant in the Korean economy. With the world's largest shipbuilding industry and the fifth largest steel production, industry in the Republic of Korea accounts for 27.9 per cent of GDP. This is well above the 17.4 per cent OECD average.

- The 2006 OECD *Environment Performance Review of Korea* noted that "Korea is one of the few OECD countries which have not improved its energy intensity (energy use per unit of GDP) relative to 1990." In its 2006 *Energy Policy Review of Korea*, the International Energy Agency (IEA) found Korea's energy efficiency targets as not particularly ambitious.

- The new targets set under the green growth plan to enhance efficiency from 0.290 TOE/US$' 000 in 2013 and to 0.233 TOE/US$' 000 in 2020 appear to be an improvement on the targets in the General Energy Conservation and Efficiency Improvement Plan adopted in 2004. In comparative terms, however, energy intensity remains slightly above that of most IEA member countries.

- The Republic of Korea could improve its position by seeking greater convergence with other OECD countries by gradually raising its energy efficiency targets, with a view to match at least the OECD average.

- The Republic of Korea could improve compliance and results by monitoring voluntary agreements with industry, to ensure they achieve the expected targets, and consider alternative policies in case voluntary targets are not met.

Renewables and Nuclear Energy

- The Republic of Korea has daunting energy challenges. It is the world's fifth largest importer of oil (2007) and the second largest importer of coal (2008). The green growth plan to increase the share of new and renewable energy in total energy supply from 2.7 per cent in 2009 to 3.78 per cent in 2013, and 6.08 per cent in 2020 would double the share of renewables in energy supply. When renewable energy that will be generated from the 1 Million Green Homes Project is taken into consideration, the share of renewable energies in total energy supply would be 11 per cent in 2030. This will not only reduce the country's carbon footprint but also dependence on volatile fuel imports.

- In comparison with renewable energy targets adopted in many comparable countries, these Korean renewable energy targets appear to be relatively modest. However, the pace of change envisaged is remarkable considering that the country had increased its renewable energy supply only by 0.37 per cent in the past, from 2.06 per cent in 2005 to 2.43 per cent in 2008. UNEP encourages an even more aggressive target to improve future energy security and to further efforts toward green growth.

- Government will have to expand assistance for the national strategic technology development in such areas as solar and bio-energy technologies and pursue the target through various policy measures such as RPS, waste energy, and the 1 Million Green Homes Project.

- UNEP recommends that the Republic of Korea ensure that further development of nuclear energy continues to remain in line with best international standards, and that transfer and export of nuclear energy technology contributes to enhancing the safety, stability, and economic viability of nuclear energy generation in other countries pursuing nuclear energy options.

Transport, Cities and Fuel Efficiency

- The transport sector accounts for 21 per cent of Korean energy consumption, with an annual average increase rate of 6.3 per cent. As the world's fifth largest car manufacturer, the Republic of Korea has an important role to play in enabling greater efficiency in the automobile industry and significantly reducing emissions from the transport sector.

- In the area of fuel economy, countries around the world, including OECD member countries and several other countries, have set fuel economy standards. While the targets and timelines vary, there is growing convergence towards a global average reduction of 50 per cent by 2050, which would be around 25km/litre. The Republic of Korea's target of 15.1km/litre by 2016, from 11km/litre in 2009, is generally in that direction.

- In promoting a technology and innovation-driven automobile industry, the Republic of Korea could formulate specific policies and measures to provide the physical and policy infrastructure in support of the development of a smart grid system by 2013 in order to encourage plug-in hybrid and electric vehicles.

- The Republic of Korea could further promote a modal shift by ensuring that non-motorized transport modes are encouraged through the integration of cycling lanes within the larger transport infrastructure, especially public transport, both in urban and rural areas.

- The Republic of Korea announced a GHG reduction target of 31 per cent by 2020 for the building sector, which is the highest level compared to any other country. The target includes strengthening energy standards by 30 percent by 2012, achieving passive level by 2017, and zero-energy housing by 2025.

Water and Ecological Infrastructure

- The Republic of Korea faces many water related challenges due to rapid economic growth and high population density. Reports indicate that current aqua-ecosystem protection mechanisms are insufficient. Climate change could exacerbate risks of water scarcity and increase the frequency and intensity of floods.

- In response to these challenges, the Four Major Rivers Restoration as a part of the “Green New Deal” policy attempts to secure abundant water resources; create systems for flood control; improve water quality; restore ecosystems; and to create opportunities for rural development. These are important policy goals that could bring numerous positive effects to the national economy and people’s lives.

- The attempt of ecological restoration of four rivers (Han, Nakdong, Geum and Yeongsan) and their tributaries is commendable, but its implementation needs to follow approaches that will result in effective “ecological restoration”, by making efforts to enhance the ecological integrity of river ecosystems, in order to achieve the important policy objectives pursued under this project.

- UNEP recommends paying particular attention to compliance with the results of environmental impact assessments, and to ensuring the maintenance of key ecosystem functions**,** since the four major rivers are ecologically sensitive.

Green Technologies

- As seen, industry accounts for a large part of the Korean economy, in proportions that are much higher than in other OECD countries. A technological transformation that reduces the carbon intensity of industry, in particular in Korea’s manufacturing sector, is therefore a core component of a green growth strategy.

- The Korean Green Growth Plan seeks to promote the development of 27 core green technologies that would provide future engines of growth to the Korean economy. UNEP encourages that the development of new green technologies goes hand-in-hand with the greening of the existing manufacturing sector by adopting specific policy goals and targets to reduce carbon intensity and energy intensity.

- In addition, taking a more comprehensive reform of existing incentives and other support mechanisms in carbon and energy-intensive industries would complement and support efforts to spur green innovation.

Policy and Fiscal Reforms

- Carefully tailored, time-bound, and targeted fiscal and financial incentives are recognized as essential in facilitating the transition towards a green economy.

- The Republic of Korea is taking important policy and fiscal measures with include a reform of energy pricing, the creation of a national carbon market, the adoption of tax reforms that lower the tax burden on consumption of low-carbon goods, and fiscal incentives to encourage investment in green sectors.

- The creation of enabling conditions for low-carbon green growth must, however, be comprehensive. It is essential that harmful policies, including harmful subsidies in energy, transport, agriculture and fisheries that not only lead to economic and market distortions, but also undermine a proper accounting for natural capital, are reformed across the entire economy, or at least be part of a long-term plan.

- In addition, fiscal and financial incentives need to be provided in ways that will not create further production and trade-related distortions at national and international level, so that new industries can be created on an economically and environmentally sustainable basis.

Institutional Process and Participation

- The inter-agency process led by the Presidential Committee on Green Growth is an innovative approach to planning that seeks better coordination of policy-making among ministries of finance, transport, energy, environment, land, and tourism, among others, so that investment decisions are guided by multi-sectoral processes.

- The effort to clearly link the Korean Green Growth strategy with the design of the country's mid-term target for reducing greenhouse gas emissions offers a strategically important opportunity to connect growth and development policy with measures to address climate change. If successful, this would prove that changes in economic systems can simultaneously deliver prosperity and respond adequately to the challenge of climate change.

- At the same time, engaging the private sector and civil society as stakeholders and partners is fundamental. Civil society organizations in the Republic of Korea have been active participants in the debate on Green Growth; either by voicing their concerns or by contributing to analytical thinking with a view to making a contribution to the formulation and implementing of Green Growth policies.

- The Republic of Korea should further promote a process of broad-based dialogue and consultation with a cross-section of all stakeholders in order to generate the necessary public support that could prove to be essential for the success of such transformational public policies.

Learning for other Countries

- Governments should carefully weigh up the economic, social, and environmental costs and benefits of different strategies and policy options, including “green investments” as a means of achieving a more green economy. This is particularly important in times of economic crisis, when jobs are under threat and industries are re-tooling.

- Governments need to set clear and appropriate parameters and indicators in their pursuit of a green economic transformation, in order to ensure that their actions are guided by convincing sustainability goals and principles as well as environmental integrity. Such parameters and indicators should include, but are not limited to; measuring reduction in carbon dependency; reducing ecological scarcity; enhancing resource and material efficiency and decoupling growth and development from depletion of natural capital. Appropriate enhancements to the accounts of society may also be considered, in the form of adjustments to the System of National Accounts, to avoid over-dependence of accounting and reporting on the ubiquitous GDP yardstick which supports measurement of “quantitative” but not “qualitative” growth.

- A significant increase in public and private investment in green sectors such as clean technologies, renewable sources of energy, sustainable agriculture, green construction, sustainable cities and transport, and ecological infrastructure is essential to jump start a significant process of change.

- However, targeted investment alone, without concomitant domestic and international policy reforms will not lead to the enabling conditions needed for the emergence of a green economy. Governments should embrace a comprehensive portfolio of policy measures that remove harmful policies across their economies, including unsustainable subsidises and other incentives to resource extraction and pollution in areas such as energy, agriculture, fisheries, forestry, mining, and industry.

- Developing countries and emerging economies face specific challenges of achieving sustainable economic growth, reducing poverty, and enhancing well-being, while moving their economies towards a green transformation. Balancing these equally important policy goals is at the core of the green economy.

- Launching a process of transformative change that is able to re-orient resource allocation and set a long-term vision towards a green and sustainable path of growth and development requires bold leadership.

- At the same time, building a solid foundation to such a process demands broad-based dialogue and effective participation and contribution by all relevant actors and stakeholders, in order to generate the necessary public support that can prove to be essential for the success of such bold and transformational public policies.

1. The Republic of Korea's National Strategy for Green Growth

From 1962 up until the mid-1990s, the Republic of Korea implemented regular five-year economic development plans based on theories of a quantitative growth paradigm. These economic plans were developed on the premise that labour and capital were key factors of production in a quantitative growth paradigm. Extensive growth in labour and capital made extensive growth possible, but this often had the unintended consequence of fuelling the conflict between growth and quality of life, and led to increased pollution and environmental deterioration.

Despite significant economic progress, the Republic of Korea is faced with numerous challenges and constraints that require reforms and innovative approaches in various areas of the economy and the environment. The Republic of Korea is the world's sixth largest importer of petroleum and the second largest importer of liquefied natural gas (LNG). Overall it imports 97 per cent of its total energy requirements. Given its very high energy import dependence, the country is particularly vulnerable to fluctuations in energy prices and supplies. In 2008, when oil prices reached almost US$ 150 per barrel, Korea spent over US$ 140 billion on imports of energy. This represented over one-third of the country's US$ 400 billion revenues from exports, making it critical for the Republic of Korea to explore other sources of energy supply.

The rapid industrialization and urbanization has led to a significant pressure on the environment and natural resources such as forests and water resources, biodiversity and the urban environment. There is a need to alleviate such pressures on the environment by redefining growth strategies in ways that better integrate economic and environmental objectives.

The Republic of Korea's carbon emissions have increased significantly during the past 15 years, making Korea one of the countries with the fastest growth of carbon emissions. These causes and consequences of climate change require urgent responses both with regard to mitigation of, and adaptation to climate change, including by injecting supplementary investments to lessen the damage caused by climate change.

In responding to these challenges, Korean leaders are focusing efforts on the development of environmentally-friendly industries and technologies in order to stimulate the economy through additional investment, innovation, and employment generation, while having minimal adverse effects on the environment. In this context, President Lee Myung-Bak announced a "low-carbon, green growth[2]" strategy as a new vision to guide the nation's long-term development on 15 August 2008, during a national address on the 60th anniversary of the establishment of the Republic of Korea. The Korean government has presented its Green Growth Vision as an innovative development approach involving a fundamental shift in the country's growth paradigm, from "quantitative growth" to "qualitative growth". The new vision is based on a long-term strategy of green growth up to 2050, which is implemented through Five-Year Plans for Green Growth.

Under the new paradigm of qualitative growth, the essential factors of production are new ideas, transformational innovations, and state-of-the-art technology. Economic growth based on these drivers is expected to generate substantially intensive, qualitative growth unlike the extensive quantitative growth of the past. This approach facilitates a mutually beneficial relationship between economic growth and the environment. The green growth strategy has three key objectives:

1) Creating new engines of a higher and sustainable growth path by developing low-carbon, environmentally-friendly industries;

2) Ensuring climatic and environmental sustainability; and

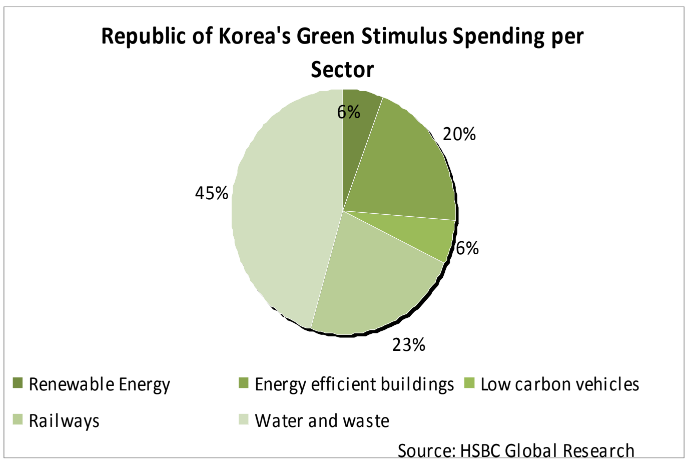
3) Contributing to the international negotiations to fight climate change.

This set of objectives provides the foundation for the green growth strategy which has been articulated through a substantial green stimulus package and a plan of action for the next five years.

1.1 Green Stimulus

The eruption of the financial and economic crisis in late 2008 resulted in a fall in the Republic of Korea's growth rate below 4 per cent in the fourth quarter of 2008. This is a significant reduction when compared to an average rate of growth of between 7 to 8 per cent in the last ten years.

Figure 1: Republic of Korea's green stimulus spending per sector



The Republic of Korea launched a "Green New Deal" on 6 January 2009 as a means of stimulating job creation and revitalizing the economy. The stimulus package, which is comprised of a mix of financial, fiscal and taxation policies, amounted to a total of US$ 38.1 billion, the equivalent of 4 per cent of Gross Domestic Product (GDP), to be implemented over the period 2009-2012. A total of US$ 30.7 billion (about 80 per cent of the total stimulus package) was allocated to environmental themes such as renewable energies (US$ 1.80 billion), energy efficient buildings (US$ 6.19 billion), low carbon vehicles (US$ 1.80 billion), railways (US$ 7.01 billion) and water and waste management (US$ 13.89 billion)[3].

A recent report noted that the Republic of Korea has been particularly efficient in the actual spending of its green stimulus, with almost 20 per cent of funds disbursed at the end of the first half of 2009, compared to only 3 per cent for most countries[4].

In addition, the Korean Government introduced income and corporate tax cuts. Income tax was reduced by 2 per cent. The threshold of tax deductions was raised from 1 million to 1.5 million won (approx. US$ 1,284 – 1,784). Corporate tax will also be reduced from 25 per cent to 22 per cent in 2009 and to 20 per cent in 2010 for large companies and from 13 per cent to 11 per cent in 2009 and to 10 per cent in 2010 for small and medium enterprises (SMEs)[5].

These measures seem to have contributed to stimulating economic recovery. The Republic of Korea was one of the few member countries of the Organization for Economic Co-operation and Development (OECD) that registered a positive growth in the first quarter of 2009 (0.1 per cent). It recorded the highest growth rate in the second quarter (2.3 per cent)[6].

The Korean Green New Deal represents a policy for creating jobs and revitalizing the economy. In the short-term, it aims to respond to the recent economic downturn, and in the mid- and long-term, to boost green growth[7]. The Green New Deal will run through 2012, while the long-term strategy will continue to be pursued through five-year green growth plans; the first of which is implemented from 2009 to 2013.

1.2 Five-Year Plan for Green Growth

Beyond the green stimulus, the Republic of Korea appears to be making a major shift in orienting its economy towards a long-term strategy for green growth. In July 2009, the country adopted a Five-Year Plan for Green Growth (2009/2013) to serve as a medium-term plan for implementing a "low-carbon, green growth vision" announced a year earlier.

The Five-Year Plan encompasses a number of projects that were previously announced as part of the Green New Deal. For instance, the Five-Year Plan integrates the Four Major Rivers Restoration Project previously designated as the main project in the Green New Deal, as well as the "Strategy for New Growth Engines", announced by the Korean Government on 13 January 2009. As such, the Five-Year Plan is an amalgam of several existing and newly designed projects on green growth, articulated as part of a mid- to long-term strategy. In some respects, the Five-Year Plan has expanded the Korean Green New Deal in terms of overall government investment, the number of projects, and the set of policy and fiscal reforms envisaged. In other cases, it streamlined the number of existing projects thus focusing on projects the Korean Government deemed of primary importance, such as the promotion of green technologies.

The plan represents a guide for national policy directions for the green growth vision, specifying future action plans on investments, target goals for each year, including the role of the various actors and stakeholders, such as ministries, along with other government agencies in pursuing the green growth strategy. Under the plan, US$ 83.6 billion, representing 2 per cent of GDP, will be spent in the area of climate change and energy, sustainable transportation and the development of green technologies (for details on the investment plan, see Annex 1).

The Five-Year Plan outlines a set of three strategies, ten policy directions, and 50 core projects. The three strategies comprise measures for addressing climate change and securing energy independence; the creation of new growth engines; and the improvement of the quality of life. Legislators in Korea have been considering a "Basic Law for Green Growth", which will provide the legal basis for Korea's green growth strategy. On December 29, 2009, the Korean National Assembly adopted the Basic Law, which President Lee Myung-Bak signed into law on January 13, 2010.

Table 1: Three strategies and 10 policy directions in Korea's 5-year green growth plan	
Strategies	**Policy directions**
Measures for climate change and securing energy independence	Reduce carbon emissions
	Decrease energy dependence and enhance energy self-suffici
	Support adaptation to climate change impacts
Creation of new growth engines	Develop green technologies as future growth engines
	Greening of industry
	Develop cutting-edge industries
	Set up policy infrastructure for green growth
Improving quality of life and strengthening the status of the Country	Green city and green transport
	Green revolution in lifestyle
	Enhance global cooperation on green growth

Spending on the green growth plan is expected to stimulate production worth 182 to 206 trillion won (US$ 141.1 billion to US$ 160.4 billion) during 2009-2013 with a yearly average production inducement of 36.3 to 41.2 trillion won. This production inducement corresponds to 3.5 to 4.0 per cent of estimated 2009 GDP. The value-added inducement is calculated at 75.0 to 94.9 trillion won 58.4 billion to US$ 73.9 billion) over the five years, with a yearly average of 15.0 to 19.0 trillion won (US$ 11.7 billion to US$14.8 billion). These estimates are based on two scenarios developed by the Presidential Committee on Green Growth, using input-output tables[8] to calculate the expected macro-economic gains from the country's five-year green growth plan.

Through the implementation of the Five-Year Plan, the Korean government expects to create jobs in green industries for 1.18 to 1.47 million people during the five years. In the design of the 50 projects included in the Five-Year Plan, there appears to be a strategy focusing first on large infrastructural projects such as the Four Major Rivers Restoration Project. It is planned that investment will then be directed into the high-technology sectors (the 27 core technologies), which should provide future engines of growth for the country, making use of its highly-educated work force.

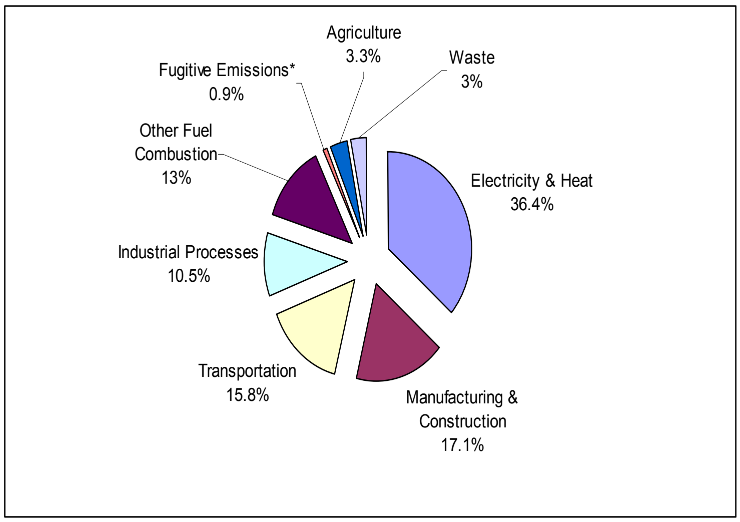
Table 2: Estimated economic effects of Korea's Five-Year Plan for Green Growth						
Indicator/period	**Economic gains**					
	Production inducement (US$ Billion)		Value-Added inducement (US$ Billion)		Job creation (thousand people)	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
2009-2013	141.1	160.4	58.4	73.9	1,561	1,805
Yearly average	28.3	32.1	11.7	14.8	312	362
Ratio of Yearly Average to GDP (%) **	3.5*	4.0*	1.5*	1.8*	34.4**	39.8**
* Estimated 2009 GDP = 1,029.5 trillion won (= US$801.0 Billion) ** Number of unemployed in 1st quarter 2009 (908,000)						

2. Key Aspects of the National Strategy and Five-Year Plan for Green Growth

2.1. Climate Change

Achieving an effective mitigation of greenhouse gas emissions and strengthening the capacity to adapt to climate change are two key aspects of the Republic of Korea's strategy for green growth. Throughout 1912-2008, the average surface temperature in Korea rose by 1.74°C, which is above the world average. Moreover, for the last 40 years, the sea level around Korea (Jeju Island) rose by 22 cm, which is three times higher than the global average sea level rise[9].

Figure 2: GHG Emissions by Sector in 2005 (CO_2, CH4, PFCs, HFCs, SF6, excludes land use change).



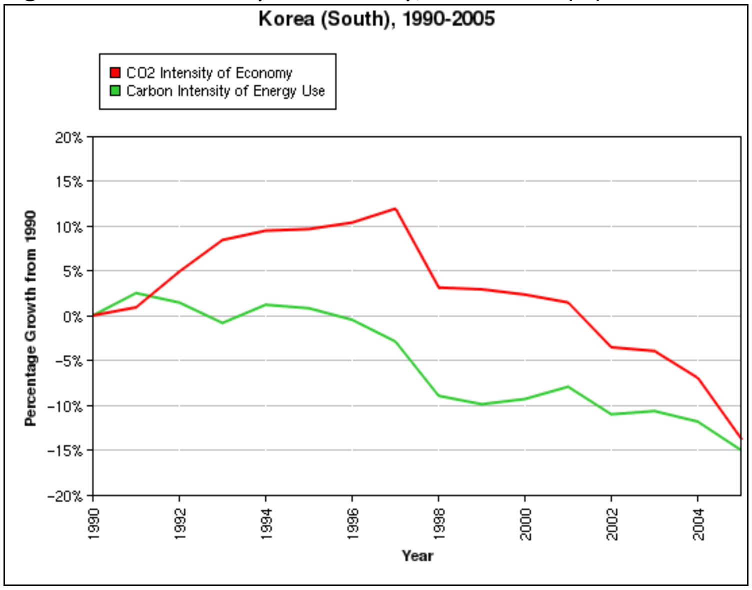
Source: Based on data from Climate Analysis Indicators Tool (CAIT) Version 6.0. World Resources Institute, 2009.

Korea's carbon emissions both in total and per capita doubled between 1990 and 2005, making it the fastest growing source of emissions in the OECD (see Annex 5). This has given raise to concerns about the climate change impacts of the country's rapid pace of growth and industrialisation.

On a sectoral basis, the Republic of Korea's greenhouse gas emissions are concentrated in electricity and heat, manufacturing, transportation, and industrial processes. Energy-related emissions from all sectors cumulating to 456.6 Mt CO_2e in 2005, account for the bulk of GHG emissions (see Figure 2).

The Korean Presidential Committee on Green Growth estimates that under a business-as-usual scenario, the Republic of Korea's carbon emissions are estimated to increase by 30 per cent by 2020.

Figure 3: CO_2 intensity of economy, 1990-2005 (%)



Source: World Resources Institute. The Climate Analysis Indicators Tool (CAIT).

The carbon-intensity of the Korean economy has declined noticeably since 1997 (Figure 3), but remains relatively high in comparison with other OECD member countries.

In fact, compared to the IEA average, in 2004 Korea's energy-related CO_2 emissions per unit of GDP (a measure of CO_2 intensity) was over 40 per cent higher than Japan, nearly 23 per cent higher than the IEA Pacific average (Australia, Japan, Korea and New Zealand), and 15 per cent above the total IEA average[10].

The Republic of Korea is a non-Annex I country, and as such is not bound by mandatory greenhouse gas reduction obligations under the Kyoto Protocol. However, as a growing economy and a member of the OECD, Korea is increasingly regarded as having an important role to play in the global effort to mitigate climate change.

The OECD 2006 Environmental Performance Review of Korea stressed that the Republic of Korea's carbon dioxide (CO_2) emissions as well as its use of energy, pesticides, and fertilizers are among the highest in the OECD relative to GDP or area[11]. The Review recommended that the Republic of Korea set out in the next national plan on climate change "specific objectives and precise measures to be taken over the next few years to reduce the rate of growth of greenhouse gas emissions in order to participate actively in the UNFCCC process."

2.1.1. Korean Green Growth plans and objectives

At the G-8 extended summit held in Toyako, Hokkaido, Japan in July 2008, President Lee Myung-bak indicated that Korea would announce its mid-term emissions reduction goal in 2009. Korea announced on 4 August 2009 that it would voluntarily reduce its carbon emissions by 2020, from the 2005 level, using a target from three options. Under these scenarios, the country's emissions would be reduced by 21, 27, and 30 per cent, compared to projected growth in 2020[12].

Box 1: Korea's 2020 midterm greenhouse gas (GHG) mitigation target

Scenario 1: 21 per cent reduction from BAU (8 per cent increase from 2005 level)

- Achieved through implementation of measures with short-term cost but potential long-term benefits.

Scenario 2: 27 per cent reduction from BAU (Return to 2005 level)

- Implementation of additional measures from scenario 1, which have a mitigation cost of less than 50,000 WON (approx. US$ 28) per ton of CO_2.

Scenario 3: 30 per cent reduction from BAU (4 per cent reduction from 2005 level)

- Implementation of aggressive measures with high mitigation cost.

Notes:

Korea's 2005 GHG emission = 594 $MtCO_{2e}$
BAU = Business as Usual
Not including offsets from forest management

On 17 November 2009, the Presidential Committee on Green Growth announced a decision taken at a cabinet meeting presided over by President Lee Myung-bak to adopt the most ambitious of the three options considered, that is a 30 per cent reduction of future emissions.

Along with a mid-term mitigation goal, climate change initiatives laid out in the five-year green growth plan include the adoption of a legal and regulatory framework, carbon emissions trading, the creation by 2010 of a national GHG inventory report system, in addition to raising public awareness. Other measures announced include the adoption of new auto emission standards, a waste-to-energy programme to reduce GHG emissions from waste materials, promoting low-carbon transportation, the introduction of light-emitting diodes (LEDs); stricter heat insulation standards for buildings, and development of carbon capture and storage (CCS) technologies. A Basic Law on Low-carbon and Green Growth, which was adopted by the Korean National Assemble in December 2009, provides the basic legislation for Korea's green growth strategy, including countermeasures on climate change.

The carbon market is projected to be a major policy tool for GHG reductions in Korean Plan. It is further expected that the growing carbon market will create an innovative business environment for domestic and international industries. Although details of the carbon market, including the auctioning and/or pricing of carbon emission permits, and industries to be covered under the scheme, are yet to be defined, Korea is positioned to capitalize on this market.

Forests cover more than two-thirds of the Korean land surface. The potential for reducing emissions from the forest sector is expected to be enhanced from 1.452 billion CO_2 ton to 1.613 billion CO_2 ton in 2013. The Five-Year Plan also incorporates provisions for aid for forest projects in the Democratic People's Republic of Korea.

Additionally, the establishment of a "Carbon Point System" will reward achievement at reducing carbon emissions or the purchase of low-carbon products with "carbon points", which can be exchanged for discounts at public facilities. In October 2008, the Korean Ministry of Environment kicked off a public awareness campaign entitled "Green Start Movement". The initial participants in the programme were officials from governmental agencies, local administrations, and civic groups. The Ministry seeks to expand the movement among the general public.

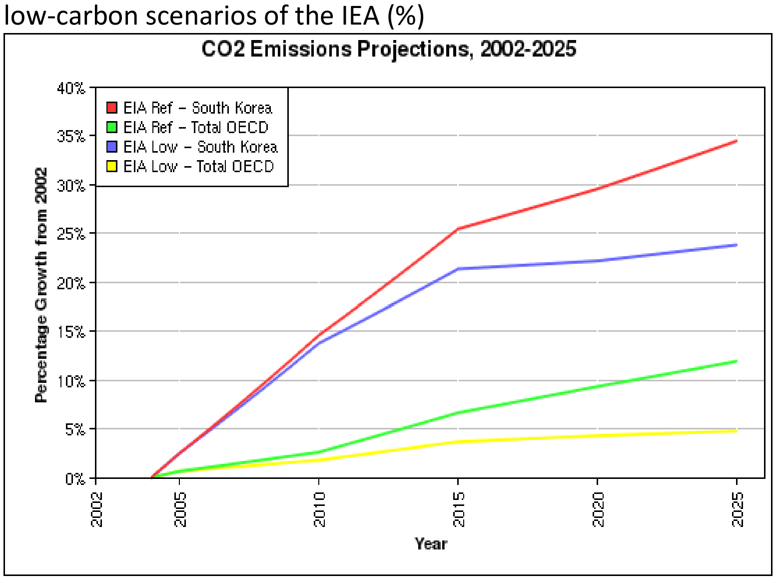
The Five-Year Plan includes measures to undertake climate change risk assessment and to develop action plans to prepare for the likely impacts of climate change on infrastructure, health, water management, agriculture, biodiversity and housing, and options for dealing with them. Efforts will focus on improving the validity of climate change forecasting.

Securing water resources is a critical dimension of climate change adaptation objectives. In that respect, around 1.3 billion cubic meters will be secured by 2012, as part of the Four Major Rivers Restoration Project (see discussion below). Ecological defence systems will be developed through the setting up of forest protection and forest ecosystem management programmes. The Republic of Korea aims to increase the capacity of national forest resources from 862 million cubic meters to 953 million cubic meters by enhancing forest protection and forest ecosystem management programmes.

2.1.2. Review

Given its status as a non-Annex I country to the Kyoto Protocol to the UNFCCC, the Republic of Korea's announcement of a national mid-term climate change mitigation target is a voluntary step that is very encouraging. The Korean Government made it explicit that its carbon emissions reduction target was not conditional to the outcome of the United Nations Climate Change Conference in December 2009. It is a "unilateral and voluntary mitigation action to be undertaken without any foreign support."[13]

Figure 4: Projected growth in CO_2 emissions under reference and low-carbon scenarios of the IEA (%)



Source: World Resources Institute. The Climate Analysis Indicators Tool (CAIT).

Although the nature and level of the emissions reduction that Korea may have to undertake under the framework of global climate change negotiations are yet to be defined, it appears clearly that achieving the objectives of a low-carbon green growth will require an effort to reduce the carbon intensity of the Korean economy and the pace of growth of carbon emissions.

In 2004, Korea recorded a 105 per cent increase in its carbon dioxide emissions compared to the level of the 1990s; a rate second only to China's. Future emissions are expected to keep growing fast. Both in the reference scenario and low-emission-scenario, projections by the International Energy Agency indicate that the growth of carbon emissions in Korea will remain well above that of the average in the OECD countries. Under the reference scenario, which assumes that the level of growth in carbon emissions continues from the 2002 level, Korea would increase its emissions by close to 35 per cent in 2025, compared to less than 15 per cent for the whole of the OECD countries. In the low-emissions scenario, the Republic of Korea's carbon emissions would grow by slightly less than 25 per cent in 2025, compared to 5 per cent for the whole of the OECD countries (see Figure 4). This makes it even more urgent and challenging to reduce GHG emissions, in order to achieve convergence with other OECD countries.

There is growing convergence of views that achieving a global reduction target that would limit the global temperature increase since pre-industrial times below 2°C – the threshold beyond which irreversible and possibly catastrophic changes become far more likely – is essential. Parties to the UNFCCC and the Kyoto Protocol have announced emission reduction targets that are being considered as negotiations proceed. The EU has announced reducing its overall emissions to at least 20 per cent below 1990 levels by 2020, and expressed readiness to scale up this reduction to as much as 30 per cent under a new global climate change agreement if other developed countries make comparable efforts.

The global effort to tackle climate change is guided, among others, by the principle of common but differentiated responsibilities and respective capabilities. As a result, the same level of emission reduction undertaken by Annex I Parties may not be demanded of countries such as the Republic of Korea. Nonetheless, it is clear that the more ambitious the target, the greater the contribution will be in responding to the urgency of action on climate change. Climate change poses serious challenges to Korea's own future development, prosperity, and security against natural disasters and other climate risks that warrant the utmost attention to reduce greenhouse gas emissions.

The Korean Government has stated that its 30 per cent GHG emissions reduction goal represents the highest reduction target recommended by the Inter-governmental Panel on Climate Change (IPCC) for developing countries. Nonetheless, the Korean Government recognizes that indicators such as economic growth, population growth, and assumptions on oil prices used to project future emissions under a reference scenario by 2020 may need to be adjusted to reflect changes in actual conditions by 2020. It is accordingly putting in place an inventory of emissions to ensure accuracy of data.

On 29 December 2009, the National Assembly passed the Framework Act on Low-carbon Green Growth. On 6 April 2010, the government adopted the Enforcement Decree of the Framework Act on Low Carbon during the 15th Cabinet meeting. Both the law and its enforcement decree are due to come into effect on 14 April 2010. The Law includes a system of mandatory reporting of carbon emissions by all carbon and energy-intensive industries. It provides a basis for the creation of a carbon trading system. The Basic Law mandates a cap on emissions, but leaves out the operational structure, the method of allocation of emissions permits, the sectoral coverage, and other details for implementing laws to decide.

The creation of a carbon emissions trading scheme is an important step forward. But its effectiveness will depend on the actual cap on emissions, the mechanism for allocation of emissions permits, and the sectoral coverage. In particular, whether the power generation sector, the steel and automobile industries and other high-emission sectors are covered or not, and modalities of granting them emission allowances, are likely to be determinant. For example, the potential that an increased share of renewable energy will lead to lower CO_2 emissions can easily be diffused by a carbon trading scheme that allows power plants to receive free allowances or to operate under a very loose "cap" on emissions.

As a non-Annex I Party to the Kyoto Protocol Korea is not bound by mandatory annual reporting and annual review of GHG emissions under the Kyoto Protocol national greenhouse gas inventory system. However, as for all non-Annex I Parties to the Kyoto Protocol, Korea is compelled to produce periodical reporting as part of national communications. A further step forward to the creation of a national GHG inventory system would be to consider articulating it on a measurable, reportable, and verifiable basis under existing or future global reporting schemes of the UNFCCC and Kyoto Protocol.

The Five-Year Plan identifies adaptation to climate change as a key priority for Korea. A significant portion of the funds set for adaptation to climate change will be used as part of the Four Major Rivers Restoration Project (discussed below). For Korea and other countries in Asia, sea-level rise and associated flooding are among the most serious risks posed by climate change. The fourth assessment report by the IPCC indicates that for one metre sea-level rise with high tide and storm surge, an estimated 2,643 km2 or about 1.2 per cent of the total area of the Korean Peninsula could face inundation. Measures to respond to sea-level rise could take the form of protection, accommodation, and retreat. As substantial socio-economic activities and populations are currently highly concentrated in the coastal zones, protection should remain a key focus area in Asia. The IPCC reports suggest that coastal protection constructions in Asia for 5-year to 1,000-year storm-surge elevations need to be considered.

A number of measures proposed under the Four Major Rivers Restoration Project are meant to provide such defences. At the same time, forests and wetlands that are prevalent in a large part of the Korean peninsula, if properly conserved and made more resilient, could play important infrastructural functions, and provide natural defences against increasing hazards associated with climate change, such as storms, cyclones, flooding and sea-level rise. However, as a result of global warming, the coverage of broad-leaved Korean pine forests is projected to decrease by 20 to 35 per cent, which may affect the capacity of forests to remain as effective natural defences against future climate impacts. This makes it critical that protection of forests be strengthened as expected effects of climate change will reduce forest density in parts of the country.

The implementation of ecological restoration, through reforestation, including riparian reforestation, can significantly enhance resilience. The review of a large number of restoration projects under the UNEP-led study on The Economics of Ecosystems and Biodiversity (TEEB) suggests that through ecological restoration, resilience improvements can be found in three significant areas of adaptation: (1) freshwater security; (2) food security (both artisanal fisheries and small farms productivity); and (3) natural hazard risk management (cyclones, storms, floods, droughts)[14].

2.2. Energy Efficiency

A successful execution of the green growth strategy, such that it delivers low-carbon growth entails a decoupling of economic growth from carbon emissions and intensive-energy use. This, in turn, requires significant reductions in the carbon-intensity and the energy-intensity of growth. Korea faces challenges in that regard, given that despite important progress in the past several years, energy-intensity remains high in comparison with other OECD countries. The 2006 OECD Review noted that "Korea is one of the few OECD countries, which has not improved its energy intensity (energy use per unit of GDP) relative to 1990".

2.2.1. Korean Green Growth plans and objectives

The Five-Year Plan involves measures targeting high-emission industries, through a "negotiated agreement" between the government and large energy-consuming companies in order to reduce energy consumption. The "negotiated agreement" will be applied to companies with an annual energy consumption over 500 thousand TOE in 2010, over 50 thousand TOE in 2011, and over 20 thousand TOE in 2012. In the transport sector, there will be new standards to increase the fuel efficiency for automobiles and institute a reporting system on transport companies with high-energy consumption (further discussed in section 2.4 below). A ban on incandescent lights, which are considered to have a low energy performance, will be introduced by 2013 in order to promote the diffusion of light emitting diode bulbs (LEDs) with 3 to 5 times higher energy-efficiency.

The electricity pricing system will be changed into a cost-based electricity pricing system. It is expected that the change in pricing will give a strong signal to corporate and household energy users which may translate in important behavioural change and energy savings. At the same time, there appears to be an attempt to minimize the effects of energy pricing on lower-income households, with an objective of reducing the number of households whose energy expenditure is worth 10 per cent of their total revenue from 7.3 per cent of total households in 2009 to 5.0 per cent in 2013.

Overall, this set of measures for the development and dissemination of hybrid electric vehicles, the adoption of stringent standards on fuel efficiency, energy conservation and green buildings, and the promotion of investment in energy conservation facilities should increase total energy efficiency from 0.317 ton of oil equivalent TOE/US$' 000 in 2009 to 0.290 TOE/ US$' 000 in 2013 and to 0.233 TOE/ US$' 000 in 2020.

2.2.2. Review

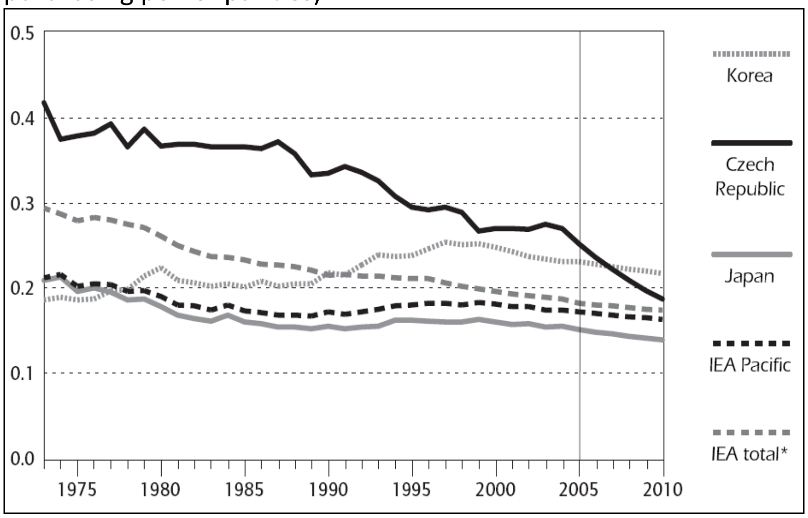
Enhancing energy efficiency is particularly important given that manufacturing and energy-intensive industries remain predominant in the Korean economy. With the world's largest shipbuilding industry and the fifth largest steel production, industry in Korea accounts for 27.9 per cent of GDP which is well above the 17.4 per cent OECD average.

In 2004, the Korean Government adopted a General Energy Conservation and Efficiency Improvement Plan, which set the objective of enhancing energy efficiency so that Korea's energy intensity is reduced from 0.359 TOE/US$' 000 in 2004 to 0.328 in 2007, and then to 0.294 by 2012. In its 2006 Energy Policy Review of Korea, the International Energy Agency noted that

Korea's current energy efficiency targets were not high at that time and could be improved. The new targets set under the Five-Year Plan to enhance efficiency from 0.290 TOE/US$' 000 in 2013 and to 0.233 TOE/US$' 000 in 2020 appear to be an improvement on the targets in the General Energy Conservation and Efficiency Improvement Plan. In comparative terms, however, energy-intensity will remain slightly above that of most IEA countries (see Figure 5).

The banning of inefficient light bulbs is in line with policies that are being implemented in a number of countries around the world. Measures to phase out incandescent lights have already been announced in countries such as Australia (by 2010), the Philippines (by 2010), and the member countries of the European Union (by 2012). In Denmark, the ban became operational as of October 2009.

Figure 5: Energy Intensity in Korea and other Selected IEA Countries, 1973 to 2010 (TOE/US$' 000 at 2000 prices and purchasing power parities)



*excluding Luxembourg and Norway throughout the series, as forecast data are not available for these countries.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2006; *National Accounts of OECD Countries*, OECD Paris, 2006; and country submissions (IEA, *Energy Policies of IEA Countries: The Republic of Korea,* 2006, Figure 8).

The focus of the effort to reduce energy intensity in the industrial sector will depend of the effectiveness of implementing voluntary agreements with industry. Whereas such an approach is not new in Korea, having been practiced in the past, more stringent monitoring may be required as Korea is in the process of setting measurable carbon reduction goals at the international level.

This will make it necessary for the country to ensure that objectives and targets are met within the timeframe indicated, and that measures to reward compliance or otherwise sanction non-compliance are also part of the policy approach.

The experience with collective voluntary approaches in the OECD countries suggests that failing such a stringent approach, "negotiated agreements" may lead to significant problems of free-riding, as firms manage to avoid the imposition of mandatory targets while maintaining a *status quo* on their emissions and energy-intensity. Therefore, it is critical that voluntary agreements with industry are monitored to ensure that they achieve the expected targets, and that alternative policies are considered in case voluntary targets are not met. The Korean Government's newly announced "negotiated agreements" with measuring, reporting, and monitoring (MRV) processes will help in this regard.

Reforming energy prices so that they reflect true market costs is a natural complement to setting standards and targets on energy efficiency. The energy pricing reform discussed below will therefore play an important part in advancing the effort on efficiency improvement.

2.3. Renewables and Nuclear Energy

Korea has daunting energy challenges. It is the world's fifth largest importer of oil (118 Mt of imports in 2007 and second largest importer of coal (100 Mt of hard coal imports in 2008)[15]. Given its high energy import dependence, Korea is seeking to expand its renewable energy generation through target setting and regulator measures.

2.3.1. Korean Green Growth plans and objectives

Under the Five-Year Plan, the share of new and renewable energy in total energy supply is expected to increase from 2.7 per cent in 2009 to 3.78 per cent in 2013, and 6.08 per cent in 2020. Renewable energy generation from the "1 Million Green Homes" project would increase this share to 11 per cent in 2030.

In 2006 the amount of waste generated daily in Korea was approximately 320 thousand tons. Currently, energy generated from waste accounts for 76 per cent of the renewable energy in Korea. To develop such a potential, the Korean Government plans to implement measures for waste resources and biomass energy by utilizing waste energy, agricultural and marine biomass, forest biomass, and building low carbon and green villages. To generate energy from 3.86 million tons per year of combustible and organic waste resources, 48 environmental energy facilities will be installed by 2013. In addition, in order to recollect and reuse the heat from incinerators, 17 remaining heat collecting facilities are planned to be built, and to recollect and reuse the landfill gas from landfill sites all over the country, 25 landfill gas recollecting facilities are planed to be built. A comprehensive system for treatment of waste resources from the industrial sector will be prepared by 2011. Technologies that are currently employed in the chemical industry will also be deployed to promote the development of renewable energy. To efficiently produce and utilize waste energy, integration and broad-banding of energy plants will be pursued by 2020.

Nuclear energy has been an important source of energy supply in Korea. Under the green growth strategy, Korea seeks to further develop its nuclear technology. The country will gradually increase the proportion of nuclear energy in power generation from 24 per cent in 2009, to 27 per cent in 2013, and to 32 per cent in 2020.

The development of tidal power is a notable change in the country's energy matrix. Starting virtually from nil in 2008, tidal power generation will expand to 0.9 per cent of total renewable energy generation in 2010 and 5.2 per cent in 2020, representing a 50 per cent annual increase.

Hydropower generation is also expected to increase, with the construction of new dams and 42 hydroelectric plants that would generate 278,471 MWh per year. Nonetheless, the share of hydropower in the total renewable energy supply will decrease, as a result of larger increases in the other renewable resources such as bioenergy, wind, tidal power, and solar PV and solar thermal.

Other targets include building fourteen “Environment Energy Towns” in eight areas nationwide by 2020. Such towns will employ efficient use of waste resources, green power, and biomass. In small regional communities, a total of 600 low-carbon green villages are expected to be built. The government plans to build one million energy-saving green homes by 2020 and to refurbish one million existing houses using new and renewable energy.

Table 3: New and renewable energy (NRE) deployment in Korea: Status and projections (Unit: Thou. TOE, %)

	2008	**2010**	**2015**	**2020**	**2030**	**Annual increase (%)**
Solar thermal	33 (0.5)	40 (0.5)	63 (0.5)	342 (2.0)	1,882 (5.7)	20.2
PV	59 (0.9)	138 (1.8)	313 (2.7)	552 (3.2)	1,364 (4.1)	15.3
Wind	106 (1.7)	220 (2.9)	1,084 (9.2)	2,035 (11.6)	4,155 (12.6)	18.1
Bioenergy	518 (8.1)	987 (13.0)	2,210 (18.8)	4,211 (24.0)	10,357 (31.4)	14.6
Hydro	946 (14.9)	972 (12.8)	1,071 (9.1)	1,165 (6.6)	1,447 (4.4)	1.9
Geothermal	9 (0.1)	43 (0.6)	280 (2.4)	544 (3.1)	1,261 (3.8)	25.5
Marine	0 (0.0)	70 (0.9)	393 (3.3)	907 (5.2)	1,540 (4.7)	49.6
Waste	4,688 (73.7)	5,097 (67.4)	6,316 (53.8)	7,764 (44.3)	11,021 (33.4)	4.0
Total	**6,360**	**7,566**	**11,731**	**17,520**	**33,027**	**7.8**
Primary Energy (M TOE)	**247**	**253**	**270**	**287**	**300**	**0.9**
Share (%)	**2.58%**	**2.98%**	**4.33%**	**6.08%**	**11.0%**	

Source: Korea Energy Management Corporation, April 2010.

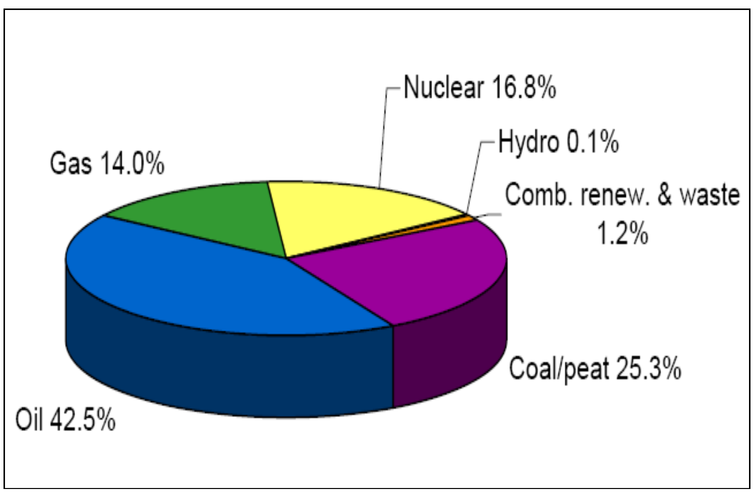
Apart from these technological options and targets, measures are being considered to create economic incentives and regulatory standards that will create a market for demand and supply of renewables. These include economic incentives to increase the use of solar energy in homes and small buildings. To increase the distribution of new and renewable energy, measures such as Renewable Portfolio Standard (RPS) and Renewable Fuel Standard (RFS) will be adopted from 2012. The RPS will require large-scale energy plants to supply new and renewable energy, and the required supply share will be increased annually up to 10 per cent by 2022.

By 2030, a smart grid system will be established comprising a network of electric power suppliers that incorporates advanced control and communication systems to efficiently manage power production and distribution. The information technology-based network would lead to more efficient overall energy production and consumption. Furthermore, it would allow renewable energy sources with variable production rates like solar and wind energy to be better utilized and make a larger contribution to energy supply. This system is expected to drastically reduce CO_2 emissions and contribute to enhancing energy security.

2.3.2. Review

The Korean energy matrix is largely dominated by fossil fuels, accounting for over 80 per cent of total primary energy supply, the remaining consisting of nuclear energy mainly, and a little fraction of renewables (see Figure 6). As such, the new targets for renewable energy generation in the Republic of Korea are an important step forward in reducing the country's reliance on fossil energy and energy import-dependence. Increased use of clean energies will also be critical in order to reduce carbon emissions in the industrial and residential sectors.

Figure 6: Share of total primary energy supply in the Republic of Korea in 2007 (excl. electricity trade)

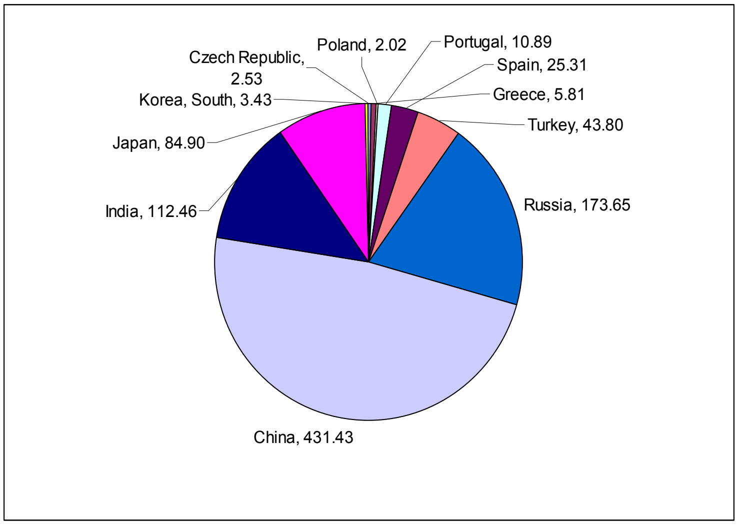


Source: IEA Energy Statistics, 2009.

Measures to improve energy and material efficiency, by converting waste into energy and expanding the potential in energy generated from biomass appear to be encouraging, given that these two sources of energy have shown a potential to increase energy generation from renewable sources. Together with hydroelectricity, they made up the bulk of renewable energy generation, accounting for 95 per cent in the share of renewable energy in 2005.

However, despite the importance of hydroelectricity in the Republic of Korea's renewable energy supply, the volume of hydro-electricity generation remains relatively low when compared with the installed capacity in many other developed and developing countries (see Figure 7). In its search for new and cleaner sources of energy, the Republic of Korea could further expand its potential to generate electricity from hydropower.

Figure 7: Net hydroelectric power generation, 2006 (Bn Kw/h)



Source: Energy Information Administration, International Energy Annual 2006.

There appears to be efforts in that direction. As part of the Four Major Rivers Restoration project, there are plans to construct 42 hydroelectricity generating plans. These 42 hydroelectric plants with a total cost of around US$ 163 millions are expected to generate 278,471 MWh per year. In addition to expanding the share of hydropower in total energy use, this will contribute to reducing about 150 thousand tons of CO_2 and replace 470 thousand barrels of oil for power generation per year.

To respond to the increasing energy demand, Korean authorities plan to expand nuclear energy supply and also improve infrastructure and continuous development of capacities in accordance with the results of regular safety assessments. The Republic of Korea is the world's sixth largest generator of nuclear electricity, accounting for 4.8 per cent of-global generation[16-].

In its 2006 Energy Policy Review of the Republic of Korea, the International Energy Agency concluded that Korea's nuclear energy industry is a model for other countries. The report noted that the nuclear energy regulatory framework implemented by Korea is comprehensive and in line with best international practices[17].

Overall, there appears to be an increased interest in nuclear power generation in OECD countries, in large part as a result of policies to address climate change. The IEA projects in its 450 ppm scenario that nuclear power along with renewable energies will have increased shares in the total global energy mix by 2030[18].

Typically, a number of environmental and social concerns arise with respect to the development of nuclear energy. They range from safe storage and long-term disposal of nuclear waste to risk of proliferation of nuclear weapons. The specific procedures for further developing nuclear energy should carefully consider these issues and devise ways to address them in a manner compatible with agreed international norms. Cautious and diverse measures to strengthen public trust on nuclear energy should also be considered. In addition, it is important to ensure that further development of nuclear energy continues to remain in line with best international standards, and that transfer and export of nuclear energy technology contributes to enhancing the safety, stability, and economic viability of nuclear power generation in other countries pursuing nuclear power options.

The rapid expansion in tidal power will add to the country's renewable energy supply. In addition to tidal power plants that are operating in Shiwa Lake, new plants are being proposed at Incheon/Ganghwa Bay and Garorim Bay. These proposed sites have large tidal ranges, up to 9 meters, with extensive areas of intertidal mudflats that are of high ecological value, especially for waterbirds, in addition to their importance as fishery grounds. The tidal-flats around Incheon/Ganghwa include nationally designated protected areas such as the Republic of Korea's Natural Monument No. 419 under the title of "Ganghwa tidal flat and Black-faced Spoonbill Breeding Sites." The Republic of Korea has recognized the importance of natural resources such as tidal flats and bays in its 4th National Report under the Convention on Biological Diversity[19]. In pursuing efforts of conservation of such valuable ecosystems, the construction of the tidal power plants demand a careful assessment of its possible negative effects and ways to mitigate them.

In 2002, the Republic of Korea adopted a fixed minimum price for renewable energy, which contributed to increase renewable energy use. New measures to regulate energy pricing and offer incentives for clean energy generation are important steps in creating an environment conducive to behaviour change and investment in clean energy. The launching of a RPS with attracting private investment and market based mechanism is an innovative trial. The experience in other countries could provide useful insights for the Republic of Korea's efforts in this direction.

Overall, the target of achieving 3.78 per cent share of renewable energies in 2013; 6.08 per cent in 2020, and 11 per cent in 2030 appear to be modest in comparison with targets that exist in many comparable developed countries. However, the pace of change that is envisaged is remarkable considering that the country had increased its renewable energy supply only by 0.37 per cent in the past, from 2.06 per cent in 2005 to 2.43 per cent in 2008.
In order to achieve the target of 11 per cent of renewable energy supply by 2030, the implementation of policies and measures set in the Five-Year Plan will be essential. In addition, to expand renewables in mid- and long-terms, new renewable technology development and fostering the industry are very critical. In this sense, national strategic technology development assistants in solar, wind, fuel cell, bio energy sectors should be increased further.

2.4. Transport, Cities and Fuel Efficiency

The Intergovernmental Panel on Climate Change (IPCC) has indicated that the global vehicle fleet's fuel economy needs to improve by 50 per cent by 2050 to stabilize emissions from road transport[20]. The Global Fuel Economy Initiative (GFEI) launched by UNEP, together with the International Energy Agency, FIA Foundation (Fédération Internationale de l'Automobile), and the International Transport Forum, seeks to double the fuel economy, in line with IPCC and G8 recommendations. As the world's fifth largest car manufacturer, the Republic of Korea has an important role to play in enabling greater efficiency in the automobile industry and significantly reducing emissions from the transport sector.

2.4.1. Korean Green Growth plans and objectives

The Five-Year Plan sets regulatory standards on fuel efficiency and GHG emissions from the transport sector that will require a redesign of cars to either drive 17 kilometres per litre or cut greenhouse gas emissions below 140 grams per kilometre between 2012 and 2015. New fuel efficiency and emission rules will be applied to 30 per cent of automobiles sold in 2012, rising to 100 per cent by 2015.

Efforts are being made to develop renewable transport fuels. In this regard Korea plans to adopt a renewable fuel standard (RFS), which will make it mandatory for transport fuel suppliers to provide bio-diesel, bio-ethanol, and bio-gas for automobiles. Fuel suppliers will have to supply 3 per cent of their transportation fuel from bio-diesel sources by 2012, and 7 per cent in 2020.

An investment of 25.3 trillion won (US$ 19.7 billion) in green cities and further development of railway and other means of mass transport are expected to increase the role of public transportation to 55 per cent of total transport use by 2013. The passenger transport load of trains is set to increase from 19 per cent in 2009 to 30 per cent in 2013.

Bicycle use will be promoted with the construction of 3,114 km of additional bicycle lanes nationwide between 2009 and 2018. About 1,700 km of bicycle lanes will be constructed along the waterfront pavements of the four major rivers. It is anticipated that this would increase the use of bicycles from 1.5 per cent in 2009 to 5 per cent of the modal split in 2013.

2.4.2. Review

The transport sector accounts for 21 per cent of energy consumption in Korea, with an average annual increase rate of 6.3 per cent. The number of vehicles is at 17 million, and increases by 13 per cent a year[21]. Policies and measures to enhance sustainability in the transport sector are therefore critical to promoting green growth.

In July 2006, the Korean government set long-term sectoral energy consumption reduction goals of reducing emissions by 7 per cent in the transport sector and by 6 per cent in the building sector by 2020, as compared with projected emissions[22]. The Five-Year Plan seeks to expand that effort with additional strategies and standards in the transport and construction sectors.

The effort by the Korean Government to orient its car industry into technology, rather than cost-driven, competition is considered to be an important strategic direction. As a leading car manufacturer, expanding investment in the development of low-carbon vehicles such as hybrid cars and electric vehicles deserve to be a high priority in Korea. Around US$1.80 billion was allocated to the promotion of low carbon vehicles in the Korean stimulus plan. In order to realize the full potential of greening the automobile industry, specific policies and measures will need to be defined, including the development of a smart grid system by 2013 as well as specific policies and measures to encourage plug-in hybrid and electric vehicles.

There appears to be an effort in modal shift towards non-motorized transport systems with the construction of over 3000 km worth of cycling lanes. Experience suggests that to be effective, non-motorized transport facilities such as cycling lanes need to be integrated into a larger network of non-motorized transport, public transport, and private vehicle. The creation of a long segment of bicycle lanes along the waterfront pavements of the four major rivers can promote sustainable forms of transportation in recreational activities. However, the larger potential, in particular for mitigating climate change, lies in a cycling network that allows users to use bicycles instead of personal cars for commuting for work, schooling and other urban mobility uses. Without the integrated planning of cycling lanes within the larger transport infrastructure, the full potential of promoting low-carbon transportation may not be realized.

In the building sector, the retrofitting of the existing buildings stock has proved to be an effective way of reducing energy consumption in the residential sector and improve material efficiency. There are also important opportunities for new employment. In Germany, for instance, a programme on retrofitting the existing housing stock to improve energy efficiency has succeeded in retrofitting over 200,000 apartments, creating 25,000 new jobs and sustaining 116,000 existing jobs[23]. In its stimulus package, Korea has allocated US$ 6.19 billion to improving energy efficiency in buildings. The development of green buildings is also part of the 27 priority green technologies (discussed below).

Currently available advanced building technologies can reduce residential energy use by 80 per cent compared to traditional designs[24], while simple adoption of common technologies such as insulation can reduce energy with an estimated 30 per cent at a net negative life cycle cost. Experience from around the world indicates that, due to the fragmentation of the building sector, economic incentives are comparatively ineffective as compared to “command and control” measures such as green building standards and utility-demand control programmes. The Republic of Korea announced a GHG reduction target of 31 per cent by 2020 for the building sector. There are encouraging targets of strengthening energy standards by 30 percent till 2012, achieving passive level by 2017, and reaching zero-energy housing by 2025.

2.5. Water and Ecological Infrastructure

Amid rapid economic growth and high population densities, Korea continues to face challenging water-related issues. A 2006 Environmental Performance Review of Korea undertaken by the OECD[25] concluded that much work must still be undertaken to reach the country’s water quality objectives for rivers and reservoirs. Biochemical oxygen demand remains the primary focus of these management efforts, while heavy metals and persistent contaminants have not so far received much attention. Moreover, the protection of aquatic species and biodiversity requires proactive management.

Water scarcity is another challenge facing the Republic of Korea. Water scarcity becomes most acute when one considers demand and supply in the context of future socio-economic and natural changes that may occur. The socio-economic factor with the greatest potential impact is population growth; the natural factor of greatest concern is climate change.

With global warming likely to continue, levels of flooding and drought are expected to worsen. In Korea, it is expected that the level of precipitation during the summer months will increase with almost no change of level in the winter. As temperatures are also projected to rise with global warming, more severe droughts may occur in the winter.

The recurrence of flooding has significant costs to the Korean economy, some of which could have been saved by investing in disaster prevention measures. The annual flood damage was estimated at 170 billion won (US$ 132.3 million) in the 1970s. It reached 2.7 trillion won (US$ 2.1 billion) since the 2000s. The Republic of Korea currently spends an average of 5.3 trillion won (US$ 4.3 billion) as annual investment in flood prevention and recovery expenses.[26] In order to weather expected climate irregularities, additional water control policies will likely be necessary.

2.5.1. Korean Green Growth plans and objectives

In response to these challenges, the Five-Year Plan includes a project on the restoration of the Republic of Korea's four major rivers. The Four Major Rivers Restoration Project was first announced as part of the "Green New Deal" policy launched in January 2009. It was later included in the Five-Year Plan released in July 2009. Its funding, a total of 22.2 trillion won (US$ 17.3 billion), is reflected in the Five-Year Plan total investment[27].

The Four Major Rivers Restoration Project concerns not only the four main rivers – Han, Nakdong, Geum and Yeongsan – but also a number of related projects on tributaries**.** The overall project consists of three sets of projects: 1) the main project – the Han, Nakdong, Geum and Yeongsan rivers restoration projects; 2) projects on the 14 tributaries of the four major rivers; and 3) maintenance of local rivers and other small rivers that directly inflow into the four major rivers. These projects have five key objectives: 1) securing abundant water resources against water scarcity; 2) preparing well-coordinated measures for flood control; 3) improving water quality and restoring ecosystems; 4) creating multipurpose spaces for local residents; and 5) promoting regional development centred on rivers.

The Four Major Rivers Restoration Project will aim at securing sufficient water volume by building 16 weirs. These 16 weirs are expected to secure 800 million cubic meters of water. The project will increase peak water levels of 96 agricultural reservoirs so as to secure 250 million cubic meters of water. Additionally, the construction of 3 small and medium size multipurpose dams is expected to yield another 250 million cubic meters of water.

Flood control measures involve an expansion of the water gates of tributaries, which would allow a quick water level decline and fast draining of flood. In addition, 2 flood-control areas and 3 underflow areas of river sides will together expand the flood control capacity up to 920 million cubic meters of water.

Additionally, the project seeks to ensure that, by 2012, 86 per cent of river reaches should maintain water quality (BOD less than 3ppm) by expanding sewage treatment facilities and establishing green algae reduction facilities. In terms of adaptation strategies to climate change and sea level rise, federal and local governments are bound to maintain an adequate level of salinity concentration to protect drinking water supply and other water usages. In order to monitor water quality, Korea's Ministry of Environment has expanded the existing Tele-Monitoring System (TMS) to 586 sewerage and waste water treatment facilities by the end of 2009. This includes 323 sewerage facilities, 58 waste water treatment facilities, and 205 operating sites.

On ecosystem restoration, an Eco-river Restoration Programme (ERP) initiated in 2008 is being implemented in the context of the Four Major Rivers Restoration Project. One of the ultimate goals of the programme is to restore indigenous and endangered aquatic species and maintain the quality of water and ecosystems. The other national programme to restore freshwater ecosystems is to develop an aquatic ecosystem-monitoring network. Since 2007, preliminary field surveys have been conducted at more than 540 locations. More than 929 km of national streams will be restored as part of the Four Major Rivers Restoration Project. A follow-up project will be planned by 2010 to restore about 120 local streams. More than 84 riparian wetlands will also be reconstructed. Riparian areas will be afforested or reforested, and will also be used for biomass production.

Finally, the project seeks to support regional economic development. This is pursued through the creation of multipurpose spaces for cultural and touristic activities near rivers which are expected to contribute to job creation and local economic revitalization. Overall, it is expected that the project will create 340,000 jobs and generate an estimated 40 trillion won (US$ 31.1 billion) of positive economic effects.

The implementation of the project follows three phases. In phase 1, approximately 16.9 trillion won (US$ 13.1 billion) will be spent on the "main project" dredging operations, and building weirs, small dams and embanking reservoirs on the four major rivers. Most of the main projects are planned to be completed by 2011; projects for small dams and reservoirs for storing water will be completed by 2012. In phase 2, another 5.3 trillion won (US$ 4.1 billion) will be invested on improving water flow and sewage systems of tributaries. Projects for the development of Seomjin River and other tributaries to the four rivers would be completed by 2012. Phase 3, includes restoring local and small rivers, and developing cultural and tourism attractions around the four major rivers. The Ministry of Culture, Sports and Tourism is involved in this phase.

The Office of National River Restoration under the Ministry of Land, Transport, and Maritime Affairs is the lead agency for the project. In the implementation of the project, the office will operate in cooperation with the Ministry of Culture, Sports and Tourism, the Ministry for Food, Agriculture, Forestry and Fisheries, the Ministry of Environment and the Ministry of Land, Transport and Maritime Affairs.

The Korean government conducted an environmental impact assessment (EIA) of the Four Major Rivers Restoration Project in order to assess the potential effects of the project and to devise response measures. The results of the EIA were announced on November 6, 2009[28].

On ecosystems, the assessment identified around 68 legally designated protected species and natural treasures that may be affected by the Four Major Rivers Restoration Project. The assessment concluded that direct impacts would be minimal if mitigation measures are implemented. Measures planned include an adjustment and reduction of the intensity of the construction work during the winter time when migratory birds arrive. Small size habitats such as small rivers corridors and food places will be created to provide sanctuaries and places for laying eggs. In addition, green belts will be constructed to provide additional habitats for animals to live in a natural environment.

With regard to the natural environment, the assessment mainly addressed potential risks to wetlands that surround the four rivers. It was found that out of 100 wetland sites located in the project area, 54 wetlands may be directly or indirectly affected by the project. These 100 wetlands cover 12.5 per cent of the total area which will be affected by the project. Considering ecological functions of the wetlands, the Korean Ministry of Environment decided to conserve wetlands that have high ecosystem value. Parts of the wetland areas that are likely to be affected are compensated for through the construction of man-made wetlands. As a result, after the four major rivers projects, in total 84 alternative or new wetlands are expected to be created and ecological and environmental functions of the rivers are expected to be improved. In addition, lower river ways will be created with mild slopes of 1.5 ratio so as to lead to a natural creation of wetland areas after the completion of the projects.

Regarding water quality, Korea's National Institute of Environmental Research, which was entrusted with an assessment of water quality, concluded that water quality will generally be improved as a result of the project. It has been estimated that pollution from mud that may occur during the construction phase will not lead to weighted density (by standard of dry season) of more than 10 mg/litre. In the case that floating matters exceed 15 mg/litre, it is planned that the construction period and intensity will be adjusted and that additional pollution reduction facilities will be installed. As 570 million of cubic meters of dredged materials will result from the dredging of the rivers, there is plan to create a sedimentation basin and a diversion waterway will be installed at the storage yards of the dredged material in order to prevent secondary water pollution. The Korean government is considering options for a differentiated use of the dredged material according to the grain size and the level of contamination.

The Korean Ministry of Environment has the responsibility to ensure follow-up and implementation of the conclusions of the IEA. In that process, the existing Environment Evaluation Board will be transformed into a Post-management Investigation Commission after a re-composition of its membership. The future Post-management Investigation Commission will be entrusted with monthly investigation, monitoring and inspection of the implementation of measures to mitigate identified environmental effects.

2.5.2. Review

Challenges facing Korea in relation to climate change and its impact on rainfall, flooding and water are indeed serious. The Four Major Rivers Restoration Project seeks to respond to these challenges. It is expected to bring numerous positive effects by providing significant ecological infrastructures for the national economy and people's lives. However, a prudent ecological approach is necessary given the significant scale of the project, and the fact that the four major rivers are sensitive ecosystems.

In line with the significance of the challenges that it seeks to address, the Four Major Rivers Restoration Project is a large project involving among others the building of 16 new weirs on the main streams of the four rivers and 2 new dams on their tributaries; the renovation of two estuarine barrages; the embankment of 87 existing irrigation dams; the strengthening of 377 km of river bank; and the dredging of 570 million cubic meters of sand and gravel from a total 691 km of the rivers. These imply major infrastructural work in the implementation of the project.

Therefore, the attempt of ecological restoration of the four main rivers and their tributaries is commendable, but its implementation needs to follow approaches that will result in effective "ecological restoration" by making efforts to enhance the ecological integrity of river in order to achieve the important policy objectives pursued under this project. The study on The Economics of Ecosystems and Biodiversity's (TEEB) review of a large number of restoration projects suggests that resilience improvements can be found in three significant areas of adaptation: (1) freshwater security; (2) food security (both artisanal fisheries and small farms productivity); and (3) natural hazard risk management (cyclones, storms, floods, droughts). An ecosystem-based adaptation could yield many of these benefits in the context of the Korean river restoration.

The Republic of Korea showed commitment to international efforts to protect and conserve wetlands by hosting the 10th Meeting of the Conference of the Contracting Parties to the Ramsar Convention on Wetlands in 2008. Many of the resolutions and other outcomes of that conference, including Resolution X.19 “Wetlands and river basin management: consolidated scientific and technical guidance”[29] and Resolution X.24 on “Climate change and wetlands,” are relevant instruments to consider[30].

The follow-up and implementation of the conclusions and recommendations of the EIA done by the Ministry of Environment are also critical to ensure environmental integrity of the project. In addition, it is important that communication with relevant stakeholders continue to be strengthened in order to achieve an effective implementation of measures identified through the EIA and to develop appropriate measures for unexpected environmental impacts.

2.6. Green Technologies as Future Growth Engines

Technology is a crucial factor in promoting green growth. In the Korean green growth strategy, the development of green technologies is conceived as the pillar of the country’s economic transformation in the medium and long-term, after a first phase of investment in large infrastructure projects as part of the Green New Deal.

2.6.1. Korean Green Growth plans and objectives

The technology component of the green growth plan was derived from a “Strategy for New Growth Engines” announced by the Korean Government on 13 January 2009. The “Strategy for New Growth Engines” was reclassified as a part of the five-year green growth plan, focusing on 27 core technologies. These 27 technologies are considered to have a potential to provide new engines for growth to the Korean economy. They are divided into four categories: (1) technologies for short-term intensive investment, (2) technologies for mid-term intensive investment, (3) technologies for long-term intensive investment, and (4) technologies for long-term gradual investment (see Table 4).

To achieve this technological transformation, a substantial investment plan has been put in place, covering phases from research and development, deployment to commercialization of the technologies. A total investment of more than 2.8 trillion won (US$2.2 billion) is earmarked to fund research and development up to 2013.

Projects in the area of information technology (IT) will contribute to enhancing the use of IT in the economy and society. Investment in such projects will amount to about 4.2 trillion won (US$ 3.3 billion) by 2013. The Presidential Committee on Green Growth estimated that the projects would generate 7.5 trillion won (US$ 5.8 billion) in production, create 52,000 jobs during 2009-2013, and reduce 18 million tons of carbon emissions in 2013.

The “greening” of key industries in the Korean economy is another important aspect of the envisaged technological shift. This involves a transformation of production processes in the steel, fibre and textile, petro-chemistry, and the shipbuilding industries to increase resource and energy efficiency. The Korean Government is focusing its efforts in this regard on investment in research and development and facility upgrades.

Table 4: List of 27 core technologies in Korea green growth national plan		
Sector	**27 Core Technologies**	
Climate change	1. Monitoring and modelling for climate change	(4)
	2. Climate change assessment and adaptation	(4)
Energy source technology	3. Silicon-based solar cells	(1)
	4. Non silicon-based solar cells	(4)
	5. Bio-energy	(4)
	6. Light water reactor	(1)
	7. Next-generation fast reactor	(3)
	8. Nuclear fusion energy	(3)
	9. Hydrogen energy R&D	(3)
	10. High-efficiency fuel cell	(3)
Efficiency improvement technologies	11. Plant growth promoting technology	(3)
	12. Integrated gasification combined cycle	(3)
	13. Green cars	(2)
	14. Intelligent infrastructure for transportation and logistics	(4)
	15. Green city and urban renaissance	(3)
	16. Green building	(3)
	17. Green process technology	(2)
	18. High-efficiency light-emitting diodes / Green IT	(1)
	19. IT-combined electric machines	(3)
	20. Secondary batteries	(2)
End-of-pipe technology	21. CO_2 capture, storage and processing	(3)
	22. Non- CO_2 processing	(2)
	23. Assessment of water quality and management	(2)
	24. Alternative water resources	(2)
	25. Waste recycling	(2)
	26. R&D in monitoring and processing of hazardous substances	(3)
R&D in Virtual Reality	27. Virtual reality	(2)

(1) Technologies for short-term intensive investment;
(2) Technologies for mid-term intensive investment;
(3) Technologies for long-term intensive investment; and
(4) Technologies for long-term gradual investment.

By 2013, the government plans to build “Green Industry Complexes,” which will mainly use waste resources, green power, biomass, and other new and renewable energy sources. Finally, the government will encourage green partnerships between large and small and medium-sized companies. It is envisaged that this green partnership between the large companies and SMEs will help accelerate the development of advanced technologies for fuel efficiency and emissions reduction.

There is an effort to develop a set of cutting-edge technologies, which have the potential to promote growth in service industries and minimize impact on environment and natural resources.

These include robotics, Advanced Nano Products (ANP), IT-convergence high-tech products, biomedicines, and the telecommunications and information technologies and broadcasting services. Over the next five years, a total of 10.9 trillion won (US$ 8.5 billion) will be invested to cultivate development of these industries. In the area of telecommunication and broadcasting services, the Korean Government expects to increase the amount of exports by more than two-fold from US$ 52 billion in 2008 to US$ 123.7 billion in 2013.

2.6.2. Review

Industry accounts for a large part of the Korean economy, in proportions that are much higher than in other OECD countries. A technological transformation that reduces the carbon intensity of industry, in particular in Korea's manufacturing sector, must be a core component of a green growth strategy. There appears to be an approach relying on quick-return technologies, including those able to deliver end-of-the-pipe solutions to pollution and carbon emissions. At least 10 out of 27 core technologies identified are energy, material, and process efficiency improvement technologies. Many of these are specific to the automobile sector, including investment in the development of electric cars and intelligent infrastructure for transportation and logistics.

In the development of new and renewable energy technologies that are dearly needed to reduce the country's reliance on fossil energy, the Republic of Korea appears to be putting a clear emphasis on nuclear, solar photovoltaic and bioenergy technologies. Questions have been raised about the effectiveness of government support to specific industries and technologies, as opposed to promoting innovation based on competition among various possible technologies depending on their technical potential and economic costs and benefits. For example, silicon-based solar cells and non-silicon based solar cells figure among those technologies that will receive support for further development. In its 2006 review of Korea's energy policies[31], the International Energy Agency remarked that support provided for the development of solar photovoltaic through a feed-in-tariff was more than six times that of wind. In this sense, the government is keen on gradually reducing such feed-in-tariffs in certain sectors and is planning to introduce RPS (Renewable energy Portfolio Standard) by 2012. The RPS is expected to generate better competition among the various renewable energy technologies without "picking winners".

It is not self-evident to what extent some of the technologies included in the list of 27 core technologies quality as "green technologies", when referring to parameters such as climate change or carbon and energy-intensity. Certain technologies, including information technologies, virtual reality, and the development of a medicinal service industry, have therefore be considered in the context of a broader policy objective of promoting desirable qualitative growth and further diversification of the Korean economy into a knowledge and service economy.

A clear linkage between investment in the development of green technologies, and the phasing out of support and subsidies to fossil-based and energy-intensive technologies may need to be considered to ensure a consistent approach to technological transformation. To that effect, fiscal reforms that previous reports by UNEP and other institutions have called for need to be reaffirmed (see section on fiscal and policy measure below).

Overall, the development of green technologies is expected to generate 481,000 jobs by 2012 and 1.18 million jobs by 2020. Green technologies are projected to reduce 130 million tons of carbon dioxide emissions by 2020, which corresponds to around a quarter of the country's' total GHG emission of 594 $MtCO_{2e}$ in 2005.

3. Policy and Fiscal Reforms

In March 2009, UNEP released a report on the "Global Green New Deal"[32], which benefited from contributions from several intergovernmental and civil society organizations and experts. The report underscored the central importance of reform in the international and domestic policy architecture, in order to provide the enabling conditions for the emergence of a green economy. It recommended domestic policy reforms to substantially reduce carbon-inducing or regressive subsidies (e.g. fossil fuels) and instead to create positive fiscal and other incentives and appropriate taxes to encourage a greener economy. Domestic reforms were also discussed in order to deal with some common issues in land use and urban policy, public transport, and the pricing of carbon.

The Global Green New Deal report encouraged governments and other decision makers to capitalize on the historic opportunity presented by the financial and economic crisis by refocusing public spending and private investment in green economic sectors, such as green construction, renewable energies, sustainable transport, and water management. The report argued that an investment of 1 per cent of global GDP (i.e. approximately US$ 750 billion) over the next two years could provide the critical mass of green infrastructure needed to reduce carbon dependency and to generate a significant greening of the global economy.

3.1. Korean Green Growth plans and objectives

The Republic of Korea's green growth strategy includes a range of measures towards policy, regulatory and fiscal reforms aimed at supporting a transition to a green economy. The Five Year Plan attempts to provide policy signals on the effective control of carbon emissions. It contains measures to enhance energy and resource efficiency and to address ecosystem degradation. Climate change mitigation and adaptation, energy security, resource efficiency and waste management, water supply and water quality, flood control, and green technological innovation would be some of the measurable outcomes, were the plan to be successfully implemented.

The Korean Government has committed to injecting into the greening of its economy a total of 107.4 trillion won (US$ 83.6 billion) between 2009 and 2013. This represents 2 per cent of the Korean GDP and is twice the amount of investment suggested in the UNEP report.

The investment plan for Green Growth projects was developed in close collaboration with relevant government agencies, in particular the Korean Ministry of Strategy and Finance. The Ministry of Ministry of Strategy and Finance has given assurance that funding for green growth projects will be given priority over other funding, in order to enable a swift implementation[33].

Carefully tailored, time-bound, and targeted fiscal and financial incentives are recognized as essential in facilitating the transition towards a green economy. A range of incentives are to be offered for private sector investments. These include tax benefits to individual investors, the issuance of long-term and low-interest green bonds and savings, and the creation of a green fund aimed at facilitating access to credit by small and medium-sized enterprises. Individual investors will also be given tax exemptions on their interest income from "green bonds" and other financial products to be issued by banks. Credit guarantees for green projects will increase from 2.8 trillion won (US$ 1.9 billion) in 2009 to 7 trillion won (US$ 5.4 billion) in 2013. In addition, the government seeks to mobilize investment from pension schemes and to launch a green private equity fund.

3.2. Review

The OECD's 2006 Environmental Performance Review of Korea noted that environmental expenditure in Korea – covering expenditure for pollution abatement and control, public water supply and nature protection – reached over 2 per cent of GDP, "a relatively high level by OECD standards". The 2 per cent of GDP announced for the green growth plan represents a good indication of an effort to mobilize a sizable amount of resources for investment in green sectors and a significant re-orientation of resource allocation.

There are preliminary indicators that the Korean private sector is supportive of these initiatives. A survey of 300 Korean companies undertaken by the Federation of Korean Industries revealed that 70 per cent of the companies supported the green growth strategy and expected the strategy to improve the economy. Moreover, 41.4 per cent of the surveyed firms expressed a willingness to make investments in green growth projects. Similarly, the Korean Chamber of Commerce and Industry (KCCI) has, in general, expressed support for the government's road map[34].

The fiscal measures and incentives designed in the Korean Green Growth plan are instrumental in mobilizing green investments and can be expected to yield environmental benefits that would contribute to addressing national and global environmental challenges, while enhancing the quality of life and well-being of the Korean people. The Korean Presidential Committee on Green Growth estimates that spending US$ 83.6 billion on the Green Growth plan would stimulate production worth between US$ 141.1 billion and US$ 160.4 billion during 2009-2013 and create between 1.18 and 1.47 million jobs.

Policy and fiscal measures contained in the green growth plan are encouraging, but they need to be complemented with further reforms, particularly in sectors that consume natural capital and contribute to ecological scarcity (e.g. resource extraction and polluting activities). The Republic of Korea's indicators of carbon and energy intensity remain among the highest in the OECD. While important efforts are being made and more action is announced to enhance energy efficiency, these need to be complemented with further reforms of energy pricing, subsidies, and taxation.

The Green Growth plan envisions a reform of energy pricing to reflect full cost, which represents a step forward. However, there does not appear to be a major attempt at reforming energy subsidies that keep distorting energy markets. A UNEP report that examined Korea's energy pricing and taxation policy concluded that reforming energy subsidies and the system of energy taxation could yield environmental gains with minimal potential adverse social and economic effects[35].

Following a trend common in most OECD countries, the share of agriculture in the Korean economy decreased from 9 per cent of GDP in 1986-88 to below 3 per cent of GDP in 2006-2008. However, the Republic of Korea remains among the countries with the highest rate of producer support as a percentage of GDP within the OECD (nearly three times the average percentage of support in the OECD)[36]. Korea's CO_2 emissions and use of energy relative to its GDP and land area are among the highest, while its use of pesticides and chemical fertilizers are the highest among OECD countries. Agricultural subsidies not carefully targeted may continue to support unsustainable forms of production and run counter to the social, economic, and environmental policy goals of the Green Growth strategy.

Subsidies in the fishery sector continue to be a matter of concern. The 2006 Review by the OECD noted that the doubling of budgetary transfers to fishery policies since 2000 was mainly to preserve the marine environment. A recent Review of Fisheries in OECD Countries Policies found that half of transfers in 2004 (US$ 562 million) were used for fisheries infrastructure, such as the improvement of fishing ports; 10 per cent for resource enhancement; 10 per cent for the improvement of fish farms; and 10 per cent for the modernisation of fish markets[37]. However, it is also understood that in certain cases, fisheries subsidies meant for environmental conservation purposes may directly or indirectly contribute to over-capacity and over-fishing and should therefore be designed and implemented with caution.

In addition, where countries have succeeded in establishing effective fishery management regimes at the domestic level, distant fishing, in which Korea is involved through fishery access arrangements, presents a risk that excess capacity is transferred to other fishing grounds that often lack effective management regimes. The net effect is growing pressure on global fishing stocks that inhibit efforts to achieve a sustainable level of fishing at the global level.

4. Institutional Process and Participation

The Republic of Korea formulated its green growth strategy by relying on an institutional approach that leverages on existing as well as new structures within government. There is an ongoing effort to involve other actors in the private sector, academia and civil society; as well as measures aimed at fostering education, awareness and behavioural change among the general public.

4.1. Korean Green Growth plans and objectives

The planning and formulation of the Republic of Korea's Green Growth strategy and its five-year plan has brought about an inter-agency process that involves all government ministries. The Presidential Committee on Green Growth, established in 2009, is a fundamental pillar of this institutional set-up. With representatives from all government ministries, the private sector, academia, and civil society, the Committee has met four times since its creation and before the release of the Five-Year Plan for Green Growth.

At each ministry, a Chief Green Officer, generally at Director-General level, is the designated focal point for interacting with the Committee. Korea Environment Institute, Korea Institute for Industrial Economics and Trade, Korea Institute of Public Finance, and scholars from economics and environment circles participated in the formulation of Korea's Green Growth strategy.

Korean policy makers have sought to foster understanding and awareness of the objectives of the Green Growth strategy among the general public and to induce public action to support those objectives. Educational programmes have been developed, that focus on providing information and raising awareness to encourage behavioural change in daily consumption patterns. Measures in this area include the expansion of a "carbon labelling system" started in January 2009 and the launching of a new "green lifestyle index".

Box 2: Carbon labelling system in Korea

Since July 2008, the Korean Ministry of Environment has conducted a pilot project of carbon labelling on ten categories of products in order to promote low-carbon consumption. The carbon-labelling scheme was fully launched in January 2009. The purpose of the scheme is to show the overall amount of carbon dioxide and other greenhouse gases associated with the life-cycle of a product including production, distribution, use and disposal. Korea's Eco-Product Institute under the Ministry of Environment is in charge of the certification of low-carbon products. Manufacturers apply for the certification on a voluntary basis.

Changes in consumption patterns are also being promoted within government and the private sector. The Republic of Korea has adopted a green procurement law (the Green Consumption Enhancement Act) to increase the consumption of environmentally-friendly products by central and local government agencies. Private consumption of eco-friendly products is promoted through a "Carbon Cash-back System", which grants "carbon points" to consumers purchasing low-carbon products. Carbon points can then be exchanged for concessions at public facilities.

Additionally, a Carbon Point System is promoted to encourage households to save energy, water, and gas. About 400,000 households were participating in this program as of October 2009. There is an effort to stimulate the production of environmentally-friendly goods so as to supply products that respond to changing consumers choices. In that regard the Korean government plans to double the share of its eco-friendly agricultural products from 4.5 per cent in 2009 to 10 per cent in 2013.

4.2. Review

In the follow-up to the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, in 1992, and the adoption of Agenda 21, Korea established a Presidential Committee on Sustainable Development. The Committee included representatives of government, the private sector, academia, and civil society. It was seen as an innovative approach to promote multistakeholder involvement in the formulation and implementation of environment and sustainable development policies and was heralded by the United Nations in its review of the implementation of Agenda 21.

The new Presidential Committee on Green Growth established as an institutional mechanism for the Green Growth Strategy is structured following a relatively similar model. There is an indication that this policy and institutional process has contributed to streamlining government action. Green growth related projects that were planned under the different ministries were integrated in ways that would enable focused policy direction and provision of financial and fiscal support in a more effective manner. For example, the Korean Ministry of Strategy and Finance reported that in 2008, 267 Green Growth-related projects were submitted by 20 ministries and offices, with a total budget of 148 trillion won. The green growth planning process resulted in packaging these projects into nine core projects and 27 related industries that form the Green Growth plan.

There appears to be an effort to link the Green Growth strategy with the formulation of a long-term strategy to address climate change. If successful, this would prove that changes in economic systems can simultaneously deliver prosperity and respond adequately to the challenge of climate change.

Beyond central government agencies, there appears to an effort to promote green growth at the local level. Local governments in the Republic of Korea are developing their respective five-year plans on Green Growth, which would translate the national plan into local implementation. It is expected that through such plans, local authorities will be able to tailor green growth projects to the needs and priorities of their constituencies[38].

A series of presentations and public hearings were undertaken to introduce the green growth strategy to the Korean public. The general public and consumers can be significant drivers of change and should be actively engaged in the implementation of the green growth strategy. Further promoting a process of broad-based dialogue and consultation with a cross-section of all stakeholders could prove to be essential for the success of such transformational public policies.

5. Conclusion

Despite remarkable economic progress, the Republic of Korea is still faced with numerous sustainable development challenges that require reforms and innovative approaches in various areas of the economy. The country's energy challenges are enormous, as it imports 97 per cent of its total energy requirements. The rapid industrialization and urbanization have resulted in a significant pressure on the environment and natural resources such as forests and water resources, biodiversity and the urban environment. Freshwater scarcity remains a critical challenge facing Korea.

The Republic of Korea's carbon emissions have increased significantly during the past 15 years, making Korea one of the countries with the fastest growth of carbon emissions. Climate change presents risks of higher levels of flooding and drought, which are already costing the country billions of dollars in damage. Urgent measures are needed to address climate change both with respect to mitigation and adaptation.

In responding to these challenges, the Republic of Korea has embarked onto a major attempt to fundamentally transform the country's growth paradigm from "quantitative growth" to low-carbon, "qualitative growth"; from an economy that is based on extensive growth in labour and capital to an economy driven by investment in natural capital assets, transformational innovations and state-of-the-art technology.

The Republic of Korea responded to the financial and economic crisis in January 2009 with an economic stimulus package equivalent to US$ 38.1 billion of which 80 per cent was allocated to more efficient use of resources such as freshwater, waste, energy-efficient buildings, renewable energies, low-carbon vehicles, and development of the rail network. Beyond this immediate response to the crisis, the Korean Government has initiated a new plan to achieve transformative change through a Five-Year Plan for Green Growth. The Korean National Strategy for Green Growth has set ambitious goals for addressing climate change, enhancing energy and material efficiency, developing renewable sources of energy, promoting sustainable forms of transportation, investing in water and ecological infrastructure, and promoting a new set of green technologies as future engines of growth. It is significant in size, mobilising over US$ 83 billions or 2 per cent of GDP over five years.

The Republic of Korea is equally taking important steps in the area of policy and pricing reforms by creating a new carbon market, reviewing energy pricing, and expanding incentives for environmentally-friendly businesses and consumer behaviour. The country's unilateral decision to set a national GHG emissions reduction target is an indication of the seriousness of its resolve to respond to the challenge of climate change and to contribute to the global effort to address this challenge.

This report shows that these measures are encouraging steps in creating a policy architecture that could stimulate green investment and contribute to making such investment economically viable. UNEP encourages the stepping up of investment in addressing the key ecological scarcities facing the Korean society and economy, and to fuel a new dynamism that reorients the economy towards a green path of growth and development. To that effect, as outlined in the previous sections of this report, UNEP encourages further policy, regulatory and fiscal reform in order to remove existing policy and market distortions in areas such as energy, agriculture, and fisheries.

UNEP also encourages a careful assessment of the economic, social, and environmental costs and benefits of different strategies, policy options, or choice of projects so as to minimise potentially negative effects and maximise sustainable development gains. In that regard, effective use of environmental and sustainability assessment is warranted, given the scale and nature of certain green growth projects relating to highly sensitive ecosystems.

Achieving the fundamental changes pursued in the Korean green growth strategy requires a strong government commitment, but equally necessitates positive engagement of the private sector and civil society as stakeholders and partners. UNEP encourages a process of broad-based dialogue and consultation with a cross-section of all stakeholders in order to generate the necessary public support that could prove to be essential for the success of such transformational public policies.

6. Annexes

Annex 1: Investment in the Five-Year Plan (2009 – 2013) in billion US$

Category of action plan and policy direction	Amount of investment			
	Total	2009	2010-11	2012-13
	83.6	13.6	37.6	32.4
[1] Measures for climate change and securing energy independence	44.3	6.7	22.7	14.9
1. Reduce carbon emissions	4.4	0.8	1.7	1.9
2. Decrease energy dependence on oil and enhance energy self-sufficiency	11.6	2.2	4.4	5.1
3. Support adaptation to climate change impacts	28.3	3.7	16.7	7.9
[2] Creation of new growth engines	22.3	3.7	8.3	10.2
4. Develop green technologies as future growth engine	8.8	1.6	3.3	3.9
5. Greening of industry	3.6	0.6	1.4	1.6
6. Develop cutting-edge industries	8.5	1.2	3.0	4.2
7. Set up policy infrastructure for green growth	1.4	0.2	0.5	0.6
[3] Improving quality of life and strengthening the status of the country	21.7	4.0	8.2	9.5
8. Green city and green transport	19.7	3.7	7.4	8.6
9. Green revolution in lifestyle	1.5	0.3	0.6	0.6
10. Enhance national status as a global leader in green growth	0.5	0.1	0.2	0.2
Note: Currency rate (= Korean Won / U.S. Dollar) = 1284.7 (June 30, 2009)				

Annex 2: Investment plan for the Four Major Rivers Restoration Project "Main project" (US$ billion)

Lead ministry	**Investment**				
	Total	2009	2010	2011	2012*
Ministry of Land, Transport and Maritime Affairs	10.6	0.6	4.8	4.7	0.4
Ministry of Food, Agriculture, Forestry and Fisheries	2.2	0.1	0.4	0.8	0.9
Ministry of Environment	0.4	-	0.2	0.2	
Total	13.1	0.7	5.4	5.7	1.3
(Note) Most of the main projects are planned to be completed by 2011. * Building small dams and embanking reservoirs for increasing water storage capacity will be completed by 2012.					

Annex 3: Investment plan for the Seomjin **river and the tributaries to the four major rivers (US$ billion)**

Lead ministry	Investment				
	Total	2009	2010	2011	2012
Ministry of Land, Transport and Maritime Affairs	1.3	-	0.4	0.5	0.4
Ministry of Food, Agriculture, Forestry and Fisheries	0.2	-	-	0.1	0.1
Ministry of Environment	2.6	0.8	0.9	0.5	0.5
Total	4.1	0.8	1.2	1.2	0.9
Note: These projects are planned to be completed by 2012.					

Annex 4: Issues to address in the assessment of the usefulness and feasibility of wetland restoration projects

Assessments for the selection of appropriate wetland restoration projects should include the following questions (adapted from the Annex to Resolution VII.17):
a. Will there be environmental benefits (for example, improved water quantity and quality, reduced eutrophication, preservation of freshwater resources, biodiversity conservation, improved management of "wet resources", flood control)?

b. What is the cost-effectiveness of the proposed project? Investments and changes should in the longer term be sustainable, not yielding only temporary results. Aim for appropriate costs in the construction phase and appropriate running costs for future maintenance.

c. What options, advantages or disadvantages will the restored area provide for local people and the region? These may include health conditions, essential food and water resources, increased possibilities for recreation and ecotourism, improved scenic values, educational opportunities, conservation of cultural heritage (historic or religious sites), etc.

d. What is the ecological potential of the project? What is the present status of the area in terms of habitats and biological values, and in particular will any current features of wetland conservation or biodiversity importance be lost or damaged? How is the area expected to develop with respect to hydrology, geomorphology, water quality, plant and animal communities, etc?

e. What is the status of the area in terms of present land use? The situation will differ widely between developed countries, countries with economies in transition, and developing countries, and within such countries depending on local circumstances, with respect to the objectives of restoration and rehabilitation. In particular, marginal lands yielding few benefits in the present situation can often be improved.

f. What are the main socio-economic constraints? Is there a positive regional and local interest in realising the project?

g. What are the main technical constraints?

Source: Principles and guidelines for wetland restoration (Resolution VIII.16). "Wetlands: water, life, and culture" 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Valencia, Spain, 18-26 November 2002. Box 2. Issues to address in the assessment of the usefulness and feasibility of wetland restoration projects

Annex 5: Other Ramsar Resolutions on the conservation of tidal flats and wetlands

Res VII.21 "Enhancing the conservation and wise use of intertidal wetlands"
http://www.ramsar.org/pdf/res/key_res_vii.21e.pdf

Para. 11: CALLS upon Contracting Parties to document the extent of loss of intertidal wetlands that has occurred in the past and to inventory those intertidal wetlands which remain, and their conservation status;

Para. 14: FURTHER URGES Contracting Parties to identify and designate as Wetlands of International Importance a greater number and area of intertidal wetlands, especially tidal flats, giving priority to those sites which are important to indigenous people and local communities, and those holding globally threatened wetland species, as encouraged by Resolution VII.11; and

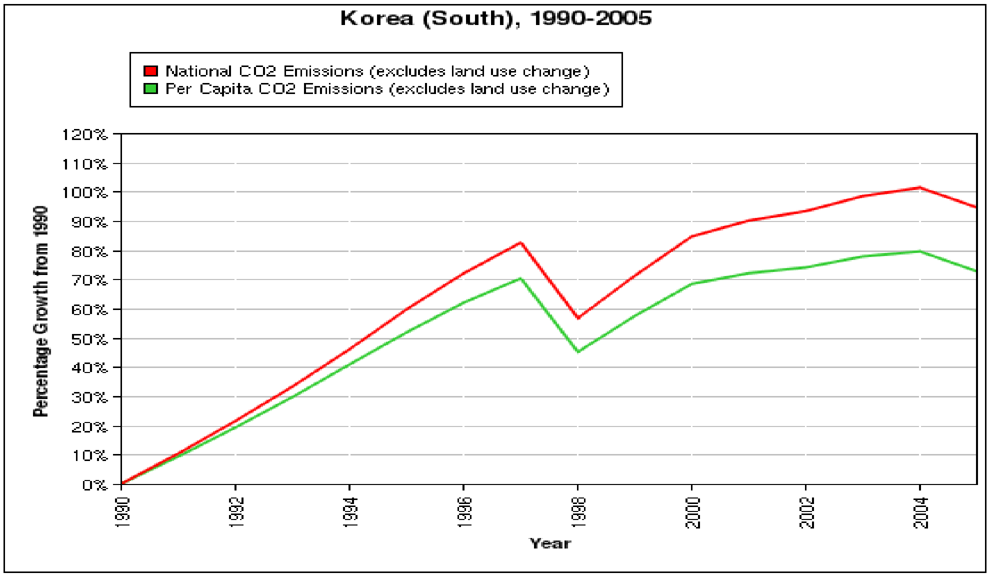
Res X.22 "Promoting international cooperation for the conservation of waterbird flyways"
http://www.ramsar.org/pdf/res/key_res_x_22_e.pdf

Para. 22: WELCOMES the statement by the Republic of Korea to the 35th meeting of Ramsar's Standing Committee that intertidal mudflats should be preserved and that no large-scale reclamation projects are now being approved in the Republic of Korea, and ENCOURAGES all Contracting Parties in their efforts to protect such habitats in future and to monitor them and mitigate any past development impacts on or losses to them.

Res VIII.4 "Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)"
http://www.ramsar.org/pdf/res/key_res_viii_04_e.pdf

Para. 14: Urges Contracting Parties to ensure that coastal wetlands and their values and functions for human well-being, including their role in mitigating the impacts of climate change and sea-level rise and their importance for the conservation of biological diversity are fully recognized in planning and decision-making in the coastal zone, including through ICZM initiatives.

Annex 6: National and per capita CO_2 emissions, 1990-2005 (excluding land use change)



Source: World Resources Institute. The Climate Analysis Indicators Tool (CAIT).

ACRONYMS

ANP	Advanced Nano Products
BOD	Biological Oxygen Demand
CAIT	Climate Analysis Indicators Tool
CCS	Carbon Capture and Storage
CH_4	Methane
CO_2	Carbon dioxide
GDP	Gross Domestic Product
EPI	Environmental Performance Index
ERP	The Eco-river Restoration Programme
FIA	Fédération Internationale de l'Automobile
GFEI	The Global Fuel Economy Initiative
GHG	Greenhouse Gas
GND	Green New Deal
H_2	Hydrogen
HFCs	HFCs
IEA	International Energy Agency
ILO	International Labour Organization
IOE	International Organisation of Employers
IPCC	The Intergovernmental Panel on Climate Change
ITUC	International Trade Union Confederation
Kwh	kilowatt hour
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
MLTM	Ministry of Land, Transport and Maritime Affairs
MOCT	Ministry of Culture, Sports and Tourism
MOFAFF	Ministry of Food, Agriculture, Forestry and Fisheries
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation Development's
PFCs	Perfluorocarbons
PPM	parts per million
RFS	Renewable Fuel Standard

RPS	Renewable Portfolio Standard
R&D	Research and Development
SF6	Sulfur Hexafluoride
SMEs	Small and Medium Enterprises
TMS	Tele-Monitoring System
TEEB	The Economics of Ecosystems and Biodiversity
TOE	Ton of oil equivalent
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change

Endnotes

[1] Green Economy: For UNEP, a "green economy" can be defined as a system of economic activities related to the production, distribution, and consumption of goods and services that result in improved human well-being over the long term, while not exposing future generations to significant environmental risks and ecological scarcities. A green economy is characterized by substantially increased investments in green sectors, supported by enabling policy reforms. These investments, both public and private, provide the mechanism for the reconfiguration of businesses, infrastructure and institutions, and the adoption of sustainable consumption and production processes. Such reconfiguration will lead to a higher share of green sectors in the economy, more green and decent jobs, reduced energy and material intensities in production processes, less waste and pollution, and significantly reduced greenhouse gas emissions. While it will be necessary to measure progress towards a green economy, it is counter-productive to develop generic green economy indicators applicable to all countries given differences in natural, human, and economic resources. Rather, focusing on the process of transitioning to a green economy acknowledges that countries will take many different paths in achieving this objective, and recognizes that a green economy in one country may look quite different than a green economy in another country.

Green Jobs: Green jobs reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable. Green jobs can include work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment. Green jobs are found in many sectors of the economy from energy supply to recycling and from agriculture and construction to transportation. They help to cut the consumption of energy, raw materials and water through high-efficiency strategies, to de-carbonize the economy and reduce greenhouse‑gas emissions, to minimize or avoid altogether all forms of waste and pollution, to protect and restore ecosystems and biodiversity. Green jobs play a crucial role in reducing the environmental footprint of economic activity. This reduction is gradual and the different jobs contribute to different degrees. Workers manufacturing fuel-efficient or hybrid cars, for example, contribute less to reducing emissions from transport than those working in public transport systems. Moreover, what is considered fuel-efficient today will no longer qualify in ten years' time. The notion of a green job is thus not absolute, but there are "shades" of green and the notion will evolve over time (see UNEP, ILO, IOE, and ITUC (2008). Green Jobs: Towards decent work in a sustainable, low-carbon world. September, United Nations Environment Programme, accessible at:
http://www.unep.org/greeneconomy/GreenJobs/tabid/1377/language/en-US/Default.aspx

[2] The concept of "Green Growth" was first adopted at the "Ministerial Conference on Environment and Development" jointly hosted by the Ministry of Environment of the Republic of Korea and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2005. It was initiated by Republic of Korea, the host country, and included in the outcome of the Conference, "Seoul Initiative Network on Green Growth". Source: Korea Ministry of Environment.

[3] Robins, N., Clover, R. and C. Singh (2009). *Building a Green Recovery*. May. HSBC Global Research, New York.

[4] Robins, N., Clover, R. and C. Singh (2009). *A Global Green Recovery ? Yes, but in 2010*. August. HSBC Global Research, London.

[5] The Republic of Korea Ministry of Strategy and Finance. Briefing on the Green New Deal.

[6] OECD.Stat.Extracts. Key Short-Term Economic Indicators: *Quarterly National Accounts (GDP Constant Prices).* Data extracted on 9 September 2009 at http://stats.oecd.org/Index.aspx?DatasetCode=SNA_TABLE1
[7] The Republic of Korea Ministry of Strategy and Finance. Briefing on the Green New Deal.
[8] 2005 input-output tables, the most up-to-date input-output tables as of 2009, were used in the calculation.
[9] National Emergency Management Agency, Republic of Korea. Accessible at: http://eng.greatkorea.go.kr/1/1-1.asp
[10] IEA (2006) *Energy Policies of IEA Countries: The Republic of Korea. 2006 Review.* Paris: International Energy Agency. http://www.iea.org/textbase/nppdf/free/2006/korea2006.pdf
[11] OECD (2006) Environment Performance Review of Korea. Paris: OECD.
[12] Korea.net, Seoul maps out plans to cut greenhouse gas emissions. 5 August 2009. http://www.korea.net/.
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[14] The Economics of Ecosystems and Biodiversity: http://www.teebweb.org/
[15] IEA (2009). Key World Energy Statistics 2009. Paris; International Energy Agency.
[16] International Atomic Energy Agency, April 2010.
[17] IEA, 2006. Op. cit.
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[21] Korea Ministry of Land, Transport and Maritime Affairs, http://www.uncrd.or.jp/env/4th-regional-est-forum/Presentations/07_BS2_Korea.pdf
[22] IEA, 2006. Op. cit.
[23] UNEP (2009). Global Green New Deal: A Policy Brief. http://www.unep.org/pdf/A_Global_Green_New_Deal_Policy_Brief.pdf
[24] UNEP, ILO, IOE and ITUC, 2008. Op. Cit.
[25] OECD (2006) Environment Performance Review of Korea. Paris: OECD.
[26] South Korea Ministry of Land, Transport and Maritime Affairs and the Ministry of Environment, 2009
[27] The initial budget of 16.9 trillion won (US$ 13.1 billion) announced in January 2009 was increased to 22 trillion Won (US$ 17.3 billion) when the Five Year Plan was released in July 2009. Korean officials have explained this increase in the total funding of the project by its expansion beyond the four main rivers and the inclusion of the estuaries to the four rivers.
[28] The Environmental Impact Statement (EIS) was prepared by the Regional Construction Management Administration after collecting opinions from various stakeholders. The EIS includes the anticipated and assessed environmental impacts. The draft was shared with the local residents, environmental organizations, and relevant experts to gather diverse opinions for 20 days. The EIS was then submitted to the Regional Basic Environmental Offices, under the authority of the Ministry of Environment. To verify feasibilities of the EIS, Korea Environment Institute (KEI) and the Environmental Assessment Team comprised of independent experts were entrusted for review of the EIS. The final EIS agreement was set after the opinions of KEI were considered. The final EIS, agreed by the Regional Basic Environmental Offices and the Regional Construction

Management Administration, covers four categories (ecosystem, natural environment, water quality, and others) in short.

[29] Res X.19 "Wetlands and river basin management: consolidated scientific and technical guidance", includes under its Guidelines Box N the following:
N3. Carry out Environmental Impact Assessment (EIA) and Cost Benefit Analysis (CBA) studies for land use or water development projects which may have significant impacts on rivers and wetlands, using independent multidisciplinary teams and in consultation with all stakeholders, and consider alternative proposals including the no-development option; and
N4. Disseminate the findings of any EIA and CBA in a form that can be readily understood by all stakeholders.

[30] This Resolution recognizes the services that wetlands provide to climate change mitigation (Res X.24; para. 1), especially in acting as carbon stores (Res X.24; para. 8).

[31] IEA, 2006. Op. cit.

[32] Barbier, E.B. (2009). A Global Green New Deal. Report prepared for the Economics and Trade Branch, Division of Technology, Industry and Economics, United Nations Environment Programme. Geneva, April. Available at http://www.unep.org/greeneconomy/docs/GGND-Report-April2009.pdf, UNEP (2009). Global Green New Deal: A Policy Brief. http://www.unep.org/pdf/A_Global_Green_New_Deal_Policy_Brief.pdf

[33] Communication from a meeting with representatives of the Presidential Committee on Green Growth, 29 July 2009.

[34] Communication from a meeting with representatives of the Korean Chamber of Commerce and Industry, Business Institute for Sustainable Development on 30 July 2009.

[35] UNEP and United Nations Foundation (2004). Energy Subsidies: Lessons Learned in Assessing their Impact and Designing Policy Responses.
http://www.unep.ch/etb/publications/energySubsidies/Energysubreport.pdf

[36] OECD (2009). Agricultural Policies in OECD Countries: Monitoring and Evaluation. Highlights.
http://www.oecd.org/dataoecd/37/16/43239979.pdf

[37] OECD (2009), *Review of Fisheries in OECD Countries Policies and Summary Statistics 2008.* Paris: OECD.

[38] In a bid to familiarize central and local government officials with the concept of green growth, the Korean Prime Minister has led a series of 19 lectures on green growth to government officials. Five such lectures were directed at central government officials and 14 to local government officials. Altogether, over 5,000 central and local government officials attended those sessions.

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ECONOMICS DEPARTMENT WORKING PAPERS No. 798

by Randall S. Jones and Byungseo Yoo

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ABSTRACT/RÉSUMÉ

Korea's green growth strategy: mitigating climate change and developing new growth engines

Korea's greenhouse gas emissions almost doubled between 1990 and 2005, the highest growth rate in the OECD area. Korea recently set a target of reducing emissions by 30% by 2020 relative to a "business as usual" baseline, implying a 4% cut from the 2005 level. Achieving this objective in a cost-effective manner requires moving from a strategy based on voluntary commitments by firms to market-based instruments. The priority is to establish a comprehensive cap-and-trade scheme, supplemented, if necessary, by carbon taxes in areas not covered by trading. Achieving a significant cut in emissions requires a shift from energy-intensive industries to low-carbon ones. Korea is strongly committed to promoting green growth through its Five-Year Plan, which envisages spending 2% of GDP per year through 2013. One challenge is to ensure that these expenditures are efficiently targeted so as to develop green technologies, while avoiding the risks inherent in industrial policy.

This Working Paper relates to the 2010 *OECD Economic Survey of Korea*
(www.oecd.org/eco/surveys/korea)
JEL classification: Q28, Q48, Q54, Q56, Q58
Keywords: Korean economy; climate change; greenhouse gas emissions; Kyoto protocol; green growth; emissions trading system; environmental taxes; energy subsidies; renewable energy; Clean Development Mechanism; carbon tax; energy efficiency; R&D; green certificates; National Strategy for Green Growth.

Stratégie de croissance verte pour la Corée : lutter contre le changement climatique et tirer parti des nouvelles sources de croissance

Les émissions de gaz à effet de serre ont pratiquement doublé en Corée entre 1990 et 2005, soit la progression la plus forte dans la zone de l'OCDE. La Corée s'est récemment fixé un objectif de réduction des émissions de 30 % en 2020 par rapport au statu quo, ce qui représente une baisse de 4 % par rapport au niveau de 2005. Pour réaliser cet objectif avec le meilleur rapport coût/efficacité possible, il faut passer d'une stratégie reposant sur des engagements volontaires des entreprises à la mise en place d'instruments de marché. La priorité est d'établir un dispositif complet de plafonnement et transfert, complété, si nécessaire, par une taxe sur le carbone dans les secteurs qui ne sont pas couverts par des permis d'émission. Réduire sensiblement les émissions implique de privilégier les industries sobres en carbone par rapport à celles à forte intensité énergétique. La Corée est déterminée à promouvoir la croissance verte via son plan quinquennal, qui prévoit de dépenser à cet effet 2 % du PIB par an jusqu'en 2013. L'un des principaux enjeux est de veiller à ce que ces dépenses soient efficacement ciblées sur le développement des technologies vertes tout en évitant les risques que présente toute politique industrielle.

Ce Document de travail a trait à l'*Étude économique de l'OCDE de la Corée*, 2010
(www.oecd.org/eco/etudes/coree).
Classification JEL: Q28, Q48, Q54, Q56, Q58
Mots clés: économie coréenne ; changement climatique ; émissions de gaz à effet de serre ; Protocole de Kyoto ; croissance verte ; système d'échange de permis d'émission ; taxes environnementales ; subventions d'énergie ; énergies renouvelables ; Mécanisme pour un développement propre ; taxes carbone ; efficacité énergétique ; R-D; certificats verts ; Stratégie nationale pour la croissance verte.

TABLE OF CONTENTS

Tables

Figures

Boxes

KOREA'S GREEN GROWTH STRATEGY: MITIGATING CLIMATE CHANGE AND DEVELOPING NEW GROWTH ENGINES

Randall S. Jones and Byungseo Yoo[1]

Korea is strongly committed to promoting green growth. On the 60th anniversary of the founding of the Republic of Korea in August 2008, the President proclaimed "Low Carbon/Green Growth" as the nation's vision to guide development during the next 50 years.[2] In order to implement this vision, the government announced in July 2009 the "National Strategy for Green Growth" up to 2050, which includes mitigating climate change, creating new engines for economic growth and improving the quality of life (Box 1).[3] This paper analyses policies to implement these strategies. Policy recommendations are summarised in Box 3 at the end of the paper.

Mitigating climate change

Climate change is one of the key challenges facing the world in the 21st century with serious environmental and economic implications. While there are significant uncertainties about the cost of inaction, it would undoubtedly be immense as sea levels rise, agricultural yields decline and infectious diseases become more prevalent.[4] Climate change risks unpredictable and irreversible damage worldwide.

In August 2009, the government presented the options of cutting GHG emissions by 21%, 27% or 30% relative to the projected level in 2020, which is based on a "business-as-usual" (BAU) scenario of a 36.9% rise in emissions between 2005 and 2020 (Figure 1).[5] Relative to 2005, the three options imply an 8% increase in emissions, no change or a 4% cut, respectively. After analysing the scenarios on the basis of

1. Randall S. Jones is head of the Korea/Japan Desk in the Economics Department of the OECD and Byungseo Yoo is a senior economist on that desk. This paper initially appeared as a chapter in the *OECD Economic Survey of Korea* published in June 2010 under the responsibility of the Economic and Development Review Committee. The authors would like to thank Anne Carblanc, Andrew Dean, Alain de Serres, Jane Ellis, Robert Ford, Brendan Gillespie, Vincent Koen, Dirk Pilat and Masahiko Tsutsumi for comments on earlier drafts. Special thanks go to Lutécia Daniel for technical assistance and Nadine Dufour and Pascal Halim for editorial assistance.

2. Korea also pushed for green growth to feature prominently on the agenda of international organisations. In 2005, the "Seoul Initiative Network on Green Growth" was adopted at the Ministerial Conference of the United Nations Economic and Social Commission for Asia and the Pacific. In addition, Korea chaired the 2009 OECD Ministerial Council Meeting that adopted the "Green Growth Declaration".

3. The government set a target of reducing energy intensity by one-third from the 2006 level by 2020, reaching the OECD average. This paper will not explicitly discuss increasing energy independence as it will be a natural consequence of mitigating climate change and shifting to a low-carbon economy.

4. Recent assessments show a permanent 14% loss in average world consumption per capita from both market and non-market impacts (Stern, 2007).

5. The BAU baseline makes assumptions on oil prices (from the Energy Information Agency), population (official projection) and economic growth (Korea Development Institute).

Korea's capacity to make reductions and the subsequent macroeconomic impact, the Cabinet selected the most ambitious option of a 30% reduction by 2020 relative to the BAU baseline, despite the industrial sector's concern about the possible negative impact on their international competitiveness. The 2020 targets for Japan, the United States and the EU are for still larger emission reductions of approximately 30%, 17% and 13%, respectively, relative to 2005. Korea's mid-term target is thus positioned between the advanced countries and developing countries. Mexico also pledged to reduce emissions by up to 30% relative to its BAU baseline by 2020, on the condition of adequate financial and technology transfer mechanisms from developed countries. In contrast, Korea's target is not conditional on international agreements and support. Although not legally binding, the target should help guide Korea's climate change policy framework. After examining the level of energy use and greenhouse gas (GHG) emissions, this section looks at Korea's current policy framework and then proposes new measures to achieve the mid-term target.

Box 1. The National Strategy for Green Growth (announced in July 2009)

Three objectives:

1. Promote a synergistic relationship between economic growth and environmental protection.
2. Improve people's quality of life and promote a green revolution in their lifestyles.
3. Contribute to international efforts to fight climate change and other environmental threats.

Three strategies:

1. Mitigating climate change and promoting energy independence.
2. Creating new engines for economic growth.
3. Improving the quality of life and enhancing Korea's international standing.

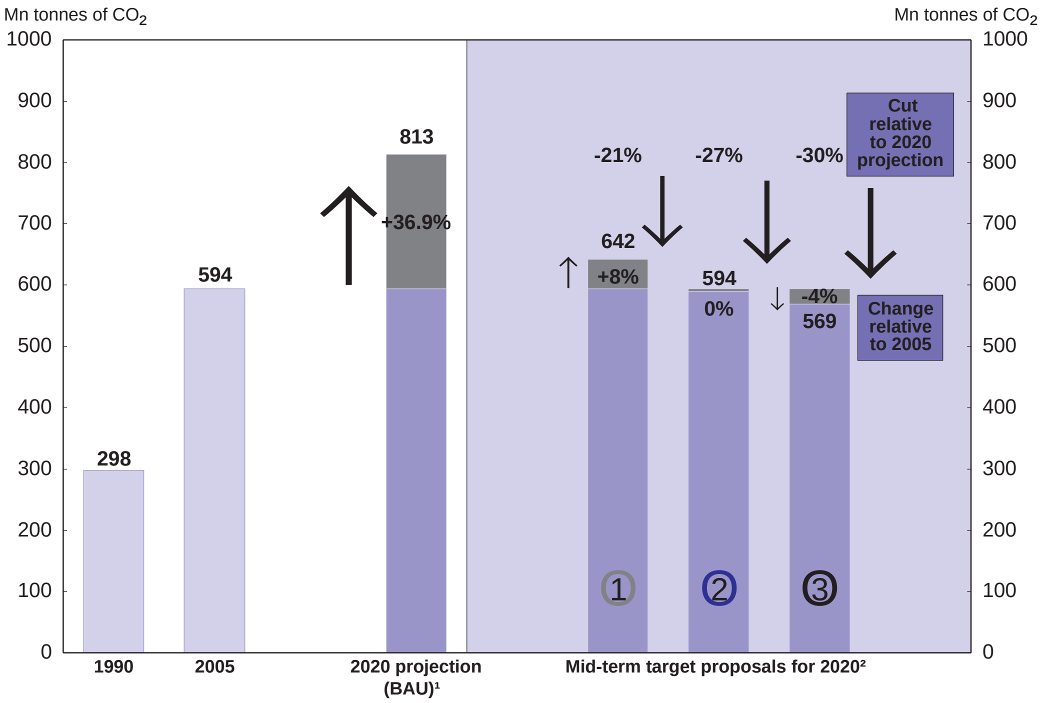
Ten policy agendas to achieve the three strategies:

1. *Effective mitigation of greenhouse gas emissions*: the government will pursue mitigation strategies for buildings, transport and industry, require reporting on emissions and promote forestation.
2. *Reduction in the use of fossil fuels and the enhancement of energy independence*: Korea will reduce energy intensity to the OECD average, increase the use of renewable energy and expand nuclear power capacity.
3. *Strengthening the capacity to adapt to climate change*: Korea will launch the "Four Major Rivers Restoration Project" and increase the share of "environmentally friendly" agricultural products to 18% by 2020.
4. *Development of green technologies*: The government will pursue the development of important green technologies, boosting its world market share in the relevant sectors to 8% within five years.
5. *The "greening" of existing industries and promotion of green industries*: Exports of green goods in the major industries will rise from 10% in 2009 to 22% in 2020 and the government will help small and medium-sized enterprises (SMEs) green their business.
6. *Advancement of the industrial structure to increase the role of services*: the government will develop health care, education, finance, contents industry, software and tourism as the core of high value-added services.
7. *Engineering a structural basis for the green economy*: The government will gradually introduce an emissions trading system, make the tax system greener and extend public credit guarantees to green industry.
8. *Greening land and water and building the green transport infrastructure*: The share of passenger travel by rail will rise from 18% in 2009 to 26% in 2020, and metropolitan mass transit from 50% to 65% over the same period.
9. *Bringing the green revolution into our daily lives*: Carbon footprint labeling will be enacted, the government will increase mandatory procurement of green goods and education on green growth will be expanded.
10. *Becoming a role-model for the international community as a green growth leader:* Korea will actively engage in international climate-change negotiations and increase the share of green ODA from 11% to 30% in 2020.

Overview of energy use and greenhouse gas emission trends in Korea

Korea's energy intensity was a quarter above the OECD average in 2008 and the fourth highest in the OECD area (Figure 2).[6] During the period of rapid economic growth between 1971 and 1997, energy use increased at an 8.8% annual rate, led by the commercial and transport sectors (Table 1). Energy intensity, which was 42% below the OECD average in 1971, peaked during the 1997 crisis. The crisis proved to be a turning point for energy consumption growth, which decelerated to a 3.3% pace during the following decade, leading to a marked fall in energy intensity. Moreover, the main drivers of energy consumption shifted to the residential sector, reflecting higher living standards, and the industrial sector, as exports recorded double-digit growth rates. By 2007, the industrial sector accounted for about half of energy use in Korea, followed by the transport, residential and commercial sectors.

Figure 1. The mid-term target scenario for reducing greenhouse gas emissions in Korea



1. Business-as-usual scenario based on assumptions about population, oil prices and economic growth.
2. The three options were introduced in August 2009 and option three was chosen in November.

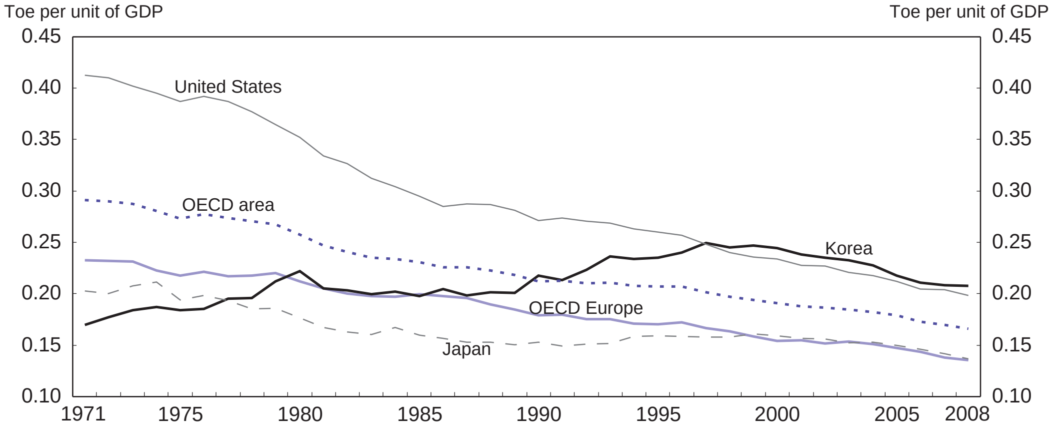
Source: Presidential Committee on Green Growth (2009a).

Korea's GHG emissions accounted for 1.3% of the world total in 2005, making it the 15th-largest emitter in the world and ninth in the OECD area (Figure 3). While Korea's emissions almost doubled between 1990 and 2005, 83% of the increase occurred by 2000. On a per capita basis, Korea's emissions rose by 71.6% over the period 1990 to 2005, far outstripping the OECD average of 2.1% (Table 2, Panel A). The growth in GHG emissions per capita can be explained by changes in per capita income, energy intensity and GHG emissions per unit of energy. The large increase in GHG emissions per capita was primarily a result of rapid economic growth, which doubled per capita income (second column). Moreover, the 2.3% decline in energy intensity (third column) was much less than the OECD average of

6. Energy intensity – total primary energy supply (TPES) divided by GDP – is affected by many non-energy factors such as climate, geography, travel distance, home size and manufacturing structure.

15.3%. These factors were partially offset by a relatively large fall of 12.7% in GHG emissions per unit of energy (fourth column), reflecting greater use of natural gas and nuclear power.[7]

Figure 2. Korea has become one of the most energy-intensive economies in the OECD area
Tonnes of energy per unit of GDP in thousand 2000 US$ using PPP exchange rates



Source: IEA/OECD (2009a), *Energy Balances of OECD Countries 2009*, IEA/OECD, Paris.

Despite the rapid increase, the level of per capita GHG emissions in Korea in 2005 was more than one-fifth below the OECD average (Panel B, first column). This is explained by Korea's relatively low level of GDP per capita (second column) and GHG emissions per unit of energy (fourth column), which more than offset the impact of above-average energy intensity (third column). These figures point to the conclusion that cutting energy intensity, notably by reducing the weight of energy-intensive industries in the economy, is key to slowing the growth of GHG emissions in Korea and keeping the level below the OECD average. The greening of existing industries – where there is significant scope to do so – may also help.

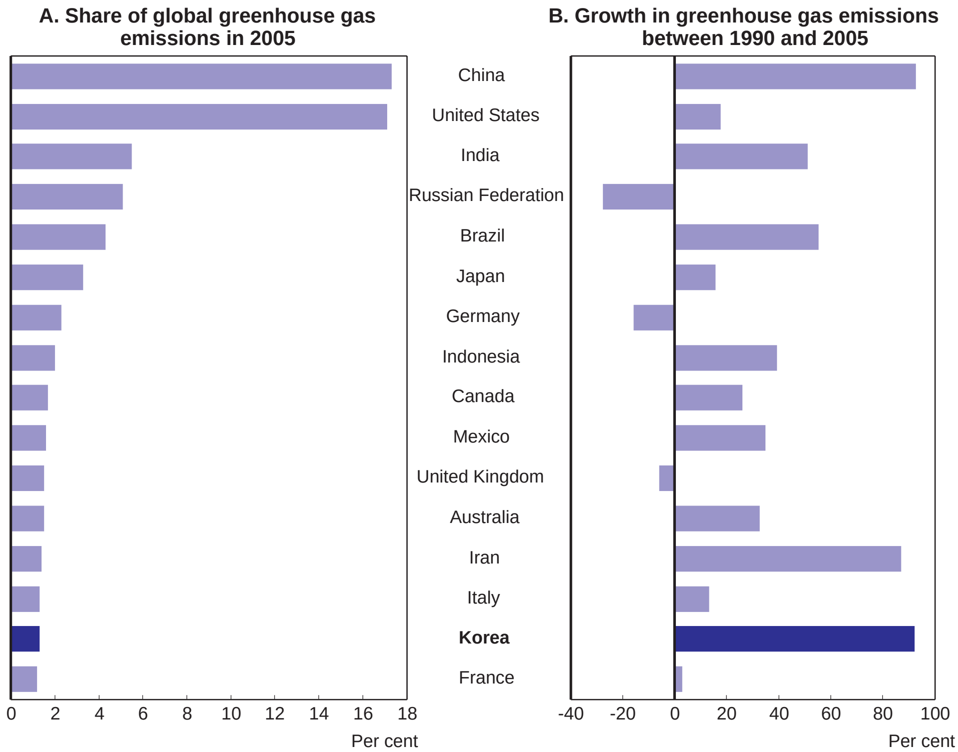
Table 1. Trends in final energy consumption in Korea

	Average annual growth rate (per cent)			Composition (per cent)			Percentage-point change 1997-2007
	1971-97	1998-2007	1971-2007	1971	1997	2007	
Industry	8.9	4.0	7.3	43.9	45.0	51.7	6.7
Transport	10.6	2.2	7.7	15.6	23.7	20.6	-3.1
Residential	3.2	6.9	3.8	35.3	9.0	12.6	3.5
Commercial	15.1	0.9	10.2	4.1	17.6	12.5	-5.1
Other	14.8	-1.9	9.3	1.2	4.7	2.7	-2.0
Total	8.8	3.3	6.8	100.0	100.0	100.0	0.0

Source: IEA/OECD (2009a),Energy Balances of OECD Countries 2009, IEA/OECD, Paris.

7. The shares of natural gas and nuclear energy in TPES increased by 10 percentage points (3% to 13%) and 3 percentage points (15% to 18%), respectively, between 1990 and 2005. CO_2 emissions from natural gas are less than a quarter of that from oil.

Figure 3. International comparison of greenhouse gas emissions



Source: *OECD Environmental Database*.

Korea's policy measures to address climate change

Korea ratified the Kyoto Protocol to the UN Framework Convention on Climate Change in 2002 as a non-Annex I country, meaning that it had no obligation to set a specific GHG reduction target for 2008 to 2012. Nevertheless, as required by all parties under the Framework Convention, Korea has implemented polices to combat climate change since the establishment of its Committee on Climate Change Response in 1999. The key measures are discussed below.

Voluntary and negotiated agreement systems

The National Committee on Saving Energy launched a voluntary agreement system in 1998 to encourage energy efficiency in the business sector. Firms that participate in the programme sign agreements with the government specifying their voluntary energy conservation and GHG emissions reduction targets, as well as their timelines and strategies, which are monitored by the government. In return, the firms are eligible for low interest-rate loans on energy-saving facilities, tax benefits and technical support. By 2008, a cumulative total of 19 million tonnes of energy (toe) had been saved, equivalent to a 58 million tonne reduction in CO_2 emissions (around 10% of annual emissions). Cost savings during the decade amounted to 0.6% of GDP for the participating firms, which increased from 46 in 1998 to 1 323 in 2008. Although voluntary approaches are not cost-effective in addressing environmental externalities, they can reveal information about abatement costs and environmental damage at an early stage (de Serres *et al*., 2010).

Table 2. Decomposition of greenhouse gas emission trends[1]

A. Percentage change between 1990 and 2005

	GHG emissions/population[2]	GDP/population[3]	Energy/GDP[4]	GHG emissions/energy[5]
Canada	8.2	29.7	-15.6	-1.2
France	-4.7	22.1	-9.2	-14.0
Germany	-19.0	21.9	-19.8	-17.2
Italy	9.6	17.3	3.0	-9.3
Japan	11.8	16.7	-4.0	-0.2
Korea	**71.6**	**101.1**	**-2.3**	**-12.7**
United Kingdom	-10.6	36.5	-22.1	-15.9
United States	-0.9	30.8	-21.4	-3.5
OECD average	**2.1**	**28.9**	**-15.3**	**-6.5**

B. Level in 2005

	GHG emissions/population[2]	GDP/population[3]	Energy/GDP[4]	GHG emissions/energy[5]
Canada	23.1	30.6	0.206	3.7
France	8.6	26.5	0.105	3.1
Germany	12.0	26.6	0.114	4.0
Italy	9.7	25.7	0.096	3.9
Japan	11.2	27.1	0.102	4.0
Korea	**11.6**	**20.1**	**0.149**	**3.1**
United Kingdom	11.1	28.2	0.095	4.1
United States	25.0	36.9	0.145	4.7
OECD average	**14.4**	**25.8**	**0.127**	**4.4**

1. GHG emissions/population = (GDP/population) * (Energy/GDP)* (GHG emissions/energy).
2. In tCO_2 eq per head.
3. In thousand 2000 US$ using PPP exchange rates.
4. For total final energy consumption in ktoe/ billion 2000 US$ using PPP exchange rates.
5. For total final energy consumption in Mt CO_2eq / ktoe.

Source: IEA and OECD calculations.

The government launched a pilot project of mandatory negotiated agreements on energy use in 2010. It includes 38 firms, covering 41% of total energy consumption in the industrial sector. The negotiations resulted in agreements to reduce energy use by 3.7% (relative to the average of 2007-09) between 2010 and 2012, which is greater than the 3% cut that they originally proposed. This system will be replaced by the GHG and Energy Target Management System. Under this approach, companies in power generation, manufacturing, construction, waste management and transport will negotiate targets with the government, subject to penalties in case of failure to meet the targets.

Energy-efficiency programmes

Korea has introduced three energy-efficiency programmes for electronics and appliances:

- *Mandatory energy-efficiency standards and labelling* (1992): 23 items are currently subject to energy-efficiency standards, including refrigerators, air conditioners, washing machines and dishwashers, which require them to achieve at least a minimum level of efficiency in order to be sold. Energy-efficiency ratings are attached to products to encourage consumers to choose energy-efficient products and firms to manufacture or import them.

- *The high-efficiency appliance certification* (1996): the government awards labels to products with energy-efficiency levels that are higher than those required by law. A total of 46 items are subject to certification, including converters, LED lighting systems and oil-fired hot-water heaters.

- *Standby electricity reduction programme* (1999): manufacturers are encouraged to make products that automatically switch to power-saving mode when not in use in order to minimise standby electricity consumption. The government grants labels for 20 home electronic and office equipment products, such as televisions, microwaves, computers and printers, which meet the official standard. Warning labels are applied to products that fail to meet the standard.

In order to save fuel and reduce GHG emissions by cars, the government launched the Average Fuel Economy (AFE) regulation in January 2006, patterned on the US Corporate Average Fuel Economy (CAFE) system. Under Korea's regulation, the average fuel economy of all cars sold by a manufacturer over one year must meet the standards, which depend on engine capacity. This system boosted average fuel economy by 6.6% (10.8 to 11.5 km/litre) between 2006 and 2008 and reduced CO_2 emissions by 7.3%.

Clean Development Mechanism and the carbon market

The Clean Development Mechanism (CDM) is one of three programmes introduced by the Kyoto Protocol, which together with emissions trading and Joint Implementation (JI),[8] constitute the official international carbon market.[9] The CDM, which was launched in 2001, allows emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. CERs can be traded and used by Annex I countries to meet a part of their emission reduction targets under the Kyoto Protocol.[10] Korea, as a non-Annex I country, has been actively involved in the CDM since unilateral projects – those funded by developing countries' own money and not by Annex-1 countries – were allowed in 2005. Korean investment companies own the CERs and can sell them to any Annex-1 country in the market. Korea has 35 projects registered, with renewable energy projects accounting for a third of them.[11] Another 47 projects are in the process of registration. As of February 2010, the UNFCCC expected Korea's registered projects to reduce CO_2 equivalent by an average of 15 million tonnes per year, accounting for 4.4% of the total, ranking Korea fourth behind China (59%), India (12%) and Brazil (6%).

Since 2005, the government has been operating a voluntary carbon market called Korea Certified Emissions Reductions (KCERs), which is open to firms that that have reduced CO_2 emissions by more than 500 tonnes a year through improved energy efficiency and production processes and investment in renewable energy development. Companies receive KCERs for their voluntary GHG reduction projects, which can be traded in the market or purchased for around 5 000 won (about $4.50) per tonne. In practice, there are few buyers given the lack of a domestic reduction obligation, so the government buys most KCERs to promote and compensate measures to reduce GHG emissions. As of the end of 2009,

8. Like the CDM, JI is a project-based mechanism that feeds the carbon market by enabling industrialised countries to carry out joint implementation projects with other developed countries.

9. The global carbon market doubled from $63 billion in 2007 to $126 billion in 2008. The allowance market occupied three-quarters while the project market, including CDM, accounted for the remaining quarter.

10. The projects are registered with the UNFCCC and pass through a rigorous process designed to ensure real and measurable emission reductions that are additional to what would have occurred without the project.

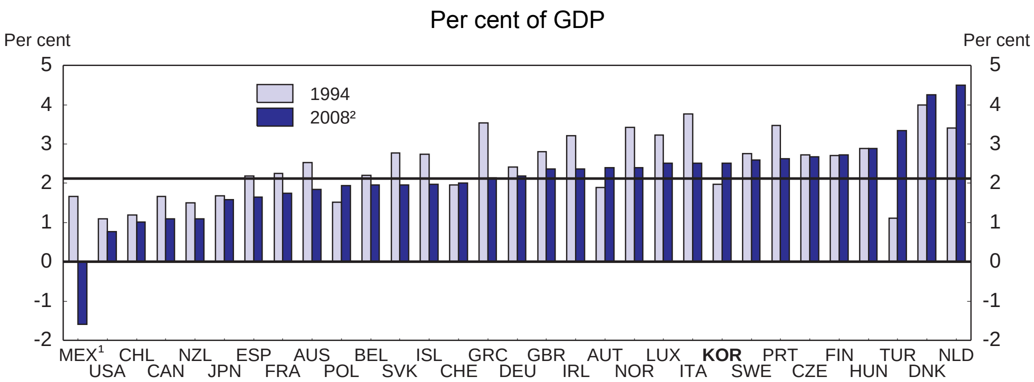
11. As of February 2010, a total of 2 209 projects has been registered, with anticipated annual CERs amounting to 342 million tonnes of CO_2 equivalent.

287 projects had generated 5.6 million KCERs, out of which 4.7 million had been purchased by the government for 23 billion won ($20 million). The government also launched a carbon fund of 105 billion won with the participation of private money in 2007 to invest in CDM projects and purchase CERs or allowances.

Environmental taxes

Revenue from environmental taxes in Korea increased from 2% of GDP in 1994 to 2.5% in 2008, thus surpassing the OECD average, which actually decreased slightly over the same period (Figure 4). Given Korea's low overall tax burden, environmental taxes accounted for 9.5% of total tax revenue, well above the OECD average of 5.4%. The rising share in Korea reflects tax reforms to encourage energy conservation and protect the environment. Between 2001 and 2007, the government raised the tax on diesel by 2.4 times in real terms and the tax on LPG butane by 6.8 times. Heavy oil for industrial uses, which had been tax-exempt in order to support industry despite its highly polluting effect on the environment, became subject to taxation in 2001. By 2009, the tax had been raised five-fold in real terms, but still amounted to only about 3% of the price.

Figure 4. Revenues from environmental taxes



1. In Mexico, consumer prices on motor vehicle fuels are held more or less constant, in spite of large variations in world market prices. In years when world market prices are high, the excise tax on fuels turns into a subsidy – equalling 1.8% of GDP in 2008.
2. Arithmetic average. The weighted average was 1.6%.

Source: *OECD/EEA Database on instruments used for environmental policy.*

The share of taxes in energy prices in Korea is relatively high compared to North America and Japan, although less than in Europe (Table 3). Overall prices for diesel, gasoline and light fuel for households and industry in Korea are significantly higher than the OECD average, regardless of whether purchasing power parity or market exchange rates are used. For example, the price of gasoline is 2.8 times higher than the OECD average using the former and 72% higher using the latter. The higher prices have helped to slow the growth of Korea's energy consumption and GHG emissions during the past decade. However, 80% of the revenue from the transport-energy-environment tax, which covers gasoline and diesel, is earmarked for transport infrastructure, primarily roads, thus undermining the effectiveness of energy taxation. Investment in railroads, a more energy-efficient mode of transport, is limited to one-fifth of total earmarked revenue. Energy taxation should be improved by removing earmarking to allow a more efficient allocation of the budget, particularly in the context of the need for fiscal consolidation.

Table 3. Share of taxes in energy prices
Per cent of total price

	Asia		North America		Europe			OECD average
	Korea	Japan	USA	Mexico	France	Germany	UK	
A. Share of taxes (in per cent) in 2009[1]								
Diesel	46.7	36.3	21.0	15.1	59.1	59.0	65.4	--
Unleaded gasoline	56.2	51.2	20.6	16.3	65.1	65.9	64.5	--
Light fuel oil for households	19.3	7.8	4.7	n.a.	26.2	27.7	28.5	--
Light fuel oil for industry	19.3	9.1	4.9	n.a.	13.0	14.0	25.2	--
B. Price per litre using PPP exchange rates (US$) in 2009								
Diesel	1.79	0.90	0.65	0.94	1.09	n.a.	1.57	1.06
Unleaded gasoline[2]	2.05	1.05	0.62	0.93	1.36	n.a.	1.60	0.73
Light fuel oil for households[3]	1 250	580	665	n.a.	627	n.a.	665	699
Light fuel oil for industry[3]	1 247	411	435	580	477	n.a.	n.a.	492
C. Price per litre using market exchange rates (US$) in 2009[1]								
Diesel	1.09	1.11	0.65	0.57	1.39	1.56	1.62	1.07
Unleaded gasoline[2]	1.24	1.28	0.62	0.57	1.73	1.88	1.65	0.72
Light fuel oil for households[3]	758	713	665	n.a.	798	745	686	769
Light fuel oil for industry[3]	757	505	436	353	607	626	687	519

1. The third quarter of 2009 for Germany.
2. Premium unleaded (95 RON) gasoline prices are used for France and the United Kingdom.
3. Per 1 000 litres.

Source: IEA/OECD (2010).

Creating a new policy framework: getting the price right through market-based instruments

Although these policies have helped to slow the increase in GHG emissions since 2000, emissions almost doubled between 1990 and 2005, as noted above. Achieving the emission reduction that has been included in the mid-term plan at a low economic cost will therefore require a policy strategy based on a more effective mix of instruments. The key is to rely on pricing instruments to a much larger extent so as to put a global price on greenhouse gases. Pricing GHG has several advantages. In the short run, it minimises the cost of reducing emissions by equalising the marginal abatement cost across all individual emitters for any reduction objective. Over the long run, market instruments provide incentives for firms to develop new technologies that will help lower future abatement costs. From the perspective of investors, a clear and credible price for carbon is needed as early as possible to make appropriate investment decisions for the future. New technologies that are still at an early stage of development, such as carbon capture and storage, may never be developed and deployed on a large scale without such a price signal. A market approach also reduces the costly burden of gathering the information necessary for regulation. In particular, under an emissions trading system (ETS), the authorities only need to specify the appropriate level of emissions and then rely on price signals to achieve it (Goodstein, 2007). In sum, a market-based approach that sets a clear price is clearly superior to voluntary measures, negotiated agreements or a sector-specific approach that calculates energy efficiency by sector and adds up the reductions that can be achieved.

Emissions trading systems (ETS) and carbon taxes: the pros and cons

Environmental taxes, such as the carbon tax already in place in a few countries and an ETS based on emission permits, are the main instruments for putting a price on GHG emissions. Both meet the efficiency criteria, as they encourage emitters to adopt abatement solutions that cost less than the level of the tax or permit price, thereby ensuring that the least-expensive abatement options are fully exhausted. Both also reduce the current demand for energy and make the price of renewable energy sources more competitive.

Furthermore, the two instruments give strong incentives for monitoring and enforcement by the authorities and, assuming that the permits are auctioned, generate revenues that can be used to reduce labour taxation, thereby increasing efficiency.

Although a carbon tax cannot set a fixed emission cap for the whole country, an advantage of an ETS (Box 2), it also provides a clear price signal that promotes private-sector investment in energy-saving technology. Moreover, a carbon tax has some advantages, as it is easy to adopt from a technical standpoint, has lower transaction costs and guarantees the maximum and minimum cost, although the optimal carbon tax rate can change over time.

In comparison, an ETS is generally more costly to implement, owing mainly to its more complex design. But once start-up costs are overcome, it has a number of clear advantages. *First*, an ETS can secure a more targeted level of emission reduction than a carbon tax. Indeed, there is less certainty as regards the amount of emission reductions associated with a certain level of tax, and thus it may require several iterations to achieve the desired level of emission cuts. *Second*, it facilitates linkages with foreign carbon markets, which could lower the cost of reducing emissions for Korea. *Third*, the participation of firms in the market for permits creates a constituency for maintaining the system.[12] *Fourth*, unlike a carbon tax, a trading scheme does not need to be adjusted for inflation or growth.

Box 2. The main characteristics of a cap-and-trade emissions trading system

A mandatory ETS based on cap and trade allows holders of permits the right to emit a certain amount of GHG. The total amount of permits is set at the overall desired level of future emissions by the covered sources. Emitters can trade permits among themselves in an open market, as those who emit less than their target can sell permits to those who exceed it. The price of traded permits depends, in part, on the total amount of permits. One key question is how to allocate the permits. A grandfathering approach – granting permits for free based on past emissions – is politically attractive and is used in some countries to gain the support of incumbent firms. However, if emitters expect that such an approach will continue, the incentives to reduce emissions would be weakened. Moreover, giving away permits to existing firms would act as an entry barrier, as new firms face higher costs than existing firms, and it may encourage non-viable firms to remain in business solely to receive free emission permits. A better approach is to sell permits through an auction scheme, similar to the plans for allocating frequency spectrum for mobile telephony. Although auctioning permits is more costly for firms, it would provide revenues for the government, thus allowing reductions in other taxes and their associated distortions. If policy makers instead choose a grandfathering approach, they should at least announce that it will be phased out, thereby strengthening incentives to reduce emissions.

Firms face considerable risk and uncertainty about prices in an ETS, which can be volatile. One remedy is to allow firms to save or bank permits that are not used in the trading period in which they are issued. Such an approach increases efficiency by allowing firms to adjust their emissions reduction schedule to their investment programme. A recent study found that banking cuts abatement costs, while increasing the amount of GHG emission reductions even in the short term (Bosetti *et al*., 2008). The borrowing of permits has a similar effect, although there is a need for caution as firms do go bankrupt. Allowing firms to smooth their emission profiles through the business cycle by banking and borrowing permits also helps to limit price volatility (Philibert and Reinaud, 2004).[1] Banking and borrowing, however, require adequate compliance mechanisms and long-term targets to be effective. Another option to manage risk would be to set emission targets based on intensity (*e.g.* emissions per unit of output), rather than on the absolute amount, thereby allowing the automatic adjustment of emission objectives to unexpected shocks to output growth and marginal abatement costs (Ellis and Tirpak, 2006). However, intensity targets would complicate international links with ETS that are based on absolute amounts.

1. In the European ETS, for example, the spot price fell from over € 30 per ton of CO_2 to under € 1 between the spring of 2006 and the spring of 2007 in the absence of banking provisions, which were avoided in the pilot stage as they would have caused serious environmental damage.

12. An ETS that gives away permits for free is less costly for firms than a carbon tax. As noted below, however, such an approach is less efficient than auctioning permits.

A comprehensive cap-and-trade ETS appears to be the best option

On balance, the case for using an ETS as the main instrument to control carbon emissions in Korea is compelling, in spite of the initial start-up costs. However, given that an ETS works best at the level of relatively large emitters, even a fairly comprehensive ETS may exclude certain sectors, notably households and offices. Taxation, on the other hand, is the instrument of choice for small and diffuse sources such as households, farmers and small businesses, thus leaving scope for a carbon tax to co-exist with an ETS. It is important, though, to minimise overlap and complicated interactions between an ETS and a carbon tax that would raise uncertainty about the overall outcome (OECD, 2006). In particular, the two instruments should be set to minimise differences in the explicit and implicit carbon prices across sectors (de Serres *et al*., 2010).

The government will submit legislation in 2010 to establish a framework for an ETS under a cap-and-trade scheme and set the starting date.[13] Given the ability of a well-designed system to reduce GHG emissions in a cost-effective manner, Korea should quickly introduce an ETS with wide coverage, ideally by auctioning the initial permits, in order to achieve its 2020 target.[14] The scheme should include banking and possibly borrowing of permits to limit risk, uncertainty and volatility. In addition, Korea's ETS should be as comprehensive as possible in its coverage. As for a carbon tax, the government is considering such an approach as well. If the ETS is not comprehensive, a carbon tax would be an effective policy to cope with excluded sectors, while limiting overlap and complicated interactions.

A key obstacle to the implementation of an ETS and/or a carbon tax in many countries is concern about their impact on the international competitiveness of domestic industries.[15] An effective climate change policy requires that some firms do not survive, either because demand for their products falls or because more GHG-efficient firms – domestic or foreign – increase their market share. However, OECD analysis has found that the effects of climate policies on competitiveness are likely to be small and limited to only a few energy-intensive industries, particularly if an ETS has broad international coverage (OECD, 2009c). This illustrates the importance of wide coverage in the post-Kyoto framework. Otherwise, the emission cuts in some countries with an ETS and/or carbon tax would be partly offset by increases elsewhere, a phenomenon referred to as carbon leakage. However, recent OECD research found that unless only very few countries take action against climate change, leakage rates will be relatively small (OECD, 2009d).

Removing environmentally harmful energy subsidies

Another priority is to remove subsidies[16] to fossil fuel-based energy production and consumption, which boost GHG emissions. A recent OECD study found that closing the gap between domestic and international fossil fuel prices could cut GHG emissions in the subsidising countries by as much as 30% relative to BAU levels by 2050, and by 10% globally (Burniaux *et al.*, 2009). Moreover, eliminating subsidies would increase efficiency and save fiscal resources that could be used more productively.

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13. ETS are already in place or are about to be implemented in the European Union, Australia, Canada, New Zealand, Norway and some states in the north-eastern part of the United States. A growing number of other countries, including Japan, are considering introducing an ETS (Burniaux *et al*., 2008).

14. Korea's introduction of an emission cap-and-trade programme in 2008 covering NOx, SOx and Total Suspended Particles (TSP) in the capital region is giving it experience in operating an ETS.

15. Another concern is a possible adverse impact of a carbon tax on income distribution, reflecting its regressive nature. This can be addressed, at least in principle, via the tax-benefit system (Duval, 2008).

16. The definition of subsidies in OECD analysis of the energy sector includes grants or soft loans to producers or consumers of energy, market price support and differential tax rates on different fuels (OECD, 2005a).

Korea has few explicit subsidies for fossil fuels and they do not protect any important domestic industries. The main subsidy is for the production of coal and its use in the form of charcoal briquettes by low-income households. In 2008, domestic coal production amounted to only 2.8% of Korea's coal imports (Table 4). Nevertheless, this subsidy distorts resource allocation and encourages excessive consumption of coal, which has more harmful emissions than other fossil fuels. Despite the gradual decline in the subsidy, it still amounted to 267 billion won in 2009, equivalent to around 5% of total environment-related spending by the central government. The government should eliminate this subsidy in favour of more environmentally friendly measures to support low-income groups.

Another, more indirect, subsidy is the sale of electricity at prices below costs. Overall, the recovery rate – the unit price as a share of the total unit cost – was 93.8% in 2007, but it varies widely among sectors (Table 5). In particular, the recovery rate in the residential sector was high at 99.2% compared to 90.5% in industry and only 39.2% in agriculture. Without the subsidy, the electricity price for industry would be around the OECD average.[17] The subsidy for industry widens the price gap with services (most of which are included in the general category in Table 5) to 34%, much larger than the 21% gap in unit costs. There are also cross-subsidies in natural gas (Moltke *et al.*, 2004). The 2008 National Energy Master Plan through the year 2030 stated that Korea should abolish cross-sector subsidies, thereby allowing prices to match unit costs in each sector.

Table 4. Coal production and briquette price subsidy

	1989	1999	2007	2008	2009
Coal production (million tonnes)	20.8	4.2	2.9	2.8	2.5
Total subsidy (billion won)[1]	46	323	339	297	267

1. The subsidy covers subsidies for briquette manufacturers, industrial accident insurance premiums, and school expenses for children of mine workers.

Source: Ministry of Knowledge Economy.

Table 5. Recovery rate of electricity price by sector in 2007

	Average	General	Residential	Industrial	Educational	Agricultural
Unit price (won/kWh)	77.9	97.7	114.3	64.6	77.2	42.5
Total unit cost[1] (won/kWh)	83.0	90.1	115.3	71.4	87.1	108.2
Recovery rate (%)	93.8	108.4	99.2	90.5	88.7	39.2

1. Unit cost is all production and sales cost, plus the cost of capital.

Source: Government of Korea (2008), *The National Energy Master Plan 2008-2030*, Seoul.

Creating new growth engines for the future

Achieving large reductions in GHG gases requires shifting the economic structure away from the energy-intensive industries that have driven Korea's rapid development thus far. However, fighting climate change need not hinder economic growth, as moving to a more sustainable growth path brings new opportunities to increase output and employment, provided that action is taken early so that GHG emissions can be reduced progressively. While the shift to a low-carbon society will reduce jobs and activities in some sectors, this will be offset by the creation of new jobs and the expansion of other sectors.

17. In 2008, Korea's electricity prices for industry and households were \$0.087/kWh and \$0.128/kWh (using purchasing power parity exchange rates), while the OECD averages were \$0.108/kWh and \$0.141/kWh, respectively (IEA/OECD, 2010).

Environmental policies can act as a catalyst for eco-innovation, in particular by creating new markets for low-carbon technologies and equipment. The net impact of environmental policies on employment could be positive insofar as green jobs tend to be concentrated in more labour-intensive sectors, such as renewable energy, recycling, public transport and construction. According to one estimate, boosting investment in renewable energy to $630 billion by 2030 would create at least 20 million additional jobs worldwide, making it a much larger source of employment than today's fossil energy industry, which includes mining, petroleum extraction, refining and fossil power generation (UNEP, 2008).

The Five-Year Plan for Green Growth, 2009-13

To implement the National Strategy for Green Growth, which covers the years up to 2050 (Box 1), the government announced in July 2009 the Five-Year Plan for Green Growth. This initiative revives the practice of five-year plans, which were used between 1962 and the mid-1990s. While the government recognises that the "effectiveness of five-year plans dwindled as the Korean economy more broadly embraced market economy principles", it believes that they are useful for national consensus building and to incorporate green growth spending in the national budget (Presidential Committee on Green Growth, 2009b). The Five-Year Plan absorbed the Green New Deal for 2009-12, which was announced in January 2009 to tackle the financial crisis through job creation and to secure new growth engines by transforming Korea into a green economy.[18]

The Five-Year Plan calls for spending 2% of GDP per year over the period 2009-13, completely financed by the central government budget except for 8.5 trillion won (0.8% of GDP) in spending by two public enterprises.[19] The government estimates that the plan will induce production worth 182-206 trillion won (around 20% of 2009 GDP) and create 1.6 to 1.8 million jobs (a 10% rise in employment) by 2013, suggesting a relatively high fiscal multiplier of around two.

The high level of spending in the Five-Year Plan is due in part to the inclusion of large construction projects among the 600 projects (Table 6). Two of the ten spending categories, which are mainly focused on public construction, account for 61 trillion won – more than half of total expenditures. *First*, "Greening the land, water and building the green transport infrastructure" (category 8) includes ongoing railway projects as part of the government's plan to boost the share of passenger transport by rail from 18% in 2009 to 26% in 2020. This will be achieved by further expanding the high-speed train system, Korea Train eXpress (KTX), which started in 2004 and already accounted for a little more than one-half of long-distance rail passengers in 2008.[20] *Second*, "Strengthening the capacity to adapt to climate change" (category 3) includes water management, such as river restoration and sewage facility projects. The Korean peninsula experiences droughts in the spring and heavy monsoon rains in the summer and climate change is exacerbating this pattern. A large share of this spending (15.4 trillion won) is for the "Four Major Rivers Restoration Project", which notably includes the construction of 16 new weirs (dams that allow water to flow over the top) on the four major rivers, two new dams on their tributaries and heightening the banks of 96 existing agricultural reservoirs. The Project has five aims: *i)* securing abundant water resources; *ii)* implementing comprehensive flood control; *iii)* improving water quality and restoring the ecosystem;

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18. The Green New Deal included 36 projects, such as the Four Major Rivers Restoration Project and railroad construction. Spending is divided between water and waste management (13 trillion won), railroad construction (11 trillion won), energy-efficient buildings (10 trillion won), low-carbon vehicles (3 trillion won) and renewable energy (3 trillion won). The government expects this programme to create 0.9 million jobs.

19. Local governments are developing their own five-year plans to implement the national plan.

20. The line connecting Daegu and Busan is to be completed by the end of 2010, while a line connecting Seoul to Mokpo in the southwest is to be completed by 2014. This spending would not be included in the OECD's definition of environmental expenditure.

iv) creating multipurpose spaces for local residents; and *v)* promoting regional development centred on rivers, leading to the creation of 340 thousand jobs (Government of Korea, 2009). In contrast to the large share of infrastructure construction, spending on R&D accounts for 12% of the Five-Year Plan.

Table 6. The Five-Year Plan for Green Growth (2009-13)
Trillion won[1]

	Total	2009	2010	2011	2012	2013
Total	**107.4**	**17.4**	**24.2**	**25.7**	**20.6**	**19.4**
Central government budget	98.9	17.4	20.5	21.9	19.6	19.4
Public enterprises' investment	8.5	-	3.7	3.8	1.0	-
Memorandum item: total green technology R&D investment in all categories	*(13.0)*	*(1.9)*	*(2.2)*	*(2.5)*	*(2.8)*	*(3.5)*
1. Adapting to climate change & enhancing energy independence	**57.5**	**8.5**	**15.5**	**16.0**	**9.8**	**7.7**
1. Effective mitigation of greenhouse gas emissions	5.4	1.0	0.9	1.0	1.1	1.3
2. Reduction of the use of fossil fuels and the enhancement of energy independence	15.4	2.8	3.8	2.9	3.0	2.8
3. Strengthening the capacity to adapt to climate change	36.7	4.7	10.9	12.0	5.6	3.6
(Four Major Rivers Restoration Project)	*(15.4)*	*(0.8)*	*(6.4)*	*(7.1)*	*(1.1)*	*(-)*
2. Securing new growth engines	**23.5**	**3.9**	**4.1**	**4.7**	**5.3**	**5.6**
4. Development of green technologies	7.6	1.5	1.4	1.5	1.5	1.6
5. The "greening" of existing industries and promotion of green industries	4.5	0.7	0.9	0.9	1.0	1.0
6. Advancement of industrial structure to increase services	9.7	1.4	1.5	2.0	2.4	2.5
7. Engineering a structural basis for the green economy	1.8	0.3	0.2	0.3	0.4	0.5
3. Improving living standards & enhancing national status	**26.4**	**5.0**	**4.6**	**5.1**	**5.6**	**6.1**
8. Greening the land and water and building the green transport infrastructure	23.9	4.6	4.2	4.6	5.0	5.5
9. Bringing the green revolution to daily lives	1.8	0.3	0.3	0.3	0.4	0.4
10. Becoming a role-model for the international community as a green growth leader	0.7	0.1	0.1	0.1	0.1	0.1

1. Actual budgets for 2009-10 and projections for 2011-13.
Source: Ministry of Strategy and Finance and Presidential Committee on Green Growth.

The October 2009 mid-term fiscal plan (2010 *OECD Economic Survey of Korea*) incorporated the expenditures contained in the Five-Year Plan for Green Growth announced in July. Nevertheless, the total amount of spending for the years 2011-12 did not increase compared to the 2008 mid-term fiscal plan. This could be explained by two factors. *First*, outlays in some non-green growth categories may have been cut. *Second*, some previously planned expenditures may have been re-categorised as green growth. To the extent that it is the latter, the role of the green growth plan in shifting spending priorities appears less important. Nevertheless, the plan is likely to affect public expenditure decisions going forward.

Given the large size of the Five-Year Plan, it is crucial that spending be implemented in a transparent and effective manner, in line with the OECD's recommendations on good practices for managing public environmental expenditures (OECD, 2008d). Green growth infrastructure projects should be subject to the same *ex ante* cost-benefit analysis as other public investment. In Korea, the Public and Private Investment Management Centre (PIMAC) was established as an independent organisation in 1999 to conduct *ex ante* evaluations of large-scale public investment projects. During its first five years, it rejected about 80% of the proposed projects, resulting in significant cost savings (OECD, 2005b). Moreover, the performance of each green growth project should be carefully monitored and regularly reviewed as part of the budget process to ensure that it achieves the desired policy goals. In an era of fiscal consolidation, choosing cost-effective policy measures is especially important. The Five-Year Plan should therefore rely on policies with well-designed incentive schemes that activate market forces. For example, R&D tax credits are likely to lead to a more efficient allocation of resources than direct subsidies for specific projects (de Serres *et al*., 2010).

R&D in green technologies

Technological change is the key to minimising the cost of addressing the climate change problem (OECD, 2010e). To encourage innovation in green technologies, the first priority is to put a credible price on carbon, preferably through emissions trading, as noted above. Market forces would then provide a powerful incentive for the development of new low-carbon technologies and would guide resources to the best technologies, making them more cost-competitive.[21] However, price signals alone cannot ensure adequate R&D and innovation given market failures, such as those related to learning-by-doing and market size, as well as the inability of innovators to fully capture the gains from their innovation. While such problems are common to all types of R&D, it is magnified in the area of climate change by policy uncertainty and weak protection of intellectual property rights (IPR).[22] Given these market failures, public investment in R&D is needed to "kick-start" the innovation process. The government should focus on basic R&D to share the risk of developing new technologies with the private sector, particularly in large-scale projects.[23] To promote the use of new technologies, the government can provide other measures, such as commercialisation support and information services (OECD, 2010a).

Government spending on energy research, development and demonstration (RD&D)[24] fell as a share of GDP in many OECD countries between the early 1980s and the 1990s (Figure 5), reflecting the difficulties in the nuclear industry and the drop in oil prices from 1985 to 2002 (IEA/OECD, 2008a). To combat climate change and promote green growth, more public investment in RD&D worldwide appears to be needed. Korea's RD&D budget in energy-related areas rose from 0.02% of GDP in 2002 to 0.07% in 2008, the second highest in the OECD area. In terms of the absolute amount, Korea ranks fourth after the United States, Japan and France. However, the share of green technology patents originating from R&D in the environment or energy is rather small, suggesting that innovation is very multi-disciplinary (OECD, 2010b). Therefore, the authorities should be careful in emphasising R&D in a particular area.

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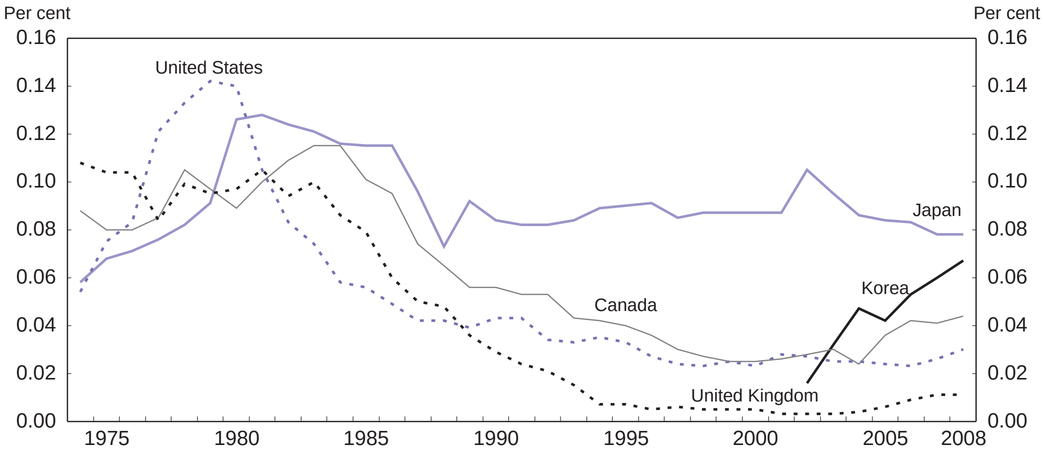
21. This is illustrated by the introduction of an emission cap-and-trade programme in 2008 covering NOx, SOx and TSP in the capital region in 2008, which led to a large increase in the number of patents on technology to reduce emissions (Kim and Kang, 2009).

22. Weak protection of IPR is likely to be particularly problematic in R&D related to climate change for two reasons. *First*, developing countries may consider access to the most efficient abatement technologies to be an important condition for their participation in emission abatement efforts. This weakens the credibility of IPR and thus reduces firms' incentive to innovate. *Second*, the value of R&D in climate change depends on the credibility of governments' abatement policies. If firms are uncertain whether governments will follow through on their intended policies, their incentives to invest in such R&D are weakened (OECD, 2008b).

23. Breakthrough technologies, such as fuel cells, advanced biofuels or advanced nuclear technologies, are estimated to require large investment in R&D at the initial stage (de Serres *et al*., 2010).

24. In the area of energy R&D, "demonstration" – projects to show that new technology is feasible, for example in renewable energy sources – is an important compliment to R&D. Korean official statistics do not include outlays for demonstration. Instead, their target is for R&D alone.

Figure 5. Government energy RD&D budget as a share of GDP



Source: IEA/OECD Energy Database.

In the Five-Year Plan, the government plans to expand its R&D investment in green technologies from 2 trillion won in 2009 to 3.5 trillion won by 2013, making a cumulative amount of 13 trillion won. This would boost green R&D from 16% of the government's total R&D spending in 2009 to 20% by 2012.[25] R&D will focus on 27 core technologies (Table 7) that were announced in January 2009 as new growth engines for Korea. These strategies were chosen following consultation with various experts and later incorporated into the Green Growth Strategy. The decision whether to include a technology in the list was based on its potential contribution to economic growth and environmental sustainability and its strategic importance. In order to co-ordinate R&D policy, the National Science and Technology Council will be closely linked to the Green Growth Committee. The "Key Green Technology Development and Commercialisation Strategies" was announced in May 2009 as a roadmap to develop these technologies. In addition to public R&D, the Five-Year Plan includes fiscal support for green R&D by SMEs.

Public R&D and public funding of private R&D have a role to play, although they may not meet the cost-effectiveness criterion, as they have no mechanism to ensure that the target is achieved at the least cost (de Serres *et al*., 2010). The success of public R&D depends on two factors. *First*, it is necessary to establish a clear and credible price for carbon beforehand to make public R&D effective in redirecting technological change towards green technologies (Bosetti *et al*., 2009). This would suggest accelerating the introduction of an ETS and a carbon tax. *Second*, it is important to upgrade the general innovative capacity, which is a key determinant of innovation in environmental technology (Hascic and Johnstone, 2010).

Despite its high level of R&D intensity and the improvement in its innovation framework, Korea still has weaknesses in fundamental research and system linkages (OECD, 2009b). To promote Korea's convergence to high-income countries, the government has focused on immediate and tangible returns from its R&D investments, focusing on "experimental development". Technological progress and the growing maturity of the Korean economy require expanding basic research from its current 15% share of total R&D and developing more sophisticated infrastructure, particularly for green technologies. The government should promote these goals by further increasing the share of basic research in public R&D spending to support private-sector innovation. For large-scale R&D projects, it is important to share the risk with private firms by investing public money in related basic research. In particular, Korea needs to bolster its capacity for basic research in universities, which employ around 70% of all doctorates but account for just 10% of total R&D spending. Moreover, a lack of co-operation between government research institutes (GRIs) and universities hinders development of closer and mutually beneficial linkages.

25. In addition, the government will double the share of its basic R&D in green technology to 35% by 2012.

The government needs to encourage closer co-operation between GRIs, universities and the private sector by facilitating joint projects, enhancing the mobility of researchers, tackling the mismatch between human resources and research spending in universities and expanding access to GRIs' research infrastructure.

Table 7. Core green technologies

Sector	27 core green technologies	Timing[1]
Climate change	1. Monitoring and modelling for climate change	Long term*
	2. Climate change assessment and adaptation	Long term*
Energy source technology	3. Silicon-based solar cells	Short term
	4. Non-silicon based solar cells	Long term*
	5. Bio-energy	Long term*
	6. Light water reactors	Short term
	7. Next-generation fast reactors	Long term
	8. Nuclear fusion energy	Long term
	9. Hydrogen energy R&D	Long term
	10. High-efficiency fuel cells	Long term
Technologies to improve efficiency	11. Plant growth-promoting technology	Long term
	12. Integrated gasification combined cycle	Long term
	13. Green cars	Medium term
	14. Intelligent infrastructure for transport and logistics	Long term*
	15. Green city and urban renaissance	Long term
	16. Green buildings	Long term
	17. Green process technology	Medium term
	18. High-efficiency light-emitting diodes/green IT	Short term
	19. IT-combined electric machines	Long term
	20. Secondary batteries	Medium term
End-of-pipe technology	21. CO_2 capture, storage and processing	Long term
	22. Non-CO_2 processing	Medium term
	23. Assessment of water quality and management	Medium term
	24. Alternative water resources	Medium term
	25. Waste recycling	Medium term
	26. R&D in monitoring and processing for hazardous substances	Long term
R&D in virtual reality	27. Virtual reality	Medium term

1. Projects are divided between intensive investment in the short, medium and long run. Long-run projects marked with an asterisk are to have gradual, rather than intensive, increases in investment.

Source: Presidential Committee on Green Growth (2009a).

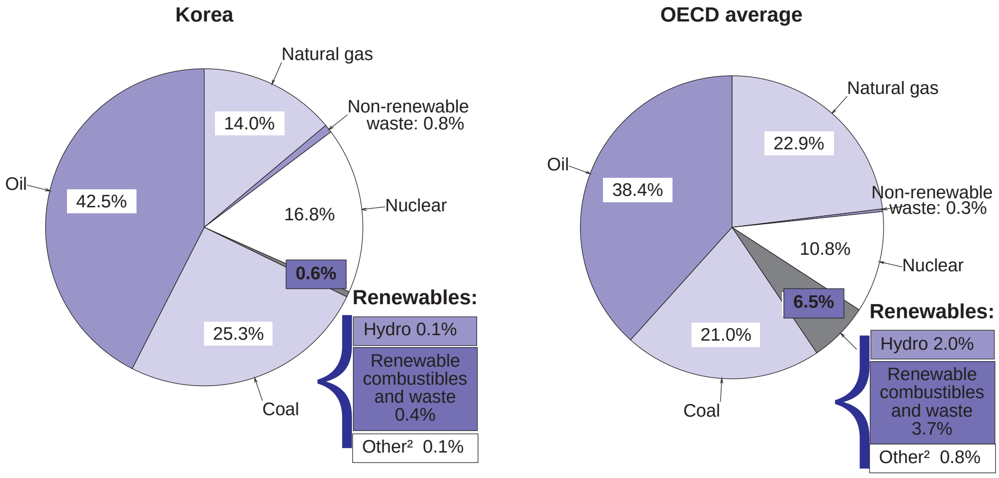
Developing renewable energy sources

The development and deployment of renewables is one of the key priorities to achieve a low-carbon society. Although worldwide investment in renewable energy reached \$155 billion in 2008, a seven-fold increase from 2002, it has been estimated that this investment must more than triple for global carbon emissions to peak by 2020 (UNEP, 2009a). The share of renewable energy in the total primary energy supply (TPES) in Korea was only 0.6% in 2007, far less than the OECD average of 6.5% (Figure 6) and the lowest in the OECD area.[26] Moreover, its share declined from 1.1% in 1990, while the share in the OECD area increased from 5.8% over the same period. There appears to be considerable scope to develop renewable energy sources in Korea; the additional realisable potential contribution of renewables in 2020

26. The Korean government's data on the share of renewable energy in TPES were higher at 2.4% in 2007 because they include industrial waste and non-renewable municipal waste as renewable energy sources. Under IEA methodology, such waste is excluded from the definition of renewable energy sources on the grounds that they are not biodegradable (IEA/OECD, 2009b).

has been estimated to amount to 43.2 TWh, equivalent to 12% of total electricity generated in 2005 (IEA/OECD, 2008b). This would be a large increase from less than 1% in 2007. In particular, Korea has a relatively large potential in solar photovoltaics (10.4 TWh) and offshore wind (9.0 TWh).

Figure 6. Energy sources in the OECD area in 2007[1]



1. As a share of total primary energy supply.
2. Geothermal, wind, solar and tide.

Source: IEA/OECD (2009a) and IEA/OECD (2009b).

The National Strategy for Green Growth established a target of increasing the share of renewable sources in TPES from 2.4% (according to Korea's definition of renewables) to 6% in 2020,[27] 11% in 2030 and 30% by 2050. The government estimates that this objective requires 111.4 trillion won of investment by 2030, including R&D of 11.5 trillion won. The public sector will provide 32 trillion won of this amount. Moreover, a Renewable Portfolio Standard (RPS)[28] will be introduced in 2012 to accelerate the diffusion of renewables. In addition, the government plans to increase the use of nuclear power, which is the least expensive means to generate electricity and produces almost zero GHG. Nuclear energy's share of electricity generation capacity is targeted to increase from 26% in 2007 to 41% in 2030.

In sum, Korea is still at an early stage in the development and utilisation of renewables. Achieving its 6% target by 2020 requires an effective and efficient policy framework based on the following principles (IEA/OECD, 2008b):

- Remove non-economic barriers, such as administrative hurdles, obstacles to grid access, poor electricity market design, lack of information and training, and social acceptance issues.
- Establish a predictable and transparent support framework to attract investment.
- Introduce transitional incentives that decrease over time to foster and monitor technological innovation and move technologies quickly towards market competitiveness.
- Develop and implement appropriate incentives that guarantee a specific level of support to different technologies based on their degree of technological maturity, in order to exploit the significant potential of the many options for renewable energy technologies over time.

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27. This objective is relatively modest compared to the EU and China, which both set targets of 20% for 2020.

28. A RPS is a regulation that requires the increased production of energy from renewable sources. It generally places an obligation on electricity companies to produce a specified fraction of their electricity from renewable sources.

- Consider the impact of large-scale penetration of renewable energy technologies on the energy system in terms of cost efficiency and system reliability.

As noted above, the government should develop a flexible framework that increasingly applies market principles as a renewable energy technology matures and its deployment advances. Moreover, as technology evolution is hard to predict, picking winners by subsidising specific projects is risky as it may lock in technologies that will not be economically efficient. For example, the high cost of biofuels suggests some caution in promoting this energy source. Indeed, the cost of support to biofuels is estimated at between \$960 and \$1 700 per tonne of CO_2 saved (OECD, 2008a), compared to the price of \$15 to \$30 price per tonne in the European ETS.

Promoting green industries

The Five-Year Plan includes 23.5 trillion won (2.2% of 2009 GDP) to secure new growth engines, in part by greening existing industries and promoting new industries. For example, among the 17 new growth engines announced in January 2009, there were six in green technology industry; new renewable energy, low carbon energy, water technology, LED application, green transport system and high-tech green city (2010 *OECD Economic Survey of Korea*). The government has launched a number of initiatives to provide financial resources to green industry. *First*, it introduced tax incentives in 2010 for financial instruments that invest in green technology and industry. Dividends and interest from bonds, deposits and investment funds that invest at least 60% of their capital in firms and projects with green certificates (see below) are tax-exempt up to certain ceilings. *Second*, as part of the Five-Year Plan, government lending for green firms and projects will be expanded. *Third*, public credit guarantees for green firms will be increased from 2.8 trillion won in 2009 to 7 trillion won in 2013, and provided under more favourable conditions. *Fourth*, the government plans to launch a green private equity fund (UNEP, 2009b). These green finance measures will fund firms, projects and technologies that are granted "green certificates", under a new programme that was introduced in April 2010. The certificates will be given by public institutes based on technologic impact, feasibility, the degree of greening and environmental impact. Green firms are defined as those for which certified green technology accounts for more than 30% of sales.

It is important to avoid the risk that granting green certificates to certain firms and projects might result in a bubble. Such a risk is demonstrated by the experience with the measures to jump-start the venture business sector in the late 1990s. Firms that met one of three criteria were designated as a venture business and received a number of financial benefits.[29] The end result was a bubble in KOSDAQ, the second-tier stock exchange. Moreover, the qualifying conditions were sufficiently vague that it reduced the credibility of the venture business sector. After the introduction of tighter criteria in 2002, the KOSDAQ price index fell 90% from its 1999 peak (2005 *OECD Economic Survey of Korea*). In establishing green certificates, the government should plan an exit strategy in order to avoid another disruptive bubble.

Direct government support for green industries raises a number of policy challenges, such as choosing which sectors should receive support, the appropriate timing of assistance and the suitable policy instrument. These decisions entail inherent risks, as illustrated by the mixed results of past government efforts to identify growth engines (OECD, 2004). Efforts to "pick winners" are inherently risky given the pace of innovative change and the possibility of being locked into the wrong technology. Moreover, there is a risk of losing significant amounts of public funds. To avoid government failure, policies to promote

29. A firm could be certified as a venture business by the Small and Medium Business Administration if it met one of three criteria: *i)* it received equity investment from venture capitalists amounting to more than 10% of its capital; *ii)* the amount (over 50 million won) and intensity of its R&D spending was high; and *iii)* it used new technologies. As of 2004, only 5% and 18% of venture businesses qualified under the first two criteria, while 77% were approved under the less stringent third criterion.

green industries should be as neutral as possible, focusing on basic and long-term R&D in technologies that are still too far from commercial viability to attract private investment. In sum, measures to promote green growth should not revert to traditional industrial policies.

The priority should be to establish a framework that will promote the transformation to a low-carbon economy at a low cost. *First*, as noted above, it is essential to establish a price for carbon through an ETS and a carbon tax. *Second*, fossil fuel subsidies should be phased out. *Third*, the shift towards a low-carbon economy requires the reallocation of labour and capital resources across sectors. For workers, labour market flexibility to promote the redeployment of workers and effective training are required (OECD, 2010c). *Fourth*, strong competition, including openness to imports and foreign direct investment, is needed to stimulate the adoption of new technology. In particular, it is important to facilitate the entry of new firms, which account for a large share of radical innovations in some fields, and the exit of firms in declining industries. In addition, the government should reduce barriers to imports of products important for climate change technology. A recent OECD study found that Korea's trade barriers in this regard are high compared to those in the EU, Japan and the United States (Steenblik and Kim, 2009).

A well-designed framework and appropriate government policies will facilitate the shift to a low-carbon economy. In 2008, energy-intensive industries, such as steel, petro-chemicals and cement, accounted for 12% of total value-added in Korea, the highest in the OECD area and well above the OECD average of 8% (Figure 7). The role of the industrial sector is also evident in a decomposition of final energy consumption by sector (Table 8). While per capita energy use in the transport, residential and commercial sectors was below the OECD average, it was almost 50% above the OECD average in industry. In contrast to the high share of energy-intensive industry in GDP, the share of the service sector in Korea is one of the lowest at 60% of value added. Energy intensity in services in Korea is less than one-third of that of manufacturing. One of the benefits of developing the service sector would be to reduce energy-intensity.[30] Such an approach would help achieve the government's target of reducing energy intensity by one-third from the 2006 level by 2020, reaching the OECD average (Figure 2).

Table 8. Per capita energy use by sector in major OECD countries
Toe per capita in 2007

	Total primary energy supply	Total final consumption per capita				
		Total	Industry	Transport	Residential	Commercial
Canada	8.13	6.19	2.43	1.75	0.97	0.92
United States	7.67	5.20	1.48	2.08	0.88	0.67
Korea	**4.57**	**3.02**	**1.56**	**0.62**	**0.38**	**0.38**
France	4.12	2.58	0.73	0.71	0.65	0.33
Japan	4.03	2.68	1.11	0.65	0.39	0.50
Germany	4.02	2.83	1.01	0.67	0.70	0.26
United Kingdom	3.46	2.34	0.64	0.73	0.66	0.26
Italy	3.02	2.36	0.80	0.70	0.47	0.24
OECD Total	**4.61**	**3.17**	**1.06**	**1.04**	**0.58**	**0.39**

Source: IEA/OECD (2009a).

Improving the quality of life through better air quality

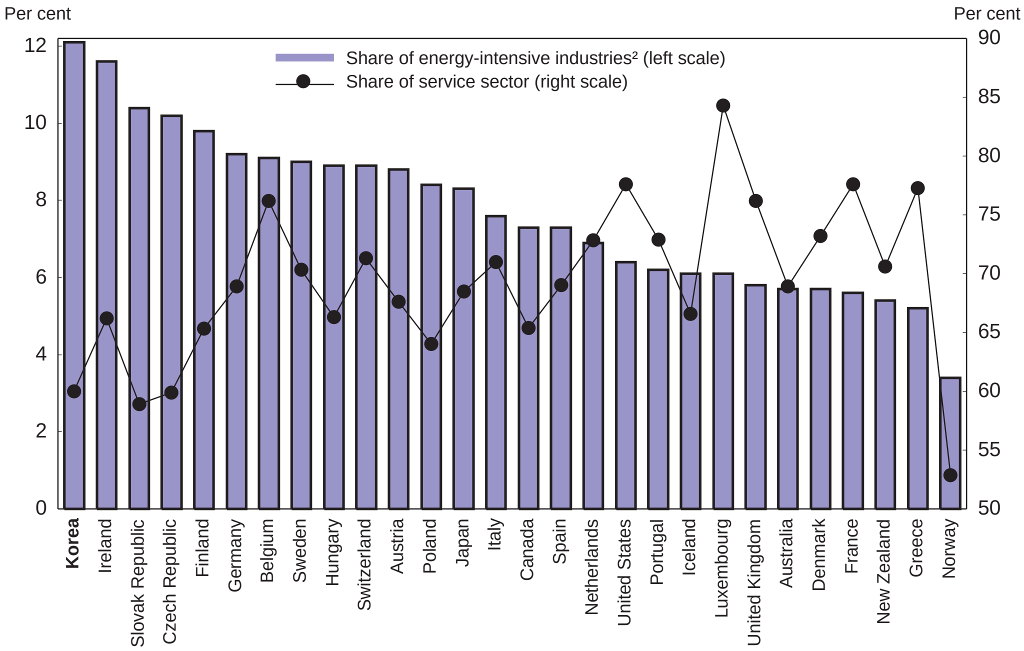
One of the benefits from cutting GHG emissions is the accompanying reduction in air pollutants, which have negative effects on human health, water quality and crop yields. Recent studies have found that

30. Indeed, a long-term econometric model estimates that reductions in GHG emissions would cause a significant expansion of the service sector (de Serres *et al*., 2010).

climate change and air quality are closely interrelated with respect to the sources, atmospheric processes and environmental effects, reflecting the fact that fossil fuel combustion is a major source of both air pollution and GHG. One study found that cutting CO_2 emissions by 10-20% compared to a BAU baseline would reduce sulphur dioxides (SO_2) by the same amount and nitrogen oxides (NOx) by 5% to 10% over the next 10 to 20 years (IPCC, 2007). The benefit, in terms of premature deaths avoided thanks to reduced air pollution, is estimated to be up to $50 per tonne of CO_2 equivalent removed (Burniaux *et al*., 2008).

Improving air quality is a priority in Korea, given that in the capital region (Seoul, Incheon and parts of Gyeonggi province), it is one of the worst among OECD countries (Kim and Kang, 2009). Although the level of emissions relative to GDP is below the OECD average (Figure 8), the concentration of emissions in the capital region, which accounts for one-half of the population, is problematic. Moreover, the increase in emissions of NOx between 1990 and 2007 was the third highest in the OECD area (Panel C). The government's objective is to improve air quality in the capital region to the average OECD level by 2014.

Figure 7. Share of energy-intensive industries and the service sector across OECD countries
Relative to total value added in 2008 or latest year[1]

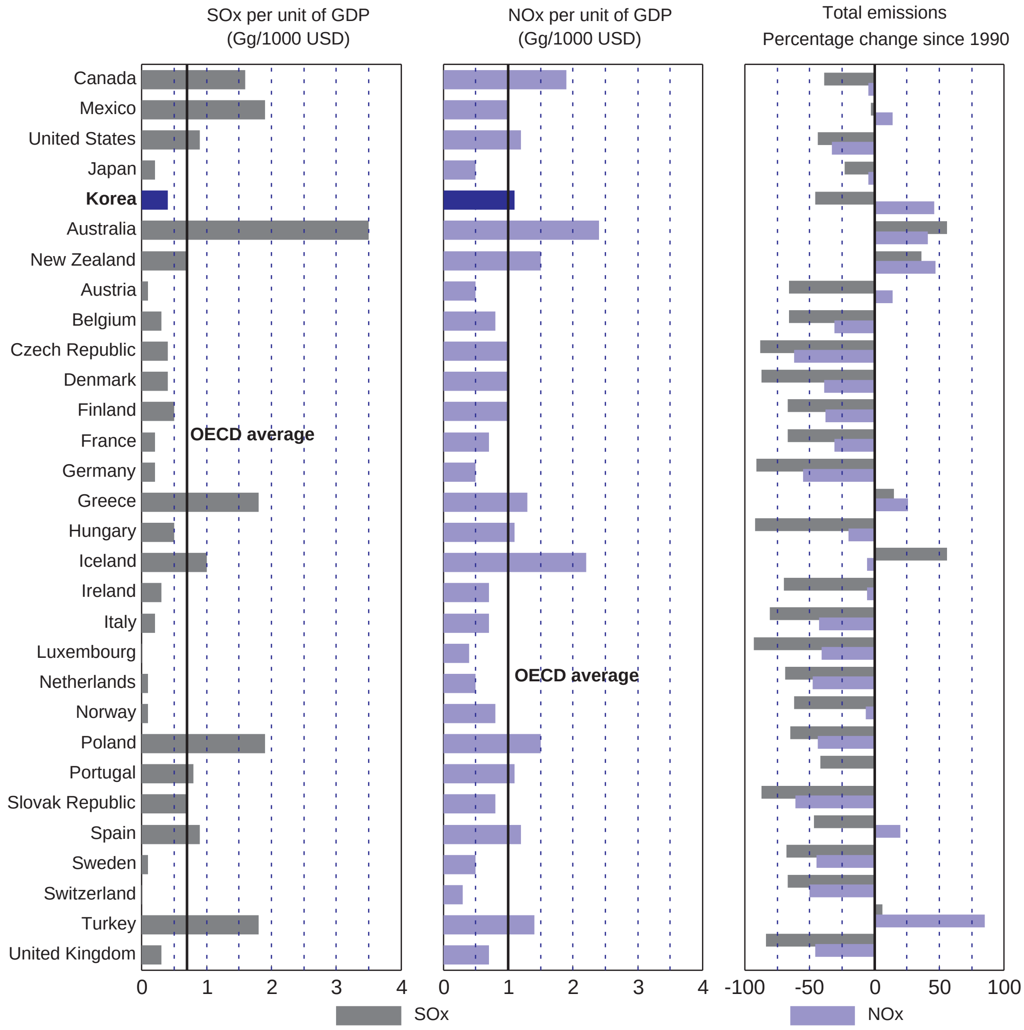


1. The data are for 2007 for Germany, Hungary, Poland, Sweden, Switzerland, United Kingdom and the United States, 2006 for Japan, New Zealand and Portugal, and 2005 for Australia and Canada,
2. Energy-intensive industries are defined as ISIC 21-28.

Source: *OECD STAN Database*.

To that end, an emission cap-and-trade programme was introduced in 2008 covering NOx, SOx and Total Suspended Particles (TSP) in the capital region. The system began with large-scale emitters and was extended to mid-size emitters in January 2010, targeting 136 factories in the capital region. It thus covers 84% of NOx, 78% of SOx and 57% of TSP emissions in the capital region. The emission levels of the three pollutants are allocated to each source within the overall total limit. Emitters with excess pollution are able to purchase emission permits from those with surplus emission allowances. In case emitters exceed their allocated amount, they have to pay a penalty charge and their permissible emission level is reduced for the following year. While the trading system applies to fixed sources of emissions, vehicles are a major pollution source in the capital region, accounting for around half of NOx emissions. Although the AFE regulations introduced in 2006 have increased fuel efficiency, the standards remain well below those in EU countries and Japan.

Figure 8. International comparison of emissions of NO_x and SO_x in 2007



Source: OECD (2010d), *OECD Environmental Data: Compendium 2009-10*, OECD, Paris.

Conclusion

To achieve its target of reducing GHG emissions, Korea should remove fossil fuel subsidies and introduce an emissions trading system based on cap and trade, supplemented by a carbon tax in areas not covered by trading. Such a market approach would minimise the overall economic cost of emission reductions by equalising marginal abatement costs across all emission sources. In addition, it would establish a credible price for carbon that would encourage innovation to reduce emissions. The government's Five-Year Plan should be carefully designed and implemented to promote such innovation and encourage the transition from energy-intensive industry to a low-carbon economy. The large-scale expenditures should be used efficiently while limiting the risk of government failure resulting from policies to "pick winners". Specific policy recommendations to improve Korea's climate change and green growth policy are provided in Box 3.

Box 3. Summary of recommendations for Korea's green growth strategy

Mitigating climate change

- Introduce market-based instruments as soon as possible to achieve the 2020 GHG emission reduction target in a cost-effective way by ensuring that abatement costs are equal at the margin across all options.
- Put a price on carbon emissions by creating a mandatory and comprehensive cap-and-trade ETS, thereby providing a clear price signal that enables market participants to make appropriate investment decisions.
- Auction ETS permits and allow them to be banked for the future and, perhaps, borrowed.
- Introduce a carbon tax in areas not covered by the ETS and use the revenue, together with that from auctioning permits for the ETS, to reduce the need for higher taxes and their associated distortions.
- Accelerate the phasing out of environmentally-harmful energy subsidies and ensure that energy prices in each sector reflect the cost of production and distribution.
- Stop earmarking environmental taxes for transport construction, especially roads.

Creating new engines for growth

- Ensure good framework conditions, including openness to foreign investment and a strong competition framework, to facilitate entry of new firms and the exit of firms in declining industries.
- Enhance flexibility in the labour market and ensure adequate training of workers to facilitate the transition toward a greener economy.
- Ensure that the spending in the Five-Year Plan for Green Growth – 2% of annual GDP over 2009-13 – is implemented in a transparent and effective manner to address market failures, while avoiding outlays designed to boost specific industries.
- Promote innovation in green technologies by increasing its share in public R&D, focusing on basic research, particularly in areas related to large-scale projects by the private sector and in technologies still too far from commercial viability to attract private investment.
- Improve the overall innovation framework by spending more on basic research, closely linking government research institutes, universities and industry and reducing the mismatch between human resources and research spending in universities.
- Encourage the development of renewable energy resources by removing non-economic barriers and establishing a predictable and transparent support framework with incentives that decrease over time.
- Design the green certificate programme and the green finance initiatives carefully to limit the risk of bubbles.

Improving the quality of life through a better environment

- Gradually reduce the level of emissions allowed under the cap-and-trade programme covering NOx, SOx and TSP in the capital region to improve air quality to the level in advanced OECD countries.
- Increase the Average Fuel Efficiency standards to reduce NOx emissions, notably in the capital region.

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CLIMATE POLICY INITIATIVE

San Giorgio Group Case Study: Ouarzazate I CSP

Climate Policy Initiative

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About CPI

Climate Policy Initiative (CPI) is a policy effectiveness analysis and advisory organization whose mission is to assess, diagnose, and support the efforts of key governments around the world to achieve low-carbon growth.

CPI is headquartered in San Francisco and has offices around the world, which are affiliated with distinguished research institutions. Offices include: CPI Beijing, affiliated with the School of Public Policy and Management at Tsinghua University; CPI Berlin, affiliated with the Department for Energy, Transportation, and the Environment at DIW Berlin; CPI Rio, affiliated with Pontifical Catholic University of Rio (PUC-Rio); and CPI Venice, affiliated with Fondazione Eni Enrico Mattei (FEEM). CPI is an independent, not-for-profit organization that receives long-term funding from George Soros.

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San Giorgio Group Case Study Overview

This paper is one of a series – prepared by Climate Policy Initiative for the San Giorgio Group – examining the use of public money to catalyze and incentivize private investment into low carbon technologies and drawing lessons for scaling up green, low-emissions funding. The San Giorgio Group case studies seek to provide real-world examples of what works and what does not in using public money to spur low-carbon growth. Through these case studies CPI describes and analyzes the types of mechanisms employed by the public sector to deal with the risks and barriers that impede investment, establish supporting policy and institutional development, and address capacity constraints.

Executive summary

Concentrated Solar Power (CSP) technology has enormous unexploited potential[1] as a reliable source of renewable energy. This is especially true in the Middle East and North Africa (MENA) region, which has abundant solar resources and good proximity to EU energy demand.

However, despite its long history of projects and trials, CSP remains in its early stages of development and is still not commercially viable. The resulting competitiveness gap between CSP and less expensive carbon-intensive energy alternatives is particularly evident in markets - such as those in MENA - where heavy fossil-fuel subsidies distort energy prices. At the same time, policies that would incentivize renewable energy sources are not in place.

This case study analyzes how the Government of Morocco, a group of development banks, and private-sector developers came together to develop the first phase of a 500 MW Concentrated Solar Power facility: the 160MW Ouarzazate I CSP plant. The plant is in the final stage of the tendering process and is scheduled to move into the construction phase before the end of 2012.

Challenges facing CSP development

Ouarzazate I's stakeholders understand that the project only makes economic sense as the first in a series of CSP installations leading to a large-scale portfolio[2] of CSP plants in Morocco and the MENA region.

Building a CSP portfolio represents a 'chicken or the egg' dilemma: in order to scale up, CSP projects need to become increasingly commercially viable — through economies of scale or through exports to Europe — to attract investment over and above finite public resources. But achieving commercial viability first requires the development of early projects which need higher levels of investment not just for capital costs, but also for capacity building and associated grid infrastructures (such as transmission lines and interconnectors).

The challenges facing the development of a CSP portfolio are financial, technical, and political. They include: attracting enough public and private financing; successfully deploying early-stage technology; building local manufacturing facilities; bringing technology costs down; brokering agreements for exports to the E.U.; and addressing competitiveness issues when subsidies for dirtier technologies create an uneven playing field.

By addressing these issues, the first publicly-supported large-scale CSP projects, such as Ouarzazate I, play a crucial role in bridging the development of a more commercially-sustainable regional CSP market.

Specifically, the Ouarzazate I project had two over-arching objectives:

1. To install CSP at a scale that sufficiently tests and demonstrates the storage technology component, triggers important cost reductions, and fosters associated economic benefits, such as local manufacturing industries, improved energy security, and a shift away from fossil fuels; and
2. To test a business model that could attract and increase private-sector backing and enhance the availability of capital and 'know-how' to support the development of a CSP portfolio.

The project is still in an early stage, hence this report cannot assess whether Ouarzazate I has been successful in meeting the first objective. However, our examination reveals that, so far, Ouarzazate I has succeeded in attracting sufficient financing in its startup phase, through a public-private partnership model. This model can efficiently allocate risks among key stakeholders in the project and may be useful in the development of an expanded CSP portfolio.

Key stakeholders in the Ouarzazate I project include:

- The Government of Morocco and the Moroccan Agency for Solar Energy (MASEN) which are expected to contribute approximately USD 883 million over the life of the plant,[3] mostly in the form of operational subsidies. Their objectives are to support local economic development by creating expertise in the solar power sector and to improve the country's energy balance by shifting from expensive fossil-fuel imports.
- International Finance Institution (IFI) donors which have committed in excess of USD 1 billion for the construction of the facility in order to complete the first key phase of a CSP portfolio designed for the MENA region.

1 The International Energy Agency (IEA) estimates that CSP could provide up to 11.3 percent of global electricity by 2050 (IEA 2010).

2 Portfolio here means a series of projects sharing a similar technology and linked by a common framework (e.g.: the Morocco Solar Plan, the Mediterranean Solar Plan, the CTF CSP Investment Plan).

3 Including changes in subsidy costs and tax revenues compared to the counterfactual.

- A consortium of private developers which will contribute USD 190 million of equity capital and expertise for an estimated 14 percent after-tax rate of return.

The following table summarizes how Ouarzazate I addressed the specific concerns of each of these stakeholders.

Who	Issue	Ouarzazate I Responses and Effects
Government of Morocco	CSP technology is expensive.	Concessional finance lowered the cost for project developers and the Government of Morocco.
	Public resources are limited.	Building Ouarzazate I is part of a greater strategic plan to replace public financial resources for CSP with E.U. export revenues. The public-private partnership model has tapped private-sector capital, technical expertise, and managerial efficiency.
	Infrastructure investments are institutionally complex and involve high transaction costs.	MASEN has successfully coordinated private and public stakeholder involvement, with support from multilateral development banks. MASEN had to work closely with all concessional lenders to coordinate their loan requirements in order to reduce transaction and compliance costs. Loan syndication could further improve efficiency of this process.
International Donors/ Agencies	Size of the investment required in Ouarzazate I exceeds the available resources of a single institution.	Seven lenders were brought on board to provide concessional financing.
	CSP technology is still far from commercial viability.	Ouarzazate I is the initial phase of a regional investment plan to drive costs down and develop capabilities for CSP through deployment and learning.
Consortium of Private Developers	High capital costs, compared to alternative power sources, make the project financially unattractive.	Support from the Government of Morocco and IFIs make the project viable.
	Ouarzazate I's economics are overly dependent on support from the Government of Morocco.	IFIs' participation provides investor security in the event that the Moroccan Government faces budget difficulties.

Key elements in the design and development of the project

This case study identifies five building blocks that were essential to get the Ouarzazate I project off the ground.

1. **Strong public support and the close alignment of key public partners:** The Government of Morocco established a favorable regulatory and renewable policy framework to encourage private-sector engagement. In particular, it established a specialized entity tasked with realizing CSP projects (MASEN) and financially supports this entity's work to implement the ambitious Moroccan Solar Plan. For the Ouarzazate I project, the government earmarked funds (of an estimated USD 60 million per year) to cover the expected difference between the prices at which MASEN will purchase power from the generator and sell it onto the grid. A comprehensive reform of the fossil-fuel subsidization system is also underway but it's too early to comment on its effects.

2. **Significant financial and technical contributions from IFIs:** CSP technology is still far from commercial viability and together with the very high capital costs this meant the project was not viable without high levels of international support. International donors and lenders provided around USD 1 billion of early concessional financing, driving down

levelized costs by an estimated 25-30 percent.[4] In addition, IFIs provided necessary institutional and specialized technical support. Their engagement helped to further mitigate private investors' perceived risks.

3. **Strong engagement and coordination of donors:** Early coordination and agreements with donors allowed MASEN to clearly indicate the terms and costs at which capital would be offered. This transparency appears to have supported competition among private investors, resulting in required rate of returns that are in line with other, less risky renewable energy projects in the country. It also appears to have supported bids in line with or below projected levels. However, donor coordination and alignment of conditions, safeguards, and reporting rules was time-consuming and challenging.

4. **A carefully designed public-private partnership model:** The public-private partnership model allows the optimal alignment of risk between public and private players. For example, in Ouarzazate I, the private developer bears construction and operational risk while the Government of Morocco bears electricity market risk (revenue risk). MASEN's role in the public-private partnership is innovative: It acts as both equity investor and power purchaser (off-taker) and thus has the ability to align public and private objectives. Ouarzazate's development and operation will show whether this alignment will be realized.

5. **A project design built on past lessons learned:** Ouarzazate I benefited from exchanges with other large-scale CSP projects that are in development in India and South Africa, as well as experience gained from a CSP project supported by the Global Environment Facility. Learning from the design and implementation of other CSP projects helps reduce project costs and increase efficiencies. This in turn will support Morocco and the MENA region to develop a CSP portfolio.

Scaling up the CSP portfolio in Morocco and the MENA region

These five building blocks provide useful experience for future projects but the Ouarzazate I model will only go so far in establishing a large-scale portfolio of CSP projects in Morocco and the MENA region. To reach the scale desired by the Moroccan and Mediterranean Plans, the CSP portfolio will require a significant amount of additional capital. Given the scarcity of public and international funds, more commercially-oriented financing models will be necessary. These commercially-oriented financing models will most likely require:

1. **Reduced technology/project costs** through economies of scale; and
2. **Higher market revenues**, such as E.U. export revenues.

By 2020, economies of scale are expected to reduce technology costs, but not to the level required to reach grid parity in Morocco and the MENA region. Were the Government of Morocco to succeed in phasing out fossil-fuel subsidies, this would further reduce—though not eliminate—the competitiveness gap between CSP and high-carbon alternatives.

It is rather feasible that renewable power exports to European markets could fill the remaining gap in the medium- to long-term. However, considerable political support will be crucial to secure E.U. Member States' demand and to broker specific agreements that make the exports a reality. Interestingly, the possibility of exporting power presents a trade-off between financial viability on the one hand, and domestic energy and environmental effects on the other. While power exports significantly lighten the financial burden of Ouarzazate I on the Moroccan national budget, they also reduce the amount of fossil-fuel electricity displaced in the country, and therefore, the energy security and environmental benefits associated with CSP. Instead, Morocco would gain export revenues and economic development.

Scaling up a CSP portfolio in the MENA region and elsewhere in the world will be challenging, given the high costs of developing early projects and the necessary infrastructure to support them. The Ouarzazate case indicates that financing specific projects is possible with the close alignment of public, international, and private stakeholders, and careful design and coordination. Such an achievement, however, may not be enough to scale up a national or regional portfolio. This greater goal may be met only if projects are commercially viable, through a reduction in costs and access to higher market revenues, both of which will require considerable political support from national and international players.

4 Financial elaboration based on initial projections. The exact impact will be known only when the winning bid is selected and the amount of each concessional loan is confirmed.

Contents

Introduction

In October 2011, Climate Policy Initiative (CPI) and the World Bank Group, in collaboration with China Light & Power (CLP) and the Organisation for Economic Co-operation and Development (OECD), launched the San Giorgio Group, a new working group of key financial intermediaries and institutions actively engaged in providing green, low-emissions finance.[5]

The San Giorgio Group recognizes that a major barrier to scaling up climate investment flows is the limited availability and understanding of empirical evidence or 'on-the-ground' examples of financial practices, environmental policies, and political signals that drive green investment. The goal of the San Giorgio Group is to fill this gap by drawing on the experience of its members to track and analyze the life cycle of existing projects, programs, and portfolios, and assess results and mechanisms that affect financial and environmental performance of these investments. Through this, we aim to distill lessons about evolving financing practices, provide insights on how to scale up climate finance, and spend resources more wisely.

Our analysis is framed by four overarching questions:

- What is the role of public finance?
- How can public money be best delivered (instruments and institutional channels)?
- How do we ensure the alignment of international and national public investment flows with private investment flows?
- How can we ensure effective investment and continued learning?

The San Giorgio Group case studies share a systematic analytical framework. They explore in depth the role of project stakeholders, the sources of return for the various stakeholders, the risks involved and arrangements to deal with them, and case-specific developments and lessons in replicating and scaling up best practices.

We explore the questions above through the Ouarzazate I Concentrated Solar Power (CSP) project in Morocco. This project is an example of how a public-private partnership (PPP) model can support risk sharing between the public and private sectors, given that CSP is an expensive early development stage technology and the ambitions to develop a much larger portfolio of CSP in Morocco and the region.

Section 2 introduces Ouarzazate I and its key stakeholders, providing an overview of the context in which the project has developed. Section 3 examines the project economics, looking at the costs and benefits of the project as a whole and from each key stakeholder's perspective. In Section 4, we review the risks involved in the project and explore the tools and design aspects that have mitigated or transferred those risks. Section 5 focuses on the public-private partnership model employed by the project, looking at how risks have been shared between the key parties involved in the project that include the Government of Morocco, international donors, and a private-sector consortium. Section 5 also considers the role of international donors and describes the process involved in engaging those international donors in the project. Section 6 draws out key lessons from Ouarzazate I that could be applied to similar large-scale CSP projects in the region and considers whether Ouarzazate is replicable and scalable.

5 For additional information see CPI website, http://climatepolicyinitiative.org/event/inaugural-meeting-of-the-san-giorgio-group/.

- Ouarzazate I is the first step in an ambitious plan to create a portfolio of CSP investments in Morocco and the MENA region.
- An attractive mix of policy incentives and international concessional finance under a public-private partnership model has been designed to attract private investors/developers.

An overview of Ouarzazate I

Project background

To meet fast growing demand for electricity, Morocco needs to double its power generation capacity by 2020. This substantial challenge is compounded by Morocco's high reliance on energy imports that currently account for 97 percent of total supply. To address the twin challenges of improving energy security and promoting sustainable development, the Government of Morocco announced a new energy strategy in 2010[6] and established the Moroccan Agency for Solar Energy (MASEN). The strategy established a set of overarching goals to:

- reduce reliance on oil to 40 percent of energy consumption by 2030;
- increase energy efficiency, inducing energy savings of 15 percent by 2020 and 25 percent by 2030; and
- increase renewable power generating capacity to 42 percent of installed power generating capacity by 2020, through the commissioning of an additional 6000 MW of wind, solar and hydro.

Also in 2009, the Government of Morocco launched the Morocco Solar Plan and set a goal to install 2000 MW of solar power capacity by 2020 through five concentrated solar power projects. The government committed to finance the cost of the Plan and set up MASEN to develop the projects, starting with the first phase of the Ouarzazate 500 MW concentrated solar power (CSP) plant, Ouarzazate I, in Morocco.

Unlike many other developing countries, private producers already generate more than 50 percent of the country's total electricity needs (CDER, 2009).[7] Building on this, the government aims to make private production the cornerstone of its two ambitious renewable energy installation programs: (1) the 1000 MW Integrated Wind Energy Program; and (2) the 2000 MW Morocco Solar Plan. Both investment programs will be developed using a public-private partnership model to gradually attract private capital into the country's fledgling renewable energy market. If successful, Ouarzazate could become a business model for future CSP projects, both in Morocco and the Mediterranean region.

CSP technology is a potentially reliable source of renewable power in regions with high 'Direct Normal Radiance' (DNI), or solar incidence, particularly if storage can extend supply to cover peak evening demand periods. CSP components are not intrinsically expensive and as experience builds, costs are expected to fall (WB, 2011a). However CSP is still at the commercial-demonstration stage—the basic technology is proven but critical energy-storage components require further demonstration.[8] As a result, CSP costs remain high and uncertain compared to other forms of power generation and producers and investors are not yet ready to develop projects without substantial public support.

Currently, several Middle East and North African (MENA) countries,[9] South Africa, Australia,[10] China[11] and India are all developing CSP projects, in many cases with the support of International Financial Intermediaries (IFIs) (Kulichenko and Wirth, 2011). However, to date, Spain and the United States have the most significant experience with CSP.[12]

6 The government of Morocco promulgated both the 13-09 Renewable Energy Law and the 57-09 MASEN Law in March 2010 (see Figure 1 for more details).

7 Three contracts of concessions with guarantee of purchase signed directly by each independent producer (IPP) with ONE have been in operation for several years: Jorf Lasfar Energy Company (Coal), Compagnie Wind of the Strait (Wind) and Electric Power of Tahaddart (Natural Gas) (ENPI, 2011).

8 Abengoa of Spain is currently developing a large-scale 280 MW CSP plant in Arizona that will feature a six-hours molten salt storage component—the plant will begin operation in 2013 (Abengoa, 2012). In the case of Ouarzazate I, there is a high risk associated with the freezing of molten salt which will be used as the heat transfer and storage fluid (WB, 2011a).

9 Including three combined gas-solar thermal plants with 20MW of solar power: Ain Beni Mathar in Morocco supported by a USD 43 million Global Environment Facility (GEF) grant; Hassi-R'mel in Algeria financed by the Government of Algeria; Al Kuraymat in Egypt, with support from GEF and the Japan International Cooperation Agency (JICA).

10 Australian Solar Flagships Program.

11 In January 2011, Chinese authorities selected a developer to build a 50 MW CSP plant in Inner Mongolia.

12 Kulichenko and Wirth (2011) estimate that 1000 MWe of parabolic trough

Ouarzazate I is concentrated solar power project financed by the Clean Technology Fund, International Finance Institutions, and the Government of Morocco. The project will be developed through a public-private partnership by a Special Purpose Vehicle—a consortium of private developers and the Moroccan Agency for Solar Energy (MASEN). The project is made possible through a substantial subsidy from the Government of Morocco, in the form of a power purchase agreement covering the expected 25-year lifetime of the project. The plant will have a capacity of between 125 and 160 MW and will use the most mature CSP technology currently available—parabolic trough—with three hours of molten salt thermal energy storage capacity. Construction of the plant is expected to start before the end of 2012.

Morocco and the MENA region have high CSP potential. With high solar incidence and proximity to E.U. markets, ambitious plans to export energy to E.U. markets are already in development. Country-led and/or regional plans in place or under development include: the E.U. funded Mediterranean Solar Plan to install 20GW of capacity on the south shore of the Mediterranean; the Desertec Industrial Initiative (DII) which aims to create a market for renewable power from the MENA region; Medgrid which aims to develop interconnections to deliver up to 5GW of Saharan solar energy to Europe by 2020; and the World Bank Arab World Initiative which aims for greater regional cooperation between Arab countries. Complementing these, the Clean Technology Fund's (CTF)[13] "Investment Plan for Concentrated Solar Power for the MENA Region" led by the World Bank and the African Development Bank has catalytic potential with plans to install 1.2 GW across Algeria, Egypt, Jordan, Morocco and Tunisia.[14]

CSP was operational in 2012. They report much lower installed capacities of other CSP technologies (10 MWe or lower of each of the other main CSP technologies including Fresnel Trough, Molten Salt Solar Tower, Water Steam Solar Team and Parabolic Dish). Of the parabolic trough projects, the United States appears to be hosting the greatest installed capacity (354 MWe in the famous SEGS plant in the Mohave Desert and 324 MWe in recently built plants), followed by Spain (550 MWe across three sites, mostly already commissioned), and the UAE (100 MWe on one site). One further project in the pipeline in the United States would however add a further 1000 MWe.

13 The Clean Technology Fund (CTF) is one of two multi-donor Trust Funds within the Climate Investment Funds (CIFs). It promotes scaled-up financing for demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse-gas emissions savings. Funds are channelled through the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and World Bank Group. The CTF finances 12 country programs (called Investment Plans) and one regional program (the MENA CSP Investment Plan). The World Bank is the Trustee and Administrating Unit of the CTF Trust Fund (ODI/Heinrich Böll Foundation, 2012).

14 The Investment Plan represents approximately 15 percent of the projected global pipeline of CSP projects and, if realized, would almost double the current global installed capacity of CSP.

The long-term vision of these initiatives is to promote the development of an economically sound CSP market that could foster associated social benefits. The steps along the way constitute a critical series of building blocks. To lay the foundations of such a market, the Government of Morocco and a selection of IFIs have committed substantial concessional finance to develop early CSP projects such as Ouarzazate I. However, a functioning market may still be some years away. Moving from a fragmented approach toward a portfolio approach would speed up achievement of this vision in the region.

Along with other large-scale CSP projects **the primary higher-level objective of the institutions backing Ouarzazate I is to install CSP at a scale that sufficiently tests and demonstrates the storage technology component, and triggers important CSP cost reductions.** Other factors will also help reduce costs including building up experience with the public-private partnership model, achieving economies of scale, and improving technology (WB, 2011a).

Other higher-level objectives include promoting green growth and local economic development by building up Morocco's renewable energy industry, improving Morocco's energy security, shifting subsidies and the Moroccan energy system away from fossil fuels and reducing Morocco's trade deficit. In addition to building CSP capacity, interconnections and development of a sizeable regional electricity market, with the possibility to export power to more lucrative E.U. markets, will be important to spur the development of a local industry at scale.

The Moroccan Government is an early mover and hopes to benefit from its contribution to the development of the CSP market in the region. To do so, it will be crucial to learn early lessons from projects being developed and to keep an eye on the long-term objectives of the portfolio.

Project details

A public-private partnership has been designed to manage and finance Ouarzazate I, drawing together private developers and/or investors and IFIs. The partnership incorporates Power Purchase Agreements (PPAs), and sets the terms for a large amount of concessional finance provided by the Government of Morocco and IFIs, some of which has been distributed via the Clean Technology Fund (CTF). This model allows the government to share costs and risks with international and private financiers and project developers. It also helps to drive overall costs down.

MASEN, the solar energy agency established by the Moroccan Government, plays a key role linking the project company and the governmental support for the project. It is currently offering private partners/consortia to take a 75 percent equity stake against its 25 percent equity stake in the Solar Power Company (SPC) special purpose vehicle, which will develop the project. The SPC/PPP partners are expected to take a total equity stake of approximately USD 253 million.[15] Under the first of two 25-year PPAs, MASEN will purchase power from the SPC at the cost of the power generated. Under the second PPA,[16] the Office National de l'Electricité of Morocco (ONE)[17] will buy all power from MASEN, at the grid price, and dispatch it from the plant.[18]

The Government of Morocco has agreed to finance the costs of the Moroccan Solar Plan through a convention which guarantees the financial stability of MASEN. A project specific convention specifies the support to be provided for Ouarzazate I to compensate MASEN for the price difference between the two PPAs. This represents the incremental cost of the CSP technology for the Moroccan market—and initial projections estimate this subsidy to reach around USD 60 million per year (WB, 2011a).

To date, IFIs have pledged over USD 1 billion in concessional loans to support construction costs and a further USD 200 million loan which provides the Government of Morocco with a safety net should it be unable to financially support the subsidy to MASEN.[19]

Importantly, without the Government of Morocco's agreement to fund the substantial viability gap and concessional financing terms provided by IFIs, the project would not be a viable investment prospect.

Project timeline

Figure 1 charts key project milestones and the roles of individual stakeholders. Commitments from IFIs to provide concessional finance[20] and agreements specifying support from the Government of Morocco to meet the viability gap and for the Office National de l'Electricité of Morocco (ONE) to purchase power were all laid out well in advance of the release of the request for proposals for a private development partner. Three full proposals from private-partner consortia are currently under consideration.

Project stakeholders

A broad group of international, national, government and non-government stakeholders are involved in Ouarzazate I. Based on publicly available sources of information, Figure 2 categorizes and maps the financial links between the stakeholders involved in the Ouarzazate I project. This case study identifies three main groups of stakeholders involved in the project: the Government of Morocco and governmental bodies (including MASEN and ONE), SPC equity providers/the private consortium, and IFIs providing grants and loans. Table 1 lists in detail the stakeholders that have contributed to the project, focusing on their financing role.

15 The SPC/public-private partnership is estimated to earmark USD 253 million as equity for construction and (MASEN only) USD 126 million to build associated facilities (WB, 2011a).

16 In the rest of the document, this second PPA is referred as Power Sale Agreement (PSA).

17 Following the merger with the Office National de l'Eau Potable (ONEP) in April 2012 ONE has been renamed Office National de l'Eau et de l'Electricite (ONEE)..

18 Morocco has a relatively stable political and regulatory environment and the PPA model goes even further to lower risks for potential private investors (Norton Rose, 2010).

19 In addition, the German Ministry of Environment (BMU), has pledged a grant of USD 19 million and European Commission Neighbourhood Investment Facility (EC NIF) a grant of USD 37 million.

20 Announcement dates for commitments to the project by IFIs are not shown in the timeline due to lack of available data. Instead commitments are plotted according to official approval dates.

Figure 1: Ouarzazate I Concentrated Solar Power project timeline

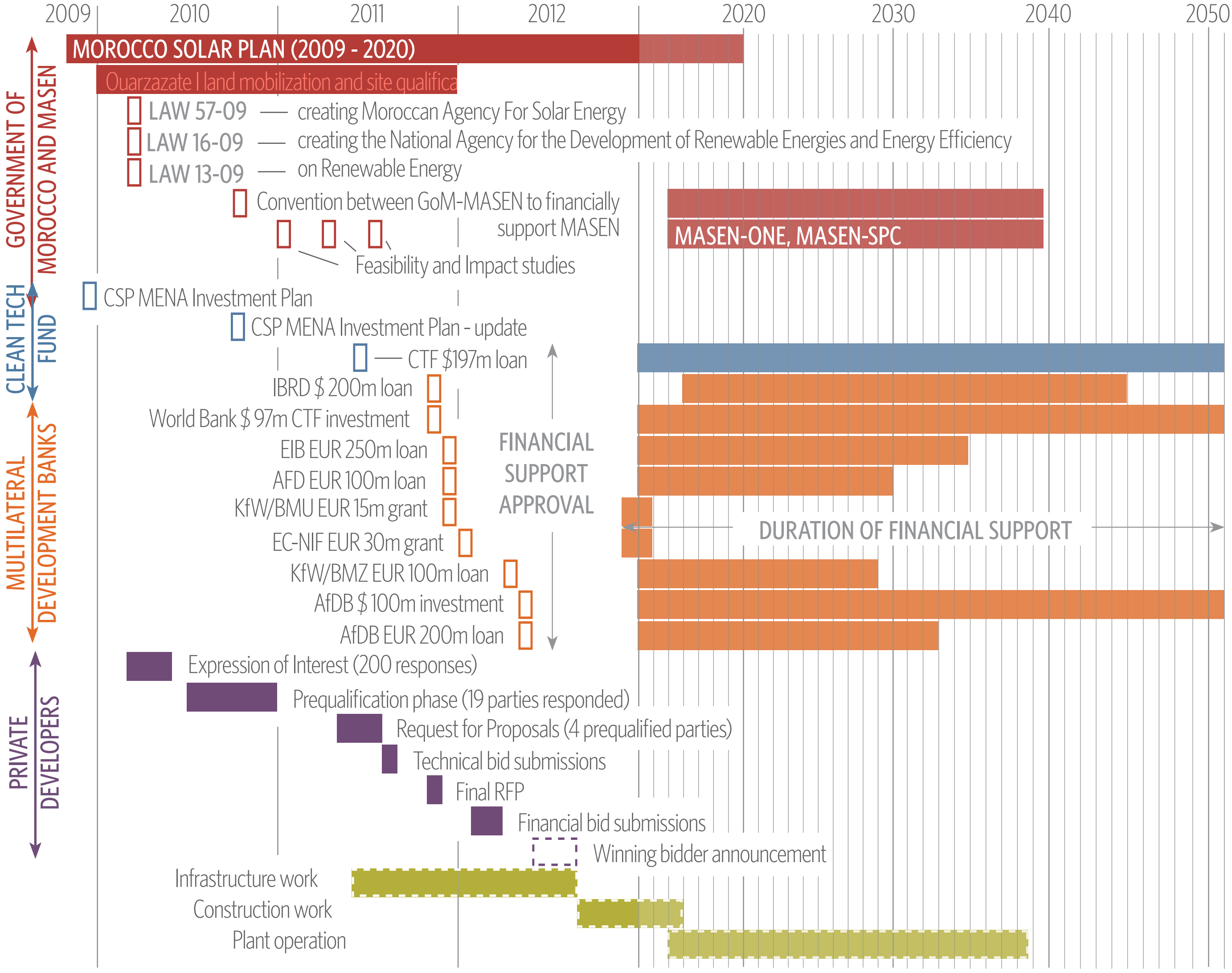


Table 1 Stakeholders description and role

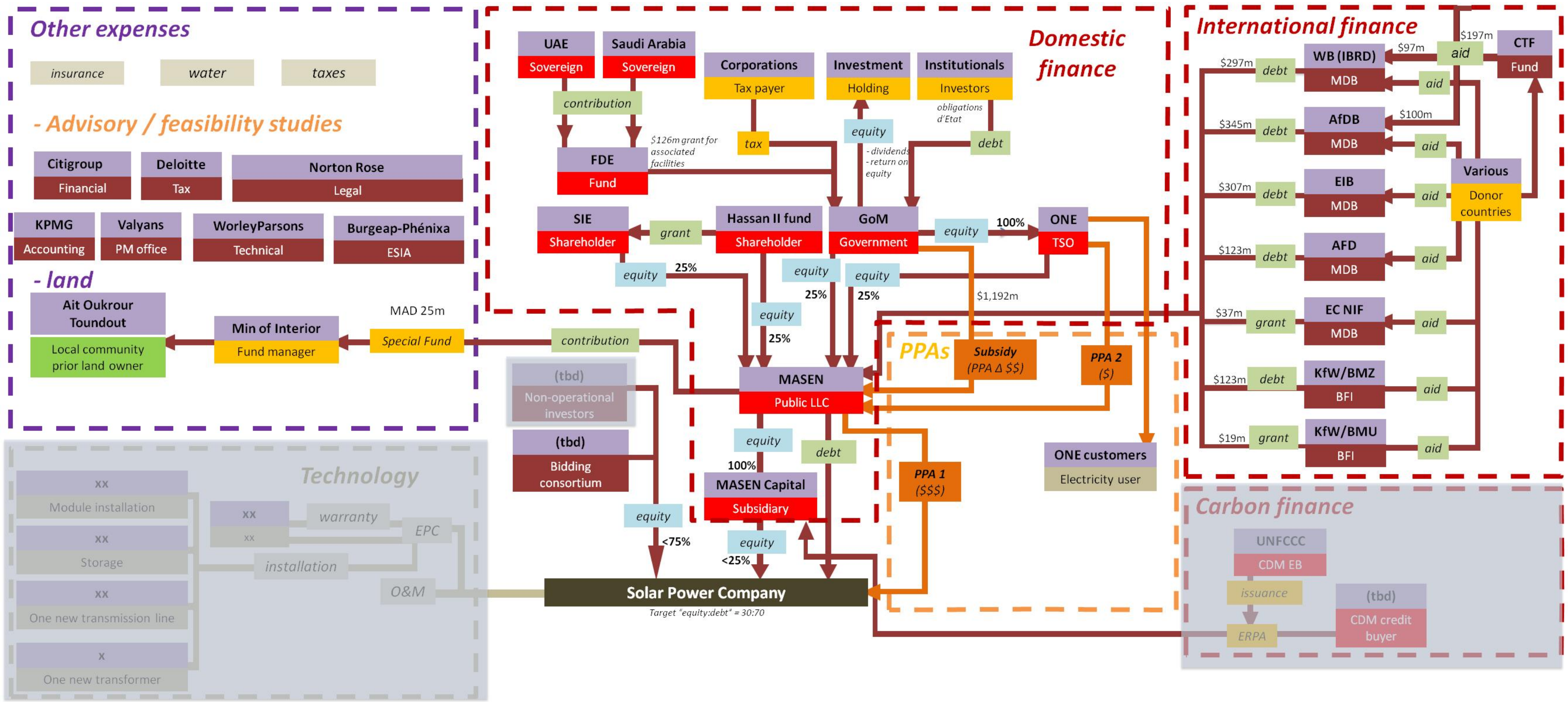
Stakeholder		Description and role	Financing role
Government of Morocco	Moroccan state	• Shareholder in MASEN	Subsidizes difference between two PPAs present in the project through the State Budget
Government of Morocco	Ministry of Interior	• Manages special community fund	N/A
Government of Morocco	MASEN	• Moroccan Agency for Solar Energy • Limited liability company (LLC) with the Moroccan State, ONE, Fonds Hassan II and the Société d'Investissements Energétique (SIE) as equal shareholders • Responsible for managing bidding process and selection of private consortium • Monitor SPC • Ownership of the CSP plant upon commissioning • Semi-annual financial reports, independent annual audit and progress reporting to donors (financial statements, physical progress and procurement) • Support R&D, training and technical innovation • Implementation of the FESMP[1]	• Finance and manage the Associated Facilities (for water supply, grid connections and land) • 25 percent equity stake in the SPC • Onward lends IFI debt and manages reporting to IFIs
Government of Morocco	ONEE	• Office National de l'Eau et de l'Electricité incorporating Office National de L'Electricité and Office National de l'Eau Potable • Construction of the transmission lines and water supply infrastructures • Power dispatch, transmission, and distribution • Environmental Management Plan for transmission lines and water supply • Shareholder in MASEN	Required to purchase all power generated by the plant from MASEN
Private	Private consortium	• Project implementation including design, construction and performance optimization of the plant • Preparation and implementation of project specific ESIA and ESMP,[2] financial reporting • Project Implementing Entity	75 percent equity stake in the SPC
International donors	AfDB	• African Development Bank	• Channel CTF financing • Provide additional concessional financing towards construction
International donors	WBG/IBRD	• World Bank Group and International Bank for Reconstruction and Development • Support to MASEN and Government of Morocco to initiate the project	• Channel CTF financing • Provide additional concessional financing to support Government's PPA subsidy
International donors	EIB	• European Investment Bank • Coordinates European donors	Concessional finance provider
International donors	AFD, KfW/ BMZ	• L'Agence Française de Développement, German Development Bank and German Development Cooperation	Co-lenders linked to EC NIF grant
International donors	BMU, EC NIF	• German Ministry of Environment, European Commission Neighbourhood Investment Facility	Grant providers

[1] The Framework Environmental and Social Management Plan (FESMP) includes institutional settings, general mitigation measures and a monitoring plan for the potential impacts expected from project activities during construction and operation stages (WB, 2011a).

[2] Environmental and Social Impact Assessment (ESIA) is to be carried out by the SPC and include a detailed Environmental and Social Management Plan (ESMP) (WB, 2011a).

Sources: various.

Figure 2: Ouarzazate I Stakeholder Mapping



Notes:
(1) The exact amount of financing by all parties will be finalized during the project's evaluation phase.
Source: CPI compiled this information from various sources. Carbon finance and technology are blocked out at present due to lack of available information.

- The Government of Morocco provides a subsidy that will cover the difference between the price at which MASEN buys, and then sells power. This subsidy is essential for the project's viability. Without it, CSP technology is still too expensive for the local market as the price of power generated is substantially higher than local grid prices.
- The Solar Power Company's revenue stream is heavily subsidized by the Government of Morocco and by IFIs' concessional finance.
- The Government of Morocco and IFIs are betting on the project's contribution to the development of a CSP market in the region that will bring longer term and broader economic benefits.

Investment, return, and profitability of Ouarzazate I

This section addresses two main San Giorgio Group questions: *What are the public and private financial inputs and what are the main outcomes of Ouarzazate I?* To assess the return profile of the Ouarzazate I project, we first consider the total project costs broken down across equity and debt contributors and across project phases. Then, we estimate returns and profitability at the overall project level and those accruing to each project contributor. Finally, in order to assess if money has been invested wisely, we apply CPI's emerging Effectiveness Framework to identify causal relationships between inputs (for example policy incentives and financing) and relevant outcomes. To the extent possible, given available data, we attempt to quantify impacts that will derive from the investment.

We have performed all our analyses on the basis of initial projections and estimates of the project sponsors and concessional financiers. In the past few months, project developers have submitted bids but, at the time of writing (August 2012), a winning bid had yet to be announced and the exact content of individual bids remained uncertain. Hence, we have relied on initial financial metrics, projections and charts to inform our overarching analysis. For a limited number of metrics (i.e. capital expenses, levelized cost of energy [LCOE], governmental subsidies), we have calculated results implied by the estimates of the lowest bid.

Project costs and sources of return

Project costs

Expected project development and operational costs are presented in Figure 3 below.[21] Project development costs include around USD 3 million[22] for land and USD 126 million for associated facilities (water connections, transmission lines, and other infrastructure requirements such as access roads).[23]

Ouarzazate **capital expenses** (CAPEX) were originally estimated at between USD 960 million and USD 1,304 million.[24] However, the lowest bid received during the tender process indicates a much lower figure: between USD 700 and USD 800 million.[25] The component contributions to CAPEX were initially estimated at 62 percent for the solar system (field and heat transfer fluid), 21 percent for the power block, 13 percent for storage, and 4 percent for site preparation. The expected equity to debt ratio for the project is 20:80.

MASEN estimates that **operating expenses** (OPEX) will amount to approximately 11 percent of gross annual revenues, which we assume includes costs for lease of water, land, and road infrastructures and should amount to approximately USD 26/MWh.[26]

21 This case study's estimated value is based on the initial projections. As with most of the financial estimates, the final amounts will be known only once the winning bid is selected.

22 Land was purchased by MASEN via ONE from the community and will subsequently be leased to the SPC.

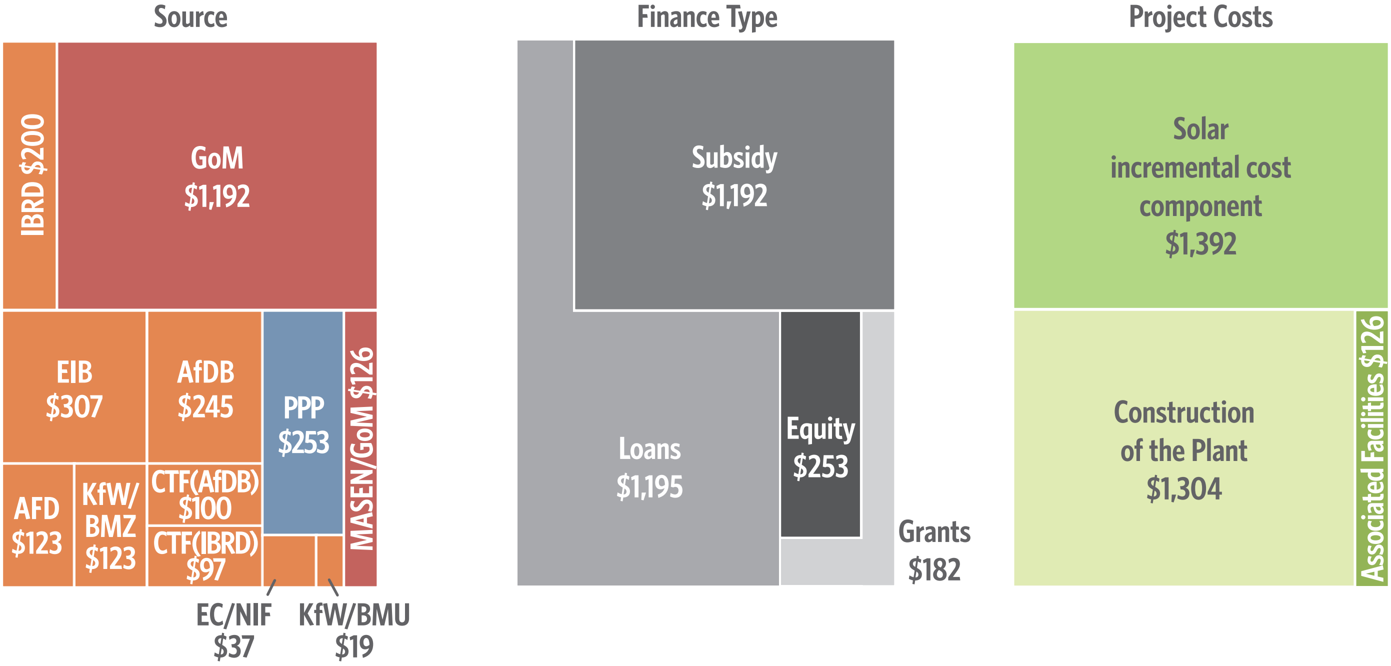
23 Funded by the Government of Morocco via MASEN, then leased to the SPC.

24 Original estimated investment cost was USD 6000/kW (WB, 2011a, p.95), resulting in USD 960 million for 160 MW installed. Sum of contributions for construction components, as reported in various sources, is USD 1,304 million, building in some room for contingency.

25 In April 2012, Project Finance Magazine reported: "The Acwapower/Aries/TSK consortium submitted a bid of USD 0.189711/kWh - around 30 percent below the other two bidders. The Enel Green Power/ACS Cobra consortium bid USD 0.244235/kWh and Abengoa/Taqa/Mitsui bid USD 0.244271/kWh, while the Solar Millenium/Orascom consortium did not bid" (Project Finance, 2012). Inserting the lowest bid in our financial model provides an estimated investment cost between 3,500 and 4,000 USD/kW(almost 40 percent lower than projected), a new LCOE of USD 194/MWh, and a governmental subsidy required of USD 40 million per year. Our estimate of the subsidy required is based on strong assumptions regarding likely wholesale electricity prices in Morocco (see footnote 30 for further information).

26 Based on initial projections (WB, 2011a). .

Figure 3: Attribution of project costs by source, financing type, and cost component (amounts in millions of USD)



Notes: Total burden on the Government of Morocco does not include fuel subsidies saved and tax revenues (netted figure estimated around USD883 million). Commitments in original currency (where not USD) are: EIB €250 million, AfDB €200 million, AFD €100 million, BMU €15 million, EC-NIF €30 million. Sources: World Bank (2011a), CIF (2011a), and AfDB (2012b).

At the time of writing (August 2012), **financing costs** for the SPC were unknown; they will be determined by the extent to which MASEN passes on the terms of IFI concessional loans. Based on lenders' indications, our financial modeling estimates a blended interest rate for the overall IFI concessional financing of approximately 3.1 percent.[27] Figure 4, below, compares this to a commercial interest rate of 9 percent (Kulichenko and Wirth, 2011) and highlights the impact of this cheaper debt provided by IFIs on the project cash flow stream (the aqua-colored area).

Expected generation and levelized cost of energy (LCOE)[28] calculations

Ouarzazate I is expected to produce an average 370 GWh of power per year for 25 years, following three years of construction. We estimate levelized cost of energy (LCOE) using the initial projections for capital expenses, the estimated value of the PPA and Power Sales Agreement (PSA), together with assumptions about the timing of cash flows and a blended rate of 3.1 percent for financing. Based on these factors, the LCOE is calculated at approximately USD 245/MWh.[29] Capital expenses account for 90 percent of costs, and operating expenses for 10 percent.

International donors and concessional lenders clearly have a substantial impact on the project's LCOE by providing up-front lower-cost financing. For example, if we replaced all concessional financing with commercial capital at a blended rate of 9 percent (Kulichenko and Wirth, 2011) the resulting LCOE would be approximately 30 percent higher, or USD 320/MWh.

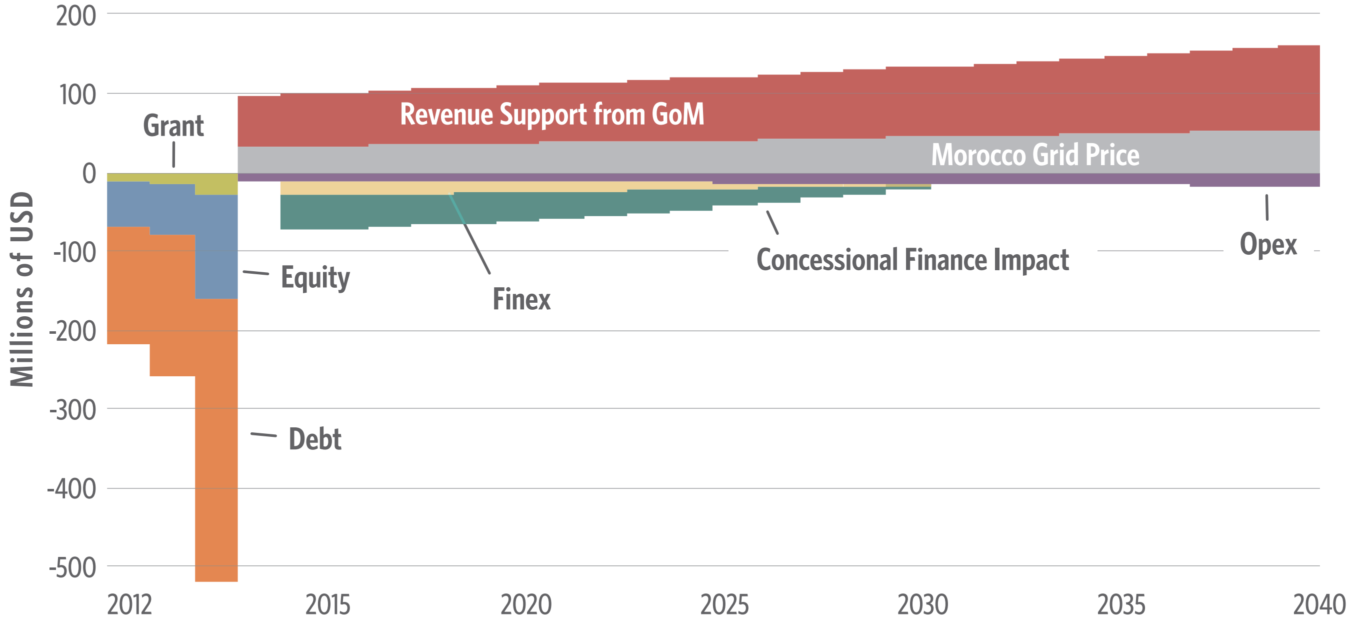
Given national grid prices of approximately USD 81/MWh, without concessional financing and continuous revenue support from MASEN, it would be impossible

27 This case study assumes that all concessional financing from IFIs is passed on directly from MASEN to the SPC. At the time of writing, the pre-announced terms were as follows (AfDB, 2012b): Clean Technology Fund's 'softer' concessional: 0.25 percent service charge and an embedded grant element of 75 percent; AFD: 4 percent interest rate, 17 years maturity with 4 years grace; AfDB: 4 percent interest rate, 20 years maturity with 5 years grace; EIB: 4 percent interest rate, 23 years maturity with 3 years grace; KfW: 2.5 percent interest rate, 15 years maturity with 3 years grace.

28 By a levelized cost, it is meant the (present value of) total project costs for each kWh of energy generated by the CSP. This provides a single, aggregated measure of costs associated with energy production that can be compared across technologies (Varadarajan et al., 2011). The LCOE method calculates the levelized cost of energy to the final user by actualizing all cash flows related to a specific energy source. Consistent with previous CPI reports, the calculation has been based on the expected after-tax internal rate of return of the project, based on anticipated cost and revenue estimates.

29 This LCOE estimation appears consistent with the our estimation for PPA price indicated by the project financiers (WB, 2011a), as well as estimates from the European Investment Bank (EIB) for CSP technology in MENA (EIB, 2010) and the projections from European Solar Thermal Electricity Association, Estela (ATKearney, 2010).

Figure 4: Project Cash Flows



Source: CPI Elaborations

for CSP to compete with lower-cost alternatives. Even if high government fossil-fuel subsidies were removed and national grid prices rose to USD 113/MWh, the cost differentials would still be difficult to overcome. (Please see Box 1 for a more detailed discussion of fossil-fuel subsidies.)

Project sources of return

The SPC's main source of return will be from electricity sales to MASEN via the PPA. We estimate the price for this at approximately USD 244/MWh. While the terms and the projections of the PPA between the SPC and MASEN are confidential, we estimate its value by adding MASEN's projection of the government subsidy (USD 60 million per year for the duration of the project) to our estimate of the PSA between MASEN and ONE. This case study assumes that the PSA will be linked to the Moroccan market's prevailing power price and, in practice, will be driven by coal generation prices. It has not been disclosed whether the PSA price will be fixed for 25 years or if it will be indexed to the grid price over time. Taking current industrial electricity tariffs in the country as a benchmark, we estimate the PSA will be set at a price of $81/MWh. This assumes that ONE does not place any margin on power purchased from MASEN before selling it.[30]

Overall Project Return

Assuming 25 years of operation, a degradation factor[31] of 0.5 percent per year, an annual escalation factor for both operation expenditures and PPA of 2.6 percent,[32] and a corporate tax rate of 30 percent, we estimate the pre-tax internal rate of return (IRR) at 9 percent and the after-tax, levered IRR for the SPC at 13.6 percent (taking into consideration the 80:20 leverage factor at project level). This figure compares closely with reported IRR benchmarks for renewable energy generation under another concessional scheme for wind energy in Morocco (Attijari, 2010).[33]

The cash flow profile over the lifetime of the project, based on the assumed project costs and revenues, is illustrated in Figure 4. The lower half of the graph shows the high upfront capital costs of the project in the first three years, as financed by debt, equity and, to a lesser extent, grants. Other costs, spread over the duration of the project are also shown, including operating and financing costs. In terms of sources of project revenue (on the upper half), the figure shows the crucial

30 This assumption derives from considering that both ONE and MASEN are public entities owned by the state and that any margin charged by ONE onto electricity sold to MASEN would have to be compensated by the government itself via the convention with MASEN. Given limited availability of data on wholesale electricitytariffs in Morocco or on the likely rate of the PSA between ONE and MASEN, we assume a PSA of 81 USD/MWh, based on electricity tariff data published online by the Moroccan Investment Development Agency (MIDA, 2012).

31 The degradation factor is the annual power generation loss due to continuous aging and fatigue of the equipment.

32 Inflation rate forecast from IMF.

33 Attijari Finance Corp reported benchmarks vary according to the chosen business model, from the less risky generation under a concessional scheme with ONE (10-12 percent IRR), to the generation directly from ONE (11-12 percent), to self production (greater than 12 percent).

support provided by the Government of Morocco to make the project profitable by filling the viability gap between high-cost CSP power and the marginal costs of power production, and also shows the income flowing from ONE to MASEN for the sale of power to the grid. The figure also illustrates savings for the SPC as a result of the concessional financing terms - actual financing expenses (FINEX) - as compared to counterfactual commercial financing terms (aqua).

Table 2: Stakeholder benefits

		Gov't of Morocco	MASEN	SPC equity holders[a]	IFIs	General public
Financial returns / benefits	Income from Solar Generation (PPA)		√	√		
	Concessional public finance	√	√	√		√
	Viability gap[b] subsidy		√	√		
	Carbon market revenues	√	√			
	Avoided subsidy and import costs	√				√
	Taxes	√				
Non-financial returns / benefits	Greenhouse-gas savings	√			√	
	Technology-cost reduction	√	√	√	√	√
	Learning	√	√	√	√	
	Green growth	√	√		√	√
	Green jobs	√	√	√	√	√
	Energy security	√			√	√

[a] Private consortium plus MASEN.

[b] Viability gap is defined as the difference between the PPA price paid from MASEN to the SPC and the PSA price paid from ONE to MASEN multiplied by the annual power generated.

Returns to individual project contributors

The expansion of CSP technology in Morocco is geared toward meeting multiple objectives and delivering multiple benefits. Table 2 summarizes both direct and indirect (portfolio-related) returns to project contributors followed by a discussion of these returns.

Government of Morocco

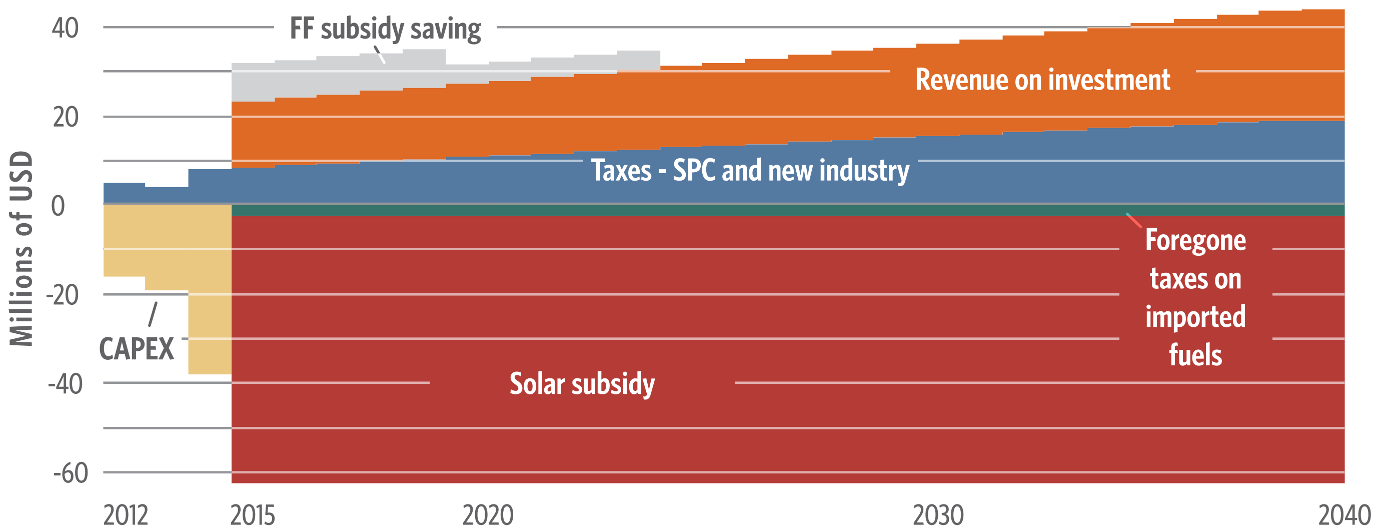
The Government of Morocco is investing heavily in the Ouarzazate I project through an annual subsidy (estimated at around USD 60 million per year), channeled through MASEN. The purpose of this ongoing subsidy is to fund the viability gap between the price MASEN pays to purchase power from the SPC, and the price at which it sells power to ONE. The Government of Morocco is betting that long-term economic benefits or higher-level objectives, that would be triggered with a move towards a CSP market in the region, will more than compensate for its early investment.

The Government of Morocco is also set to receive some revenue streams through its equity holding in MASEN, as well as tax revenues associated with the SPC, new industries and/or jobs. Figure 5 illustrates this balance of costs and benefits. The top half of the graph shows sources of revenue and budget savings for the Government of Morocco, including tax receipts, return on investment (as a stakeholder in MASEN) and savings derived from fossil-fuel subsidies displaced by Ouarzazate I. We assume that under a business-as-usual scenario, fossil fuel subsidies will be halved by 2020 and phased out entirely by 2025. The bottom half of Figure 5 shows costs incurred by the government, including through its contribution to the capital cost and the incremental-cost subsidy.

One of the Government of Morocco's primary higher-level objectives is to capitalize on its early mover advantage by becoming a hub for the CSP manufacturing and generation industry which could be a driver for long-term economic development. Evidence of the Government of Morocco's effort to embed longer-term goals in the project design includes MASEN's request for private developers to include local content valued at 30 percent of the plant capital costs in their bids.[34] Bidders are free to choose how to fulfil this request but MASEN suggests the following options: (1) indirect investment in a renewable energy manufacturing, operations and maintenance, engineering or R&D facility; (2) direct local procurement of goods and services; or (3) a combination or both.

34 WB, 2011a

Figure 5: Government of Morocco's Cash Flows



Source: CPI financial modeling (based on World Bank 2011a).

The CTF's impact indicators project that Ouarzazate I will have little if any discernible impact on local industry development, employment, and CSP cost reduction (WB, 2011a). However, combined with its second and third phases, Ouarzazate is expected to initiate local industrial development activities and to generate some local servicing and maintenance jobs. Moreover, Morocco's Solar Plan as a whole is expected to create significant local and national industrial benefits. A World Bank-commissioned study on the potential to manufacture CSP components locally in the MENA region[35] makes the following projections based on an assumed level of installed capacity of 2GW of CSP by 2020 and local content of about 30 percent in 2015, 50 percent in 2020 and 60 percent in 2025:

- creation of USD 4.6 billion of cumulated value add by 2020;
- creation of up to 11,000 full-time equivalent jobs in construction, manufacturing and operations and maintenance by 2020; and
- more than USD 3 billion of cumulated export revenues by 2020.

35 Gazzo et al. (2011)

The project will also help to shift subsidies, and the overall Moroccan energy system, away from fossil fuels. ONE's analysis estimates the government will save approximately USD 64 million in subsidies over the lifetime of the project.[36] In the first few years of the project, this corresponds to approximately USD 8.5 million/year saved, compared to the Government of Morocco's total annual fossil-fuel subsidies cost of between USD 1 and 4.3 billion (2009-2011). Most of the value of the fossil-fuel subsidy savings derives from Ouarzazate I's storage technology, which allows Ouarzazate I to displace (imported and expensive) oil-based generation used to fulfill peak demand.

The Government of Morocco will also benefit from expected **CO_2 savings** of around 240 kt per year (valued between USD 1.2 and 3 million per year).[37] The eco-

36 Amounts of fossil fuel displaced (in the baseline scenario) have been estimated by ONE and valued at the following prices and quantities: Coal: 32,000 tons at 150 USD/ton; Natural Gas: 354,000 mbtu at 10 USD/mbtu; Fuel Oil: 67,000 tons at 450 USD/ton. The estimate assumes that the Government of Morocco follows through on its subsidies phasing-out policy.

37 This assumes a displacement of the average electricity fuel mix (18 percent coal, 15 percent natural gas, and 67 percent fuel oil) although it is hoped that the use of storage technology will enable the plant to also displace peak

Box 1: Fossil-Fuel Subsidies in Morocco

Moroccan electricity generation largely relies on heavily subsidized, imported fossil fuels. Both fossil fuels and electricity are sold to the consumer below the cost of supply through a compensation system financed directly and indirectly (through the state utility) by the state. Over the past three years (2009-2011), the total burden of these subsidies on the government budget has ranged between USD 1 and 4.3 billion, or around

1-4.3 percent of the country's GDP.[1] Besides representing a heavy drain on public resources and incentivizing over-consumption of carbon-intensive energy, fuel subsidies also widen the competitiveness gap of renewable energies by lowering the average grid price by roughly 30 percent.[2]

The Government of Morocco is currently working to reform the existing subsidization system which is thought to favor wealthy citizens and failing to improve energy access for the poorest Moroccans.[3] The government has announced that fuel subsidies will be replaced gradually by targeted cash grants for families in need. Indeed, IFI appraisals of Ouarzazate I economics already factor in the halving of current subsidies by 2020 and a complete phase out by 2025. However, these changes have already sparked strikes and threats of social unrest (Achy, 2012), confirming that a direct reduction or complete removal of fossil-fuel subsidies remains a challenging political hurdle.

Increasing the deployment of renewable energy sources is a way to reduce demand for imported fossil fuels and, indirectly, the subsidies required to maintain them. However, at today's technology costs, CSP power is still too expensive for Morocco and requires high levels of public support that outweighs those savings. In the case of Ouarzazate I, the plant requires an estimated USD 60 million of direct subsidies to achieve viability, but only displaces USD 12 million of fossil subsidies per year.

Though certainly helpful, the removal of fossil-fuel subsidies alone would not be sufficient to make CSP power more competitive and sustainable. From this perspective, achieving the technology cost reductions targeted by the Morocco Solar Plan and by the CTF Investment Plan will be the cornerstone to making CSP power competitive.

1 WB, 2011a.

2 We have inferred an average level of subsidization of 30 percent from the overall value of fossil-fuel imports for 2010 (8.3 billion USD) and the cost of the fuel subsidies for the same year (2.5 billion USD).

3 In 2008, a study by Morocco's High Commissioner for Planning concluded that 20 percent of wealthy households receive three-quarters of the government-allocated support for diesel and gasoline while 40 percent of needy families receive only 5 percent (Achy, 2012).

nomic value of **environmental cobenefits** in terms of avoided local pollution (for SO_2, NOx, PM)[38] are estimated at USD 2.3 million over the life of the plant, and increase to USD 7.2 million for the complete Ouarzazate portfolio and USD 28.8 million for Morocco's Solar Plan as a whole.

Ouarzazate I's impact on Morocco's **energy security** is minimal due to its relatively small scale. In the long run, however, a larger portfolio of CSP in the country and development of a regional electricity market[39] could improve Morocco's energy security, reduce dependency on energy imports,[40] diversify energy sources towards renewable energy, and create new generating capacity to help meet high electricity demand growth.[41] Indeed, the CTF's impact indicators show that Ouarzazate I will reduce electricity imports only by a small amount (lifting renewable energy sources' share of power generating capacity to 2 percent), but that more significant reductions would follow realisation of the complete Ouarzazate portfolio (to 8 percent) and the Morocco Solar Plan (42 percent). Noting that increasing world oil prices have caused Morocco's trade deficit to balloon in recent years (by 21 percent in 2010-2011), decreasing energy imports will **enhance Morocco's balance of trade** and improve overall economic security. Improved energy security and import savings will, however, ultimately depend on the share of the CSP generated power that is kept for the local market and not exported into Europe.

load which is currently met by fuel oil.

38 Sulfur Dioxide (SO_2) valued at 5,220 USD/ton; Nitrogen Oxide (NOx) valued at: 5,165 USD/ton; (PM) valued at 20,823 USD/ton (ExternE).

39 Double 400-kV interconnections with Algeria and Spain already exist. The latter provides access to the Spanish and Portuguese markets and will provide access to the French market when the FR-ES interconnection is upgraded, which is expected to be completed in 2013.

40 Currently 97 percent of energy consumption (WB, 2011a).

41 An average 6 percent per year growth in domestic electricity demand necessitates 700-800 MW per year in new generating capacity (WB, 2011a).

MASEN

MASEN has multiple interests in the Ouarzazate I project and stands to receive multiple benefits.

As the project developer, MASEN will benefit from international concessional finance and the Government of Morocco subsidy. MASEN's cash flow profile is determined by the **guaranteed revenue stream** from the Power Sale Agreements with ONE (estimated at between USD 30 and 35 million a year) and the **fees** it receives from the Solar Power Company (SPC) under the lease to use MASEN-owned site infrastructure, 'associated facilities' (water, transmission lines, and road access), and the CSP infrastructure itself. On the negative side, MASEN is impacted by the costs of the PPA signed with the SPC (around USD 97-100 million a year) but this is compensated through a convention with the government to subsidize the costs of paying the Power Purchase Agreement with the SPC.

Other benefits may include profit on margins it generates through **repackaging concessional debt**, grants from IFIs, dividends as an equity holder of the project company, and sales of CO_2 emission rights under the **Clean Development Mechanism**.[42] The latter could amount to between USD 1.2 and 3 million per year (based on a USD5/t and USD13/t carbon price respectively).[43]

SPC equity providers

A consortium of private equity providers (including MASEN) stand to benefit from **a guaranteed revenue stream** through MASEN's PPA. This will cover SPC costs after concessional finance is factored in, plus an acceptable margin that we estimate at 13.63 percent on a levered basis. There could also be a return from patents that are generated as a result of this project. The cash flow profile of the SPC equity holders is integrated in Figure 4 and highlights both revenues and costs.

The private consortium will also **develop considerable experience** from their involvement in Ouarzazate. This will put them in a good position to invest in similar projects throughout the region.

Over time, some of the benefits will include those that stem from scalability. These include reduced technology costs, a ready workforce, and access to a wider electricity market along with other regional developers.

IFI grantors and lenders

IFI grantors and lenders provide funding to the project on the basis of its **contribution to the higher-level environmental and development objectives**. Lenders also aim to recoup the capital lent with **a minimal return on the investment**. (We estimate a blended concessional rate of 3.1 percent). As discussed, the standalone contribution of Ouarzazate I is insufficient to meet higher-level objectives. However, as the first stage of a new portfolio, it is almost inevitable that Ouarzazate I will bear some early-development costs (or "vintage costs") to which future projects will not therefore be subject. IFIs will most likely remain involved in the subsequent phases of Ouarzazate and will continue to pursue those same objectives.

General public

The general public stands to benefit from **local economic development opportunities** (jobs and training) that result from the project during construction and operation, improved energy security, and from the, eventual, technology-cost reductions that the Morocco Solar Plan will achieve. At the local level, the income (USD 3 million) from the sale of the land for the plant to ONE/MASEN is being used to fund the Ait Oukrour Toundout community's **local social development plan**. MASEN and other public stakeholders will also contribute to this fund on a voluntary basis.

Has Ouarzazate I been effective?

The San Giorgio Group aims to facilitate an overall assessment of whether money is being spent effectively. To do this, we map out the policy steps and financial inputs that support implementation activities, through outputs and eventually, to final outcomes, in order to clearly identify the causal links between policies, investments, and final impacts (see Table 3).

Based on this analysis, we identify the main factors that determined the performance of the individual intervention, and good practices which could be scaled up and replicated in other sectors, technologies, and geographies. We use a common set of appropriate criteria to systematically measure indicators such as total amount

42 MASEN's right to carbon finance revenues will be specified in the PPA between SPC and MASEN. The Ouarzazate Solar Plant Phase 1 was submitted to the CDM registry on 28 September 2011 and is currently listed at the "Prior Consideration" stage.

43 We estimate a price range of USD 5 to 13/ton as the lowest reported cost for primary CERs by Gorina (2009) and the highest paid for "pioneering primary credits" according to ICIS (2011). The amount of CO_2 emissions saved has been estimated by WB (2011a) but will have to be validated and approved by the CDM Executive Board.

invested and leveraged and the performance of financing practices in relation to green investment objectives. As we build up a larger collection of case studies, we will compare results across different settings and attempt to draw lessons about what makes climate finance more or less effective.

In the context of Ouarzazate, we assess final outcomes against Ouarzazate's expected 25 year life-cycle and associated projections.

We present the effectiveness framework as applied to Ouarzazate 1 in Table 3, which defines inputs as financial resources, outputs as direct results from the investment of those resources, interim outcomes as second order results derived from project outputs, and projected final outcomes as the cumulative benefits delivered over the lifetime of the project.

This map of interim and final outcomes highlights the expectation that Ouarzazate will yield significant environmental and economic benefits over its lifetime. The lessons generated will take Morocco and the region a step closer to the realization of a large-scale CSP portfolio.

Table 3: Summary of the effectiveness of the Ouarzazate intervention

INPUT	OUTPUT	INTERIM OUTCOME	PROJECTED FINAL OUTCOME
• Private capital: USD 253 million • Concessional public finance (grants, below-market loans): USD 1 billion • Market-like incentives (Government of Morocco subsidy): USD 1.19 billion	• Installed CSP capacity: 160MW • LCOE driven down by 25-30 percent • Local content valued at 30 percent of plant capital costs • Thousands full-time equivalent construction jobs	• Displaced fossil generation: 370 GWh p.a. • Solar Power Company IRR: 13.63 percent (after tax) • Government revenues (carbon market, taxes USD 380 million, infrastructure lease payments) • Reduced imports or additional capacity to meet rising demand • Hundreds of operations and maintenance jobs	• Avoided fossil-fuel subsidies: USD 64 million • CO_2 avoided: 240 ktCO_2 p.a. • Lessons for replication and scale up of CSP in the MENA region and beyond • Contribution to Moroccan Solar Plan eventual expected benefits: » Local economic development:[1] USD 4.6 billion value added and 11,000 full-time equivalent jobs » Shifting energy system away from fossil fuels » Improved energy security » Technology cost reduction » Development of a regional electricity market / exports to EU: USD 3 billion export revenues

[1] Local manufacturing, R&D, industrial cluster development.

Note: All figures, unless specified, refer to the whole project life time. Government of Morocco subsidy of USD 1.19 billion is gross and does not account for subsidies saved on imported fuels and additional tax revenues. Total net cost to Moroccan budget estimated at USD 883 million (WB, 2011a).

Source: data extracted from WB (2011a); AfDB (2012b)

- The public-private partnership model shares project management risks between the public and the private stakeholders. In running the plant, stakeholders' joint responsibilities help to align their interests.
- A combination of PPA contracts shifts revenue risks from the private developer (the SPC) to MASEN and the Government of Morocco, which are backed by international aid. This helps to reduce the required rate of return from the private investor and makes the project viable.
- Pre-emptive financing from international donors and multilateral banks greatly reduces the financial risks of the project while diversifying sources of capital.

Risk allocation in Ouarzazate I

To understand how risks are allocated among stakeholders, we have applied a three step risk management framework to the Ouarzazate I project. We:

1. identify and assess individual risks;
2. analyze the impacts and the mitigation instruments adopted to address critical risks;
3. Depict the overall final risk allocation framework in Ouarzazate I, highlighting the instruments and arrangements used to shift risk between entities.

In the following chapter, we explore how the Ouarzazate I risk-sharing model reallocated risks between the private and public sectors. We also review the role of IFIs in relieving both sides of some financial risks.

Risk identification and assessment

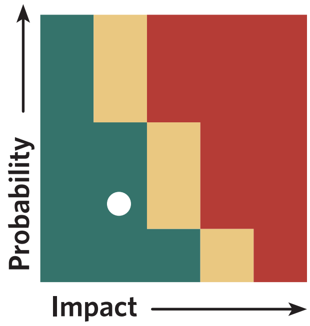
We first categorized risks in the Ouarzazate project along three major dimensions:[44]

- **Development risks** refer to risks associated with the design and implementation phase of the project including procurement (equipment/technology), construction, and financing risks;
- **Operations risks** include all risks associated with running the project, i.e. production and availability risks, operating costs (notably operations and maintenence risks), and revenues (power generation sale as affected by the power sales agreement and subsidy).
- **Outcome risks** refer to risks more specific to high-level public-policy objectives such as failure to meet environmental and local development targets, risk of overpaying on subsidies, risk of not impacting technology costs or providing suitable demonstration effects to stimulate replication and scale up.

Next, we systematically classify the identified risks according to two criteria: their probability/frequency of occurrence (from very low to very high) and their grade of impact on the project's financial and non-financial objectives (from very low to very high).

44 This approach builds upon the typical project risk breakdown along development stages by adding the 'outcome' dimension, which is dedicated to the overarching results of the program. Acknowledging the degree of subjectivity embedded in this approach, and that some risks are interrelated and may involve more than one dimension, the San Giorgio Group strives to systematically capture these three dimensions across case studies.

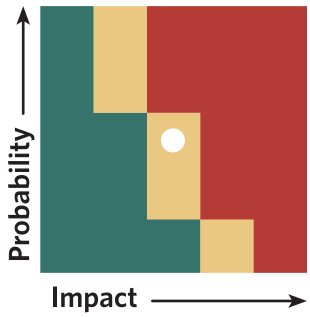
LOW-RISK EVENTS



Risk events with low probability of occurrence and low to-medium impact:

- **Project development risk**: The early-stage technology and the diverse interests of domestic and international actors make early termination a possible risk but with low impacts due to the disbursement of relatively little capital.
- **Electricity Price Risk:** This risk is borne by the Government of Morocco and international backers and is caused by low fossil-fuel prices driving wholesale prices below the benchmark set in the PPA between MASEN and ONE. This risk has low probability given the upward trend in international fuel prices (IEA, 2011).

MODERATE-RISK EVENTS

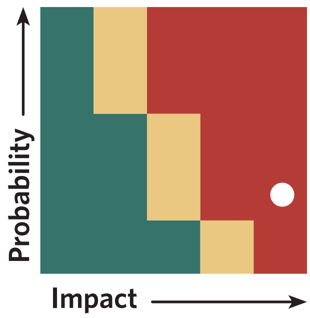


Risk events with moderate probability of occurrence, but medium-high impacts:

- **Safeguards:** The risk of non-fulfillment of social and environmental safeguards has high to medium impact as IFIs' initial assessments of the project indicate the potential for substantial environmental and social impacts.

HIGH-RISK EVENTS

Risk events with high to very high impact whatever the probability of occurrence:



- **Equipment failure:** Reduced production, increased costs, or delays could all negatively impact the financial performance of the project.[45] Plant developers bear this risk.
- **Reduced solar irradiation levels:** Reduced solar irradiation levels on a given site would result in lower than projected production output. Similar to equipment failure, the developer bears this risk, however, the Government of Morocco indirectly bears this risk since it impacts the amount of fossil fuels displaced.
- **Storage technology failure:** Failure to effectively embed the thermal storage—the least proven component of CSP technology—would render the plant unable to supply peak-load power, currently provided by expensive imported oil. This in turn would seriously undermine both the economics of the project (a risk the developer bears) and the achievement of fossil-fuel subsidy savings (a risk the Government of Morocco bears).[46]
- **Cost overruns and delays:** The project is large and applies a relatively new business model—a public-private partnership—for the country's energy sector. This makes unforeseen delays and cost overruns highly possible. As a result of EPC contractual provisions, the developers bear this risk and its costs.
- **PPA termination risk:** Should the project developers fail to deliver the project on time, MASEN could terminate the PPA and exercise the put-option in the Shareholder Agreement.[47] This is a low-probability event as MASEN is a shareholder of the SPC, however, it would have a disastrous impact on the project's financial viability.
- **Risk of insufficient funds to cover the viability gap:** Should the Government of Morocco fail to continue paying a subsidy to MASEN, the agency would be forced to default on the PPA commitment. This would make the project unviable.
- **Risk of non-achievement of project objectives and higher-level objectives:** The Government of Morocco bears this risk because Ouarzazate I is the first part of a portfolio approach that is complex, new, and in large part, contingent on the eventual export of energy to E.U. markets.

45 Norton Rose (2010) believes that solar thermal technology is now more on the proven than prototype side. Parabolic trough projects are already in place in numerous locations throughout the world and a 20 MW plant is already operational in Morocco.

46 Refer to the "Investment, Return and Profitability" section.

47 By exercising the put-option in the Shareholder Agreement, MASEN can "walk away" from the SPC by selling its shares to the other partners at a pre-determined price (Norton Rose, 2010 - WB, 2011a).

Risk analysis and mitigation instruments

Out of the high-risk events outlined above, we focus on the drivers and impacts of those that we deem the most important risks to the project fulfilling its objectives,[48] namely:

- Operating performance risk and specifically under-production as a result of equipment failure (during construction or operation) or lower than expected solar irradiation;
- cost overruns (CAPEX, OPEX, financing); and
- failure of the government to fully cover the viability gap.

The risk of non-achievement of project objectives and higher-level objectives is crucial from the point of view of public stakeholders and ultimately linked to the success of delivering the broader CSP portfolio to which Ouarzazate I belongs. A detailed analysis of this risk and of the available mitigation measures ("the five building blocks to replication") is presented in Section 6.

1. Operating performance risk

Equipment failure and uncertainty of solar irradiation levels represent risks for the ability of the plant to maintain expected energy generation levels. Equipment failure could result from operational stress of the generation processes and aging, corrosion, and fatigue of the materials. Irradiation levels can diverge from long-term forecasts due to adverse weather events, such as sandstorms, and as a result of uncertainty in original site-specific irradiation measurements.

We estimate the risk of under-production as moderately likely and quantify its impact by altering both the equipment's degradation factor from the project's initial projections, to account for equipment failure, and the forecasted level of production, to account for solar irradiance's uncertainty[49] (see Appendix B for more details).

The following factors mitigate the impacts of operating performance risk on the Ouarzazate project considerably:

- **Technology reliability**: Parabolic trough technology is the most mature of currently available CSP technologies and has been successfully implemented in several projects across the world and in similar contexts (such as Andasol in Spain, which includes storage technology), albeit at much smaller scales;
- **Expertise and advisors**: To minimize the risk of picking the wrong technology for the wrong site, MASEN has employed an experienced technical advisor and will select a capable private consortium SPC partner. To mitigate construction and operation risks, the pre-qualification phase of the tender process required bidders to have successfully[50] developed, operated, and managed large-scale thermal power plants and at least one solar power plant.

2. Cost overruns

The combination of new storage technology, the size of the power plant, and the relatively new public-private partnership financing approach make it moderately likely that project costs will go over estimates. To assess their impact, we increased both the estimated construction costs and the expected operations and maintenance charges. As expected, given the high-capital intensity of the technology, construction cost overruns have the greatest impact on levelized costs of electricity and project returns as, we assume, the project would have to raise emergency funding at more expensive commercial rates[51] (see Table 2 in Appendix B).

Specific procedures and contracts between project developers and service providers will transfer and, from the project company point of view, mitigate specific risks:

- **MASEN has undertaken to select a reputable private consortium with a successful track-record** delivering a project of similar scale and technology.
- **Engineering, Procurement and Construction (EPC) and Operations and Management (O&M)** contractual specifications, to be defined

48 Consistent with UNEP-SEFI (2008), we consider four typical risk responses: (1) **risk avoidance**, which eliminates the risk or protects the project from the risk by changing the project scope or adding resources to the project such as finances, time, and/or headcount, (2) **risk transfer**, which transfers the financial impact of the risk by contracting out part of the work to a most able party, (3) **risk mitigation**, which reduces the probability or impact of the risk to an acceptable level, and (4) **risk acceptance**, which addresses the risk should it occur.

49 Fitchtner Solar (2009)

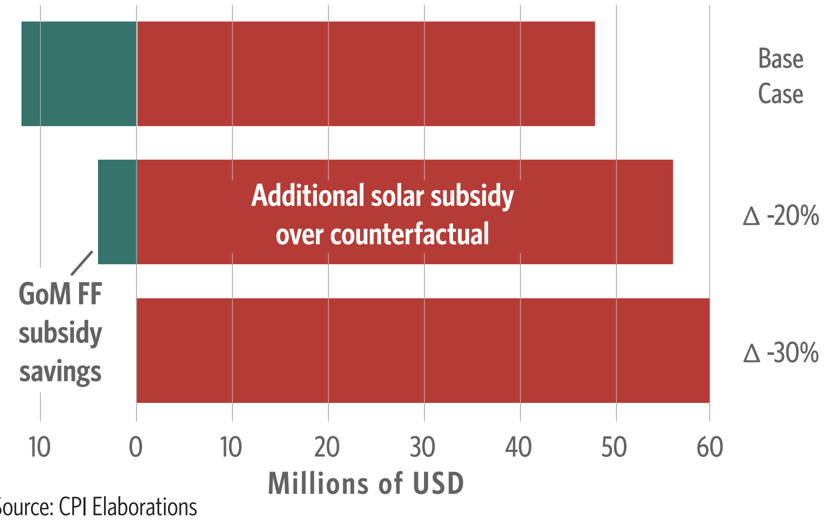
50 Successfully was defined such that the applicant had not been liable for penalties or liquidated damages in excess of 5 percent of contract value (Norton Rose, 2010).

51 Commercial lending rate estimated at 9 percent (Kulichenko and Wirth, 2011).

during the bidding process, will determine the amount of cost overruns that will fall on the project developer and sponsors and those to be absorbed by the service providers;

We anticipate the public budget will be shielded from the risk of cost overruns by the expected provisions in the PPA and the Shareholder Agreement[52] (please see the following chapter on "The Ouarzazate I risk-sharing model"). **Furthermore, the tender process will guarantee that the PPA price agreed on between MASEN and the SPC is based on a competitive projection of construction and operation costs** (with the incentive for the bidders to quote a lower price, but one they can deliver). By design, the PPA price will not be impacted by subsequent cost increases.

Figure 6: Impact of fossil fuel price changes on Ouarzazate I incremental cost



Source: CPI Elaborations

3. Support shortfalls

The ability of the Government of Morocco to support MASEN's long-term financial stability is outside the scope of this study. However, the net impact of the solar subsidy (which is key to the viability of the project) on the government budget is significant[53] and depends on the value of the fossil-fuel subsidies displaced[54] by the power that the CSP project generates. Figure 6 shows the amount of fossil-fuel subsidies that the Government of Morocco would have to pay in the absence of the Ouarzazate I project (red) and the additional solar subsidy (green) needed to meet the incremental cost of the CSP plant. As, historically, electricity tariffs for industrial usages have not shown much sensitivity to oil price fluctuations,[55] we assume that fossil-fuel price variations would not be transferred directly onto the grid price but absorbed mostly through the level of subsidization. The figure then shows that a significant decrease in fossil-fuel prices would imply a greater additional cost to the government budget compared to a scenario in which the same power is generated with conventional sources.

However, this risk is less probable given current expectations that world oil prices will continue to grow.

Risk allocation framework

In Ouarzazate I, financial engineering and policies have been designed to alter the share of the project development, operations, and outcome risks allocated to various parties. The dynamic risk allocation matrix in Figure 7[56] illustrates how risk is allocated to each major project stakeholder, on one hand, and how the overall risk profile shifts through the use of risk transfer instruments, on the other. Risk is categorized according to the estimated 'magnitude of risk' multiplied by the 'likelihood of risk':[57] 'very high' in dark red, 'high' in orange, 'moderate' in light orange and 'low' in yellow.

- As the following chapter will show in detail, in contrast to an independent power producer model (in which the private producer alone specifies the project's design and implementation), the public-private partnership model shares the management of the **project risks** between the public (Government and MASEN) and the private stakeholders.
- The amount of **construction and operation risk** that the plant developer will be able to offload to sub-contractors depends on the

52 We acknowledge that the contents of the final documents eventually signed by MASEN and the SPC may differ significantly from these expectations.

53 The solar subsidy represents approximately 0.22 percent of the total annual budget expenditures (source US Department of State, 2012).

54 Please see Box 1 in Section 3 for more details. Amounts of fossil fuel displaced (in the baseline scenario) have been estimated by ONE and valued at the following prices and quantities: Coal: 32,000 tons at 150 USD/ton; Natural Gas: 354,000 mbtu at 10 USD/mbtu; Fuel Oil: 67,000 tons at 450 USD/ton.

55 Eurelectric Electricity Tariffs (2005-2007).

56 A more detailed risk allocation matrix is to be found in Annex A.

57 Given the lack of contract-level data available on this project, this weighting system is subjective.

availability of counterparties willing to sign engineering, procurement, and construction (EPC) and operations and management (O&M) agreements.[58]

- The provision of IFIs' concessional financing before the project is initiated (pre-emptive financing) reduces the project developer's risk of capital shortages during construction (**CAPEX risk**). In turn, this significantly reduces the overall financial risk of the project including the cost of capital and required rate of return. At the same time, **the explicit backing of multiple IFIs greatly improves investors' confidence**.
- As a shareholder in the public-private partnership model, MASEN shares the plant economics, mitigating the risk perceived by the developer of an unfavorable change of renewable energy policies in the country (**policy risk**).
- During the operation phase, MASEN and the project company sign a PPA which shifts both electricity price and quantity risk (**revenue risk**) from the project developer to the public sector.

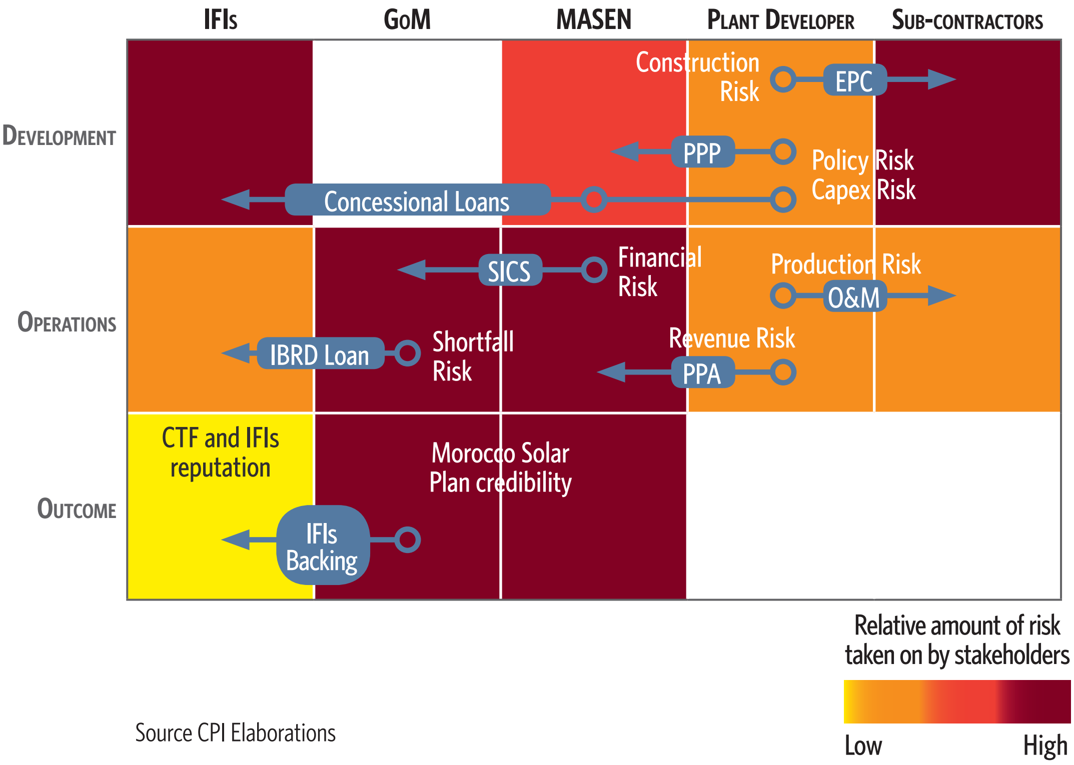
The PSA between MASEN and ONE guarantees the full dispatch to the grid of the electricity bought from the project; while the convention between the Government of Morocco and MASEN ("SICS") provides the agency with funds to meet the gap between the two power prices. Should any public budget difficulties arise (**shortfall risk**), a loan facility from the IBRD supports the Government of Morocco.

- The presence and backing of international donors partially relieves local authorities of the project implementation burden, mitigating the risk of the project failing to meet higher-level objectives (**outcome risk**).[59] However, the conditions placed on the loans and the IFI's right to object to all significant decisions increase MASEN's (and the Government of Morocco's) risk in managing the project. The following chapter provides more in-depth analysis of the public-private partnership model and the role of IFIs in Ouarzazate I, drawing lessons about how the project is being structured and implemented.

58 The availability of counterparties willing to bear full construction and operation risks is often linked with the maturity of the technology and the development of the industrial sector—hence it is usually lower for newer technologies.

59 The involvement of European donors and the European Commission may also help to mitigate the risk that subsequent phases of the Ouarzazate project would fail to access the European electricity market through power export arrangements.

Figure 7: Dynamic Risk Matrix



Source CPI Elaborations

- The public-private partnership model with competitive tendering and the two Power Price Agreements (PPAs) efficiently allocate policy risks to the public sector and project-related performance risks to the private sector. Early results from the bidding process show project costs in line with, if not below, projections.
- The process of coordinating concessional financing from lenders has been time consuming and resource intensive but has lowered transaction costs, boosted investor confidence and improved the project's economics.

The Ouarzazate I risk-sharing model

This section analyzes in detail the business model deployed in Ouarzazate I:

- the **public-private partnership model**, its principles of risk allocation and expected impacts on the project's probability of success; and
- the **role and mode of engagement of international donors**, their coordination and risk sharing arrangements.

The public-private partnership model

The commercial immaturity and the very high capital costs of CSP in Morocco mean that high levels of national and international support are necessary for the project to proceed. However, for future phases of the project, the high levels of concessional support present in Ouarzazate will not be sustainable. For this reason, the Government of Morocco designed a public-private partnership that, through a tendering process, taps financial resources, managerial capacity, and pursuit of technological innovation from the private sector, while retaining control over the quality and the quantity of the output (Burger, 2008; Teichmann, 2011).

Typical public-private partnership structures[60] align the objectives of public and private partners by transferring operational delivery risk to the private partners. These structures aim to balance the amount of both exogenous and endogenous risks[61] the public agent (MASEN in this case) transfers to the private actor, with the higher-risk premiums required by the latter. The optimal risk allocation rests on the proper identification of the nature of the risks and of the stakeholders best suited to bear them at the lowest costs. In most cases, endogenous risks (those directly related to the project, such as construction and performance risks) are best allocated to the private partner, giving them the incentive to execute the project as efficiently as possible; while exogenous risks (those external to the project, such as policy and regulation risks) are more effectively allocated to the public partner (Teichmann, 2011).

Interestingly, **in Ouarzazate I, the public partner is on both the supply and demand side** of the public-private partnership: MASEN is both the purchaser of the service and a shareholder of the company operating the plant. This feature theoretically shifts the risk burden more towards the public entity than it would with other concessions/privatizations. **This in turn should incentivize bidders to lower their required rate of return (OECD, 2008).[62] At the same time, it also allows MASEN greater control and active participation on the production side of the service.** The joint responsibility for running the plant improves the alignment of stakeholders' interests and mitigates the risk that the private project developer might inflate costs and/or operate the plant inefficiently once revenues have been granted.

60 There is a lack of consensus around the structure of a "typical" public-private partnership and its definition. In this work we refer to the definition advanced by the OECD: "A public-private partnership is defined as an agreement between the government and one or more private partners (which may include the operators and the financiers) according to which the private partners deliver the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners" (OECD, 2008).

61 Endogenous risks are the ones in which the project developer/sponsor has control to a certain extent and can directly manage in order to influence the actual outcome (e.g. technology, management of financial resources, counterparty). Exogenous risks are those onto which the project developer has neither control, nor ability to mitigate (e.g. political risks, adverse changes in national policies, currency devaluation). (OECD, 2008).

62 However, the perceived risk of dealing with the public entity as shareholder could offset this risk reduction. Given the early stage of the tendering process, this instance has not been verified.

In Ouarzazate I, the majority of risks are allocated between parties via two contracts:

- the **Shareholder Agreement between MASEN and the private consortium** (yet to be selected);
- the **PPA between MASEN and the SPC**.[63]

The Shareholder Agreement defines the allocation of shares, profits, and voting rights under the public-private partnership. It regulates the representation of minority shareholders on the Board and establishes quorum rules for management decisions. Finally, it defines liabilities and allocates the company's management risks between parties. In particular, to shield MASEN from construction risks, the agreement grants the agency a put-option, that is, the right to sell back its shares to the Consortium at a pre-defined price in the event that MASEN decides to terminate the PPA as a consequence of the private partner defaulting on its obligations (WB, 2011a).

The PPA obliges MASEN to purchase all of the power generated by the plant during its expected 25 years of operation at a pre-determined price set through the competitive tender. This guarantees the required rate of return requested by the private investor during the tender and shields the private partner from exogenous risks affecting the value of the electricity generated. These exogenous risks include oil-price spikes, government policy on fossil-fuel subsidies that would affect the electricity price on the national grid, and changes of the government policy towards renewable energy.

The PPA also requires the consortium to pay financial lump-sum penalties to MASEN in case of construction delays or failure to deliver the contracted capacity. It grants MASEN the right to terminate its purchasing commitment if the plant's performance and/or its consortium management fail to meet pre-determined requirements (WB, 2011a). In contrast to other examples of PPAs in the region, this PPA grants the emission credit rights that may eventually be assigned to the plant under the Clean Development mechanism to the power off-taker MASEN (Norton Rose, 2010).

At this stage of the project, the public-private partnership design seems to follow the principles of optimal risk sharing, allocating endogenous risks to the private partner and exogenous ones to the public agency.

However, it is too early to draw conclusions on whether this has meaningfully reduced the private sector's perceived risk and required return. More evidence is needed to establish if the lower-than-anticipated private-sector bids can be attributed to the public-private partnership design or if they are caused by lower-than-expected project cost. Early bids under the tender process suggest that levelized costs (LCOE) per unit of power are projected in line with, if not below, the LCOE estimated at the beginning of the project.[64] If the lower bid of USD189.7/MWh prevails, it would imply a lower unit cost of approximately USD 4700/kW (20 percent reduction over the projected figure) for the plant. Importantly, this would reduce the amount of incremental public subsidy required to compensate for the price difference between the PPA and PSA, from USD 60 million to USD 40 million per year.[65]

International financial institution engagement and coordination

Concessional financing drives down the levelized cost of energy generated by Ouarzazate I by around 30 percent[66] by reducing the cost of capital and the uncertainty about its availability. The International Bank for Reconstruction and Development's (IBRD) provision of a facility to partially guarantee the government subsidy also adds to investors' comfort, visibility of long-term revenues, and the credit worthiness of the PPA counterparty. Furthermore, the donors and multilateral development banks bring their project design, implementation experience, and political clout, reducing the likelihood of project failure.

In this section, we focus on the specific arrangements and coordination efforts that have facilitated the engagement of several donors and banks, helping to achieve affordable finance at scale in a relatively short time-period.

Concessional financiers in Ouarzazate I are organized around three lead-financiers: the AfDB, the WB, and the EIB (representing European donors), with the WB and AfDB channeling CTF funds. MASEN is the sole borrower of the concessional loans as well as the sole direct beneficiary. MASEN negotiated directly with IFIs and functions as a lender of funds to the SPC through a unified package that blends together the terms of the different loans. Interestingly, financing has not been pooled or syndicated[67] as is typical with the involve-

63 The exact terms of these documents are still confidential and most likely subject to changes before the tender and/or contract process is complete.

64 See note 25 in Section 3.

65 See Section 3 for details on the estimation of the PSA and PPA reference prices.

66 See Section 3 for more details.

67 "A syndicated loan is one that is provided by a group of lenders and is

ment of commercial banks. Instead, each IFI agreed to its own terms and conditions for the loan with MASEN and, more importantly, will sign a "no-objection" letter to approve all major decisions in the project. MASEN's efforts to coordinate and harmonize donors' requirements and procedures was crucial to move the process forward quickly. However, the process remains cumbersome and further improvements are needed to streamline financing arrangements and minimize transaction costs.

One key risk that requires management going forward is the likely coexistence of different interest charges, loan tenders and collateral guarantees across the loan portfolio. European donors (EIB, KfW and AFD) avoided this complication by choosing not to syndicate their contributions, but rather to contribute through a joint financing package with synchronized loans. The EIB coordinated two umbrella agreements laying down the provisions for donors' coordination:

- The **Pari-Passu Implementation Agreement** ensures that the disbursement of funds towards the project is conducted in a 'fair way' (pari-passu) across financers, that is, simultaneously on a pro-rata basis.
- The **Cross-Collateralization Agreement** stipulates that the same asset acts as collateral for all the loans included in the agreement.

To minimize the compliance burden on the borrower, all lenders developed a common set of procedures (covering procurement rules and social and environmental standards), and agreed to adopt the World Bank's procurement rules and standards for all the loans. This process has been relatively time and resource intensive but should allow a smooth ongoing operation of the financing arrangement and timely monitoring of the investment.

Importantly, early coordination and agreement with donors has allowed MASEN to provide clear guidelines on the terms and costs at which capital would be offered to private investors who are bidding for the project. This transparency appears to have incentivized competition among investors, resulting in required rate of returns in line with other, less risky renewable energy projects in the country (Attijari, 2010), and in bids in line with or below the projected levels.

structured, arranged, and administered by one or several commercial or investment banks known as arrangers" – source: Standard & Poor's (2010).

- Five key building blocks underpin Ouarzazate's progress to date. These include: (1) strong public support and the close alignment of key public partners, (2) financial and technical support from international financial institutions, (3) strong donor engagement and coordination, (4) a carefully designed business model and tendering procedure, and (5) a project design that is built on past lessons learned. These building blocks could be replicated by other large scale CSP projects in the region, given the right economic, political, and policy contexts.
- Given the finite nature of public resources, more commercially-oriented financing models will need to emerge. These financing models will most likely be supported by lower technology costs, lower project costs, and higher market revenues (e.g. E.U. export revenues).
- By 2020, technology costs are expected to come down but not to the level that is required to reach grid parity in domestic MENA markets (even accounting for phase out of fossil-fuel subsidies).
- It's feasible that renewable power exports to European markets could fill the remaining viability gap in the medium- to long-term. However, considerable political support will be crucial to secure EU Member States' demand and to broker specific agreements that make this a reality.

Is Ouarzazate I replicable and scalable?

Ouarzazate's stakeholders understand that it is one of the first in a series of CSP installations that should lead to a large-scale portfolio of CSP plants in Morocco and the MENA region. Indeed, Ouarzazate I only makes economic sense in the context of a portfolio of CSP projects which, through technology cost reductions and the development of an integrated, regional CSP market, delivers significant net economic benefits.

Herein lies a 'chicken or the egg' dilemma: **In order to scale up a CSP portfolio, given limited public resources, projects must become increasingly commercially viable.** Costs must come down through economies of scale and revenues must be enhanced through exports to Europe. But achieving commercial viability requires experience, capacity, and associated infrastructures (such as transmission lines and interconnectors). Because commercial viability and the development of a portfolio of projects are interdependent, there is no 'low-cost' first step.

Therefore, the first publicly-supported large scale CSP projects play a crucial role bridging the development of a more commercially-sustainable, regional CSP market. These first projects should reduce uncertainties about costs and risks for investors, including commercial banks. They will do this by demonstrating that the technology can deliver, that the project can be realized on time and within a budget, and that contractual arrangements allow for reliable revenue streams.

The Clean Technology Fund CSP Investment Plan alone contains USD 550 million of concessional finance for CSP projects in the MENA region over and above Ouarzazate I. IFIs that will channel this finance have expressed willingness to co-fund these projects with their own resources (CTF, 2012).

We now explore which elements have worked well so far in Ouarzazate I, and consider whether replicating elements would be sufficient to support the next round of large-scale CSP projects in the region.

What is working in Ouarzazate I?

The Ouarzazate I project is in the late stages of design specification. It is therefore premature to assess whether its implementation has been successful. However, early indicators—such as significant support from international development banks and interest from private-sector bidders—suggest that the project has potential to progress towards the final stages of development and, subsequently, operation.

As other similar large-scale CSP projects begin to get off the ground in the region, it is valuable to draw out lessons from Ouarzazate I that could be replicated by future projects. In doing so, we recognize the significant diversity among countries in the MENA region and acknowledge that new challenges could arise in each case. These could include variations in electricity market structures, as well as economic, political, and policy contexts that differ from those in Ouarzazate I.

This aside, we identify five decisive building blocks in the Ouarzazate I project which could potentially be replicated in other large-scale CSP projects in the region.

1. *Strong public support and close alignment of key public partners*

The Government of Morocco and MASEN have played a crucial role in designing and implementing an appropriate framework to support Ouarzazate I. The Government of Morocco established a favorable regulatory framework for private-sector engagement in the electricity market and a strong renewable policy framework. In particular, the government has set clear and ambitious development targets for renewable energy sources (both wind and solar);[68] it has established a specialized professional entity tasked with realizing CSP projects (MASEN) and is financially supporting MASEN's work to implement the Moroccan Solar Plan. The further opening of Morocco's electricity system to the private sector will itself help to attract financing, expertise, management skills, and entrepreneurial efficiency.[69]

Legal agreements ensure alignment between key government players. The agreement between the Government and MASEN provides certainty that the viability gap will be covered while a second agreement between MASEN and ONE guarantees connection to the grid and full dispatch of electricity.

MASEN has led the Ouarzazate project to date and plays a critical role within the public-private partnership structure. It sought expert advice to develop a project design that promotes efficient risk sharing between public and private partners. Importantly, it successfully secured substantial amounts of concessional finance from a range of international donors, whose early commitments attracted potential private-sector partners.

2. *Significant financial and technical contributions from IFIs*

IFIs have provided both financial and specialized, technical support to the project. A high level of early and sustained IFIs engagement has fostered the project's credibility and helped to mitigate risks perceived by private-sector investors. For example, the African Development Bank and the World Bank worked closely with MASEN on project design and all donors committed significant resources to make the project work, in some cases making compromises on loan requirements to reduce the burden for MASEN. This commitment to the project's success could be replicated in future interventions.

3. *Strong engagement and coordination of donors*

Considerable effort and strong coordination between IFIs and Moroccan stakeholders has been essential to get such a large and complex project off the ground. Donor coordination to harmonize conditions, safeguards, procurement, and no-objection and reporting rules was time consuming and challenging. However, it established a valuable model for subsequent projects. In the future, the syndication of loans, for example, could help reduce the project developers' burden to deal with multiple lenders and their separate loan rates, conditions, and procedures.

As subsequent projects are designed, including Ouarzazate Phase II, it will be important to promote the participation of commercial banks and capital markets, thereby increasing the leverage ratio of concessional finance. While this will be essential in order to increase the amount of capital for the technology, it will also introduce new challenges for coordination and risk sharing between parties. As Ouarzazate I has demonstrated, there may be significant benefits in dealing with these issues preemptively and transparently.

The eventual phase out of IFI support will be both unavoidable, given finite resources, and necessary, to avoid crowding-out the private finance that is core to realizing the scale of investments required (OECD, 2012).

4. *A carefully designed public-private partnership and competitive tendering procedure to attract the right expertise and efficiently allocate risk*

The public-private partnership model allows the optimal alignment of risk between public and private players, according to their expertise. For example, the private developer takes on construction and operational risk while the government takes on electricity market risk (revenue risk). MASEN's role in the public-private partnership is innovative: It acts as both equity investor and purchaser of the power (off-taker) and it has the ability to align public and private objectives. Ouarzazate's development and operation will show whether this alignment will be realized. Through MASEN's role as an equity shareholder and a conduit for concessional finance, the Government of Morocco shows it has skin in the game. This allows the government to exercise

68 Namely the 1000 MW Wind Integrated Energy Plan, the 2000 MW Morocco Solar Plan, and the 13-09 Renewable Energy Law.

69 Here we echo recent work of the OECD in indentifying, beyond financial support and policies, clear national goals, competitive and transparent processes, and private sector engagement as critical elements of a regulatory framework that supports climate-resilient investments (OECD, 2012).

greater control over the project and share in the projects' successes or failures.

In addition, MASEN has led a transparent and well-managed two-stage competitive tendering process that has attracted considerable private-sector interest. The invitation to tender expressed clear guidelines for the terms and modalities of public sector support. The SPC's ability to access sufficient concessional financing provided potential bidders with more certainty over financing costs and lowered their required rates of return.

Early indications suggest that MASEN is functioning well as a professional agency and is actively forging a conducive investment model in which it participates actively. The experience points to the benefits of setting up a new, specialized government agency to drive forward implementation of ambitious renewables objectives.

5. *A project design built on past lessons learned*

Prior to the Ouarzazate I project, the Global Environment Facility (GEF) provided support to a program that developed several CSP projects in Mexico, Morocco, and Egypt (see Annex C). All of these encountered numerous challenges and delays, including untested technology, a lack of opportunities to build up economies of scale, and unsuitable business models, which contributed to project failures.

The Ouarzazate I project benefited from exchanges with other large-scale CSP projects that are in development in India and South Africa, as well as experience gained from the above-mentioned GEF project (WB, 2011a). As such, Ouarzazate I was designed at a scale large enough to contribute significantly to building a portfolio that will drive technology-cost reductions. Partners selected a business model, the public-private partnership, which provides explicit measures to align the objectives and expectations of host governments (creating local opportunities), donors (building the experience of the public and private sectors which can be applied to future projects) and the private sector (providing investment security and opportunity). Finally, numerous studies were carried out to choose an appropriate technological mix.

Sharing lessons from the design and implementation of CSP projects will help reduce project costs and increase efficiencies that will help Morocco and the MENA region develop a CSP portfolio. The Government of Morocco is actively engaged in a number of knowledge platforms e.g. through the Climate Investment Fund, the Mediterranean Solar Plan, Medgrid, the Desertec Industry Initiative, etc.

Scaling up the CSP portfolio

Replicating the Ouarzazate I financing model will not be sufficient in and of itself to support the development of a large-scale portfolio of CSP projects. To reach the scale desired by the Moroccan and Mediterranean Plans, significant sums of additional capital will be needed. Given the scarcity of public and international support, more commercially-oriented financing models will need to emerge. These commercially-oriented financing models will most likely require:

1. Reduced technology/project costs, and
2. Higher market revenues (e.g. E.U. export revenues).

In addition, to support and stimulate the development of an active CSP market, predictable and stable policies will be required to generate positive incentives for private investors. For example, Morocco has renewable energy and solar targets in place but supports projects on a project-by-project basis instead of applying standardized policy support measures across sectors or directed toward particular technologies (e.g. feed-in-tariffs / premia, tax incentives, tradable certificates or renewable portfolio standards, carbon taxation or trading). Such a piece-meal approach could limit the potential for scale-up and replicability and ultimately slows the speed of development of CSP in the region.

The presence of conflicting policies that support fossil-fuel consumption also make it difficult for renewable technologies to compete, drain financial resources away from low-carbon investments, and weaken the perception of the country's commitment on its climate targets.[70] On a positive note, the Government of Morocco's desire to embrace private energy producers,[71] the transparency of the Ouarzazate I competitive tender, and the commitment of public resources (through MASEN) to improve the project's viability provide important incentives that should attract private investors to the country and lower the perception of regulatory and policy risk.[72]

70 Other investment barriers reported for Morocco include: inadequate institutional structures, insufficient coherence and cooperation between Ministries, insufficient strategic guidance, insufficient information made available to investors, a lack of experience in the administration, and a lack of financial incentives (EU, 2010).

71 ONE can issue competitive tenders for IPPs to supply capacity greater than 10MW and auto-producers can sell power surplus to ONE up to 50MW with tariffs including a 20 percent uplift compared to ONE's normal tariffs.

72 As a comparison, despite similar policy targets, Tunisia is struggling to attract the same interest from international private investors because there is

We now briefly consider progress toward reducing technology costs and realising renewable exports.

1. *A critical mass of publicly supported CSP projects will help to drive faster reductions in technology costs; combined with the removal of fossil-fuel subsidies, this will help move CSP towards grid parity.*

Capital costs of CSP plants remain very high. Initial estimates of capital investment costs for Ouarzazate I stood at USD 6000/kW[73]—or about three times the initial investment costs for an average coal power plant.[74]

Costs are gradually coming down and have the potential to come down much further. Hinkley et al. (2011) estimate that CSP costs have decreased by 15 percent with each doubling of cumulative deployment over the past twenty years. Meanwhile, Kulichenko and Wirth (2011) estimate that CSP levelized costs have the potential to fall from USD 0.21 – 0.26 /kWh in 2010 to USD 0.17 – 0.18 /kWh (19 percent) by 2020.[75] Figures available in initial proposal documentation for Ouarzazate I indicated LCOE of approximately USD 0.25/kWh while bids reportedly range from USD 0.19/kWh - USD 0.25/kWh (see footnote 28 in Section 3). These initial projections and the high end bid suggest that CSP costs might remain high, in line with 2010 estimates presented above. Further examination of the USD 0.19/kWh bid may shed light on whether technology cost reductions were a significant factor in driving down this consortium's price.

Nonetheless, even the lowest Ouarzazate I bid is still far from grid parity. Achieving parity would in fact require an LCOE of around USD 0.08 /kWh—a further cost reduction of 11 cents per kWh. We estimate that removal of fossil-fuel subsidies would increase grid prices to approximately USD 0.11 /kWh, which would necessitate less steep reductions of 8 cents per kWh.[76]

The current increase in the scale and number of CSP projects should help to facilitate faster technology cost reductions by building economies of scale in manufacturing, learning curve effects, and technical innovation. A critical mass of publicly supported large-scale early projects could help to drive cost reductions at a faster rate than has been witnessed to date, in turn paving the way for more commercial players to come into the market and complete the regional CSP portfolio.

a perception of lower commitment from the government and a higher level of political and regulatory instability.

73 Not yet publicly disclosed bids indicate lower capital costs. See Section 3 and note 25 for more details.

74 Hypothetical coal plant investment costs reported in the Tanger Wind Park CDM PDD are approximately USD 1,800/KW (ONE, 2007).

75 The lower end estimates are based on projections of cost reduction potentials for parabolic trough components while the higher end estimates consider a range of CSP technologies and the effect of performance data. The estimates were produced by modeling reference plants (location not specified) and do not include costs related to transmission connection, land or water.

76 Please see Box 1 for a more detailed treatment of the impact of fossil-fuel subsidies on the project.

Box 2 Preconditions for the export of renewable power to E.U. markets

- ***Bilateral and Multilateral Agreements:*** The E.U. Renewables Directive (2009/28/EC) (EU, 2009), Article 9, provides the legal basis for E.U. Member States to meet part of their renewable energy targets for 2020 by importing renewable power from neighboring countries. However, the electricity needs to be imported physically and to be consumed in an E.U. Member State.[1] Trade conditions have to be established in the form of bilateral or multilateral agreements. Morocco has already signed cooperation agreements with France and Germany and expects to sign further agreements with Spain and Italy in the near future.[2]

1 There is a limited possibility to rely on statistical transfers (i.e. the electricity is consumed domestically, but is counted toward the renewable energy share of a supporting E.U. Member State for compliance purposes under the Renewable Energy Directive) if an interconnector is under construction before 2016 to enable physical imports into the E.U.

2 In May 2011, the Desertec Industrial Initiative and MASEN also signed a Memorandum of Understanding to develop a 500MW solar Reference Project to demonstrate the feasibility of exporting solar power from Morocco to Spain, with exports expected to commence between 2014 and 2016. Source: http://www.dii-eumena.com/country-focus/morocco.html

- ***Removal of Subsidies:*** The E.U. Renewables Directive outlaws domestic operational support (such as a FiT) for electricity that is exported, to avoid double subsidization.[3] However, upfront support (concessional finance, investment grants, etc.) is permitted. The presence of a heavily subsidized PPA rules out the ability to export power generated by Ouarzazate I. Furthermore, it implies that to achieve export potential, electricity generated in following phases of the project will not be able to rely on operational support secured by the Government of Morocco.
- ***Physical Investments:*** Interconnector capacity needs to be available to export renewable power to Europe. Spare capacity seems to be available on the existing 700MW interconnection between Morocco and Spain,[4] which, for the time being would primarily allow access to Spanish and Portuguese markets,[5] although an additional interconnection to Spain is planned. An interconnection exists between Algeria and Morocco with a maximum transmission capacity of 700 MW each way, which could provide alternative routes to Europe in the future as part of an integrated E.U.-MENA market. In order to attract project developers, Office National De L'Electricité (ONE) and the Government of Morocco will need to provide clear signals regarding export revenue potential.
- ***Demand from E.U. Member States:*** The final major precondition for exports to E.U. Member States is the willingness of the states themselves to purchase renewable power from the MENA region. The European Commission's assessment of Member State National Renewable Action Plans (NREAP) indicated that the 27 E.U. Member States expected to exceed the 2020 20 percent renewable energy target in the "additional energy efficiency scenario" (20.6 percent) and only slightly miss it in the reference scenario (19 percent) (EC, 2012). This suggests there may not be much demand from E.U. countries. There are two exceptions: Luxembourg and Italy. Italy, according to its NREAP, requires a substantial amount of renewable electricity to fulfil its target under the Renewable Energy Directive and is seeking cost-effective means to achieve its obligations. At the same time, some Member States, such as Germany, have policy objectives that go beyond those of the E.U. renewable directive, and promote adoption of a post-2020 view that acknowledges the need for imports.[6]

3 In order to avoid the possibility that costs could be subsidized through E.U. concessional loans or domestic public finance, and then again through subsidized power purchase prices.

4 http://tdworld.com/underground_transmission_distribution/power_bridge_two_continents/

5 As the interconnector to France is currently congested until the planned upgrade in 2013, further physical export to France and beyond is not possible. Additional electricity from North Africa would have to be consumed in the Iberian Peninsula.

6 For example, Germany's energy concept foresees imports from North Africa by 2050 to meet its ambitious targets for GHG reduction of 80 percent by 2050 (on 1990 levels) and for the amount of renewable energy as a proportion of gross final energy consumption of 18 percent by 2020, 30 percent by 2030, 45 percent by 2040, and 60 percent by 2050.

2. *Exports to E.U. markets could make CSP production in the MENA region viable.*

One objective of the Moroccan and Mediterranean solar plans is to sell electricity to the European Union markets, given that current MENA domestic grid prices are significantly lower than current CSP generation costs. Higher power prices and existing support schemes for renewable power available in some European countries could already be sufficient to exceed the costs of CSP generation in the MENA region, thus opening the potential to achieve mutual economic benefits. MASEN's financial model simulated the expected revenues from power sales to E.U. export markets at a 30 percent premium above generation costs.

Based on the Ouarzazate I financial model and the list of plants to be developed under the Moroccan Solar Plan, MASEN could reach financial equilibrium thanks to increasing exports, from zero percent in 2015 to seven percent in 2016 and 46 percent from 2019 onward (WB, 2011a). However, there are **several preconditions** that need to be resolved before exports to E.U. markets from the MENA region can be realised (see Box 2).

Of note, the possibility to export power from Morocco's CSP plants into European markets presents a trade-off between financial viability on one hand, and domestic energy and environmental effects on the other. On one hand, 'diverting' power away from the Moroccan market through sales to Europe would significantly lighten the pressure on the national budget of covering the cost of subsidies. On the other hand, diverting renewable power away from the domestic market reduces the potential to displace fossil-fuel electricity (and hence reduces the savings that could be achieved through decreased imports and subsidies). Diverting power to E.U. markets also limits Morocco's opportunity to improve domestic energy security.

In summary, exports of renewable power to European markets are a feasible means of filling the financial viability gap, in the medium- to long-term. However, considerable political support will be crucial to secure demand from E.U. Member States and to broker specific agreements that will make exports a reality.

Scaling up a CSP portfolio in the MENA region and elsewhere in the world will be challenging, given the high costs of developing early projects and the necessary infrastructure to support them. The Ouarzazate case indicates that financing specific projects is possible with the close alignment of public, international, and private stakeholders, and careful design and coordination. Such an achievement, however, may not be enough to scale up a national or regional portfolio. This greater goal may be met only if projects are commercially viable, through a reduction in costs and access to higher market revenues, both of which will require considerable political support from national and international players.

Conclusions

CSP technology has enormous unexploited potential, particularly in the MENA region, but is still not commercially viable. This is particularly evident in markets, such as those in MENA, where energy prices are distorted by heavy fossil-fuel subsidies. **It is still too early to know if Ouarzazate I will be large enough to prove the commercial maturity of its storage component technology and to meaningfully drive the technology costs down**. However, meeting early milestones will be crucial to maintain financial backing from both the Moroccan Government and international lenders, whose early support is essential to deliver the whole portfolio of projects contained in the Moroccan Solar Plan and the MENA CSP Investment Plan.

The early signs are encouraging. **In the case of Ouarzazate, public resources have played a decisive role in getting the project up and running. Significant up-front international concessional finance has covered early-development costs** and will help the technology develop until its level of profitability is sufficient to attract unsubsidized private capital. **At the same time, international lenders need to improve the coordination and harmonization of lending packages to avoid excessive transaction costs, lengthy procedures, and unbearable compliance requirements.**

The Moroccan Government has provided generous domestic backing for the project, covering the significant price differential between power bought from generators and sold onto the grid. This has made the project viable for public and private entities. Together with the support to renewable energies, the government is also committed to phase out fossil-fuel subsidies and is currently reducing its compensation system. While this alone would be insufficient to make CSP power commercially viable, it is a necessary step towards the development of a policy framework that truly supports low-carbon investments.

MASEN's innovative design for the governing public-private partnership seems to have effectively allocated risk between private and public stakeholders.[77] Giving early notice of financing terms and costs allowed prospective investors to factor savings into their bids, attracted their interest early, and resulted in levelized cost estimates in line with, and for some bids lower, than what was projected. The public-private partnership allocated risks to the stakeholders who were best equipped to manage those risks. Construction and operating risks were assigned to private developers while political and policy risks rested within the public sphere.

In the future, CSP power will remain expensive in the Moroccan market even with fossil-fuel subsidy phase outs and technology costs reductions. **Public support alone will not assure the financial viability of the Ouarzazate project (including phases II and III). Favorable economics will only be achieved if Morocco and/or MENA succeed in establishing an export market with the E.U.** However, this will **require further investments in physical assets** (for example, transmission lines) and a **strong commitment from E.U. Member States** to go beyond their existing renewable targets. At the end of the day, this will be a question of political will, as likely as not subjected to the prevailing winds of international progress toward a post-2020 international outcome.

77 This point will be proved once the winning bid is selected and its content is made public. However, initial indications available at the time of writing support our assumption.

Index of Acronyms

AFDB	African Development Bank
AFD	Agence Française de Développement
CAPEX	Captial Expenditures
CO_2	Carbon Dioxide
CPS	Country Partnership Strategy (World Bank-Morocco)
CTF	Clean Technology Fund
CSP	Concentrated Solar Power
EIB	European Investment Bank
EPC	Engineering, Procurement, and Construction
ESIA	Environmental and Social Impact Assessment
FDE	Fond de Developpement de l'Energie
FESMP	Framework Environmental and Social Management Plan
GOM	Government of Morocco
HASSAN II	Moroccan Hassan II Fund for Economic and Social Development
IFI	International Financial Institution
IP	Investment Plan
IPP	Independent Power Producer
KFW	Kreditanstalt fur Wiederaufbau
LCOE	Levelized Cost of Energy
MENA	Middle East and North Africa
ONE	Office National ede l'Electricité
ONEE	Office National de l'Eau et de l'Electricité
ONEP	Office National de l' Eau Potable
OPEX	Operating Expenditures
PAD	Project appraisal document
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PSA	Power Sale Agreement
SEEE	Secrétariat d'Etat chargé de l'Eau et de l'Environnement
SICS	Solar Incremental Cost Support
SIE	Moroccan Energy Investment Company
SPC	Solar Power Company
UGE	Unité de Gestion de l"Environnement
WB	World Bank

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Annex A: Full risk matrix

	Risk	GOM	MASEN	Consortium	WB	Other IFIs	EPC Contractor	Treatment/Mitigation Measures
DEVELOPMENT	**Program devlopment risk** Early stage failure, capacity of MASEN and PPP to bring the project together, coordinate donors and their rules and various stakeholders, avoid CoI etc.	Loss of committed resources deployed			Loss of financial resources deployed			MASEN **staffing**, external advisors. **WB effectiveness conditions.** 2-stages **Bidding Procedure. Risk Management** Framework
	Equipment • CSP component failure / defect			Direct impact on returns			Non or partial payment	MASEN's **technical advisor. Experienced private partner. Contracts** for construction, financing to fulfill the obligations it undertakes in the PPP. Supplier's warranty for a limited period.
	Construction costs • Cost overrun / delays							**EPC contracts. Experienced advisor** to MASEN during selection process. Finalization of key documents subject to **WB No Objection**. Construction manager is also majority shareholder, hence **risk alignment**.
	Financing Risk • Failure to secure necessary Capex		Insufficient resources to complete project					Concessional Capital secured preemptively before bidding process. GoM also secured a lending facility from IBRD to cover incremental costs.
	Safeguards • Fiduciary, environmental, and social		Non payment of support if IFI safeguards not met		Safeguards not met		If lenders withdraw	**Support and checks** by donors. Compliance with IFI rules will be **contractually mandated**. WB will **monitor and evaluate implementation** effectiveness.
OPERATIONS	**Regulatory risk** • Change in GoM support	Risk of overpaying on subsidy	Risk of incomplete hedge by GoM		Risk of full / partial default			**Project Specific Convention (MASEN-GoM), IBRD loan facility.** Competitive tendering process on LCOE. Possibility for additional concessional funding. Work to realise EU export potential.
	Production / availability risk • Failure of technology, extreme weather events			Direct impact on returns	Risk of full / partial default		Non or partial payment	**Selection of technically capable private partner. Bonding requirements and liquidated damage. EPC contract** will pass risk to the suppliers. Supplier's warranty for a limited period.
	O&M cost risk • Cost overrun / delays	Increased CSP subsidy + guarantee + reduces FF subsidy savings						Selection of **experienced private development partner. Contractual specifications.**
	Power price risk • Lower than expected grid prices		Risk of incomplete hedge by GoM	MASEN default on PPA				Use of **IBRD support facility**. GoM shareholding in ONE allows control over generation capacity additions (**natural hedge**).
OUTCOME	**Project objectives** • Risk of not meeting electricity production, avoided GHG, local development targets **Higher level objectives** • Risk of not realizing technology cost reduction or demonstrating a successful project model	Undermines replication / scale up (e.g. Moroccan Solar Plan, Mediterranean Solar Plan, EU Exports)			Undermines CTF transformational objectives and ability to crowd in additional donor contributions	Undermines IFI support to Morocco/ MENA/RES/ solar		Selection of **experienced private development partner. Contractual specifications** in the bidding process. **Coordination** with teams working on **other CSP programs.**

Relative amount of risk taken on by stakeholders

Low — High

Annex B: Ouarzazate I sensitivy tests

i) Operating Performance

Table 1 depicts the sensitivity of the project IRR and of the Levelized Cost of Energy to deviations of annual production from forecasts due to uncertainty on the level of solar irradiance and/or to higher (or lower) than expected degradation factor.

Table 1: Production Variance

Production variance	-10%	BASE	10%
Annual Production (GWh)	333	370	407
IRR	6.2%	7.2%	8.3%
LCOE	302	276	254
Degradation Factor	1.0%	0.5%	0.3%
IRR	6.8%	7.2%	7.5%
LCOE	287	276	271

Source: CPI Elaborations

ii) Cost Overruns

Table 2 illustrates the effect on the project economics of cost overruns due to higher (or lower) than expected capital investments or for higher requirements to operate and maintain the plant. Given the capital intensity of the CSP plant, it's not surprising that the investment metrics are more sensitive to deviations on capital costs than on operations and management charges.

Table 2: Construction and Operations Costs overruns

Construction cost overruns	Δ+20%	Δ +10%	BASE
Capex ($ million)	1200	1100	1000
IRR after tax, levered	10.1%	11.8%	13.8%
LCOE	282	260	240
OPEX cost overruns	Δ +20%	Δ +10%	BASE
OPEX % of revenues	13%	12%	11%
IRR after tax, levered	12.9%	13.1%	13.8%
LCOE	245	242	240

Source: CPI Elaborations

iii) Support Shortfall

The impact of Ouarzazate I on the government's budget depends both on the solar subsidy and on the value of the fossil-fuel subsidies displaced by solar power that, in turn, depends on the fuel prices. **Table 3** quantifies the effect on the budget of a hypothetical variation on the base prices used in the initial project planning (150$/ton for coal, 450$/ton for fuel oil and 10$/mbtu for natural gas).

Table 3: Fuel Price Variance on 370 GWh of displaced FF electricity

Fuel Price Variance	Δ-30%	Δ-20%	BASE
Government FF Subsidies Savings (M$)	0	4	12
Additional Solar Subsidy over Counterfactual (M$)	60	56	48

Source: CPI Elaborations

Annex C: Lessons from GEF-supported CSP projects

Ouarzazate is the latest in a list of only moderately successful CSP projects in the MENA region. A study by the WB's Independent Evaluation Group (IBRD, 2010) explains why Global Environment Facility (GEF)-supported CSP projects in Egypt, Mexico, and Morocco have been slow to come to fruition—after 13 years, two of the projects are still under construction, one is out to tender while another, to be located in India, was dropped due to technical difficulties.

The GEF portfolio was intended to drive technology costs down but the planned capacity (120 MW) and the realized capacity (later downsized) plus its distribution over three countries made the realization of any economies of scale unfeasible. The spread across countries also undermined the creation of a local value chain.

A hybrid technology approach was chosen to alleviate concerns about power availability, combining conventional gas plants with solar technology. However, the hybrid technology was novel and further complicated project design and procurement, as several providers had to be integrated to provide different components. In some cases the scarcity of bidders required adjustments to procurement rules and caused subsequent delays.

Scarce information on technology costs, cumbersome procedures, and reduced numbers of bidders resulted in bids implying costs well above initial estimates. As the amount of the GEF grant was fixed in absolute value, the CSP plants had to be reduced in size, necessitating renegotiation and further delays, again reducing the expected effectiveness of public funds.

Finally, project sponsors required that plants would be operated under an IPP model, aiming to achieve a higher level of efficiency in the plant management compared to its operation by the state utility. Unfortunately, this management structure was not yet present in the host countries and was unappealing for state utilities, creating further institutional barriers in addition to the aforementioned technological ones. ESMAP (2011) indicates that, ultimately, the IPP/PPA schemes did not work and had to be restructured into public projects, at the cost of contract renegotiation and significant construction delays.

This whole experience has most probably informed the decision by the CTF to concentrate investments in fewer projects of a significant scale such as Ouarzazate and to work closely with local institutions in the host country (i.e. MASEN for the case of Morocco) in order to choose a business model that aligns the objectives and expectations of host governments (creating local opportunities), donors (building the experience of the public and private sectors which can be applied to future projects) and the private sector (investment security and opportunity).

 March 2012

OVERVIEW OF THE CLIMATE INVESTMENT FUNDS

Background

In less than three years, the Climate Investment Funds (CIFs) have moved from design to investment planning and disbursement phase. Since the design of the CIF was agreed in 2008, a great deal has been accomplished. The CIFs are now playing a key role in meeting international climate change objectives with activities in 46 countries through 39 country and regional pilots. The CIFs have allocated all of the initial pledges of $6.5 billion to pilot programs and the partnering multilateral development banks have begun to ramp up disbursements. The CIFs' progress is attributable to partner countries' full commitment to strong climate action. The current portfolio of CIF pilot countries by region is 38% Africa, 27% Latin America and the Caribbean, 26% Asia, and 9% East and Central Asia.

It is expected that by May 2012, the CIF governing bodies will have endorsed:

- 13 investment plans for $4.5 billion in CIF funding as well as an additional 3 CTF investment plans for which funding needs to be mobilized ($1.2 billion) under the Clean Technology Fund
- 19 Strategic Programs for Climate Resilience for $958.8 million in funding from the Pilot Program for Climate Resilience
- 7 investment plans for $370 million in funding from the Forest Investment Program
- 6 investment plans for $240 million in funding from the Program for Scaling Up Renewable Energy in Low-Income Countries

CIF governing bodies have approved the following projects and CIF funding:

- 26 CTF projects for $1.9 billion
- 38 PPCR grants for preparation of investment plans and projects for $25.4 million
- 7 PPCR projects for $120.9 million
- 12 FIP grants for preparation of investment plans and projects for $3.8 million
- 1 FIP project for $42.0 million
- 4 SREP grants for preparation of investment plans for $1.3 million
- 2 SREP projects for $25.0 million

The Global Role of the MDBs and CIFs

The MDBs are a substantial source of funding for low-emission, climate resilient development. The MDBs are moving forward with innovative financing for climate change utilizing concessional funding available through the Climate Investment Funds—no other institutions do more climate finance.

- Through the MDBs, the CIFs are demonstrating what can be done for adaptation and mitigation at large-scale with significant sums of money. MDBs significantly leverage concessional funding available through the CIF with their normal lending and with funding from governments, other development partners and the private sector. Leveraging in the CTF is 1:8.5.

- Under the CIF, valuable lessons are being learned: on equitable governance, on financing products that work for developing countries, on planning and implementation of climate-smart development, and on the importance of involving a range of stakeholders, including indigenous peoples and local communities.

- The CIFs' governing bodies include equal representation of developed and developing countries. In these bodies, developing and developed countries discuss funding for low-carbon growth and climate resilient strategies in a program-based, nonpolitical setting.

- CIF funding supports transformational change at the policy, institutional, and market levels.

Demand for Additional Funding

Developing countries are queuing up to participate. Without additional pledges, we will be constrained in programming for new recipients.

- Under the **Clean Technology Fund**, investment plans for Nigeria and India have been endorsed but additional funds must be mobilized. The Trust Fund Committee has also agreed to consider an investment plan for Chile. Together, the three plans are requesting $1.225 billion.

- Under the Program for **Scaling Up Renewable Energy in Low Income Countries**, the Sub-Committee has authorized the preparation of investment plans in six additional pilots. If these pilots were to be funded at the same level as the first six, an additional $240 million would be required.

- 37 additional countries have expressed an interest in accessing the **Forest Investment Program** and existing pilot countries have expressed interest in receiving additional resources.

- 13 additional countries and the Nile Basin countries have expressed an interest in accessing resources under the **Pilot Program for Climate Resilience** and existing pilot countries have expressed interest in receiving additional resources.

Avoiding a gap in climate financing

It's critical that we avoid a financing gap during the 3-5 years it will take the Green Fund to become operational.

- Decision of Durban on long-term finance affirmed the importance of continuing to provide ongoing support beyond 2012.

- The CIFs are a "ready-made" vehicle to receive additional funding and promote programming at scale to advance low emission, climate resilient development and can play a significant role in ensuring that funding for climate action continues moving forward.

- All CIF funds have been allocated and an upturn in commitments and disbursements is anticipated as we move into implementation phase with more of the participating countries.

Philippines CTF Update – Comments Matrix (December 2011)

Question / comment	Response
1. CTF cost-effectiveness and eligibility	The proposed changes will result in projects which are more cost-effective than the original net metering program. See calculations in Tables 5, 9, and 10 and discussion at paragraphs 38, 49, and 50. CTF eligibility is placed in context in Section III (paragraphs 17-32 and Figures 1-5). Detailed discussion of eligibility is delineated in Table 5 and paragraphs 36-44, which clearly indicate that the proposed changes will enhance the CTF Investment Plan. CTF guidelines note that cost effectiveness is cost per ton CO_2 equivalent avoided over the lifetime of the project, not cost per ton per year. This guidance has been followed by other CTF investment plans and projects, although there is not 100% consistency. i.e., some investment plans have presented cost effectiveness on $/ton/year basis; some have shown cost/ton over project lifetime; and some have not shown any explicit calculation of cost-effectiveness (e.g., India). The cost effectiveness of the Energy Efficient Electric Vehicles (EEEVs) and EE appliances projects is better than the originally-proposed solar net metering project and compares favorably to other proposed CTF projects (see table at end of this document).
2. What other options have been considered as alternatives to electric vehicles (e.g., CNG, LPG)?	All options have been and continue to be considered; see discussion at paragraph 51. CNG and LPG must be imported; switching from gasoline to these fuels results in minimal GHG reductions and does not enhance energy security. Switching from diesel to CNG may achieve 20% GHG reduction in best case scenario, but the energy efficiency gain would still be lower than that achieved via EEEVs. CNG and LPG may be practical for cars, light trucks, and heavy-duty vehicles, but these fuels do not present an opportunity for conversion of motorcycles and trikes, which are at the bottom of the public transport pyramid. See discussion at paragraphs 26-32 and 51. The originally proposed BRT investments led by World Bank Group are still being pursued.
3. What is the role of private sector [in the EEEVs project], which was noted in the original CIP?	The private sector is actively engaged in RE development, as discussed at paragraphs 17 and 18. Electricity generation in the Philippines is now 100% private sector. As discussed in paragraphs 17-19, concessional finance is not obviously needed for the net metering program. Public sector financing for RE projects in the near-term would crowd out private sector investment, which would be contrary to GoP overall objectives for the power sector. Private sector entities have not developed any credible investment projects for EEEVs or more efficient appliances, and GoP is therefore taking the lead in affecting change. Private sector entities will be engaged in implementation via service, supply, and maintenance contracts, and will be expected to lead replication and scale up via vehicle production, distribution, and operations and maintenance (see paragraph 39). However; total private sector investment has yet to be quantified and therefore is not shown in Table 4. Introduction of EEEVs presents classic first-mover risk: globally, new vehicle technologies and systems are being developed, but “technology push” is not sufficient to begin fleet-wide fleet conversion. “Policy pull” is required and GoP is developing an electric vehicle policy, as noted in Appendix 1, paragraph 6.
4. Grid connection: is there sufficient generation capacity? I.e., will more end-users overstress the grid? How will electric vehicles impact generation mix?	The proposed EEEVs project is expected to add 60 MW of incremental demand to the grid, which will be offset by 110 MW in savings from the EE appliances project and 138.5 MW in new RE generation capacity. Incremental demand of 60 MW is 0.37% of installed generation capacity; annual incremental energy consumption of 150 GWh is 0.22% of generation output in 2010 (see Appendix 1, Table A1.3). See discussion at paragraph 45, Table 8, and Appendix 1. Grid expansion scenarios with respect to GHG implications are presented in Appendix 1. Table 8 shows that the EEEVs project would not have a negative impact on grid-supplied power at the retail consumer level. Considering that an additional 1200 MW of coal-fired

	capacity is being developed (see Appendix 1, Table A1.2), grid-supplied electricity would not be "stressed" until replication and scale-up of 20:1 is achieved, i.e., deployment of 2 million e-trikes. Calculations presented in Appendix 1 indicate that GHG reductions will still be achieved if the grid-supplied power is 100% coal-fired: Appendix 1 shows clearly that ICE engines running on gasoline with 25% thermodynamic efficiency are more carbon-intensive than e-trikes powered with 100% coal-fired electricity. Clean energy accounts for about 66% of power generation and about 39% of total primary energy as shown in Figure 6. Figure 6 indicates that oil dominates the transport sector, presenting a tremendous opportunity for end-use efficiency gains via electric vehicles. Additional RE capacity is being developed in line with Philippines Energy Road Map, including the IBRD and IFC programs supported by CTF.
5. How to dispose of lithium ion batteries?	Li-ion batteries are classified as non-hazardous waste by US EPA and Philippines Department of Environment and Natural Resources. Batteries will be reused to the maximum extent possible and can be disposed to sanitary landfills at end of useful lifetime. See discussion at paragraph 48 and footnotes 20-22.
6. Explain further energy efficiency is a case of market failure. For energy efficiency, what will be underlying transformation? What about other options, e.g., standards and labeling?	The energy and electricity markets and regulatory framework are discussed extensively in the original CIP and for the sake of brevity these details are not repeated in the draft IP Update. Clearly, with retail electricity prices averaging around \$0.20 per kWh – the highest in the region – private sector investors and commercial banks should be racing each other to implement RE and EE projects. Since this is not happening there is an obvious market failure, which is not uncommon globally: standards and labeling are not sufficient to change consumer behavior. See discussion in paragraph 52 and Appendix 2. As noted in the original CIP, Table 4, the Philippines has yet to approve an energy conservation law (as has been done in other Asian countries), which limits application of policy instruments to address market limitations. In the absence of a comprehensive energy conservation law, CTF is an attractive prospect to catalyze innovative EE investments.
7. For the EEEVs project, what are additional costs and what is expected operating lifetime of the e-trikes? Have "learned rates" been considered in the context of replication and scale up.	The additional cost of an e-trike vs. conventional trike is at least \$1000 (see paragraph 43, and Appendix 1 paragraph 3). Operating lifetime is assumed to be 10 years as noted in paragraph 50 and Table 5. At present there is no mechanism to monetize the life-cycle fuel savings and bring those benefits as up-front project cofinancing. The pilot project conducted in Mandaluyong City has provided valuable experience, and the proposed EEEVs project has been designed based on that learning curve. Replication and scale-up potential is more than 20:1 nationwide, but the GHG reduction and cost-effectiveness estimates assume 10:1 replication and scale-up. Additional "learning rates" would result in replication and scale-up greater than 10:1.
8. What is the proposed transformational delivery mechanism for EE appliances?	The EE appliances project is at an early definitional stage. Preliminary market analysis is discussed in Appendix 2. GoP and ADB are considering different options for delivery mechanism based on the experience of converting from conventional incandescent lighting to CFLs (gained through the Philippines Energy Efficiency Project). Additional details will be presented in the draft Board documents when the project reaches the appraisal stage (after the IP Update is endorsed).
9. For EEEVs, are the GHG reductions calculated on life-cycle basis? Need to show that CTF conditions for Plug-in vehicles are	GHG reductions are based on a life-cycle basis ("well to wheels"). Estimates are consistent with that for electric vehicles in other countries. See discussion in paragraph 47 and Appendix 1. Grid expansion scenarios with respect to GHG implications are presented in Appendix 1. Net GHG reductions would be realized even if the grid was providing 100% coal-fired

met.	power. Appendix 1, Table A1.1 presents the GHG reduction estimates prepared by ADB's carbon finance team in anticipation of Clean Development Mechanism registration. These estimates are consistent with calculations made independently by the ADB project team. ADB and GoP believe that the GHG reduction estimates presented are conservative and robust.
10. For the EEEVs project, "rebound effects" should be considered.	CTF guidance does not require consideration of rebound effects. Rebound effects have not been mentioned in any other CTF Investment Plans and no questions have been raised about rebound effects in review of IPs and specific project proposals. A recent report prepared by the European Commission discusses various studies on rebound effects in considerable detail (Maxwell, D., Owen, P., McAndrew. L, Muehmel, K., Neubauer, A., *Addressing the Rebound Effect*, a report for the European Commission DG Environment, 26 April 2011). The report by Maxwell *et al* covers various sectors including energy and transport, and notes that the rebound effects are real but are difficult to quantify [which is consistent with the fact that CTF guidance does not require consideration of rebound effects]. Section 4.1, page 30 of Maxwell et al notes: *Generally, rebound effects are difficult to quantify and their significance in different circumstances is debated. For example, some of the theories controversially claim that the rebound effect can be responsible for up to 50% of increased consumption, while in others, that rebound can negate the environmental gains 100% - a so called "backfire" (Jevons, 1865; Khazzoom, 1980; Brookes,1990 and 2000). In practice, the magnitude of the rebound effect is dependent on individual circumstances e.g. sectors, technologies and income and is linked with a range of factors impacting consumption and economic growth. Understanding these factors and their role in direct, indirect and economy wide rebound effect is key to understanding the significance of the rebound effect associated with different interventions.* Clearly, this indicates that a comparison such as improved fuel efficiency in heavy duty trucks in the EU zone versus the proposed EEEVs in the Philippines would be a case of "apples and oranges." In the report by Matthews *et al*, the only study referenced for hybrid and electric vehicles covers hybrid vehicles in Switzerland. The Switzerland study concluded that there were no rebound effects (direct or indirect) associated with introduction of the more energy efficient vehicles (see Matthews *et al*, Table 1.2., page 20 and Case Example on page 76). Given the complexity of quantifying potential rebound effects, such consideration is not required by guidance of CTF, ADB, other MDBs, nor Clean Development Mechanism. As suggested by the UK, Table 9 includes a scenario discounting GHG reductions by 30% for potential rebound effects. This scenario will result in greater emissions reductions, which are more cost-effective, than the originally proposed net metering project. The calculations in Table 9 are consistent with GHG reduction estimates presented in Tables 5 and 10, and Appendix 1.
11. Why is DOE the executing agency for the EEEVs projects rather than the DOTC?	DOE is the designated agency for EE activities as well as alternative fuels including electric vehicles (see paragraph 42).
12. EEEVs fuel consumption is noted as 5 L/day in main text but 20 L/day in appendix.	The correct amount is 5 L/day; this has been corrected. Other errors and inconsistencies have been corrected.

Cost-effectiveness: Comparison of Various CTF Proposals

Program / Project	CTF Amount ($ million)	Cost-effectiveness of Direct Reductions	Cost-effectiveness with Replication and Scale-up
Egypt Urban Transport	$100	$66.67 / ton / year	$3.3 / ton
Morocco Wind & Pumped Storage [a]	$125	$73.53 / ton / year	$3.7 / ton
Philippines: IFC Renewable Energy Accelerator Program	19	$6.67 / ton	$1.33 / ton
Vietnam: IFC Energy Efficiency Program	28	$59 / ton / year	$4.2 – 6.5 / ton (15-year program lifetime)
Republic of South Africa (RSA): AfDB and IFC Energy Efficiency Program	$15	$5.56 / ton	$4.55 / ton
RSA Solar Water Heating Program	$50	$20 / ton	$4.35 / ton
RSA Sustainable Energy Accelerator Program (solar, wind, & cogeneration)	$83	$3.22 / ton	$0.65 / ton
Thailand: IFC Sustainable Energy Finance Program	$30	$4.44 / ton	n/a
Thailand: IFC Renewable Energy Accelerator Program	$40	$16.67 / ton	$1.67 / ton
Philippines: ADB EEEVs project (proposed)	$101	$37.41 / ton	$3.74 / ton

Source: project funding proposals approved by CTF Trust Fund Committee (except for Philippines EEEVs project)
Note: [a] Emissions reductions are for the entire program of 450 MW wind power + 520 MW hydro-pumped storage, with total investment of about $2.1 Billion.

CLEAN TECHNOLOGY FUND

REVISED INVESTMENT PLAN FOR THE PHILIPPINES

June 2012

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BRT	Bus Rapid Transit
CIP	CTF Country Investment Plan
CIP-R	Revised CTF Country Investment Plan
CTF	Clean Technology Fund
EE	Energy Efficiency
EEEVs	Energy Efficient Electric Vehicles
FIT	Feed-in Tariff
GHG	Greenhouse Gas
GoP	Government of the Philippines
IBRD	International Bank for Reconstruction and Development
ICE	Internal Combustion Engine
IFC	International Finance Corporation
$MtCO_2e$	Million tons of carbon dioxide equivalent
PV	Photovoltaic
RE	Renewable Energy
RPS	Renewable Portfolio Standard
SCS	Solar charging station
WBG	World Bank Group

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Government of the Philippines (GoP) is pleased to provide a revised Clean Technology Fund (CTF) Country Investment Plan (CIP) which has been updated from the version which was endorsed by the Trust Fund Committee (TFC) in December 2009. This document has been revised pursuant to discussions with the CTF Trust Fund Committee held in Washington, DC on 4 November 2011, and it also takes account of subsequent comments received and additional stakeholder consultations, superceding the revised CIP submitted in January 2012.

The revisions reflect recent adjustments and refinements to relevant national policies and priorities, including the establishment of a National Framework Strategy on Climate Change in April 2010 and an accompanying National Climate Change Action Plan, which was approved in April 2011 after extensive inter-departmental and stakeholder consultations. The Philippine Energy Reform Agenda has also been agreed, with three pillars: (i) ensuring energy security, (ii) achieving optimal energy prices, and (iii) developing sustainable energy systems.

The overall context and objectives of the CIP remain unchanged. No changes have been proposed to the CTF allocation for the projects and programs to be implemented in partnership with the World Bank Group. However, the proposed change will reallocate funds for public sector investments to be implemented in partnership with the Asian Development Bank (ADB), originally proposed to support an Energy Efficient Appliances Project and a Rooftop Solar Development Project, to cleaner and more energy efficient transport under an Energy Efficient Electric Vehicles (EEEVs) Project and a revised approach to renewable energy promotion through a Solar Energy Development Project. The funding request for the Energy Efficient Appliances Project is withdrawn, though the Government plans to pursue this idea in modified form, subject to the availability of alternative financing. Table ES1 summarizes the indicative financing plan as endorsed by the CTF Trust Fund Committee in December 2009. Table ES2 presents the indicative financing plan after the proposed reallocations.

The Government's proposed investment in the EEEVs Project stems from its strategy to emphasize investment in end-use energy efficiency in public transport systems via public-led investment as a high priority for market transformation. As a net importer of energy, the shift in priority for CTF funding to electric vehicles will simultaneously reduce greenhouse gas emissions, contribute to better urban air quality and associated health benefits, and improve energy security.

With respect to the proposed Solar Energy Development Project, it must be noted that Philippine consumers pay some of the highest electricity tariffs in the world. As there are no subsidies for the generation sector, consumers and policy makers are rightfully concerned about further electricity price increases that may result from feed-in tariffs which are higher than average retail electricity tariffs. At the same time, a solar feed-in tariff proposed by the electricity regulator has created large interest from the private sector for new investment, but the proposed feed-in tariff for solar will apply only to an additional 50 megawatts (MW) of ground-mounted installations. Private sector developers have indicated interest in installing up to 300 MW of capacity. In this context, the government has decided not to “crowd out” this significant private sector interest, which is why the net metering solar rooftop expansion project proposed in the original CIP will not be pursued. However, the proposed Solar Energy Development Project can help to transform that segment of the solar rooftop market outside of the proposed solar feed-in tariff (and 50 MW cap) while supporting the development of net metering in the country.

Table ES1: Indicative Financing Plan Endorsed in December 2009 ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	RE and EE (ADB)	Total
CTF	75	50	125	250
GoP / DBP	180	50	50	280
IBRD Loans	250	250	0	500
IFC Loans	250	0	0	250
ADB Loans	0	0	400	400
Private sector	750	0	350	1,100
Total	**1,505**	**350**	**925**	**2,780**

Source: CTF Investment Plan for Philippines 2009
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, WBG=World Bank Group

Table ES2: Indicative Financing Plan After Reallocation ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Electric Vehicles (ADB)	Solar Energy Development (ADB)	Total
CTF	75	50	105[a]	20[a]	250
GoP / DBP	180	50	99	20	349
IBRD Loans	250	260	0	0	510
IFC Loans	250	0	0	0	250
ADB Loans	0	0	300	80	380
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing (AFD loans)	0	245	0	0	245
Total	**1,505**	**605**	**504**	**120**	**2,734**

Source: MDB teams
ADB=Asian Development Bank, AFD=Agence Franciaise de Developpement, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, (tbd)=to be determined, WBG=World Bank Group
Notes:
[a] For the EEEVs project, a CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan). For the Solar Charging Systems component a CTF grant of $4 million is requested to ensure its technical viability and whether solar charging could be implemented within the current tariff of about $0.20/kWh; see discussion in main text and concept paper in Appendix 2 for further details.
[b] Private sector entities will participate in project implementation via supply of goods and services. For the EEEVs project, private sector investment is expected during replication and scale-up, and as such no private sector cofinancing is shown in Table 4. Private sector cofinancing for the Solar Energy Development project has yet to be determined.

During stakeholder consultations with non-government and civil society organizations (NGOs, CSOs) conducted in Manila in May 2012, a number of key issues were highlighted, with subsequent adjustments made to the CIP:

(i) a range of issues and alternatives were put forward regarding design of the EEEVs Project, including those relating to the funds flow model, where civil society organizations emphasized the need for transparency, especially in light of the upcoming local elections, and it was clarified that manufacturers would receive direct funding;
(ii) participant contributions also influenced the proposed EEEVs Project design with respect to warranty issues, disposal options, and the e-trike design;
(iii) it was noted that there have been significant price reductions in the cost of solar power, especially in the last year, so a solar rooftop project with net metering could be

developed without the subsidies provided by way of the feed-in tariff – and this was incorporated into the revised CIP, albeit at a more modest scale than conceived in 2009;

(iv) civil society and renewable energy representatives expressed strong interest in promoting the use of solar energy to charge electric vehicles, without imposing any additional financial burden to the drivers and end users, and a proposal for such a pilot project was incorporated into the CIP that is meant to encourage private investors to provide such services and broaden support for electric vehicles with the lowest possible carbon footprint.

The adjustments to the CIP are based on broad stakeholder engagement covering CSOs, NGOs, local government units, industry representatives, and public transport owners and operators. The proposed CIP revisions will achieve a better balance between supply-side and demand-side investments, without crowding out private sector investment in renewable energy while fully supporting the Philippines energy reform objectives to promote affordable and sustainable energy security. The proposed projects will result in greater and more cost-effective GHG emissions than proposed in the original CIP, with enhanced development impacts.

As the EEEVs Project has reached the appraisal stage, it is presented simultaneously to the CTF Committee for funding approval alongside the requested endorsement of the revised CIP. Additional project-specific considerations relating to the Solar Energy Development Project will be addressed when that project reaches the appraisal stage and is presented for funding approval to the Trust Fund Committee.

I. INTRODUCTION

1. The Philippines Clean Technology Fund (CTF) Country Investment Plan (CIP) was endorsed by the Trust Fund Committee (TFC) in December 2009, with an envelope of $250 million in CTF cofinancing. The original CIP comprised clean energy and transport sector investments in both the public and private sector.

2. The proposed change will reallocate funds for public sector investments led by Asian Development Bank (ADB) from the original net metering with solar power generation concept to investments in energy efficient electric vehicles (EEEVs) including a solar-powered charging stations (SCS) component. The scope of the project proposed in the original CIP -- net metering with rooftop solar -- will be reduced and the project will be formulated in the context of the Philippines evolving renewable energy framework. This change in investments is consistent with the long-term objectives of the original CIP. The overall context and objectives of the CIP are the same as the original CIP. The revised CIP (CIP-R) is a business plan owned by the Government of the Philippines (GoP), and is a dynamic document with the flexibility to consider changing circumstances and new opportunities.

3. No changes have been proposed to the CTF allocations for the International Bank for Reconstruction and Development (IBRD) and International Finance Corporation (IFC). Therefore, this document primarily covers the proposed changes and program to be implemented by the Asian Development Bank (ADB), and is organized as follows:

- Section I – Introduction to the Philippines revised CTF CIP;
- Section II -- Review of the status of implementation of the original investment plan;
- Section III -- Explanation of the circumstances and rationale for revising the investment plan and making changes to the projects or programs included;
- Section IV -- Description of the proposed changes, i.e., proposed reallocation of funds as requested by the GoP;
- Section V -- Assessment of the potential impact of the proposed changes on achieving the objectives and targets of the original investment plan;
- Appendix 1 – Summarizes the GoP decision-making process and stakeholder consultations relating to the proposed changes to the CIP; and
- Appendix 2 and 3 – Concept papers for the proposed investments to be supported with CTF cofinancing.

II. STATUS OF ORIGINAL INVESTMENT PLAN IMPLEMENTATION

4. The status of program and project development and approvals is presented in Table 1 and discussed below.

Table 1: Processing Status of IBRD and IFC Investment Programs and Projects

Project	TFC Approval Date	CTF Amount ($ million)	Leveraged Funding ($ million)
IFC Renewable Energy Accelerator Program	September 2010	20	330
IFC Sustainable Energy Finance Program	February 2011	10	209
IBRD Renewable Energy/Energy Efficiency Project	December 2012	45	200
IBRD Urban Transport (BRT) Project (Cebu)	September 2012	25	170
IBRD Urban Transport (BRT) Project (Manila)	September 2013	25	385
Total IBRD, IFC and Leveraged Investments		**125**	**1,294**

Source: MDB project teams.

IBRD Renewable Energy Program

5. The IBRD/CTF operation would support investments in renewable energy (RE) generation and in utility-level energy efficiency (EE). The operation would build on IBRD projects that are active in these sub-sectors. In RE, the focus will be on leveraging private sector investment in the context of the emerging policy and regulatory framework for renewables, and ensuring that CTF is used strategically to leverage as much private investment as possible. In EE, the goal is to scale-up the efforts of electric cooperatives (ECs) to continue to reduce losses, as one key input for enhancing the financial strength of these service providers. Stronger ECs will be better able to expand their customer bases, contributing to critical access objectives, and to serve those new customers with an increasing proportion of clean energy.

6. While the Philippines has an advanced framework for private participation and for attraction of private financing, there are significant barriers to the scale-up of RE and utility-led EE. For example, for administrative ease, the country has opted for a single, national feed-in tariff (FIT) rate per technology; but supply chain and other costs vary widely in the country, so some economically beneficial projects will not be financially viable under the FIT mechanism. Specific FIT rules are still to be finalized and made effective. The FIT regime will also not extend to certain renewable technologies (e.g., geothermal), nor will it cover off-grid generation. CTF will be used to provide critical additionality and leverage such that more, good projects will be financed, especially in regions of the country that might not otherwise see much activity. In the EC sector, there are 119 service providers but only about half are currently rated credit-worthy, and investment flows are falling well short of requirements even for the credit-worthy. CTF is targeted at both the supply side – by leveraging the flow of private credit to support investments – and at the demand side, by establishing programmatic eligibility criteria that will help incentivize more ECs to become credit-worthy.

7. GoP has made its formal request for project preparation funds from the CTF, and project preparation work is set to accelerate. Project appraisal is upcoming, and presentation to the IBRD Board is scheduled in mid-2013.

IBRD Urban Transport Program

8. The Program comprises investment and advisory services components to support the implementation of Bus Rapid Transit (BRT) projects in Cebu and Manila. The advisory services component includes support for implementation of the National Environmentally Sustainable Transport Strategy (NESTS). Since the Philippines CIP was prepared in December 2009, there have been a few minor changes made to the scope and design of the urban transport component. These adjustments are outlined below.

9. Through project preparation work undertaken since the initial CTF investment proposal, it has become evident that to ensure successful implementation of a BRT system in the Philippines, substantial capacity and institution building work will be necessary. To this end, it has been agreed with the counterparts that the BRT program would be undertaken in two phases, beginning with a Phase I demonstration project in Cebu City, from which lessons learned and institutional structures derived would be applied to Phase II, the development of a BRT in Manila. Given the substantive social and political hurdles involved in the Manila phase, the counterparts agreed that a successful demonstration in Cebu would facilitate more rapid implementation in Manila.

10. Also, for Phase I, to maximize greenhouse gas emissions mitigation benefits, as well as safety, gender, and poverty impacts, the program scope has been slightly expanded to also include upgrading the existing SCATS area traffic control system to better manage traffic and non-motorized transport (NMT) flows, not only on BRT corridors, but for the entire transport network. Further, Phase I will include significant training and capacity building work not just for the local government, but also relevant stakeholders, such as the jeepney operators.

11. Finally, since the initial CTF proposal, a parallel Sustainable Urban Energy Program (P125401) has been undertaken by the IBRD in Cebu City, through which it was determined that the greenhouse gas emissions from the transportation sector were 721,000 tons CO_2e in 2010, about 40 percent of Cebu's total greenhouse gas emissions. While this figure will be verified and refined during the CTF project preparation, the estimate provides a basis upon which to develop preliminary greenhouse gas emissions reduction targets that may be attributable to Phase I in Cebu, versus Phase II in Manila. Through the expanded project scope, a range of 100,000 to 150,000 tons CO_2e emissions reductions per year may be a reasonable estimate for Phase I, with more substantive emissions reductions to be expected in Manila, which is many times the size of Cebu City and has a much higher motorization rate. The success of Phase I is critical to expanding the scope to Phase II. However, in addition to CO_2e emissions reductions, it is expected that the Phase I demonstration project would have considerable impact on improving access to the poor, providing safer and more effective transport services to all residents, and influencing changes in land use design with a long-term impact on the city's ability to address climate change related issues.

12. Since the program will be undertaken in two phases, rather than one, funding allocations have been adjusted accordingly, as shown in Table 2. Further, additional financing and technical assistance funding has been secured from the Agence Française de Développement (AfD), which is also reflected in the revised figures. The CTF funds will continue to be needed to cover part of the additional costs of BRT systems compared to conventional bus networks.

Table 2: Revised Financing Plan for IBRD Urban Transport Program (US$ million)

Funding Source	**December 2009 Original Proposed Contribution**	**October 2011 Revised Proposed Contribution**	
		Phase I	**Phase II**
Government of the Philippines	50	15	35
IBRD	250	110	150
Clean Technology Fund	50	25	25
Agence Française de Développement	0	45	200
Total	**350**	**195**	**410**

Source: IBRD.
Notes: * To be confirmed during preparation.

13. Overall progress is shown above in Table 1. Project preparation work is proceeding well and 4 missions have been undertaken since April 2011. The Government has made a formal request for project preparation funds from the CTF. QER for the project is set for 3 July 2012, and appraisal is targeted for September/October 2012, with presentation to the Bank's Board in March 2013.

IFC Programs

14. As of October 2011, two private sector program proposals have proceeded: $20 million was approved in September 2010 for the IFC Renewable Energy Accelerator program, and $10 million was approved in February 2011 for the IFC Sustainable Energy Finance program.

IFC Renewable Energy Accelerator Program (REAP)

15. IFC would provide appropriate incentives for qualified solar, wind, and biomass developers to accelerate the implementation of RE projects. These projects would provide immediate GHG reduction impact and provide valuable information on the types and amounts of incentives required to catalyze RE development in the country. IFC will continue to develop projects with CTF support in close coordination with the GoP and the policies that govern private sector growth. The rationale is the same as envisioned in the original CIP. IFC continues to work with project developers and refining financial structures in the development of projects. Overall progress is shown above in Table 1.

IFC Sustainable Energy Financing Program (SEFP)

16. The program supports the scale up of sustainable energy finance projects in Philippines. It aims to contribute to increasing private sector involvement, support captive and grid-tied RE development, EE market transformation, and enhance energy savings. The CTF funds will continue to be needed to incentivize local financial institutions to undertake financing in lower carbon emitting technologies. The rationale is the same as envisioned in the original CIP. IFC continues to work with various stakeholders in developing projects under the program. IFC has a pipeline of projects that are at various stages of development that would fully utilize IFC's CTF allocation.

III. CIRCUMSTANCES AND RATIONALE FOR INVESTMENT PLAN REVISION

17. The overall rationale for CTF intervention in the energy and transport sectors remains unchanged. The revisions reflect recent adjustments and refinements to relevant national policies and priorities, including the establishment of a National Framework Strategy on Climate Change in April 2010 and an accompanying National Climate Change Action Plan, approved in April 2011 after extensive inter-departmental and stakeholder consultations. The Philippine Energy Reform Agenda has also been agreed, with three pillars: (i) ensuring energy security, (ii) achieving optimal energy prices, and (iii) developing sustainable energy systems. The GoP is requesting that the ADB allocation be revised to accommodate an Energy Efficient Electric Vehicles (EEEVs) Project and a Solar Energy Development Project. Major changes in circumstances since 2009 that have contributed to this adjustment include:

(i) The specific rules for the Renewable Portfolio Standard (RPS), feed-in tariffs (FIT), and net metering have yet to be finalized and become fully effective, though GoP remains fully committed to the RPS, FIT, and net metering programs. Finalization of the implementing rules is expected within the next 2 years, but there is no fixed deadline for completion.

(ii) The Philippines Department of Energy has proposed that the RPS for solar power apply to installation of 50 MW over a 3-year period, limited to ground-mounted installations.[1] The proposed feed-in tariff has attracted initial private sector interest for several times this capacity. This private sector interest, combined with rapid decreases in solar photovoltaic system costs, obviates the need for concessional financing for projects which will avail of the solar FIT. However, RE development still entails higher initial capital costs, the retail market for solar power is non-existent, and concessional financing is needed during the foreseeable future to accelerate RE market transformation with the long-term objective of achieving grid parity. There is strong stakeholder support for continued public sector investment in RE development.[2]

(iii) Increases in fossil fuel prices since 2009 point to the need for additional investments in energy end-use efficiency, including the transport sector.

(iv) A successful pilot test of EEEVs,[3] conducted with ADB support, is ready for scale up. This project has support from the highest levels of the Government of the Philippines.

18. Based on circumstances (i) and (ii), the net metering project using distributed solar power proposed in the original CIP may still be relevant, but the project concept needs to be reformulated considering the evolving regulatory framework and market realities. In particular, given the private sector interest to develop solar projects under the proposed FIT and RPS (which will be limited to 50 MW of ground-mounted installations), and current installed costs for solar PV systems, FIT-supported investments in solar power will not require concessional financing. However, outside of the FIT envelope, concessional financing will be needed in the near term to accelerate solar market development and to establish a new use of solar power: off-grid solar charging for electric vehicles. Therefore, the original rooftop solar concept is being retained with a reduced scope, and the details will be developed by early 2013.

19. Taking account of circumstances (iii) and (iv), GoP believes that the bulk of concessional financing offered from CTF could be better utilized in the near term to begin converting the public vehicle fleet to EEEVs. Introduction of electric and hybrid vehicles is being complemented by other alternative and cleaner fuel development, including domestic production of renewable diesel and ethanol to meet mandated blending requirements, as well as other transport initiatives including public transport projects supported by IBRD (discussed in Section II).[4]

20. Given the need for convergence between climate change and energy security objectives, GoP proposes to shift part of the original $125 million of CTF resources slated for the solar net metering concept, and re-direct $105 million to the EEEVs project including a $4 million grant for demonstrating solar charging stations and a $1 million grant for project implementation support (fine-tuning of technology options, technology transfer, local industry support and capacity building). The balance of $20 million is proposed to support financing of a Solar Energy Development Project centered on rooftop PV applications as discussed above. The prospective investments are appropriate for CTF support given their transformational nature and the replication and scale-up potential. The shift of some CTF resources to demand-side

[1] Philippines Department of Energy, Resolution dated 28 June 2011.
[2] Presentations from key stakeholder consultations are available at the following links:
https://www.dropbox.com/sh/5q2tobxqsovqp1l/xJkQYjJj90
http://www2.adb.org/Projects/eTrike/events.asp
[3] The vehicles are motorcycles with side cars which provide taxi services, known locally as "tricycles"; this tricycle design is somewhat unique to the Philippines. The pilot-tested EEEVs are also referred to as "e-trikes." The transport services provided by tricycles are similar to auto-rickshaws utilized in other Asian countries including Bangladesh India, Indonesia, and Thailand. Hence the potential for replication and scale-up is regional in scope.
[4] For the sake of brevity, an exhaustive discussion of transport sector interventions including demand management and other "avoid and shift" prospects is not included here. A detailed discussion is presented in the original CIP.

investments is fully consistent with GoP energy and transport policies as outlined in the original CIP. A summary of stakeholder engagement during preparation of the revised CIP is presented in Appendix 1. The proposed projects are discussed below and in Appendices 2 and 3.

21. The changes in the proposed projects to be implemented in partnership with ADB are based on broad stakeholder engagement, including with government agencies, civil society organizations (CSOs), non-government organizations (NGOs), local government units (LGUs), industry representatives, and public transport owners and operators. The engagement process, including recent consultations, provided for discussions on a range of ideas and suggestions about the CIP, the proposed EEEVs project, and RE development. Participants at the stakeholder consultations raised a range of issues and provided alternatives for ADB and DOE to consider, and these are reflected in the updated program and EEEVs project design, including the funds flow model. Civil society representatives advocated for a more transparent funds flow model – especially in light of the upcoming local elections – and were pleased to see that the project would be funding manufacturers directly. Other aspects where participant contributions influenced the CIP-R and proposed project design include warranty issues, disposal options, and design of the e-trike itself. The consultation process also led to the decision to retain the rooftop solar concept proposed in the original CIP, albeit with a more modest budget (and specific components still to be determined).

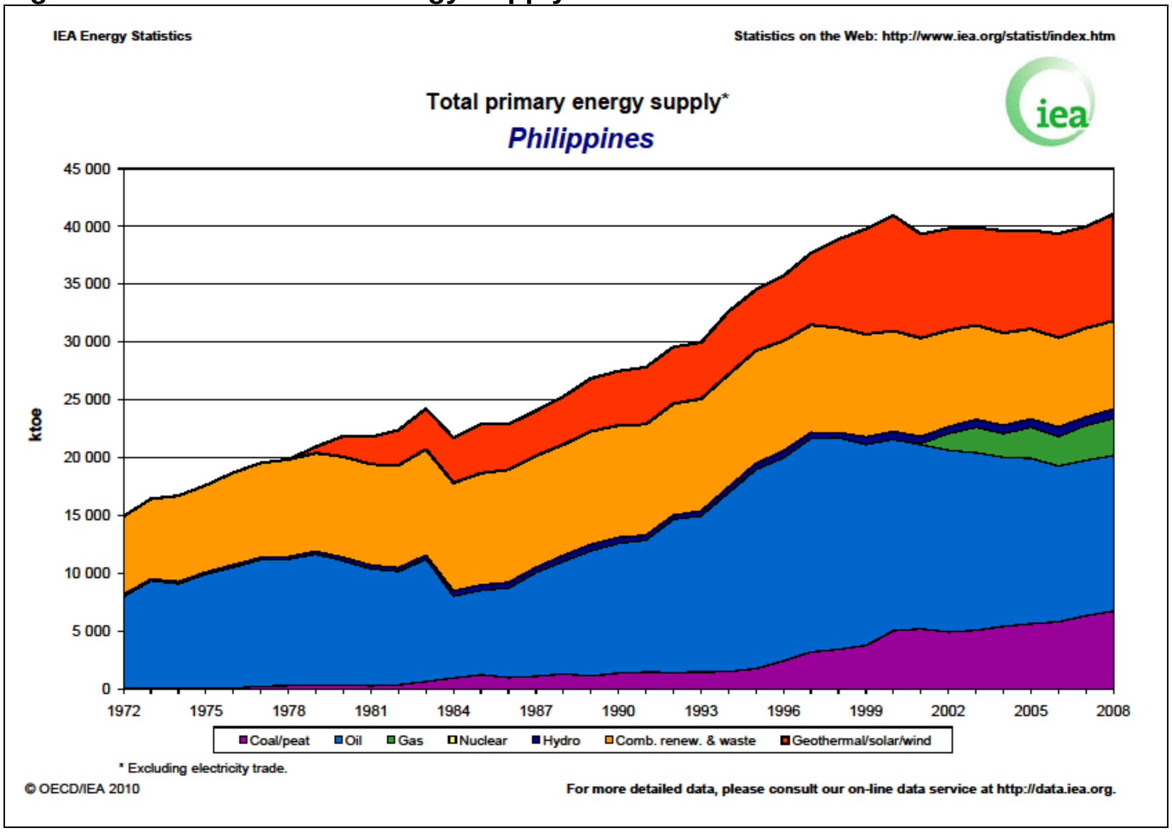
22. GoP is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework as described in the original CIP. Figure 1 illustrates trends in total primary energy supply, indicating that coal and natural gas have displaced oil for power generation, while the share of renewables has not increased substantially during the past several years. The trend of increasing coal use is of particular concern with respect to energy security and GHG emissions objectives. The IBRD and IFC programs (noted above in Section II) will focus on RE and EE investments intended to reduce demand, add clean energy generation capacity, and replace what might otherwise be power capacity additions through fossil fuels.

23. In 2010, the Philippines spent approximately $8.78 billion[5] on imported oil – 39% more than in 2009, about 66% of which was used by the transport sector. Under a business as usual scenario, with growing population and urbanization, the cost of fuel imports is likely to increase by multiple times over the next 10-15 years. GoP plans to improve energy security – a national priority alongside low-carbon development objectives – through RE, EEEVs, and other EE investments.

24. Based on the McKinsey marginal CO_2 abatement cost curve (Figure 2) and a study by ADB (Figure 3), GoP developed the investment strategy for the energy sector as shown in Figure 4, including $250 million in CTF financing. Energy efficient vehicles (including EEEVs), although a GoP priority, were not part of the original CIP prepared in 2009, as no project or program had been formulated at that time. The GoP now proposes to adjust its priorities considering changed circumstances in relation to increased private investor interest in RE generation projects, consumers' concern over potential impacts of the feed-in tariff, and prospects of higher electricity tariffs.

[5] Source: Department of Energy, available at: http://www.doe.gov.ph/DO/Report2010.htm

Figure 1: Trends in Total Energy Supply



Source: IEA, accessed on 11 August 2011 from: http://www.iea.org/stats/pdf_graphs/PHTPES.pdf

Figure 2: McKinsey Marginal CO_2 Abatement Cost Curve

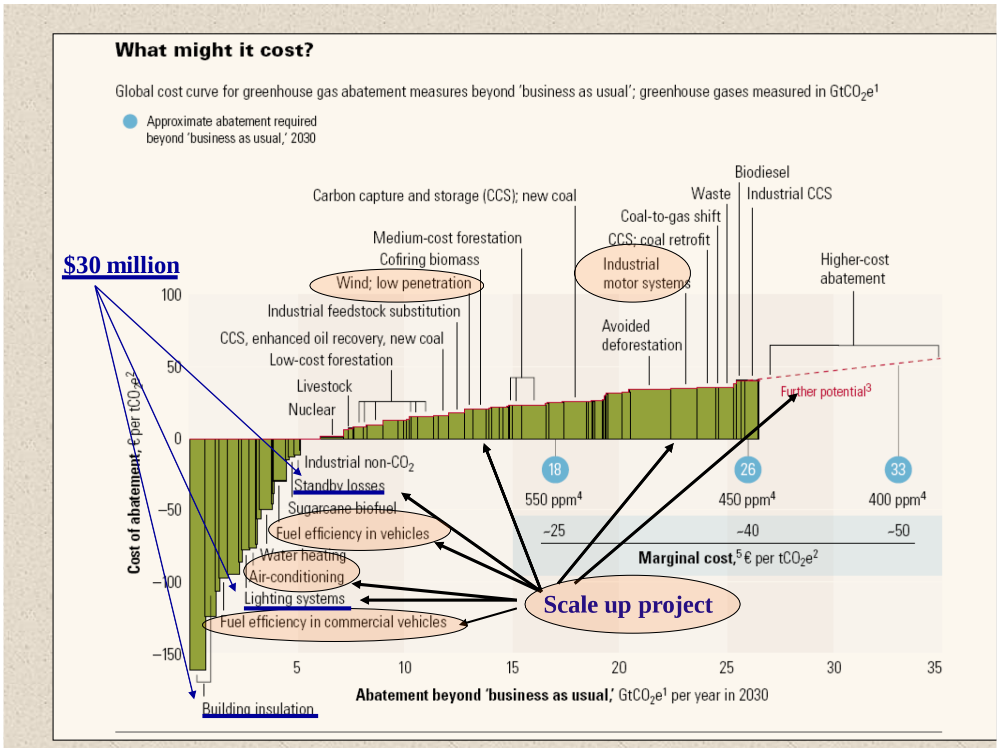


Figure 3: Philippines Marginal CO_2 Abatement Cost Curve

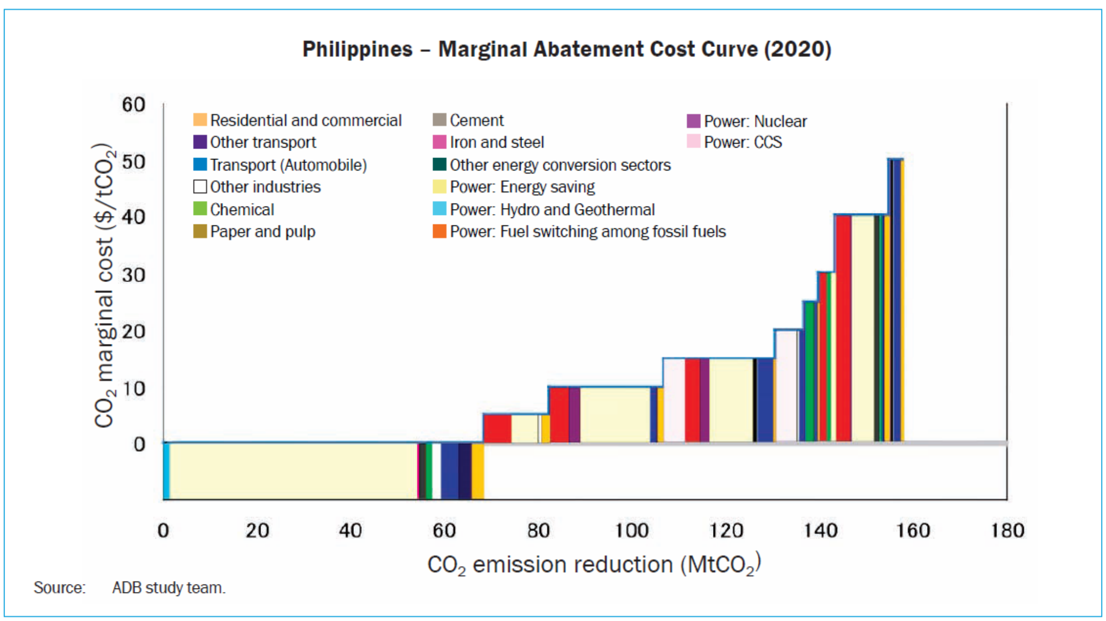
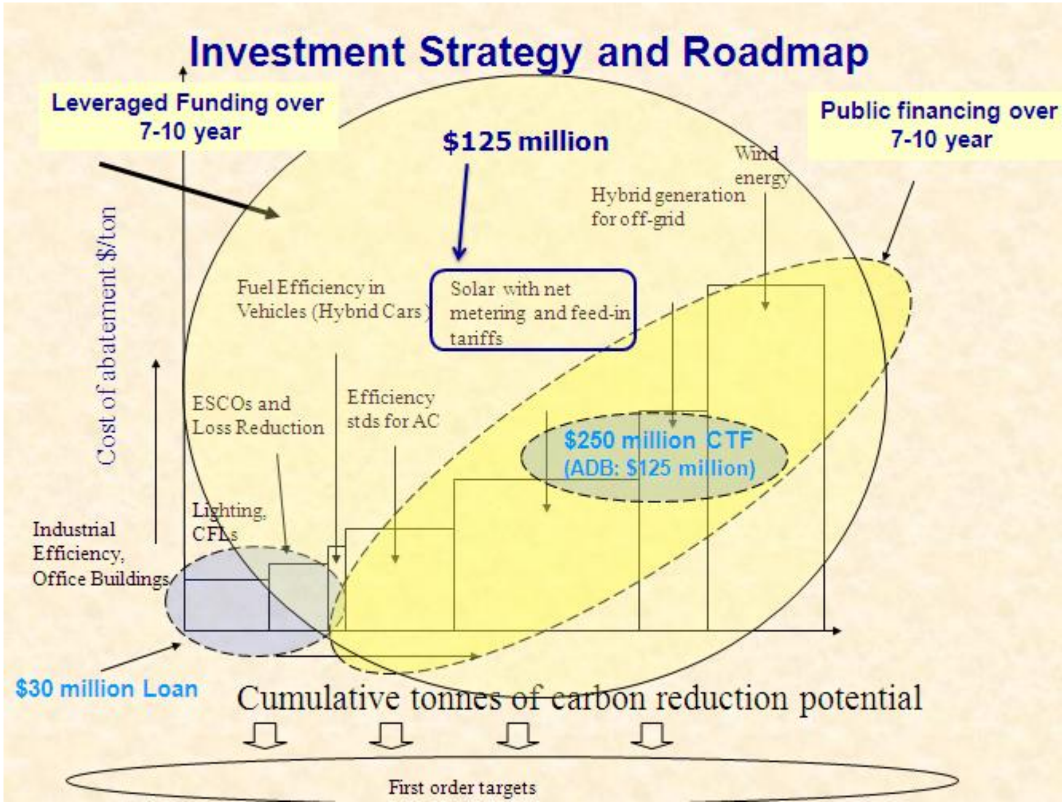
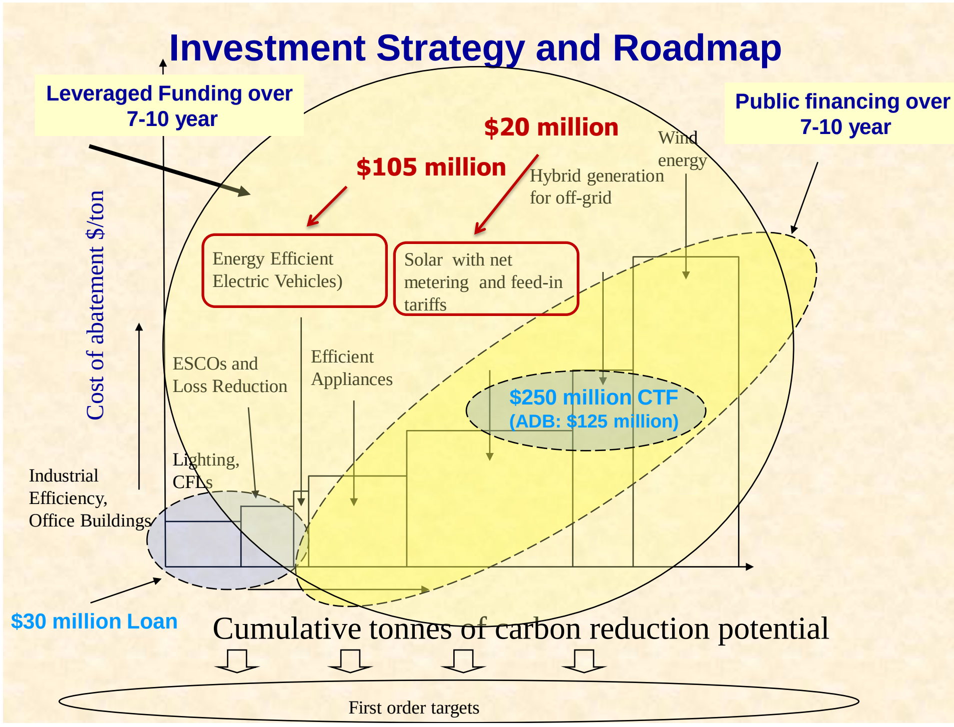


Figure 4: Investment Strategy and Priority CTF Projects (December 2009)



25. The government's high priority projects are illustrated Figures 4 and 5, with the former representing the originally proposed use of CTF resources, and the latter representing the updated CTF Country Investment Plan. The outer circle represents overall potential investment in various clean energy interventions, including private sector investments, superposed on the McKinsey curve for the Philippines. The small ellipse at the lower left represents investment potential in more efficient lighting, which has been partly addressed through public sector investment with ADB financial support. The larger ellipse represents the bulk of potential clean energy investment, toward which the original CIP directed $250 million in CTF cofinancing. Of this $250 million, $125 million was proposed to cofinance the startup of the net metering program with solar photovoltaic (PV) systems.

Figure 5: Investment Strategy and Priority CTF Projects (June 2012)



26. ***The GoP remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health.*** The general approach and overall objectives for low-carbon development presented in the original CIP remain the same. GoP is committed to reducing energy intensity and greenhouse gas (GHG) reductions through a comprehensive policy framework as described in the original CIP. The energy and transport policy frameworks discussed in the original CIP remain in effect. The GoP remains fully committed to its development policy framework for energy security, climate change, environmental management, and public health. The general approach and overall objectives for low-carbon development presented in the original CIP remain the same.

27. ***The strategic rationale for CTF intervention in the energy and transport sectors remains unchanged.*** Comparison of Figures 4 and 5 clearly shows consistency in the underlying clean energy and cleaner transport strategies. The transport sector, power generation, and other energy end-use are highly dependent on imported fuels, which render the country vulnerable to energy supply disruptions and global price fluctuations. The Philippines has a variety of RE resources – biomass/biogas, geothermal, small hydropower, solar and wind – with estimated total potential of more than 15,000 MW, of which about 35% has been developed. In the near term, biomass, geothermal, hydropower, and wind are expected to account for most of the new RE capacity additions. Additional potential from solar and waste-to-energy is high but commercial development of these resources has high start-up costs; solar and waste-to-energy are not expected to contribute at the gigawatt (GW) scale in the immediate future. However, as noted, the landscape for solar power is changing rapidly as hardware costs continue to decrease, and near-term MW-scale development of solar PV systems is envisioned as an interim step to future GW-scale capacity. <u>Therefore, investments in more energy efficient transport systems and complementary development of solar rooftop systems with net metering are critical in the near to medium term.</u> Figure 5 illustrates the proposed partial reallocation of CTF funding to support the introduction of EEEVs and demonstration of solar charging, discussed in more detail below.

Status of Renewable Energy and Energy Efficiency Development

28. The Philippines RE potential is high, but new investment has been limited during the last several years relative to the potential. Table 3 shows the installed capacity as of 2010, and projected additions as outlined in the National Renewable Energy Program (NREP), which was formulated under DOE's leadership. Actual RE potential may prove to be higher, as prices for RE power generation technology fall and new systems are commercialized. Therefore, the NREP is a dynamic document, and the proposed capacity additions are not "cut in stone." For example, Table 3 shows a solar power objective of 285 MW by 2030, but a long-term aspirational target of 1,528 MW of solar potential is noted in the NREP, and commercial potential may be even higher.[6]

Table 3: Installed Renewable Energy Capacity and Projected Additions (MW)

Resource	Installed Capacity in 2010	Targeted Capacity Additions				Total Capacity Addition 2011 – 2030	Total Installed Capacity by 2030
		2015	2020	2025	2030		
Geothermal	1,966	220	1,100	95	80	1,495	**3,461**
Hydropower	3,400	341.3	3,161	1,891	0	5,394	**8,724.1**
Biomass	39	276.7	0	0	0	276.7	**315.7**
Wind	33	1,048	855	442	0	2,345	**2,378**
Solar	1	269	5	5	5	284	**285**
Ocean	0	0	35.5	35	0	70.5	**70.5**
TOTAL	**5,438**	**2,155**	**5,156.5**	**2,468.8**	**85**	**9,865.3**	**15,304.3**

Source: Philippines Department of Energy

29. To catalyze investment in RE, the Renewable Energy Law (R.A. 9513) became effective in 2009. The Renewable Energy Law mandates a universal charge on all customers to finance the proposed incentives for RE, especially the proposed FITs.[7] The Philippines already has the region's highest retail electricity tariffs. The potential increase in retail electricity price from this tariff could potentially further harm the broader economic development and investment climate. Although high electricity prices in the Philippines make clean energy projects financially attractive, without broad market transformation the desired objectives of the Renewable Energy Law will be difficult to achieve. The desired transformation requires adoption of new clean energy systems at scale, more responsive regulation, and consumer acceptance.

30. The already high retail electricity tariffs should make the Philippines one of the most attractive places for investments in EE. While high prices provide excellent incentives to undertake EE projects, very few EE projects have been implemented to date. The main barriers are considered to be lack of flagship projects to lead the way and generally weak awareness of EE opportunities by end users. The government has addressed the issue of lighting and building inefficiencies through the Philippine Energy Efficiency Project (PEEP), which is being implemented with ADB support. The PEEP is financing development of energy service companies (ESCOs) and implementation of a large-scale program to switch from use of incandescent to compact fluorescent lamps (CFLs). The PEEP is providing valuable learning experience to inform project design for EEEVs, solar lighting systems,[8] and energy efficient appliances.

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[6] The low-carbon scenario outlined in the original CIP (Figure 8 and Table 2) includes development of 2000 MW by year 2030.

[7] The incentives include a renewable energy certification scheme, feed-in tariffs, renewable energy portfolio standards, net metering schemes, priority dispatch options, and support for renewable energy host communities.

[8] For example, ADB recently provided technical and financial assistance for installation of solar lighting systems in the Boni Tunnel in the Metro Manila area. This installation offers a technical and business model for utilization of solar

Priority Introduction of Energy Efficient Electric Vehicles

31. Transport sector energy consumption is expected to grow at an average annual rate of 3.2%, with road transport accounting for 90% of energy demand for transport by 2030. The public transport sector, mainly tricycles, jeepneys, and buses, contributes a large portion of the country's CO_2 emissions: 3.5 million registered motorcycles and tricycles release 10 million tons of CO_2 into the atmosphere each year and consume close to $3 billion worth of fuel. Introducing new technology is the best immediate option to mitigate transport emissions. Electric vehicles are 3–5 times more efficient than internal combustion engine (ICE) vehicles, whether fueled by gasoline, compressed natural gas (CNG), or liquefied petroleum gas (LPG).[9] The public transport sector can thus save a significant portion of imported energy and reduce CO_2 emissions by switching to energy-efficient electric vehicles (EEEVs).

32. EEEVs represent a new and rapidly advancing technology with the promise to transform the way energy is used compared to today's ICE vehicles. For net energy importing countries such as the Philippines, EEEVs can dramatically reduce the country's oil dependency and improve long-term energy security. EEEVs generate no harmful local air and noise pollution and can be powered by indigenous RE. The envisioned fleet conversion will contribute to making the transport sector's energy use sustainable, by introducing new technology that eventually will allow domestic hydropower, geothermal, solar, and wind power to be used as a fuel source for the transport sector, replacing the largely imported fossil fuels used today.[10]

33. GoP's preliminary modeling shows that a 7% electric vehicle penetration by 2015 and 15% by 2030 can reduce fuel imports by approximately 6% in 2015, 13% in 2020, and more than 40% by 2030 with concomitant reductions in GHG emissions and other air pollution. The proposed electric vehicle policy[11] directly supports electric vehicle related businesses and will exempt importation of all electric vehicles (plug in and hybrid) from taxes for nine years. The proposed EEEVs project will support the Department of Energy's Fueling Sustainable Transport Program and the Alternative Fuel Vehicles Incentives Act of 2011. ***This move to begin electrification of the vehicle fleet is fully consistent with the National Environmentally Sustainable Transport Strategy (NESTS) described in the original CIP.***

34. The transport sector accounted for about one-third of national GHG emissions in 2009 (excluding emissions from land use change and forestry). Transport sector emissions have increased by about 6-10% per year since 1990, from about 10 million tons per year CO_2e in 1990 to about 29 million tons CO_2e per year in 2007.[12] Vehicles are one of the dominant sources of urban pollution that threatens both people's health and economic activity. In the Philippines, motorcycles and tricycles comprise more than 52% of the vehicle population, and these vehicles are the bottom of the transport sector "pyramid." Compared to other vehicles, motorcycles and tricycles are less expensive (and therefore more affordable), they are very visible in most cities of the country, and they play an important role in the transport market, particularly as a key short-distance transport mode for "last-mile" connectivity. However, the use

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resources for EEEV charging systems. A brief description of the Boni Tunnel installation is available online at: http://www.adb.org/news/adb-support-brightens-dark-highway-tunnel-solar-powered-lights

[9] Greenhouse gas calculations are presented in the Appendices.

[10] Today, fossil fuels are trucked to the remotest consumption points from thousands of kilometers away. Domestic hydrocarbon production is dominated by natural gas, predominantly in offshore basins.

[11] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid and Other Alternative Fuel Vehicles Incentives Act of 2011.

[12] CTF Investment Plan for the Philippines, endorsed in December 2009; paragraph 8 and Figure 3.

of these vehicles contributes to the already declining state of the environment, particularly urban air quality. In an ADB study, transport sector emissions accounted for 30% of air pollution in the Philippines and about 80% of air pollution in Metro Manila.

35. In order to improve urban transportation systems, control pollution from fossil fuels, enhance energy security, and mitigate long-term GHG impacts, the GoP has embarked on an ambitious program to introduce electric and compressed natural gas (CNG) vehicles into the public transportation fleet.[13] ADB is supporting a demonstration project[14] for introduction of e-trikes in Mandaluyong City (part of the Metro Manila core urban area). The initial results have been positive,[15] and GoP has requested ADB to provide financial support for the commercial deployment of 100,000 e-trikes by 2016.[16] The proposed EEEVs project will create an early-adopter opportunity to innovate in establishing sustainable local e-trike manufacturing capacity, battery and vehicle leasing schemes, and associated services for vehicle operation and maintenance, including prototype solar charging stations (SCS): the project is being designed to deliver an end-to-end infrastructure solution for cleaner transport which is consistent with GoP's overall energy security, economic development, and climate change objectives.

36. The private sector has indicated interest in EEEV development, including building and operating solar charging stations (SCS) for electric vehicles, but investors face a chicken-and-egg dilemma: until a commitment is made for large-scale deployment of EEEVs, private investors are unwilling to finance development of a charging network.[17] Therefore, the EEEVs project will include a prototype SCS component. The stations will utilize rooftop arrays at public transport stations, selling electricity at the same price as grid-supplied electricity so that EEEV operators can achieve the cost savings accruing from using electricity as transport fuel, while demonstrating the technological viability of the solar charging systems. The long-term objective is to facilitate scale-up of solar charging systems and achieve grid-parity (see further discussion in Appendix 2).

Renewable Energy Development

37. In keeping with the long-term objectives for energy security and economic development, GoP is committed to developing indigenous RE resources in a manner which protects consumer interests. RE development typically entails higher up-front capital costs, but lower operating and maintenance costs, and in most cases zero fuel costs.[18] The incremental upfront costs may be thought of as advance payments for renewable "fuel", which are amortized and depreciated over the lifetime of RE systems – the fuel may be free, but the conversion to useful energy is not. Policy support via FITs is designed to eliminate the upfront cost barrier, but in the absence of an operational FIT and RPS, as noted above, there is a need for concessional financing to support RE development.

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[13] CNG is used in some other countries (e.g., South Asia) for autorickshaws, and conceivably could be used for tricycles. However, GoP's emphasis on energy security and reduction of petroleum product imports points toward electrification as the preferred option.
[14] Financed by RETA 6441: *Efficiency Improvement and Connectivity Strengthening in Southeast Asia*. Manila.
[15] A summary of the initial results of the pilot and project concept can be found at: http://www.adb.org/projects/etrike/etrike-industry-presentation.pdf
[16] ADB. 2010. *Technical Assistance to the Republic of the Philippines for Mitigation of Climate Change through Increased Energy Efficiency and the Use of Clean Energy*. Manila. (TA 7754-PHI).
[17] This situation is further compounded by a lack of proven business models in other countries which would apply to "bottom of the pyramid" transport networks. Charging networks under development in countries such as Israel and the US cater to high-end 4-wheel private vehicles, i.e., the top of the transport pyramid.
[18] Exceptions are biomass power, where feedstock is normally not free, and geothermal, where steam production may be segregated and sold to generation units.

38. While the FIT and RPS remain in regulatory suspense, ADB has supported 2 noteworthy solar energy demonstration projects. In June 2012, ADB commissioned a 570 kW rooftop solar PV system at its Manila headquarters, which is the first of its kind in the Philippines and the largest rooftop PV project in Southeast Asia. The installed cost is well below that noted in the CIP in 2009, suggesting that there is scope for rooftop solar PV development outside the envelope of the FIT (which is limited to ground-mounted installations). As noted above, earlier in 2012, ADB also supported the Boni Tunnel lighting project to demonstrate the feasibility of solar PV and lithium-ion battery technology for large-scale street lighting applications. This project comprises 59 square meters of solar panels which provide power to 94 light-emitting diodes (LEDs) with 22-watt capacity each. This project provides about 19% of the tunnel power demand, but achieves a 51% energy savings compared to the old lighting system.

39. As noted above, the rooftop solar concept presented in the original CIP is being retained in the CIP-R, albeit with a modified scope. GoP is requesting to reduce the original allocation to $20 million of CTF cofinancing to support total investment of $120 million to finance at least 40 MW of new solar PV capacity outside the envelope of the proposed solar FIT (see further discussion in Appendix 3).

IV. PROPOSED CHANGES TO THE INVESTMENT PLAN

40. The original CIP identified several prospective interventions in EE, RE, and urban transport. The indicative financing plan endorsed in December 2009 is summarized in Table 4.

Table 4: Indicative Financing Plan Endorsed in December 2009 ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	RE and EE (ADB)	Total
CTF	75	50	125	250
GoP / DBP	180	50	50	280
IBRD Loans	250	250	0	500
IFC Loans	250	0	0	250
ADB Loans	0	0	400	400
Private sector	750	0	350	1,100
Total	**1,505**	**350**	**925**	**2,780**

Source: CTF Investment Plan for Philippines 2009
ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, WBG=World Bank Group

41. ***The major change proposed is to restructure CTF funding implemented in partnership with ADB to focus on an Energy Efficient Electric Vehicles project and a revised Solar Energy Development project.*** In particular, EEEVs promise to transform the way energy is used by light-duty public vehicles. For net energy importing countries such as the Philippines, electric vehicles can dramatically reduce the country's dependence on imported energy resources, which in turn should reduce short term price volatility and increase long-term energy security. Electric vehicle technology presents the opportunity to transition from conventional fossil-fueled vehicles to vehicles which do not directly generate harmful local air and noise pollution and can be powered by indigenous RE resources such as solar, hydropower or geothermal. The complementary investments in solar energy development will provide part of the increased power demand from EEEVs.

42. These prospective investments are appropriate for CTF support given the transformational nature of the projects and the replication and scale-up potential.[19] It is proposed that $105 million be allocated to the ADB EEEVs project and $20 million to the solar energy development project, as shown in Table 5. Concept papers for the candidate investments are presented in Appendices 2 and 3.

Table 5: Indicative Financing Plan After Reallocation ($ million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Electric Vehicles (ADB)	Solar Energy Development (ADB)	Total
CTF	75	50	105 [a]	20 [a]	250
GoP / DBP	180	50	99	20	349
IBRD Loans	250	180	0	0	430
IFC Loans	250	0	0	0	250
ADB Loans	0	0	300	80	380
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing	0	20	0	0	20
Total	**1,505**	**300**	**504**	**120**	**2,429**

Source: MDB teams

ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, (tbd)=to be determined, WBG=World Bank Group

Notes to Table 5:

[a] For the EEEVs project, a CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan). For the Solar Charging Stations component a CTF grant of $4 million is requested; see discussion in main text and concept paper in Appendix 2 for further details.[b] Private sector entities will participate in project implementation via supply of goods and services. For the EEEVs project, private sector investment is expected during replication and scale-up, and as such no private sector cofinancing is shown in Table 5. Private sector cofinancing for the solar energy development project has yet to be determined.

V. POTENTIAL IMPLICATIONS OF PROPOSED CHANGES FOR ACHIEVEMENT OF INVESTMENT PLAN OBJECTIVES

43. The proposed changes will enhance both the RE and cleaner transport programs by using CTF resources to accelerate investment in advanced electric vehicle systems, and will contribute directly to the near-term strategic RE investment program. An assessment of potential implications of the proposed changes for the achievement of objectives and targets of the original CIP is summarized in Table 6 and discussed below.

44. ***Transformational impact will be enhanced.*** The scope of RE and cleaner transport sector interventions will be expanded relative to the original CIP, bringing additional value by opening a new “window” for deploying EEEVs in sustainable transport systems. More efficient battery technologies are providing a cleaner alternative to pollution-emitting ICE-powered vehicles. In some cases, conventional motorcycles emit more pollution per unit than large sport utility vehicles, because the former are not equipped with equivalent emissions-control technology.[20] Electric motorcycles and tricycles can immediately eliminate tailpipe emissions, significantly reducing urban air pollution. Commercial success of e-trikes can be replicated in other types of vehicles, including jeepneys and buses (although technical complexity increases with larger vehicles). The SCS component will demonstrate the technological viability of RE-

[19] Pakistan, Indonesia, Malaysia, Bangladesh and Thailand have expressed interest in exploring options for implementing similar projects.

[20] The Technology Review, published by MIT, 2007, available at: http://www.technologyreview.com/energy/19069/

based charging systems for e-vehicles and a business model which can be replicated and scaled up with private sector investment. The RE development project will support the GoP long-term objectives for energy security and economic development, taking into account rapid advances and cost reductions in photovoltaic solar power technology.

Table 6: Summary Assessment of Proposed Adjustments to the Philippines CTF IP

CTF Investment Criteria	Original Investment Plan: Net Metering with Solar PV	Updated Investment Plan: Energy Efficiency Electric Vehicles and Solar Energy Development Projects
Potential for GHG Emissions Savings	Direct reductions would be relatively modest but replication and scale-up potential is quite high as the investments would promote GHG reductions through RE and EE.	ADB program will target end-use efficiency improvements in the transport sector which represent permanent energy savings via avoided fuel imports. The solar charging stations will demonstrate the feasibility of fueling EEEVs with 100% renewable energy. The solar energy development project will complement the FIT and RPS objectives. Replication and scale-up potential is high for electric vehicles, solar charging stations, and solar energy development
Cost-effectiveness	Initial direct reductions of 100,000 tCO_2e per year with 10:1 replication and scale-up potential <u>Cost effectiveness</u>: CTF$125 / 1 $MtCO_2e$ / year with replication and scale-up	<u>EEEVs project</u>: 100,000 vehicles will deliver net reduction of 270,000 tCO_2e per year; with 10-year vehicle lifetime total GHG reductions are 2.7 $MtCO_2e$. Replication and scale-up potential is at least 20 to 1. <u>Cost effectiveness</u>: CTF$105 million / 2.7 million tCO_2e = CTF$38 / tCO_2e, declining to CTF$3.89 / tCO_2e with replication and scale-up of 10 to 1. [See additional notes in Table 10 and Appendix 2.] <u>Solar energy development project</u>: At least 40 MW of rooftop solar PV operating at 15% load factor will deliver net reduction of about 0.03 million tCO_2e per year assuming grid emissions factor of 0.52 tCO_2e/MWh. With 15 year lifetime total GHG reductions are about 0.4 million tCO_2e. Replication and scale-up potential is at least 10 to 1. <u>Cost effectiveness</u>: CTF$20 million / 0.4 tCO_2e = CTF$49 / tCO_2e, declining to CTF$4.87 / tCO_2e with replication and scale-up of 10 to 1.
Demonstration Potential at Scale	Transformation potential[a] of at least 10	Transformation potential is estimated to be > 20 for EEEVs and >10 for solar energy development
Development Impact	The proposed investment would demonstrate viability of the net metering system (and business model) and accelerate development of the solar PV industry in the Philippines	The EEEVs and solar energy development projects will accelerate growth of the respective industries in the Philippines by demonstrating new technology / systems and business models. Impacts with respect to energy security and environmental benefits will be higher than the original CIP. Impacts on employment also may be higher than the original CIP given the potential benefits accruing to e-trike owner/operators and private sector firms involved in supply of hardware and after-market services for EEEVs, solar charging stations, and rooftop PV systems.
Implementation Potential	As the implementing rules and feed-in tariff for net metering have not been finalized, the originally proposed project is not	The EEEVs project has been developed based on a successful pilot project in the Metro Manila region and is at an advanced stage of preparedness. The solar energy development project is in the identification

CTF Investment Criteria	Original Investment Plan: Net Metering with Solar PV	Updated Investment Plan: Energy Efficiency Electric Vehicles and Solar Energy Development Projects
	ready for implementation.	stage, building on the Boni Tunnel Lighting project and ADB headquarters rooftop solar PV experience, and is tentatively scheduled for ADB Board consideration in 2013. See Table 8 for discussion of implementation risks and mitigation.
Additional Costs and Risk Premium	The additional costs of the solar PV systems and first-mover risk associated with net metering clearly justified the use of CTF resources.	The proposed projects will focus on using CTF for covering additional costs associated with introduction of electric vehicle systems and for covering additional costs and first-mover risks in solar energy systems investments (see Appendices 2 and 3).

[a] Transformation potential is defined in paragraphs 15 - 17 of the *CTF Investment Criteria for Public Sector Operations* dated 9 February 2009.

CIP=CTF Country Investment Plan, CTF=Clean Technology Fund, EE=energy efficiency or energy efficient, EEEVs=energy efficient electric vehicles, GHG=greenhouse gas, PV=photovoltaic, RE=renewable energy, tCO_2e=tons carbon dioxide equivalent

45. ***Emissions reductions from the EEEVs and solar energy investments will be higher than in the original investment plan, with higher replication and scale-up potential.*** The direct investments in the EEEVs and solar energy development projects will result in net avoided fossil fuel emissions estimated to be at least 0.3 million $tCO2_e$ per year: about 0.27 million $tCO2_e$ per year for the proposed EEEVs project and about 0.03 million $tCO2_e$ per year for the solar energy development project (emissions reductions estimates are discussed in Appendix 2). Cost-effectiveness will be better and replication and scale-up potential is equal to or higher than the original CIP as shown above in Table 6 (also see Table 10). In addition to the substantial energy security benefits, the EEEVs project will bring environmental and public health co-benefits equal to or greater than that which would have been realized under the original Investment Plan. The solar energy development project also will support expansion of the GoP clean energy infrastructure beyond that envisioned under the proposed FIT and RPS framework.

46. ***Replication and scale-up potential will be higher than originally planned.*** Commercial deployment of EEEVs will expand the urban transport program beyond the original CIP. The replication potential for e-trikes and motorbikes alone is at least 20 to 1 based on the current vehicle fleet size; however, replication and scale-up is conservatively assumed to be 10 to 1 for purposes of calculating total emissions reductions and indirect cost-effectiveness. Replication potential for investment in solar energy systems is well over 10 to 1. Using CTF to cofinance investment on these types of pioneer projects will eliminate first-mover risk and help mobilize future commercial investment for replication and scale-up. Private sector firms will be actively engaged in project implementation via service, supply, and maintenance contracts; the private sector is expected to take a prominent role in replication and scale-up.

47. ***Development impacts and co-benefits will be maintained or enhanced.*** New investment in EEEVs and solar energy systems will improve energy security, reduce GHG emissions, and reduce local pollutant emissions with substantial public health benefits. Using CTF to cofinance these types of pioneering projects will help mobilize future commercial investments (mainly by private sector entities) for replication and scale-up, which will stimulate economic growth and facilitate the long-term transition to low-carbon development. A comparison of proposed results indicators is presented in Table 7 (additional results indicators will be developed for project proposals in accordance with CTF guidance).

Table 7: Results Indicators

Results Indicator	Baseline	Expected Program Results in Original CIP: Net Metering with Solar PV	Expected Program Results For EEEVs and Solar Energy Projects
Cost of solar power units	$18,000 with 9.8 year payback	$10,000 with 2.5 year payback [a]	[To be determined during project identification and preparation.]
Number of commercial buildings with solar panels and net metering	Limited	30,000 buildings [a]	[To be determined during project identification and preparation.]
Number of e-trikes and support infrastructure in commercial operation	20 (with lithium ion batteries, post-pilot test) and about 200 using conventional lead acid batteries and less efficient motors.	n/a	100,000 e-trikes operating by 2016. Public charging infrastructure and battery leasing established in respective regions.
Number of Solar Charging Stations and Rated Capacity	n/a	n/a	Standardized design prototype solar powered charging stations. 5 x 200 kW solar-powered charging stations operating by 2015.
RE capacity and output	570 kW rooftop solar with 15% load factor	n/a	Standardized designs for rooftop solar PV 40 MW of rooftop solar PV by 2016, [b] Energy output of 52,560 MW-h per year at 15% load factor

Notes: [a] Indicators are from Table 1 of Executive Summary of the original CIP.
[b] Assumes $3 per watt installed system cost.
Source: October 2011 Joint Mission

48. ***Implementation potential for the EEEVs and solar energy projects is high.*** The EEEVs project is scheduled for presentation to ADB's Board of Directors in August 2012. This project has strong support at the highest levels of the GoP. For this reason, the project is being submitted to the CTF Committee for consideration of funding approval simultaneously with the requested endorsement of the updated Investment Plan. The solar energy project is at the identification stage, and is expected to be prepared and presented for ADB Board consideration in 2013. Risks and mitigation measures are summarized in Table 8.

49. The Philippines Department of Energy (DOE) will be the executing agency for these proposed projects, as DOE is the designated agency for RE development, energy efficiency, electric vehicles, and alternative fuels. The scope and implementation arrangements of the proposed projects have benefited from a substantial learning curve from the Philippines Energy Efficiency Project (PEEP, supported by ADB financial and technical assistance), the EEEVs pilot projects in Mandaluyong and Taguig Cities, the Boni Tunnel Lighting installation, and the rooftop solar installation at ADB headquarters. A key lesson learned from the EEEVs pilot projects is that for transformational impact to be realized, the investments must include the complete spectrum of stakeholders including vehicle owner/operators, equipment suppliers, and after-market service providers, i.e., the project must facilitate "end-to-end" infrastructure development including the development of a credible battery industry with new technology (i.e., the full supply chain must be developed).

Table 8: Risks and Mitigation Measures

Risk	Mitigation Measure	Residual Risk
Policy and regulatory framework: Clarity of policies related to EE and cleaner transport and RE	• High energy prices and price volatility provide macro-economic support to end-use efficiency investments • Application of innovative financing to cover part of front-end capital costs and to reduce first-mover risks	L
Implementation Capacity: Readiness of owner-operators to procure and operate electric vehicles	• Technical assistance to transfer know-how on project planning, financing, risk management, especially for pioneering projects	L/M
Technology: Limited know-how for after-market service of electric vehicles	• Technical assistance and know-how transfer for newly-introduced electric vehicles will be provided based on experience from pilot project	M/H
Finance: financial benefits of EEEVs need to be monetized	• E-trike operators are expected to improve net income by 50%; a rent-to-own approach will ensure affordability of vehicle ownership • Carbon finance will be mobilized to the maximum extent possible, including prospective post-2012 carbon revenue.	L/M
Environmental Management: Management and disposal of used appliances and batteries	• Battery leasing and recycling programs are integrated into the e-trikes projects. • Rigorous application of GoP regulatory framework and ADB safeguards for environmental and social impact.	L
Development Impact: Mobilization of investment for replication and scale-up; potential disruption of access to energy to "last mile" consumers	• Work closely with vehicle owners, business associations, and domestic financial institutions to raise awareness and promote future investment in electric vehicles and solar charging stations. • Electricity demand from the EEEVs project will be offset by 1338 MW of new grid-connected capacity, more than compensating for incremental EEEV demand (see Appendix 2)	L
Carbon finance delivery risk: Verification bottlenecks are currently delaying annual payments and affecting the financing structure of large scale transactions.	• Coordinate with ADB Future Carbon Fund to identify opportunities to maximize potential carbon revenues, and reduce or eliminate delays in methodology and verification processes • Consider voluntary transaction in secondary carbon markets	M/H
Procurement : Limited number of global suppliers for electric vehicle technologies may limit competition in some instances	• Competitive bidding will be utilized in accordance with MDB and GoP requirements.	M/H
Overall risk after mitigation	**Moderate**	

50. ***Additional costs and risk premiums justify use of CTF.*** The EEEVs and solar energy development projects are both first-of-a-kind in the Philippines. The EEEVs project will be the largest effort in the Asia region to begin electrification of the public vehicle fleet. These pioneer projects face first-mover risk, and present higher-than-normal end-user costs with respect to purchase of new vehicles and appliances (e.g., the e-trikes cost at least $1000 more per unit than conventional gasoline-powered tricycles). Lower operating costs will offset the initial purchase costs, but at present there is no mechanism to monetize the life-cycle savings to assist end-users in the initial purchase.

51. Carbon finance is facing constraints due to post-2012 market uncertainties. Carbon finance opportunities will be pursued, but any revenue is expected to be "on delivery" and will not be sufficient to catalyze up-front investment. Also, any CDM funds are uncertain until

registration with the UN, which typically occurs after the projects' financial close. Moreover, projects from the Philippines not registered by December 2012 will not be eligible for carbon financing under the European Emissions Trading System.

VI. ADDITIONAL CONSIDERATIONS OF THE PROPOSED PROJECTS

Net Impact on the Electricity Grid and GHG Reductions

52. Conversion from ICE to EEEVs will save energy, as the energy losses in ICE vehicles are typically 70–80% versus 5–15% in EEEVs. Additional electricity required for the EEEVs project will depend on the relative contribution of public charging stations used during peak time (6 MW of grid-connected charging stations, plus 1 MW of solar charging stations), and overnight home-based chargers (60 MW, off-peak). As both modes of charging will be implemented, and considering that overnight charging will provide night-time "valley filling" benefits, the incremental demand presented by the EEEVs project is expected to be less than 60 MW. A "maximum demand" case of 60 MW represents incremental power demand of about 0.37% of total installed generating capacity of 16,359 MW.[21] Total incremental energy demand due to the project is estimated at 150 GWh per year (assuming e-trike consumption of 5 kWh per day, 300 days per year operation, and fleet of 100,000 vehicles), which represents incremental consumption of about 0.22% of reported generation output in 2010 and about 18.8 MW of equivalent baseload generation capacity. This additional demand on grid-supplied electricity is considered to be negligible.[22] Table 9 presents estimated changes in energy balance assuming the EEEVs and solar energy development projects are both implemented, along with other committed near-term RE development.

Table 9: Capacity Balance for Vehicle Charging, Megawatts (MW)

Capacity Additions	**MW**
Solar Charging Systems (5 x 200 kW stations)	1
New Rooftop PV and/or other solar energy installations	40
Near-term RE Power Additions (see Appendix 2, Table A2.2)	138.5
Subtotal	179.5
Maximum Demand from EEEVs Project	60
Net Capacity Additions	119.5

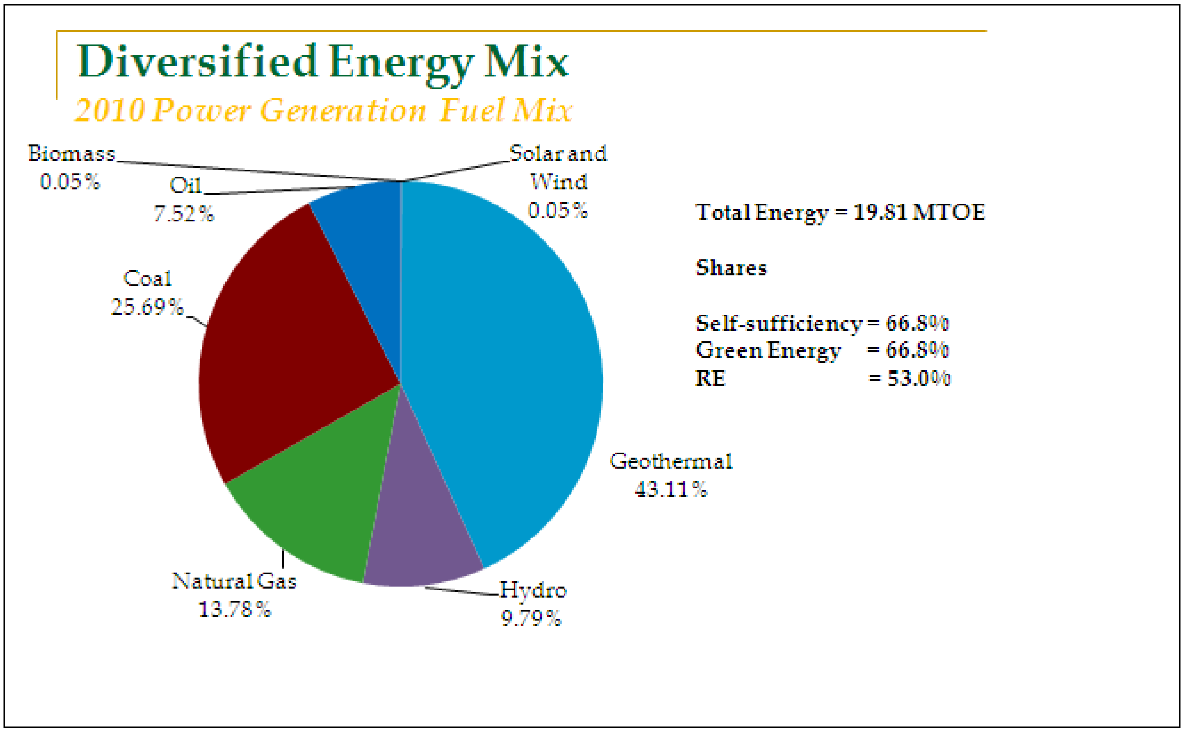
Source: ADB staff estimates

53. In the case of the Philippines, with a large share of RE in the generation mix, the GHG reductions and overall end-use EE gains will be quite significant. As shown in Figure 6, clean energy accounts for about 66% of power generation and about 39% of total primary energy.[23] The GoP plans to establish solar charging stations wherever area and site access constraints do not exist, which will make the carbon footprint of these vehicles close to zero. Assuming consumption of 5 kWh per day and 300 days per year operation, an electric tricycle will use about 1.5 MWh of electricity per year, resulting in 780 kg CO_2e per year using a grid emission

[21] Installed capacity is spread across 3 regional grids, as illustrated in the original CIP, Figure 11.
[22] Considering that 1200 MW of coal-fired capacity is being developed in addition to the 138.5 MW of RE noted in Table 9, grid-supplied electricity would not be stressed even if replication and scale-up of 20:1 is achieved: deployment of 2 million e-trikes would result in electricity consumption of 3000 GWh per year, which would require about 375 MW of equivalent baseload capacity. Baseload capacity assumes 8000 hours per year generation output. See additional details in Appendix 2.
[23] Figure 6 reflects the current situation with oil dominating the transport sector, which presents a tremendous opportunity for end-use efficiency gains via electric vehicles.

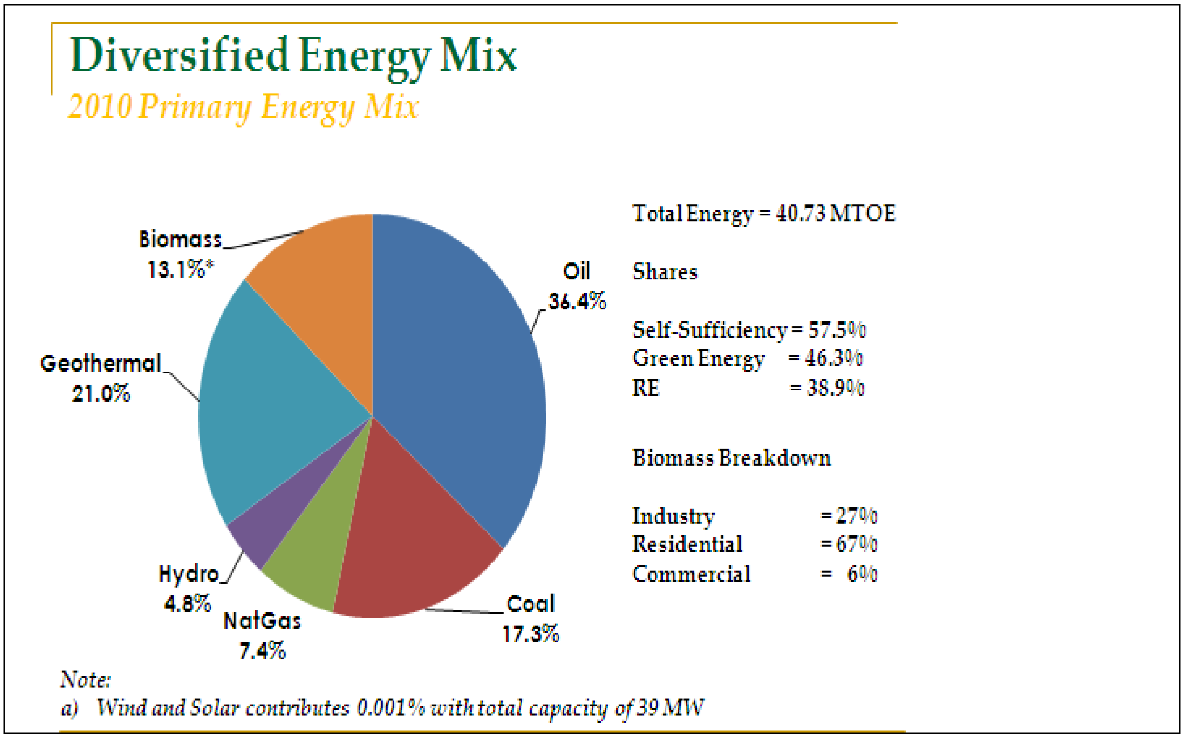
factor of 0.52 tCO_2e/MWh,[24] versus an equivalent ICE tricycle, which produces about 3.5 tons of CO_2 each for the same service delivery – more than a 70% GHG emissions reduction. This estimated GHG reduction is consistent with a recent study by MIT, which stated that accounting for the total energy consumed from well to wheel,[25] electric vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared to ICE vehicles. The savings is in even more in congested urban areas, as the average speed is low (no electricity is used while stranded in traffic jams and these vehicles will not use any air conditioning). The energy losses in electric motors are less than ICE vehicles, and transmission and distribution of electricity is more efficient and cost effective than transportation of liquid fuels to the end user (additional calculations are presented in Appendix 2).

Figure 6: Primary Energy and Power Generation Mix (2010)



[24] The grid emissions factor of 0.52 tCO_2e/MWh is consistent with 2010 generation output and various CDM projects, and is lower than equivalent emissions from gasoline-powered vehicles which would be 0.807 tCO_2e/MWh for an ICE with 30% thermodynamic efficiency (see additional calculations and discussion in Appendix 2).

[25] Energy consumed and green house gases (GHGs) emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle, details available at: http://web.mit.edu/evt/summary_wtw.pdf



Choice of Battery Technology and Disposal Implications

54. ADB's publication on electric bikes[26] identified lead (Pb) pollution as an inherent problem with electric vehicles and, as long as electric vehicles use lead acid batteries, the overall pollution loads will be several times higher than ICE. According to the United States Environmental Protection Agency, Li-ion batteries are not an environmental hazard[27], and are safe for disposal in the normal municipal waste stream.[28] While other types of batteries include toxic metals such as cadmium, the metals in Lithium-ion batteries–cobalt, copper, nickel and iron–are considered safe for landfills or incinerators. Therefore, the e-Trikes will use Li-ion batteries at the outset; the battery leasing business model will allow for more advanced batteries to be supplied in the future.

Cost Effectiveness of the Proposed EEEVs Project

55. Tables 10 and 11 show additional calculations of the cost effectiveness and transformative impacts of the EEEVs project assuming a conservative replication and scale-up factor of 10 to 1. Table 10 indicates that cost effectiveness is well within expectations as presented in CTF investment guidance, even in a pessimistic scenario discounted by 30% for potential "rebound effects." The pessimistic scenario shown in Table 10 shows that the proposed EEEVs project would be more cost-effective than the net metering project proposed in the original CIP.

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[26] ADB. 2009. *Electric bikes in the PRC: Impact on the Environment and Prospects for Growth.* Manila.
[27] http://www.ehso.com/ehshome/batteries.php
[28] http://www.epa.gov/osw/hazard/wastetypes/universal/batteries.htm

Table 10: CTF Cost-effectiveness of EEEVs Project vs. Original Net Metering Project

Net GHG Reductions ($MtCO_2e$/year)	Cost Effectiveness (CTF\$/tCO_2e/year)	Cost Effectiveness (CTF \$/tCO_2e) [a]	Scenario / Assumptions
0.33	306.06	30.06	National electricity and heat emissions factor of 0.6 tCO_2e/MWh [b]
0.27	374.07	37.41	ADB base case with grid emissions factor of 0.52 tCO_2e/MWh [c]
0.231	437.23	43.72	0.33 $MtCO_2e$/year discounted 30% for "rebound effect" [d]
2.31	43.72	4.37	Replication and scale-up of 10:1 on case assuming "rebound effect"
0.1	1250	50	Original CIP: net metering with solar PV; 25-year project lifetime [e]
1	125	5	Original CIP: net metering with solar PV; replication and scale-up of 10:1 [e]

Source: ADB Estimates.
Notes:
[a] Clean Technology Fund, Investment Criteria for Public Sector Operations, 9 February 2009; paragraph 11 notes that "...CTF co-financing will ordinarily not be available for investments in which the marginal cost of reducing a ton of CO_2-equivalent exceeds US\$200...."
[b] Emissions factor calculated for Philippines electricity and heat consumption by UK Defra.
[c] Additional discussion of emissions factors is presented in Appendix 2.
[d] Consideration of potential rebound effects is not required by CTF guidance.
[e] Adapted from Original CIP, Annex 2.

56. Table 11 illustrates how the cost of avoided CO_2 drops significantly with larger transformation brought about by the CTF investment.[29] In the small, medium, and large project scenarios, CTF cost-effectiveness is well below the upper limit guidance of \$200 per ton. Assuming a full transformation and scale-up with replication of 10-to-1, the lifecycle CO_2 cost will be well below the \$5 per ton estimated for the net metering project proposed in the original CIP. E-trikes also will generate significant fuel savings and other social co-benefits: about \$10,000 over the 10 year life, the overall cost of avoided CO_2 being about "**-\$200 per ton**" – not uncommon for end-use EE projects, which is also reflected in the McKinsey abatement cost curve for "Fuel efficiency in vehicles" (Figure 2, above) of about "-€50 per ton" or "-\$63 per ton" (based on 8 June 2012 exchange rate).

Table 11: EEEVs Project Cost-Effectiveness vs. Investment Scale

CTF Allocation and Scale Effects	Small isolated grids/ no CTF	Small Project	Medium Project	Large Project
Transformational Impact	Zero	Minimum	Partial transformation	Full transformation
Net Avoided CO_2e (t/y/vehicle)	2.5	2.6	2.6	2.7
Number of EEEVs	5,000	20,000	50,000	100,000
EEEV Cost (\$/unit)	5,000	4,700	4,500	4,000
Total Cost (\$ Million)	25	94	225	400
CTF Amount (\$ Million)	0	30	70	101
CTF Cost-effectiveness (\$/t/y)	n/a	576.92	538.46	374.07
CTF Lifecycle Cost-effectiveness (\$/t)	n/a	57.69	53.85	37.41
Cost-effectiveness with 10x Replication and Scale-up (\$/t)	n/a	5.77	5.38	3.74

\$ = US dollars, CO_2e = carbon dioxide equivalent, t = ton carbon dioxide equivalent, y = year
Source: ADB staff estimates

[29] Table 10 assumes a replication and scale-up factor of only 10 to 1 versus the 20 to 1 factor used in Table 5.

Technology Options for Cleaner Transport

57. A recent ADB study concluded that to make tricycles more energy-efficient and green, two technology options were available: (a) retrofit of existing units using conversion kits to LPG and CNG fuels; or (b) replace the propulsion system with either hybrid or purely battery-operated, or with more efficient internal combustion engine (ICE). Only the battery operated option can reduce the country's reliance on fossil fuels. Battery operated electric vehicles can also be "zero-emission vehicles", because the electricity can be generated from 100% renewable sources, and these vehicles have no tail-pipe emissions. The electric option also represents a one-step solution, while retrofitting from gas to LPG entails a two-step solution (that may merely postpone an inevitable shift to electric). More importantly, e-trikes offer the highest net income potentials for tricycle operators and drivers. The annual operating cost is nearly 50% lower than a conventional gasoline-fueled trike.

Appendix 1: Summary of Stakeholder Engagement During Investment Plan Revision

A. Background

1. During development of the original CIP, the MDBs worked closely with the Department of Energy (DOE), Department of Finance (DOF), and the National Economic and Development Authority (NEDA). These agencies agreed that the $125 million in CTF financing to be administered by ADB would be earmarked for the energy sector. Since the EEEV project is fundamentally seen as an energy project, and falls within the mandate of the DoE–led Fueling Sustainable Transport Program, project ownership rests with the DOE, with the DOF as the key counterpart for all MDB-financed projects, including those with CIF funding. DOE communicated this to the Department of Transport and Communication (DOTC) and the Department of Environment and Natural Resources (DENR), explaining DOE's interest in reallocating CTF resources from the previously planned renewable energy (rooftop solar development) and energy efficiency (energy efficient appliances) projects to the proposed the EEEVs project. NEDA also was kept informed of these developments, and it approved inclusion of the EEEVs project in the GoP's foreign assistance program (Attachment 1a). The President of the Philippines serves as Chair of the National Climate Change Commission (CCC), and has supported the e-trikes pilot project and development of the EEEVs project. Given this tacit endorsement, DOE did not solicit further official comment from the CCC.[30]

2. Subsequent to presentation and discussion of the CIP-R in November 2011, a group of local and international civil society organizations (CSOs) raised concerns about a perceived lack of consultation on the proposed reallocation of CTF funds from supporting the promotion of renewable energy to sustainable transport. ADB responded in writing, clarifying that the EEEVs project was still under development, and therefore, wide discussions and consultations would address the vehicle design, safety, disposal, post-sale issues, and other concerns raised by various stakeholders. A specific set of consultations was subsequently organized and held on 21-23 May 2012, covering both the allocation of CTF resources and design of the EEEVs project. These consultations are summarized below in Section C.

3. The EEEVs project team and the Government have been actively engaging on project design with a range of stakeholders – tricycle drivers, suppliers, manufacturers, government officials, lawmakers, and academic institutions – for more than one year. Since July 2011, ADB has hosted, on behalf of DOE, 7 informal industry meetings to foster improved communications and potential cooperation among international investors and members of the local tricycle manufacturing community. ADB has shared at these meetings, among others, findings from the pilot project in Mandaluyong, technical details of e-trike specifications, charging options, and bidding processes. These and more formal meetings and workshops have provided venues for professional networking within this nascent industry.

4. The DOE also undertook a nationwide e-trike design competition and selected 3 top designs from 180 entries. An internationally reputed car designer is working on a design that meets international safety and comfort standards taking into account ideas from the 3 winning designs and the feedback of the drivers on the pilot units.

5. The EEEVs project concept is thus the result of extensive and extended engagement with a range of stakeholders, and the proposed solar energy development project concept has also benefited from an active dialogue amongst stakeholders dating back to the original CTF

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[30] It should be noted that inter-governmental consultation is primarily the responsibility of the government.

Investment Plan's development. A solar energy development project is now being retained as part of the proposed CTF investment, based on stakeholder feedback, with the project concept to be further refined. The history of stakeholder engagement feeding into this Update is summarized below.

B. Informal Industry Meetings

6. Beginning in July 2011, the EEEVs project team began hosting informal industry meetings to foster communication and cooperation amongst industry players and to ensure local buy-in throughout the project preparatory process. Seven informal meetings were held to encourage representatives of the local tricycle manufacturing community to ask questions about e-trike specifications, design and bidding processes, and to maintain open communication with the project team. These well attended meetings took place on the following dates (a list of organizations represented is given in Attachment 1b):

- July 12, 2011 at the Asian Development Bank;
- July 26, 2011 at the Serendipity Lounge, Discovery Suites;
- August 9, 2011 at the Serendipity Lounge, Discovery Suites;
- August 23, 2011 at the Serendipity Lounge, Discovery Suites;
- September 6, 2011 at the Savannah Function Room, Discovery Suites;
- September 20, 2011 at the Savannah Function Room, Discovery Suites; and
- October 25, 2011 at the Savannah Function Room, Discovery Suites.

7. Company representatives were encouraged to submit presentations regarding e-trike design and business practices. Working groups comprising project team members and industry representatives were established to explore different aspects of the scale-up of a local e-trike manufacturing, assembly, and battery supply business model. The topics examined include (i) the best possible set of criteria for companies to participate in the project and how to best structure a local industry, (ii) registration and franchising challenges and potential solutions; and (iii) developing a set of options and best practices for e-trike disposal and recycling.

8. Through the informal meeting process, the project design team gained valuable insight into the challenges and concerns facing local manufacturers regarding the scale-up planned as part of the e-trike project. Primary concerns include production capacity, government support (taxes, duties and fees), the ADB bidding process, and e-trike design specification.

C. More Formal Meetings and Workshops

9. The project team has also organized more formal engagement with those interested in the EEEVs project design over the past year. Stakeholders have ranged from international electric vehicle experts, representatives of local governments, representatives from the Philippine Department of Energy (DOE) and other government agencies, representatives from Congress, and international battery manufacturers. Meetings such as these will continue throughout the project preparatory process and will transition to building community awareness and addressing industry, community and driver concerns as project implementation moves forward.

1. Energy Efficient Electric Vehicles Forum, April 28, 2011

10. The Energy Efficient Electric Vehicles Forum at ADB served as an important venue for project concept introduction on behalf of government and industry representatives. The proposed project was introduced by the ADB and DOE, and international consultants discussed best practices for electric vehicles around the globe. The Forum emphasized the role of government support and incentives in creating a successful electric vehicles program, the role of the private sector in achieving successful economies of scale, and the importance of technology transfer to achieve the economic and environmental goals of the project.

2. Boracay Consultation Workshop, August 14-15, 2011

11. Members of the project team traveled to Boracay Island to assess the existing conventional tricycle market and how to successfully work with local government officials and tricycle drivers to implement a full transfer to ADB sponsored e-trikes beginning in early 2012. Team members noted the concerns of local tricycle drivers, such as hilly conditions and passenger preferences geared towards promoting tourism (where to store luggage, seats facing out, etc.). Following the meetings and follow-up from project team members, the Municipal Council of Malay, which includes Boracay, passed a resolution on September 20, 2011 to shift to e-trikes in 2012. The resolution expresses the Council's support for the project not only on the Island of Boracay, but throughout the Philippines.

3. Meetings with Battery Manufacturers (Various Dates)

12. The project team has met with various international battery manufacturers – Toshiba, Samsung, LG, Kokam, etc. These meetings have enforced the team's commitment to lithium ion battery technology, helped to evaluate various power capacity options and cost concerns, and have helped to determine how to structure the e-trike leasing program to maximize benefits to end users. The project team is working with battery manufacturers to achieve a cost-effective, lightweight, and environmentally sound battery solution that can sustain the industry on a long-term basis.

4. Workshop with Japanese Battery Manufacturers, November 23, 2011

13. The DOE and ADB hosted a workshop for industry representatives and interested parties featuring presentations by Japanese manufacturers. Presenters included PriceWaterhouse Coopers Aarata, PUES Corporation, Yamaha Motor Co., Ltd., Prostaff Co., Ltd., Tokyo R&D Co., Ltd., Toyota Industries Corporation, Nissan Motor Co., Ltd., and SIM Drive Corporation. A question and answer session followed.

5. Workshop in Tokyo, November 28, 2011

14. A workshop was hosted at the Asian Development Bank Institute in Tokyo with representatives from the Philippine Embassy to Japan and ADB. Participants were invited to tour the Nissan factory and to see the electric vehicle model, the Leaf, in production. Participants included PwC, ITS Network, PUES Corporation, Tokyo R&D Co., Ltd., Assemblepoint Co., Ltd., Nissan Motor Co., Ltd., Toyota Industries Corporation, Toshiba Corporation, Prostaff Co., Ltd., E-Minimo Co., Ltd., MK & Associates, and Ibrida Cell Co., Ltd.

6. Electric Vehicle Summit in Shanghai, November 29-30, 2011

15. Representatives from DOE, ADB, and the Philippine e-trike industry attended the Electric Vehicle Infrastructure Summit in Shanghai from November 29-30, 2011. Features of the summit included the following:

- Outlook of the People's Republic of China (PRC) EV industry and infrastructure development in next 5 years from a regulatory perspective;
- Develop effective business models to ensure the commercial success of EV infrastructure in the PRC;
- Standardization: EV roadmap in the PRC;
- Cutting-edge EV, battery and charging technologies showcase;
- How to work with governments and regulators to ensure future proof policy development in PRC;
- Future business models for auto manufacturers in PRC and how to maintain;
- Profitability with new industry landscape;
- Technical innovations for future EVs and how it could benefit auto OEMs;
- Collaborating to accelerate development of vehicle-grid connectivity standards; and
- World pioneering EV pilot project case studies and implications.

16. Participants included the Department of Energy, the Department of Environment and Natural Resources, the Department of Finance, the Department of Interior and Government, the Department of Science and Technology, the Department of Trade and Industry, the Department of Transportation and Communications, Land Transportation Franchising and Regulatory Board, Land Transportation Office, Mandaluyong Tricycle Regulations Office, Metropolitan Manila Development Authority, National Economic Development Authority, Office of Senator Ralph Recto, Fabella Sto. Rosario Tricycle Operators and Drivers Association, Golden eBike Philippines Inc., eSave Transport System, Green Vector Ventures, Inc., GerWeiss Motors Corporation, Partnership for Clean Air, FilOil, North 68 Corporation, MD Juan Enterprises, Mto Seiki Mtg. Corp., and PHUV Inc.

7. Workshop with Korean Battery Manufacturers, December 13, 2011

17. On December 13, 2011 a workshop was held with representatives from the e-trike manufacturing industry, the project team, and Korean battery manufacturers. Presentations were given by Eco One and LG Chem Company, ETH Co., Ltd., and Power Logics. A question and answer session followed.

8. Presentation by Dr. Alastair Bacon, January 10, 2012

18. The ADB hosted representatives from the industry and from the DOE to hear a presentation by Dr. Alastair Bacon, the Vice President for Driveline and Transmission Systems for Ricardo, a global multi-industry consultancy for engineering, technology, project innovation and strategy. A question and answer session followed.

9. Consultation with Civil Society Organizations, February 9, 2012

19. ADB, DOE and 9 civil society representatives based in Washington, DC discussed the proposed reallocation of $125 million of CTF funding from the renewable energy (solar power generation and net metering) concept included in the original CIP to an energy efficient (EE)

appliances project and EEEVs project. During the meeting, discussion initially covered process issues, including the need for consultation and inter-agency support for the CIP-R. Discussion then shifted to address several substantive issues, beginning with alternatives considered for inclusion in the CIP-R, potential for emissions reductions and cost effectiveness, and closing with clarifications about additional costs and risk premiums. As the CSOs had shared their concerns in advance of the meeting, ADB and DOE explained their positions on each issue, and agreed to follow up the issue of GHG reductions highlighted in a recent report by the UNDP Risoe Center report (which is noted in Appendix 2).

10. Industry Meeting, March 30, 2012

20. On March 30, 2012, an industry meeting was held at ADB headquarters for DOE project updates and an open forum question and answer session. Over 60 people were in attendance from organizations and companies such as Meralco, Dow Chemical, Venture Japan K.K., Golden e-Bike Phils., Toyota Tsusho, Pricewaterhouse Coopers, Motolite, Itochu Corporation, Terra Motors Japan, Metchem, Gerweiss Motors, etc. Discussion largely surrounded the flow of funds, the bidding process, and the requirements and qualifications of the supplier.

C. May 2012 CTF Stakeholder Consultations

21. A range of CSOs, NGOs, private sector, and other interested stakeholders were invited to participate in public consultations regarding the revised CTF Country Investment Plan, including the proposed EEEVs project on 21-23 May 2012. A steering committee with representatives from various interested CSOs/NGOs began meeting in February 2012 to develop agenda items and identify participants. The 3-day consultations began with discussions on the use of CTF resources for renewable energy versus sustainable transport investments. They then turned to issues surrounding design of the EEEVs project and CTF support for the renewable energy sector.

22. Day 1 of the consultations was entitled “Why Not Renewable Energy for the Clean Technology Fund?,” and its objectives included:

1. To present the CTF and the original Country Investment Plan (CIP) with its original components;
2. To understand the current state of RE in the Philippines and why a shift was being proposed to sustainable transport for the CTF;
3. To present the revised CIP and rationale for deviating from the original; and
4. To engage in a discussion on the use of the CTF for a transformational strategy in the energy sector to address growing demand.

23. Based on advice from the consultations steering committee, over 160 invitations were issued by email together with a web-based notice opening them to the public,[31] and nearly 100 participants attended to hear speakers and discuss related topics. Presentations included “Philippine Policy Framework for Renewable Energy”, “Harnessing RE Resources: Potential,

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[31] There was good agreement among steering committee members on a range of issues, but full consensus could not be reached on all aspects of timing and approach prior to their conduct. DOE requested ADB to move ahead based on directions received from the steering committee, and a neutral facilitator was engaged to moderate discussions. Many of the relevant documents had been posted on the web some time in advance of the meetings, while others were distributed the week prior to the events. Every effort was made to send invitations more than a week in advance of the meetings (and many organizations were aware of the impending consultations), but some received invitations later. Adjustments were made to the announced agendas based on the availability of speakers and resource persons.

Benefits and Challenges", "Is there Financing for RE Projects?", "CTF Philippine Investment Plan Update", and "Why the Shift?". Participants discussed progress made in net metering, new climate funds becoming available for renewable energy, the DOE and the ADB's collective commitment to renewable energy, and why the revised CIP reflected a higher priority for sustainable transport and energy efficiency initiatives – including e-trikes.

24. Day 2 of the consultations, entitled "Electrification of Public Transport: Why E-trikes?", was organized by the Clean Air Initiative for Asian Cities (CAI-Asia), the Partnership for Clean Air (PCA) and DOTC in cooperation with DOE and ADB. The consultation was designed to clarify and discuss the rationale for electrification of tricycles using CTF resources. Presentations led by CAI-Asia and PCA included "The Role of Tricycles on Urban Transport in the Philippines", "Plans and Programs of DOTC on Alternative Vehicles (including Electric)", and discussion of the pilot e-trike programs in Mandaluyong and Boracay. Participants discussed the hierarchy of public transportation and the role tricycles play within that hierarchy, lessons from the pilot programs, and electrification and alternative fuel policies being pursued by the DOTC. The DOE also reconfirmed the Government's commitment to the EEEVs project. A brainstorming at the end of the day centered on which project elements seemed most ready to proceed versus those needing further attention to design issues or implementation arrangements.

25. Day 3 of the consultations was hosted by the DOE and the ADB and addressed the subject of "Alternative Fuel Vehicles & Finance and Project Design" to address specific aspects of EEEVs project design and to understand and seek inputs on the proposed financing scheme. The discussion was also used to revisit the question of CTF resources being allocated to renewable energy development versus sustainable transport. Presentations and discussions on the concluding day of the consultations centered on the EEEVs project design, the proposed flow of funds, as well as the DOE implementation plan. A large part of the day was devoted to an open forum question and answer session.

26. Minutes were prepared for each of the 3 days of consultations, and these were distributed to participants for their review prior to finalization. To accommodate additional inputs on documentation discussed during the consultations, a commentary period of one month was provided (no further comments were received). Furthermore, at the request of civil society representatives, interested stakeholders who were not able to attend the consultations were able to submit comments to be included in the consultation minutes through the ADB website (again, none were received). The agendas, participant lists, presentations and minutes of these stakeholder consultations are available at the following links:

https://www.dropbox.com/sh/5q2tobxqsovqp1l/xJkQYjJj90
http://www2.adb.org/Projects/eTrike/events.asp

27. In follow-up to the consultations, it was agreed that there would be further discussions with renewable energy sector and other stakeholders. These were held in a spirit of compromise and problem solving on 28 May and 6 June, ending with a positive note of support for the EEEVs project and a revised proposal for CTF investment in the renewables sector. Dialogue continues with trike drivers and other stakeholder groups, based on the outcomes of these consultations. Five working groups were established, covering the topics of: payment options, driver selection, boundary collection, disposal of old tricycles, and sustainable charging options.

28. Based on more than a year of stakeholder engagement, and as a direct outcome of the consultations held on 21-23 May 2012 and subsequent discussions, a revised Investment Plan for the CTF allocation to be implemented in partnership with ADB, with the outcomes summarized in the table below.

Summary Outcomes Following CTF Stakeholder Consultations

Pre-consultations	Post-consultations
Proposed CTF allocation in partnership with ADB of $125 million as follows: • $101 million for EEEV's project, including $100 million investment and $1 million capacity building grant to support technology transfer • $24 million for Energy Efficient Appliances Project	Proposed CTF allocation in partnership with ADB of $125 million as follows: • $105 million for EEEV's project, including $100 million investment, $1 million grant capacity building grant to support technology transfer, and $4 million grant to support prototype e-vehicles solar charging stations • $20 million for Solar Energy Development Project
Proposed EEEV Project parameters: • Project financing scheme: direct payment to suppliers, funds collected from drivers through LGUs • E-Trikes assumed to be charged from the electricity grid • Selection criteria for LGUs and drivers within LGUs to be decided during implementation • Vehicle design and safety: new e-trike designs were to be made public during bidding • Post-sale: discussions on warranty limited to battery and key parts • Procurement: pre-qualification documents to be obtained at the DOE • Tricycle disposal plan to be completed during implementation	Proposed EEEV project parameters: • Project financing scheme: clarified direct payment to suppliers, E-Trike implementation office to be established in each independent LGU, and collection from drivers may be outsourced, where possible • Solar charging of e-trikes to be piloted and actively promoted as public, private, or public-private-partnership venture (demonstration proposed with $4m grant) • Criteria for both selection of LGUs and drivers within selected LGUs finalized, an application for e-Trike developed, to be finalized after detailed consultation with drivers in each LGU • Vehicle design and safety: competition-based designs confirmed for project support; new e-trike design was made public during the 3-day consultation • Post-sale: Minimum 3-year warranty covers all spare parts and overall performance of the vehicle, with small stand-by fleet to ensure drivers do not lose income in case of vehicle break-down • Procurement: Pre-qualification documents have been posted on both ADB and DOE websites • Material recovery plan complete, taking note of stakeholder concerns; vehicle disposal options broadened, with the ultimate goal of 100% scrapping

Project implementation support arrangements:
 	
• Industry working groups
• ADB project team
• DOE project team
	Project implementation support arrangements:
	
	• Industry and other stakeholder working groups established, covering:
	  o payment options,
	  o driver selection,
	  o boundary collection,
	  o disposal of old tricycles, and
	  o sustainable charging options.
	• ADB and DOE project teams
	• ADB Advisory Group (representative experts from transport, energy, environment, and urban development communities of practice)

Proposed Solar Energy Development Project parameters: • Withdrawn from original CIP due to concerns over enabling conditions and markets trends: (i) delay in feed-in tariff, (ii) lack of net metering, (iii) cap of 50 MW for solar tied to FIT imposed by DOE; (iv) significant price impact to end consumers from adding higher cost solar power in the energy mix, and (iv) already strong private sector industry and interest in solar power. • Since 200-300 MW solar rooftop power could not be implemented in the next 3 years, no CTF support was proposed	Proposed Solar Energy Development Project parameters: • Proposed $20 million CTF support for project (assuming an $80 million ADB loan, and $20 million GoP counterpart funding) based on: (i) DOE convinced solar panel prices have decreased sufficiently since 2009 to allow for a 60-70MW project to be designed and implemented without any subsidies through feed-in-tariff, (ii) means investment will be outside the DOE 50 MW policy cap • Solar charging for e-Trikes to be piloted at 5 sites (through proposed $4 million grant), each of 200 kW capacity, or 1 MW total, which may be able to provide charging to about 1000 e-trikes.

Attachment 1a: NEDA Board Approval of the EEEVs Project

Official Gazette
Edited at the Office of the President of the Philippines
pursuant to Commonwealth Act No. 638 as amended by the Administrative Code of 1987

NEDA Board approves e-Trike and hydroelectric power plant upr

A March 26, 2012 press release from the National Economic and Development Authority

The NEDA Board approved on Thursday two energy projects amounting to P24.1 billion. These projects aim to promote sustainable transport, achieve energy efficiency and thus address market transformation in the sector.

The P21.5 billion Market Transformation through Introduction of Energy Efficient Electric Tricycle (e-Trike) Project will reduce fuel consumption of tricycles by 2.8 percent, equivalent to 560,926 oil barrels.

"The project will distribute 100,000 E-Trikes to tricycle operators on a lease-to-own arrangement, replacing their old gas-fed and two-stroke gasoline engine units. This way, we are also able to protect our environment," Socioeconomic Planning Secretary and NEDA Board Vice Chair Cayetano W. Paderanga Jr. said.

During Phase I of the project, 20,000 e-Trikes will be distributed to operators in Metro Manila, Boracay, Puerto Princesa City, Cabanatuan City, and Davao City while 80,000 units will be provided to operators in yet to be determined municipalities/cities during Phase II. The project also aims to promote the establishment and development of new associated electric vehicle support industries such as battery leasing/recycling/disposal, motor supply chain, and charging stations. This Department of Energy (DOE)-proposed project will be financed through a P12.9 billion loan from Asian Development Bank (ADB), P4.3 billion loan and P43 million grant from the Clean Technology Fund (CTF), P860 million Clean Development Mechanism (CDM) facility and P3.397-billion government counterpart funding.

Attachment 1b: List of Organizations Represented During Informal Discussions on Design of the EEEVs Project

1 3C Distributors International Inc
2 Aboitiz Power
3 AETI
4 Aksyon Klima
5 ALCapone Incorporated
6 Almozora Motors Corporation
7 Alternative Energy Trailblazers Inc
8 AMA Group of Companies
9 Amara Chivalry Contractors Inc
10 AMCA SMART Solutions Inc
11 AMEO Makati
12 APPEND
13 Archdiocese of Manila Ministry on Ecology
14 Asian Institute of Management
15 ASSCOM Multi Purpose Cooperative
16 Ateneo School of Government
17 Atin To Development Services
18 Batangas Laguna Autocenter Inc
19 Battery Doctors Phils.
20 Board of Investments
21 Cenro San Juan City
22 Center for Clean and Renewable Energy Development (C-CRED)
23 Center for Community Transformation
24 Chamber of Automotive Manufacturers of the Philippines, Inc.(CAMPI)
25 City Government of Makati
26 Clean Air Initiative-Asia Center
27 Clean Engines Phils. Inc.
28 Clean N Green Energy Solutions
29 Clean Rock Renewable Energy Resources Corp.
30 Climate Change Commission
31 Continental Sales, Inc (CSI)/LGK Grp of Co's
32 Corinthian Trucking
33 Cosmos Cars and Services, Inc. (on behalf of the North 68 group)
34 Cyber Cycling Inc
35 DBP Leasing Corporation
36 De La Salle University
37 Department of Energy
38 Department of Transportation and Communication
39 Design Upholstery
40 Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ)

41 Development Academy of the Philippines
42 Don Bosco College
43 Dow Chemical Pacific Limited
44 Earth Institute Asia Inc.
45 ECOS Foundation
46 Edward Marcs Philippines Inc
47 eJeepney Transport Corporation
48 Elaia Green Vehicles Corp.
49 Electric Vehicle Association Of the Phils.
50 Energy Logics Philippines
51 Energy Regulatory Commission (ERC)
52 Environmental Transportation Solutions (ETS)
53 Enzolutions Inc
54 E-Save Transport Systems, Inc
55 EV Motor Systems
56 Exponential Growth Realty
57 Fabricator Phils Inc
58 Fairways and Bluewater
59 Far Eastern University
60 FDC-PWG
61 FilOil Gas Inc
62 FRAU Electric Vehicles
63 Fundline Finance Corporation
64 GerWeiss Motors Corporation
65 Global Content & Research Ltd
66 Goldbell Philippines Inc
67 Golden eBike Phils Inc
68 Great Treasures Alliances International
69 Green Convergence
70 Green Frog Zero Emission Transport
71 Green Tech EcoCenter (GTE)
72 Green Vector Ventures Inc.
73 Greenpeace Southeast Asia
74 GSD C&T CO., LTD
75 Honda Philippines
76 INAFI
77 Institute for Climate and Sustainable Cities
78 Institutional Sales Engineer-Industrial Battery
79 International Cyber-Cycle Inc.
80 Itochu Corporation
81 JLBTC
82 June A. Yasol Alternative and Renewable Energy Consultancy
83 Korea Trade Center (KOTRA) Manila

84 Kymco Philippines
85 Land Bank of the Philippines
86 LAPOCOF
87 Lucky Garvonbill Trading/Yanhao Partnering China
88 Manila Electric Company
89 Mapua Institute of Technology
90 MCX Motor Phils.
91 MDPPA
92 MERALCO
93 Meralco Energy Corporation
94 METCHEM Business Solutions Inc
95 MH ADXPression Inc
96 Motolite
97 Motor Vehicle Parts Manufacturers Association of the Philippines Inc (MVPMAP)
98 Moving Ecology
99 National Anti-Poverty and Corruption
100 National Anti-Poverty Commission
101 National Renewable Energy Board
102 NCTS
103 NewJec Inc. International Operations
104 NGO Forum on ADB
105 Nito Seiki Manufacturing Corporation
106 North 68 Corporation
107 Oriental and Motolite Mktg. Corp
108 Partnership for Clean Air (PCA) Inc.
109 Philippine Chamber of Commerce and Industry (PCCI)
110 PEMC
111 Phil ETRO EV Inc
112 Philippine Electricity Market Corp.
113 Philippine Social Enterprise Network, Inc.
114 Philippine Solar Power Alliance (PSPA)
115 Philippines Vehicle Utility Inc (PHUV)
116 Pinno Technologies
117 PNOC Renewables Corp.
118 PricewaterhouseCoopers
119 Ramcar Technology
120 REAP
121 Renewable Energy Technology Center
122 Robert Bosch Inc
123 Skysea Energy
124 Solar Electric Company Inc
125 Southern Luzon State University
126 Sustainable Energy and Technology Solutions
127 Technostrat Corporation

128 Terra Motors Japan
129 Torrex Consulting
130 Toyota Tsusho Philippines Corporation
131 Unionbank
132 United Nations Development Programme
133 UP Electrical and Electronics Engineering Institute
134 UP SAVER
135 Venture Japan K.K.
136 Vita Verde
137 WINACE Holding Philippines
138 WWF Philippines
139 Yamaha Motors Phils.
140 Yiho Corporation

Appendix 2: Market Transformation with Energy Efficient Electric Vehicles (ADB)

Problem Statement

1. The Philippines transport sector accounted for about one-third of total GHG emissions in 2009 (excluding emissions from land use change and forestry); transport sector emissions have increased by about 6-10% per year since 1990, from about 10 million tons per year carbon dioxide equivalent ($MtCO_2e/y$) in 1990 to about 29 $MtCO_2e/y$ in 2007.[32] Vehicles are one of the dominant sources of urban pollution that threatens both people's health and economic activity. In the Philippines, motorcycles and tricycles comprise more than 52% of vehicle population. Compared to other vehicles, motorcycles and tricycles are less expensive. They are very visible in most cities of the country and play an important role in the transport market particularly used as alternative mode transport for short distances. However, the use of these vehicles contributes to the already declining state of the environment, particularly air quality in urban areas. In an ADB study, transport sector emissions accounted for 30% of air pollution in the Philippines and about 80% of air pollution in Metro Manila.

2. Accounting for the total energy consumed from well to wheel[33], electric vehicles can reduce energy consumption by up to 50% and greenhouse gas emissions by up to 60% compared to internal combustion engine (ICE) vehicles. Electric vehicles will also reduce greenhouse gases and other harmful emissions because: (i) electric vehicles use no electricity while stranded in traffic jams (no air conditioning), (ii) electric motors have higher efficiencies than internal combustion engines, and (iii) transmission and distribution of electricity is more efficient and cost effective than transportation of liquid fuels to the end user.

3. In the Philippines, a typical tricycle driver uses about $5 worth (5 liters) of gasoline to drive 100 km in a day and can save about $4 a day by switching to an electric tricycle: for 100 km, an electric tricycle will consume about 5 kWh of power costing about $1.[34] With large-scale adoption, these individual savings would accumulate to a significant national savings. Replacement of 100,000 gasoline tricycles with electric tricycles at a cost of about $450 million, for example, can generate about $150 million each year from avoided fuel costs (assuming 300 days per year operation). As noted in the main text (paragraph 52), e-trikes are expected to cost at least $1000 more than conventional trikes, but this cost will be more than recovered through reduced operating costs over a nominal 10-year lifetime. <u>Although the daily and life-cycle cost savings favor electric tricycles, there is no ready mechanism to monetize these savings for acquisition and deployment of electric vehicles at fleet scale.</u>

4. The private sector has indicated interest in building and operating solar charging stations for electric vehicles, but investors face a chicken-and-egg dilemma; until a commitment is made for large-scale deployment of EEEVs, private investors will not finance development of a charging network. This first mover barrier can be overcome by including a component for prototype solar charging stations in the EEEVs project, for which CTF grant support is requested.

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[32] CTF Investment Plan for the Philippines, 2009; paragraph 8 and Figure 3.
[33] Energy consumed and green house gases (GHGs) emitted from the time a vehicle's energy source leaves the well to the time it is consumed by the vehicle, details available at: http://web.mit.edu/evt/summary_wtw.pdf
[34] Assuming cost of electricity of $0.20 / kWh in the Philippines. As noted above, in the Mandaluyong City pilot project, e-trikes were driven about 55 km per day.

Proposed Transformation

5. CTF cofinancing will be utilized to overcome the first-mover risks and cost barriers associated with introducing electric 3-wheelers ("e-trikes") as a first step in electrification of the public vehicle fleet: the proposed project will facilitate deployment of 100,000 e-trikes. This will be the largest known project of this scope implemented in the Asia-Pacific region.[35] The physical investments (project outputs) include: (i) e-trike procurement, (ii) battery leasing, (iii) efficient electric motor supply chain, (iv) public charging stations, (iv) recycling and disposal, and (vi) communication, social mobilization, and technology transfer. CTF funds will be used alongside ADB's loan to amortize up-front capital costs over a longer period than otherwise possible. GoP's strategy is notable in that fleet electrification is to be initiated at the bottom of the transport pyramid, addressing the needs of poorer consumers including last-mile connectivity. Globally, most electric vehicle development is targeting the upper end of the private car market, with vehicles such as the Nissan Leaf which retails for around $30,000.

6. Successful demonstration of the electric vehicles at this scale will facilitate replication and scale up of e-trikes and other public vehicles including jeepneys and buses. Further, development of local battery suppliers and maintenance/service industries will be fostered.

7. The SCS component will deploy rooftop PV arrays [with battery storage] at public transport stations. The electricity produced will be sold at the same price as grid-supplied electricity so that EEEV operators can achieve the cost savings accruing from using electricity as transport fuel, while demonstrating the technological viability of the solar charging systems. The long-term objective is to facilitate scale up of solar charging systems and achieve grid parity, but this requires demonstrate at commercial scale: the stations must support several hundred EEEVs to demonstrate the technology and the business model. In the Mandaluyong pilot test, actual driving of about 55 km per EEEV per day was documented, with consumption of about 3 kWh of energy. Assuming 3-4 hours of generation per day (15% load factor), 1 MW of solar capacity will generate about 3.5 MWh of electricity per day, which is sufficient to support 1000 EEEVs. The solar charging stations are proposed to be initially deployed in Boracay and Puerto Princesa, where the stations can support the majority of EEEVs deployed in the first phase of project implementation.

8. The cost of solar PV has rapidly declined in the last 3 years, and is now at parity with petroleum-fired electricity generation. However, the total cost of the stations will include the solar PV array, battery storage, controllers, etc., and the initial cost of electricity will be higher than current grid-supplied electricity. Concessional financing is needed in order to sell the electricity to EEEV operators at grid parity. In the longer term, as PV costs continue to decline, the electricity is expected to reach grid parity.

Implementation Readiness

9. The E-trikes project is at the appraisal stage and is scheduled for presentation to ADB's Board of Directors in August 2012. The GoP is working on an electric vehicle policy[36], which among others will exempt importation of all electric vehicles and components free of taxes for 9

[35] A detailed presentation on the proposed project is available online at: https://www.dropbox.com/s/g56m7lnjgdr1m6m/SH%20Presentation%20-%20Meralco%20EV%20summit.pdf

[36] Senate Committee Report No. 44 on Senate Bill No. 285–Electric, Hybrid and Other Alternative Fuel Vehicles Incentives Act of 2011.

years. In addition there will be other incentives to set up electric vehicle businesses in the Philippines.

Rationale for CTF Financing

10. Electric vehicle deployment is both constrained and favored by several factors:

- Commercial development and deployment of electric vehicles will increase Philippines's energy security, save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources, including renewable electricity.
- Fleet-scale electric vehicle projects are at the pioneer stage and face additional costs and risks which are not being covered by conventional project financing. Creative financing approaches, including the use of concessional funds, are needed overcome first-mover risks and mainstream large-scale vehicle fleet financing.
- Carbon finance can provide some financial support, but is not sufficient to overcome the cost and risk barriers noted above.
- In order to realize the fuel cost savings expected for EEEVs, the SCS component will require grant support so that the electricity can be sold at grid parity at the outset.
- CTF can provide a catalytic role in reducing or eliminating first mover risk for fleet-scale projects, and foster accelerated replication and scale-up in the near term.
- The replication potential for e-trikes alone is more than 20 to 1. A substantial learning curve has already been overcome during the pilot project.
- GHG reductions and cost-effectiveness are comparable to or better than the original CIP (as discussed in the main text).

Financing Plan

Source	Amount (US $ million)
GoP	99
ADB	300
CTF (loan)	100
CTF (grant) [a]	5
Total	**504**
Carbon Finance [b]	0

[a] A CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan).
[b] No provision has been made for the carbon finance risks associated with post-2012 uncertainties. Carbon finance is not expected to contribute to upfront project co-financing.

Project Preparation Timetable

Milestone	Date
ADB Project Identification	May 2011
Appraisal / Negotiations	June 2012
ADB Board Consideration (Approval)	August 2012
Project Completion	August 2016

Additional Notes on GHG Calculations and Electric Vehicle Eligibility for CTF

GHG Reduction Estimates

11. ADB's carbon fund team has reviewed the proposed EEEVs project for potential CDM registration (independently of the ADB project team). As the pilot-tested EEEVs have reduced energy consumption as well as higher passenger capacity than conventional trikes, potential GHG reductions have been estimated on a per vehicle basis as well as a per passenger-kilometer basis. The range of estimates and assumptions are shown below in Table A2.1. As noted in the main text, the base case with reductions on a per vehicle basis applied to 100,000 vehicles yields estimated GHG reductions of 0.27 million tCO_2e per year. Table A2.1 also shows estimated reductions based on the 2010 generation output ("grid mix"), with an emissions factor of 0.52 tCO_2e/MWh, and scenarios of 100% RE-based electricity and 100% coal-based electricity: net reductions are achieved in all scenarios. The grid emissions factor of 0.52 tCO_2e/MWh is at the mid-range of emissions factors used for several recently registered Clean Development Mechanism (CDM) projects in the Philippines.[37]

Table A2.1: Emissions Reduction Estimates (tCO_2e/year)

Case	Reduction on Per Vehicle basis	Total Reductions	Reduction on Per Passenger Basis	Total Reductions	Grid Mix
Optimistic	3.634	363,400	6.361	636,100	100% RE
Base	2.698	269,800	5.425	542,500	Current mix
Worst case	1.834	183,400	4.561	456,100	100% coal

Source: ADB carbon fund team
Assumptions:

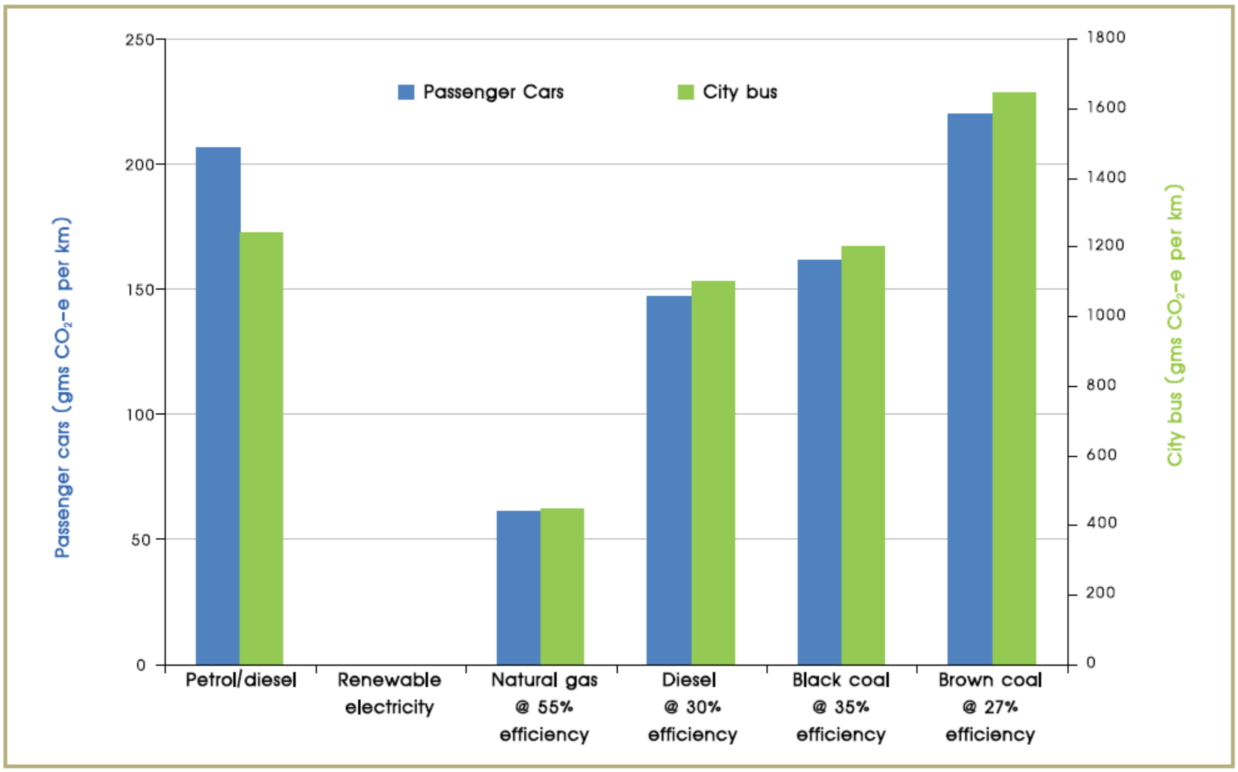
Vehicle operation / day	80	km / day
Passengers in the conventional vehicle	4	
Passengers in Etrike	7	
Vehicle milage	15	km / lit
Vehicle operation	300	days / year
Etrike electricity consumption	6	kWh / day
Emission factor of grid	0.52	tCO2e / MWh
Emission factor of petrol	2.271793	kg CO2e / lit

12. The grid mix scenarios shown in Table A2.1 are consistent with other analyses illustrated in Figure A2.1 below which shows the potential reductions of electric depending on the fuel used for grid-supplied electricity. [Note that Figure A2.1 is based on analysis of 4-wheel vehicles (cars and buses) and does not represent the local conditions in the Philippines.] Obviously, 100% RE-based vehicle charging provides the largest GHG reductions, and as noted above, the EEEVs project includes a component for prototype solar charging stations to demonstrate the technological viability and commercial potential of RE-based charging. In 2010, grid supplied electricity output was about 27% from geothermal, hydropower and other RE, and

[37] E.g., see Project Design Document for "ANAEROBIC DIGESTION SWINE WASTEWATER TREATMENT WITH ON-SITE POWER PROJECT (ADSW RP2024)," registered on 7 January 2011. The Project Design Document was accessed online on 14 November 2011 at: http://cdm.unfccc.int/filestorage/S/2/Z/S2ZGB9RM5FO7D6W0E4PL3INVQCK8TH/2010.pdf?t=RFR8bHVvMXd5fDDh1GRICO3d4xwrYQ2HbisL

gas-fired power accounted for another 29% of output: the effective "all Philippines" grid emissions factor for 2010 is estimated to be 0.517 tCO2e/MWh, which is roughly equivalent to natural gas-fired electricity. According to the analysis shown in Figure A2.1, if "brown coal @ 27% efficiency" is used to provide the incremental power needed to charge the EEEVs, there would be no GHG reductions. However, Figure A2.1 is relevant for cars and buses in Europe, but does not provide an "apples to apples" comparison with local conditions in the Philippines. The existing 3-wheel vehicles in the Philippines have much higher emissions than that for cars and buses referenced in Figure A2.1. Also, emissions from EEEV charging are based on the Philippines grid mix because it is not possible to know precisely the source of incremental electricity used for battery charging. Because charging times will vary and the marginal capacity on the grid changes with season and time of day, and also because the additional amount of electric generation required for the proposed EEEVs fleet is minimal (only 0.22% of 2010 generation output), using the average grid emission factor is the best approximation.

Figure A2.1: Relative Greenhouse Gas Emissions for Petroleum vs. Electric Vehicles



Source: United Nations Environment Programme, Risoe Centre, 2011. *Technologies for Climate Change Mitigation, Transport Sector*. TNA Guidebook Series. March 2011. Available online at: http://tech-action.org/Guidebooks/TNA_Guidebook_MitigationTransport.pdf
Emissions are calculated using vehicle data cited for the Renault Fluence Z.E. and Tindo electric bus combined with fuel carbon intensities published in the Australian National Greenhouse Factors, July 2010, available at: http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx

Projected Changes in Grid Emissions Factors

13. The Philippines Department of Energy *Power Development Plan 2009-2030* reports that near-term generation expansion comprises 1338 MW of committed capacity, of which 1200 MW is coal-fired, 70 MW is geothermal, 51 MW is hydropower, and 17.5 MW is biomass (see Table

A2.2, below). Projecting beyond the current commitments is difficult, as the generation mix will be affected by the renewable portfolio standard and feed-in tariffs discussed in the main text. Table A2.3 presents grid emission factors for three expansion scenarios assuming (i) generation output for 2010 and (ii) current commitments shown in Table A2.2, (iii) a doubling of coal-fired capacity on top of 2010 generation output, and (iv) a 10-fold increase in coal-fired capacity on top of 2010 generation output. Of these 3 expansion scenarios, the first is considered to be firm, the second is considered to be plausible, and the third is considered to be unlikely. As noted in the main text, the incremental demand posed by 100,000 EEEVs is 0.22% of 2010 generation output. Replication and scale up to 2 million EEEVs would represent 4.4% of 2010 generation output, but the actual share of future grid output would be lower given the programmed capacity additions.

14. The third scenario presented in Table A2.3 presents a grid emissions factor which is well below the calculated emissions factor for the current fleet of gasoline-powered tricycles (see further discussion below at paragraphs 15-19). Alternatively stated, with expansion of coal-fired power 10 times beyond current level, with no additional RE capacity additions, the grid supplied power would still be less carbon-intensive than the gasoline-fired ICE vehicles being replaced. This conclusion is consistent with independent estimates prepared by ADB's carbon fund team shown above in Table A2.1.

Table A2.2: Near-term Generation Expansion

Grid	Project Name	Capacity (MW)	Target Completion	Location	Proponent
Luzon	2x300MW Coal-Fired Power Plant	600	4th Qtr. Of 2012	Mariveles, Bataan	GN Power
	Sub-total Luzon	600			
Visayas	3x80MW CFB Power Plant Expansion Project	240	Unit I-March2010 Unit II-June 2010 Unit III-Jan 2011	Brgy. Daanlungsod, Toledo City, Cebu	Cebu Energy Development Corporation (Global Business Power Corp.)
	2x100MW Cebu Coal-Fired Power Plant	200	Unit 1-Feb 2011 Unit 2-May 2011	Naga, Cebu	KEPCO SPC Power Corporation (KSPC)
	17.5MW Panay Biomass Power project	17.5	2011	Brgy. Cabalabaguan, Mina, Iloilo	Green Power Panay Phils., Inc.
	Nasulo Geothermal Plant	20	2011	Nasuji, Valencia, Negros oriental	Energy development Corporation
	2x80MW CFB Power Plant	160	Unit I-Sep 2010 Unit II-Dec 2010	Brgy. Ingore, La Paz, Iloilo	Panay Energy Development Corporation (Global Business Power Corp.)
	Sub-total Visayas	638			
Mindanao	Sibulan Hydroelectric Power (Unit I-16.5MW) (Unit II-26MW)	43	Unit I-Feb2010 Unit II-Apr 2010	Sta. Cruz, Davao del Sur	Hedcor Sibulan, Inc.
	Cabulig Mini-Hydro Power Plant	8	June 2011	Plaridel, Jasaan, Misamis oriental	Mindanao Energy Systems,Inc. (MINRGY)
	Mindanao 3 Geothermal	50	July 2014	Kidapawan, North Cotabato	Energy Development Corporation
	Sub-total Mindanao	101			
Total Philippines		1,338			

Note: Mindanao 3 Geothermal Plant was moved to 2014 from its original target year of 2010

Source: Philippines Department of Energy, *Power Development Plan 2009-2030*; Table 4.

Table A2.3: Grid Emissions Factor Scenarios

Source	Output in GWH	% of grid mix	Emissions Factor (t/MWh)	Total Emissions (t/y)
Base Case: generation output in 2010				
Oil-based	7101	10%	0.6	4260600
Hydro	7803	12%	0	0
Geothermal	9929	15%	0	0
Other RE	90	0%	0	0
Coal	23301	34%	0.9	20970900
Natural gas	19518	29%	0.5	9759000
Total	67742	100%	0.517	34990500
Expansion Scenario 1: Current Generation Expansion shown in Table A1.2; no other renewable energy is added. Grid factor increases to 0.553 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	9%	0.6	4260600
Hydro	8026	10%	0	0
Geothermal	10420	14%	0	0
Other RE	213	0.3%	0	0
Coal	31711	41%	0.9	28539900
Natural gas	19518	25%	0.5	9759000
Total	76989	100%	0.553	42559500
Expansion Scenario 2: Coal output expanded by 2x; all others fixed at 2010 output. Grid emissions factor would be slightly higher than gasoline emissions factor @ 40% thermodynamic efficiency of 0.605 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	8%	0.6	4260600
Hydro	7803	9%	0	0
Geothermal	9929	11%	0	0
Other RE	90	0%	0	0
Coal	46602	51%	0.9	41941800
Natural gas	19518	21%	0.5	9759000
Total	91043	100%	0.615	55961400
Expansion Scenario 3: Coal output expanded by 10x; all others fixed at 2010 output. Grid emissions factor would approximately equal gasoline emissions factor @ 30% thermodynamic efficiency of 0.807 tCO_2e/MWh.				
Source	**Output in GWH**	**% of grid mix**	**Emissions Factor (t/MWh)**	**Total Emissions (t/y)**
Oil-based	7101	3%	0.6	4260600
Hydro	7803	3%	0	0
Geothermal	9929	4%	0	0
Other RE	90	0%	0	0
Coal	233010	84%	0.9	209709000
Natural gas	19518	7%	0.5	9759000
Total	277451	100%	0.806	223728600

Source: ADB staff estimates, based on Philippine Power Statistics, 2010.
Note: Estimates of generation output assume that the additional biomass, coal, and geothermal run at 80% output; and that additional hydropower runs at 50% output.

Comparison of ICE Emissions vs. Grid Emissions Factors

15. As noted in the main text, conversion from ICE to EEEVs will save energy, as the energy losses in ICE vehicles are typically 70–80% versus 5–15% in EEEVs. A brief discussion follows to illustrate how current ICE efficiencies compare to the emissions scenarios presented in Table A2.3, and whether improvements in ICE efficiencies and sustainable renewable fuels could achieve the same GHG reductions envisioned in the proposed EEEVs project.

16. The energy and CO_2 content of gasoline expressed in terms of carbon intensity, analogous to a grid emissions factor, is calculated as follows:

Gross energy content of gasoline: 34.2 Megajoule (MJ) / liter (L)

Converted to kWh: 34.2 MJ / L x (1 kWh / 3.6 MJ) = 9.5 kWh / L

Theoretical Carbon intensity: (2.3 kg CO_2e / L) / (9.5 kWh / L) = 0.2421 kg CO_2e / kWh

17. This theoretical carbon intensity of gasoline, which assumes 100% thermodynamic efficiency, is much lower than the grid emissions factor estimated for 2010 generation output (the Base Case shown in Table A2.2 and Table A2.3). In practice, thermodynamic efficiencies of motorcycle/tricycle engines are probably on the order of 20%. Automobiles with internal combustion engines have typical efficiencies of about 25%. The Toyota Prius equipped with an Atkinson cycle engine has efficiency of 34% at peak power output of 52 kW.[38] Table A2.4 shows these efficiencies in terms of carbon intensity, compared with the emissions scenarios shown in Table A2.3.

Table A2.4: ICE Efficiencies vs. Grid Emissions Scenarios

Vehicle / ICE Efficiency	Carbon Intensity	Comparison to Emissions Scenarios in Table A1.3
3- and 2-wheelers / 20%	(0.2421 kg CO_2e / kWh) / 0.2 = **1.21 kg CO_2e / kWh**	More than 2.3 times as "dirty" as current grid mix and about 50% "dirtier" than Scenario 3.
Light duty vehicle / 25%	(0.2421 kg CO_2e / kWh) / 0.25 = **0.97 kg CO_2e / kWh**	"Dirtier" than Scenario 3. *Roughly equivalent to 100% coal-fired electricity.*
Toyota Prius / 34%	(0.2421 kg CO_2e / kWh) / 0.34 = **0.712 kg CO_2e / kWh**	The Prius engine is "dirtier" than the 2010 grid mix and Scenarios 1 and 2, but cleaner than Scenario 3.

Source: ADB staff estimates

18. An ICE would need to achieve 47% efficiency to have an emissions factor equivalent to the 2010 grid mix, calculated as follows:

(0.2421 kg CO_2e / kWh) / (0.517 kg CO_2 e / kWh) = 47%

[38] Source: David J.C. MacKay. 2009. *Sustainable Energy Without the Hot Air*;" page 262. Available on line at: www.withouthotair.com.

19. This calculation shows that the current trikes would require upgrading to or replacement with ICEs with 47% efficiency to achieve the same emissions reductions expected from the proposed EEEVs project. ***However, after more than 100 years of ICE technology development, there is no engine on the market with 47% efficiency that could be deployed at scale.*** Further, the current push by the world's major automobile manufacturers towards EEEVs suggests that there is no expectation of such an efficiency breakthrough in the near future. If such a breakthrough does occur, a converted fleet would need to be powered by sustainable renewable fuels in order to achieve the GHG reductions and the non-climate benefits associated with EEEVs.

Electric Vehicle Eligibility

20. CTF guidance acknowledges the realities of building 100% RE-based charging infrastructure in advance of electric vehicle (EV) deployment: EVs are being marketed worldwide in advance of RE-based charging networks, and there is no country pursuing a 100% RE-based charging objective at present. Therefore, ***CTF guidance does not require that EVs be powered with RE.*** The CTF Investment Criteria for Public Sector Operations, 9 February 2009; footnote 6 to paragraph 6 (b) (iv) states:

> "Plug-in electric vehicles would be considered only when the energy systems from which they draw the power are less carbon intensive than the emissions from a stand-alone electric hybrid."

21. In this case, the pilot-tested e-trikes are considered to be "plug-in electric vehicles." However, to the best of ADB and GoP knowledge, "stand-alone electric hybrid" trikes or motorcycles have not been marketed and pilot-tested, so an "apples-to-apples" comparison is not possible. The calculations presented above are intended to demonstrate that the EEEVs project meets the CTF eligibility criteria. Until a stand-alone electric hybrid 3-wheeler appears on the market so that an apples-to-apples comparison can be made, the foregoing calculations and discussions indicate that the proposed EEEVs project meets the CTF eligibility requirement.

Appendix 3: Solar Energy Development (ADB)

1. The rooftop solar project concept presented in the original CIP is being retained, but given the rapidly changing landscape for solar PV development, the detailed scope remains to be identified and developed. GoP is requesting to reallocate $20 million of CTF cofinancing to support total investment of $120 million, which would finance an estimated 40 MW of new solar PV and/or other RE capacity.

Problem Statement

2. In keeping with the long-term objectives for energy security and economic development, GoP is committed to developing indigenous RE resources in a manner which protects consumer interests. RE development typically entails higher up-front capital costs, but lower operating and maintenance costs, and in most cases zero fuel costs (which is the case for solar power).[39] The incremental upfront costs may be thought of as advance payments for renewable "fuel", which are amortized and depreciated over the lifetime of RE systems [alternatively stated, the fuel may be free, but the conversion to useful energy is not]. Policy support via FITs is designed to eliminate the upfront cost barrier, but in the absence of an operational FIT and RPS, there is a need for concessional financing to support RE development.

3. New RE development is being constrained because feed-in tariffs (FITs) and other regulations pursuant to the Renewable Energy Act of 2008 have not been finalized, and may not be in place for another 2 years (as noted in the main text). Private sector developers are keen to take advantage of the FIT regime, but new investment is in suspense because the FIT regulatory framework is not final. This uncertainty is compounded by consumer concerns that that the cost of the FITs will ultimately result in higher retail electricity tariffs, which average around US$0.20 / kWh -- the highest in Asia. This is of specific concern to public transport operators who are being encouraged to adopt EEEVs to replace conventional ICE vehicles. At the macro-economic level, the cost of the FIT program will be offset by avoided costs of imported fuels for power generation, but the economic benefits cannot be readily monetized and passed on directly to consumers.

4. The proposed FIT support will be limited to only 50 MW of ground-mounted solar installations, but the potential envisioned in the low-carbon development scenario is 2000 MW[40]. Solar PV systems have good load-following generation output, which reduces stress on the grid during afternoon demand peak. Space for ground-mounted solar power plants in Manila and other cities is limited or non-existent; the obvious prospect for urban area solar PV development is in rooftop installations.

5. Rapidly declining costs for solar PV systems suggest that policy support may not be necessary for commercial development. However, the market reality is that private investors are reluctant to move forward on new investments until the RE regulatory framework is finalized, especially the RPS and net metering provisions. In the absence of this policy support, purely voluntary solar PV investment will require concessional financing.

6. Against this policy and regulatory backdrop, ADB has supported 2 noteworthy solar energy projects. In June 2012, ADB commissioned a 570 kW rooftop solar PV system at its Manila headquarters which is the largest PV project in the Philippines to date. The installed

[39] An exception is biomass power, where feedstock is normally not free.
[40] See original CIP, Figure 8 and Table 2.

cost is well below that noted in the CIP in 2009, suggesting that there is scope for rooftop solar PV development outside the envelope of the FIT (which is limited to ground-mounted installations). [This rooftop solar project has been implemented in parallel with an expansion of ADB headquarters, which has been designed to achieve state-of-the-art green building certification.] Earlier in 2012, ADB supported the Boni Tunnel lighting project to demonstrate the feasibility of solar PV and lithium-ion battery technology for large-scale street lighting applications. This project comprises 59 square meters of solar panels which provide power to 94 light-emitting diodes (LEDs) with 22-watt capacity each. This project provides about 19% of the tunnel power demand, but achieves 51% energy savings compared to the old lighting system. These projects are demonstrating the technological viability of solar PV and aiding in price discovery.

7. The technical benefits of rooftop solar PV are substantial: (i) the system generates power at the point of consumption, reducing the need for centralized generation and avoiding the transmission losses associated with centralized generating plants; (ii) solar PV has reasonably good load-following characteristics, generating maximum power output at times of peak demand in buildings (mainly for space cooling); and (iii) with eventual implementation of net metering, building owners will be motivated to implement EE measures to maximum net electricity sales to the grid. In theory, carbon finance and/or a FIT could monetize these technical benefits, but the proposed solar FIT will be limited to ground-mounted installations, and carbon finance is not readily delivered as upfront project cofinancing. In the current regulatory environment, the financial viability of rooftop solar will be dependent on savings associated with avoided costs of grid-supplied power, rather than revenue from sale of electricity. Therefore, some other form of concessional finance is needed to facilitate investment at the scale required for market transformation. [A key lesson learned from the ADB rooftop and Boni Tunnel projects is that for large buildings and facilities like the Boni Tunnel, the space available for solar arrays results in solar power output below the total demand of the building or facility. For these types of installations it is not clear that net metering will provide a meaningful contribution to financial viability (although the economic benefits via avoided fossil fuel consumption are obvious). Net metering should provide a more meaningful incentive for private residential buildings, where available rooftop area may be sufficient to cover most of the demand (from lighting, refrigeration, TVs, and space cooling).]

Proposed Transformation

8. The legal framework and the economic incentives provided by high energy cost have not been sufficient for adoption of clean energy and energy efficiency by ordinary citizens and businesses. The proposed project will incorporate lessons learned the Philippine Energy Efficiency Project and other initiatives, in particular: (i) *economy of scale through* bulk procurement of at least 40 MW of new solar PV systems; and (ii) *improve technology credibility* through actual operations of rooftop systems at ADB headquarters and the Boni Tunnel lighting system.

9. The Philippines Renewable Energy Law with its RPS and Feed-in Tariffs with net metering[41] is a pioneering framework for the entire ASEAN region. This Law also provides for establishing a voluntary market for Renewable Energy Certificates. These provisions will not bring any fruit without appropriate investments in the sector. ADB will support this market

[41] "Net Metering" refers to a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the electricity grid; (Source: Section 4 (gg), Philippine Renewable Energy Act of 2008)

creation opportunity with a Government-led project that will quantify the benefits of solar technology to consumers, establish product quality benchmarks in the market and develop secondary supply and maintenance chains. Currently the specialized electronic meters (that can record electricity flow in both directions) and solar panel are not readily available in the retail market in the Philippines, and are controlled by a small number of technology vendors and service providers. A large scale project will bring in more players and choices to the market and improve sector efficiency.

10. CTF resources are proposed to enhance the investment project design as follows:

- CTF investments will bring down the cost of these technically proven projects through bulk procurement and public awareness “packaging” (described above) to be financially and technically viable in the Philippines, reduce pay-back period for the customers, and increase credibility of the technology by maintaining (or improving) standards and providing direct incentives to try the new technology
- CTF resources will cover part of the additional up-front costs of solar PV [details to be determined]. Financing instruments such as partial credit guarantees, contingent financing, and other output-based assistance will be evaluated during project design to determine an optimum use of CTF cofinancing. Different business models will also be considered, e.g., rent-to-own and other supplier credit approaches, and virtual rooftop projects where poorer communities build a common ground-mounted PV facility to avoid rooftop load structural limitations of residential buildings.
- CTF resources will improve the “depth” of the ADB project by increasing the economies of scale and scope for high-cost investments, which will shorten the pay-back period and increase the financial rates of return.
- The proposed market transformation initiative would cover at least 40 MW of new capacity installed at commercial, government offices, and/or large residences. It will encourage other building owners and electricity customers to switch, as the market transforms and the prices fall. The replication potential is at least 10 to 1, which is quite conservative considering the low-carbon development scenario of 2000 MW solar capacity by 2030.

Implementation Readiness

11. The implementation of the project will be led by DOE in partnership with other stakeholders including private sector investors, and local government units as appropriate. DOE has sufficient expertise to manage the ADB investment project, and project management support will be included in the scope, including capacity building for participating financial institutions and service companies. The project is at the identification stage and is expected to be prepared and presented for ADB Board consideration in 2013.

Rationale for CTF Financing

12. Solar energy development is constrained by several factors:

- Accelerated introduction of solar energy systems will increase Philippines’s energy security, save foreign exchange, and protect against global price fluctuations by using non-tradable domestic energy sources, but these economic advantages cannot be readily monetized to support investment in solar energy projects.

- Although the installed cost of solar PV systems has rapidly declined in the past 2-3 years, and is projected to continue declining, the capital cost of rooftop PV remains a barrier in the absence of net metering or other policy support. Creative financing approaches, including the use of concessional funds, are needed to cover additional up-front capital costs to consumers.
- Management and technical expertise to identify and implement rooftop solar opportunities is limited in the Philippines.
- Perceived financial risk, i.e., payback periods on large capital investments may be in the range of 7-8 years or longer versus less than 3 years desired by building and plant owners.
- Commercial financing for candidate investments is not readily available, and as such private developers are unable to finance solar energy projcets.
- The investment project to be supported by CTF is replicable and scale-able without long-term concessional financing. As the more building owners' enterprises gain comparative advantage, intra-sector competition will help drive replication. Commercial financing of solar energy will also increase as banks and other financial institutions gain experience on the CTF-supported project, and as government-sponsored RE funds are replenished through taxation mechanisms.

13. At least 40 MW of rooftop solar PV operating at 15% load factor will deliver net reduction of about 0.03 million tCO_2e per year assuming grid emissions factor of 0.52 tCO_2e/MWh. With 15 year lifetime total GHG reductions are about 0.4 million tCO_2e. Replication and scale-up potential is at least 10 to 1. The cost-effectiveness is calculated as follows: CTF$20 million / 0.4 tCO_2e = CTF$49 / tCO_2e, declining to CTF$4.87 / tCO_2e with replication and scale-up of 10 to 1.

14. The indicative financing plan and preparation timeline are shown below.

Financing Plan

Source	Amount (US $ million)
GoP	20
ADB	80
CTF	20
Total	**120**
Carbon Finance[a]	n/a

[a] Carbon finance estimate is not expected to provide upfront project cofinancing.

Project Preparation Timetable

Milestone	Date
ADB Project Identification	Q3 / 2012
Appraisal / Negotiations	Q2 / 2013
ADB Board Consideration (Approval)	Q3 / 2013
Project Completion	Q3 / 2016

Q2=second quarter, Q3=third quarter

Supplemental Appendix: Use of CTF Resources to Support Philippines EEEVs Project

A. Background

1. The 2005 Gleneagles G-8 Summit in July 2005 stimulated a concerted effort by the development community to broaden and accelerate support to developing countries relating to energy access and climate change through the Clean Energy Investment Framework (CEIF).[1] The CEIF provides the basis for definition of a range of possible initiatives to be developed within each multilateral development bank (MDB). Pursuant to the CEIF, in 2008 the donor community committed approximately $6.1 billion to the new Climate Investment Funds (CIFs) to be invested through the MDBs.[2] About $5.2 billion equivalent was pledged to the Clean Technology Fund (CTF) for climate change mitigation in developing countries.[3] ADB's Board of Directors approved the use of CTF resources on 5 November 2009.[4] The partnership agreement was approved on 18 March 2010.

2. The joint MDB mission for Philippines was conducted in July 2009; the CTF Country Investment Plan (CIP) was endorsed in December 2009. The CIP was revised in 2011 and 2012 to include the proposed EEEVs project; the revised CIP was requested to be endorsed by the CTF Trust Fund Committee in June 2012.[5] Project and loan documentation includes a separate cofinancing agreement for the CTF funds, similar to that for other official cofinancing.[6]

3. The design of the CTF acknowledges some of the operational problems and limitations of the Clean Development Mechanism (CDM) and the Global Environment Facility (GEF), and it specifically seeks to leverage donor financing with commercial bank financing and private sector-led investments.[7] CTF generally targets energy efficiency (EE), renewable energy (RE), and cleaner transport opportunities, and includes consideration for non-climate benefits and development impacts. CTF is "technology-agnostic." Newly commercialized technologies may be supported, but CTF is not intended to be a substitute for venture capital to support new technology development.

4. The CTF principles and objectives are fully consistent with the *ADB Strategy 2020* emphasis on inclusive and environmentally sustainable growth; private sector development and operations; and investment focus on infrastructure, environment (including climate change), and financial sector development. CTF is also fully consistent with the *ADB Energy Policy 2009* focus on clean energy development, in particular the emphasis on energy efficiency and

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[1] ADB's Energy Efficiency Initiative was launched at approximately the same time.
[2] The participating MDBs are the World Bank Group (including its private sector window the International Finance Corporation [IFC]), the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, and the Inter-American Development Bank. World Bank is the trustee of the CIFs.
[3] Details can be found at www.worldbank.org/cifs
[4] ADB Board Paper R215-09, November 2009.
[5] The revised CIP and the proposed EEEVs project were submitted to the Trust Fund Committee for consideration at the same time.
[6] The detailed mechanics of funds transfer are covered in the "Financial Procedures Agreement between Asian Development Bank and the International Bank for Reconstruction and Development as Trustee of the Trust Fund for the Clean Technology Fund," dated 18 March 2010.
[7] CDM has been somewhat successful for industrial energy efficiency projects, but has a very poor record of utility grid improvement and demand-side management projects; collectively, these categories comprise less than 10% of registered projects. As of 18 October 2011, only 9 transport sector projects have been registered out of 3,534 projects, representing 0.22% of total projects. Energy supply projects, including RE, comprise just over 67% of total registered projects. Project information accessed on 18 October 2011 at: http://cdm.unfccc.int/Statistics/Registration/RegisteredProjByScopePieChart.html

renewable energy; access to energy for all; and energy sector reforms, capacity building, and governance.

B. Project Eligibility

5. The Philippines CIP will cofinance renewable energy (RE), energy efficiency (EE), and cleaner transport investments in both the public and private sector. The Investment Plan has been updated at the request of the Government of the Philippines (GoP); the revised financing plan is summarized in Table SA31.1. The proposed project to support energy efficient electric vehicle (EEEVs) deployment is fully consistent with the context and objectives of the CIP.

Table SA31.1: Philippines Revised CTF Financing Plan 2012($million)

Financing Source	Renewable Energy (WBG)	Urban Transport (WBG)	Energy Efficient Electric Vehicles (ADB)	Solar Energy Development (ADB)	Total
CTF	75	50	105[a]	20[a]	250
GoP / DBP	180	50	99	20	349
IBRD Loans	250	180	0	0	430
IFC Loans	250	0	0	0	250
ADB Loans	0	0	300	80	380
Private sector	750	0	(tbd) [b]	(tbd) [b]	750
Other cofinancing	0	20	0	0	20
Total	**1,505**	**300**	**504**	**120**	**2,429**

Source: MDB teams

ADB=Asian Development Bank, CTF=Clean Technology Fund, DBP=Development Bank of the Philippines, EE=energy efficiency, GoP=Government of the Philippines, IBRD=International Bank for Reconstruction and Development, IFC=International Finance Corporation, RE=renewable energy, (tbd)=to be determined, WBG=World Bank Group

Notes:

[a] For the EEEVs project, a CTF grant of $1 million is requested for fine-tuning of technology options, technology transfer, local industry support and capacity building (implementation support, including monitoring and evaluation activities will be financed by the ADB loan). For the Solar Charging Systems component a CTF grant of $4 million is requested to ensure its technical viability and whether solar charging could be implemented within the current tariff of about $0.20/kWh; see discussion in main text and concept paper in Appendix 2 for further details.

[b] Private sector entities will participate in project implementation via supply of goods and services. For the EEEVs project, private sector investment is expected during replication and scale-up, and as such no private sector cofinancing is shown. Private sector cofinancing for the Solar Energy Development project has yet to be determined.

6. The proposed project meets the CTF eligibility criteria, as discussed below and as summarized in Table SA31.2.[8]

[8] Further discussion is included in the revised CIP.

7. The proposed Project is consistent with the scope of transport sector intervention outlined in the CIP, bringing additional value by opening a new "window" for deploying sustainable transport systems beyond bus rapid transit lines. More efficient battery technologies are providing a cleaner alternative to pollution-emitting internal combustion engines. In many cases, conventional motorcycles emit more pollution than large SUVs because they are not equipped with equivalent emissions-control technology.[9] Electric motorcycles and tricycles can immediately eliminate tailpipe emissions, significantly reducing urban air pollution. Commercial success of EEEVs can be replicated in other types of vehicles, including jeepneys and buses.

8. The EEEVs Project will result in avoided fossil fuel emissions of about 0.27 million $tCO2_e$/y. With a minimum vehicle lifetime of 10 years, the project will generate 2.7 million $tCO2_e$ total reductions. Cost-effectiveness is estimated as: CTF$105 million / 2.7 million tCO_2e = CTF$ 38/ tCO_2e, declining to CTF$3.89/ tCO_2e with replication and scale-up. The EEEVs project will bring environmental and public health co-benefits equal to or greater than that which would be realized under the original CIP. The non-climate benefits are much greater than what could be achieved through other RE and EE investments.

9. Commercial deployment of EEEVs will expand the urban transport program beyond the original CIP. The replication potential for EEEVs is at least 10 to 1, and is expected to be as high as 20 to 1. CTF cofinancing on this type of pioneer project will eliminate first-mover risk and will help mobilize future commercial investment for replication and scale up.

Table SA31.2: Summary Assessment of CTF Eligibility

CTF Investment Criteria	Proposed EEEVs Project Eligibility
Potential for GHG Emissions Savings	ADB program will target end-use efficiency improvements which represent permanent energy savings via vehicle fleet conversion and avoided fuel imports. Replication and scale-up potential is high for electric vehicles.
Cost-effectiveness	100,000 vehicles will deliver net reduction of 270,000 tCO_2e per year; with 10-year vehicle lifetime total GHG reductions are 2.7 $MtCO_2e$. Replication and scale-up potential is at least 10 to 1 and may be as high as 20 to 1. Cost effectiveness: CTF$105 million / 2.7 million tCO_2e = CTF$38 / tCO_2e, declining to CTF$3.89 / tCO_2e with replication and scale-up of 10 to 1.
Demonstration Potential at Scale	Transformation potential is estimated to be more than 20 for EEEVs (e-trikes) [a]
Development Impact	The EEEVs project will accelerate growth of the electric vehicle industry in the Philippines by demonstrating new technology / systems and business models. Impacts with respect to energy security and environmental benefits are consistent with the CIP. Impacts on employment are significant given the potential benefits accruing to e-trike owner/operators.
Implementation Potential	The EEEVs project has been developed based on a successful pilot project in the Metro Manila region and is at an advanced stage of preparedness. See Table 8 of revised CIP for discussion of implementation risks and mitigation.
Additional Costs and Risk Premium	The proposed project will focus on using CTF for covering additional costs associated with introduction of electric vehicle systems and related new business model for vehicle ownership and operations.

[a] Transformation potential is defined in paragraphs 15 - 17 of the *CTF Investment Criteria for Public Sector Operations* dated 9 February 2009.

[9] The Technology Review, published by MIT, 2007, available at: http://www.technologyreview.com/energy/19069/

10. New investment in electric vehicles will improve energy security, reduce GHG emissions, and reduce conventional pollutant emissions with substantial public health benefits. CTF cofinancing for this type of pioneering project will help mobilize future commercial investments for replication and scale up, which will stimulate economic growth and facilitate the long-term transition to low-carbon development.

11. The EEEVs Project is scheduled for presentation to ADB's Board of Directors in August 2012. The Project enjoys broad stakeholder support due to the success of the pilot project, including consumers, vehicle owners and operators, local, and national government. The President of the Philippines has enthusiastically supported project development and requested that ADB expedite process and approvals. Risks and mitigation measures are outlined in the main text of the RRP as well as in the in revised CIP.

12. Additional costs and risk premiums justify use of CTF. The EEEVs Project is first-of-a-kind in the Philippines, and will be the largest effort in the Asia region to begin electrification of the public vehicle fleet. The cost of new EEEVs with lithium-ion batteries is about $4500, versus about $2000 for conventional trikes with internal combustion engines. This up-front capital cost is offset by lifecycle operating costs of about $2000 for 200,000 kilometers, versus about $10,000 for conventional trikes. The Project presents first-mover risk (mitigated in part by the successful pilot project), and presents higher-than-normal end-user costs with respect to purchase of new vehicles. Although lower operating costs will offset the initial purchase costs, at present there is no mechanism to monetize the life-cycle savings to assist end-users in the initial purchase.

13. Carbon finance is increasingly at risk due to post-2012 market uncertainties. Carbon finance opportunities will be pursued but any revenue is expected to be "on delivery" and will not be sufficient to catalyze up-front investment. ADB expects that the project could qualify for Clean Development Mechanism (CDM) registration, but any carbon revenue would be "on delivery" and would not make a contribution as up-front cofinancing. Potential revenue from sale of emissions reductions is uncertain until registration with the UN, which typically occurs after the project's financial close.

14. Additional discussion about CTF eligibility has been presented in the revised CIP and for brevity's sake is not repeated here. A third party technical review, required by CTF procedures, concluded that the Project meets the CTF eligibility requirements.

C. Pricing and Loan Terms of CTF projects

15. As noted above, at the project or investment program level, the CTF is used to cover the additional costs and/or risks associated with low-carbon investments. For example, fleet-wide conversion to electric vehicles presents an upfront cost barrier in the form of new vehicle procurement. The additional cost can be readily estimated as the difference between capital costs for traditional trikes with internal combustion engine versus the new EEEVs equipped with lithium-ion batteries.[10] The additional risk is presented by introducing a new business model for vehicle ownership and operations, including battery leasing, for the new EEEVs.

16. The loan terms for CTF financing are presented in Table SA31.3. These are the "base" terms for public sector projects. The harder pricing terms and conditions are requested for the proposed EEEVs Project.

[10] The new EEEVs are estimated to cost $4500 per vehicle.

Table SA31.3: Proposed CTF Loan Terms

CTF Loans	Maturity	Grace Period	Principal Repayments Year 11-20	Principal Repayments Years 20-40	FY09-10 MDB Fee [b/]	FY09-10 Interest Rate [c/]	Grant Element [d/]
Harder Concessional	20	10	10%	N/A	0.18%	0.75%	~45%
Softer Concessional	40	10	2%	4%	0.18%	0.25%	~72%

Source: Climate Investment Funds. *Clean Technology Fund Financing Products, Terms, And Review Procedures For Public Sector Operations*, (Revised Document) 15 December 2011.

Notes:

a - CTF Loans May Include An Acceleration Clause, Providing For Doubling Of Principal Payments.

b - The MDB fee will be a variable charge set annually within a range of 0.1%-0.5% of the undisbursed balance of the loan, to be retained by the MDB.

c - The interest is charged on the disbursed and outstanding loan balance. Principal and interest payments accrue semi-annually to the CTF trust fund.

d - Grant element is calculated using the IDA methodology (assumptions: 6.33% discount rate for harder loans; 6.43% discount rate for softer loans; semi-annual repayments; 8-year disbursement period)

Review of the ADB Clean Technology Fund (CTF) Private Sector Proposal:
Thailand Renewable Energy Program

1. Endorsement

I have reviewed the ADB Clean Technology Fund proposal for the Thailand Renewable Energy program.. On the basis of this review, I strongly support and endorse this CTF proposal for the reasons summarized below.

2. Overall Strategy and Consistency with CTF Goals.

The original and updated versions of the CTF Country Investment Plan (CIP) for Thailand integrate the socio-economic and environmental objectives instituted by the Government of Thailand (GoT) within a coherent framework, providing mechanisms to reduce greenhouse gas (GHG) emissions, decrease energy intensity, and enhance energy security. Considerable focus has been given to the utilization of large-scale renewable energy (RE) resources and technologies, particularly in power generation projects initiated by the private sector, as a means to increase energy production and diversify the primary energy mix while minimizing negative impacts to the environment. The proposed Thailand RE Program will contribute significantly to the objectives contained in the sustainable development agenda of Thailand by deploying individual projects expected to generate an additional aggregate capacity amounting to approximately 520MW with a reduction in GHG emissions amounting approximately 843.15 tons carbon dioxide for each megawatt-hour of energy generated.

However, while interest in implementing utility-scale RE projects has increased over the recent years, the local RE market remains in an early development stage. Projects continue to face significant financial and market barriers due in part to perceived risks associated with pioneering projects and the lack of experience with RE project financing amongst local financial institutions. As such, the use of CTF for the direct financing or as guarantees along with support from ADB will address the gap between perceived and actual risks associated in project implementation and provide support to pioneering private sector utility-scale projects. The implementation strategy proposed for the Program, where individual utility-scale RE power development projects will be financed on a non-recourse basis with minimal concessionality, coupled with the possibility of utilizing supplementary regulatory support (feed-in tariffs/tariff adders), standard power purchase agreements with the Electricity Generating Authority of Thailand (EGAT) and the Provincial Electricity Authority (PEA), and potential financing from carbon trading, is expected to demonstrate a replicable project financing method that will assist in building the capacity of project developers and local financial institutions towards RE project development and implementation.

The significant demonstration value and replication potential geared towards the development of RE projects and the acceleration of local RE market development is consistent with the CIP for Thailand and with the objectives the CTF in general.

3. Program Design and Market Development

The Program focuses on the deployment of private sector RE-based generating facilities amounting to an additional aggregate capacity of approximately 520MW, particularly targeting the development of utility-scale solar, wind, and WTE technologies. More broadly, the Program has been designed to establish a track record of completed private sector initiated RE development projects and investments that will minimize perceived risks and further facilitate the participation of the private sector, thus moving the development and transformation of the local RE sector forward to a more mature stage.

The Program will build on the extensive experience of the ADB Private Sector Operations Department (PSOD) in market development and provision of financial support by catalyzing the replication and scale-up of private sector investments. The PSOD combines the use of flexible finance products and structures adapted to the target market and incorporated with other essential support services for marketing and implementation through the entire project cycle for individual projects included in the Program pipeline. As such, the Program will be expected to provide technical assistance, advisory, capacity building, marketing/promotion, and other project development services as necessary on a project-by-project basis, to ensure increased private sector and local financial institution participation and investments founded on market transformation.

4. Readiness of the Market

Given the abundance of RE resources in Thailand, amounting to a total estimated potential of 57,000MW, and the wealth of experience of the GoT in the implementation of demonstration projects and programs focused primarily on small-scale RE power generation, the local RE market continues to be in a nascent stage of development, emerging but failing to make the transition from demonstration to commercially viable projects, particularly with regard to the deployment of utility-scale power generation systems. The primary market barrier lies in the recognition of the dichotomy between perceived risks and actual risks involved in RE power development project implementation, resulting to a lack of access to long-term financing, higher upfront transaction costs associated with first movers in a relatively young market, and additional risk premiums. The application of CTF support for this Program will provide a critical impetus to assist in the reduction of market and financial barriers.

With the GoT committed to sustainable development policy targets, the high availability of RE resources, the availability of CTF co-financing, and the increasing public recognition of climate change impacts in Thailand, the components for accelerating the growth of the local RE market in Thailand appear to be in place.

5. Investment Structure and CTF Fund Utilization

The Program allows CTF funds to be structured primarily as loans or guarantees alongside additional financing support from ADB. The Program provides for the possibility of other investment modalities coming into play depending on the requirements of each project, ensuring additional flexibility in the investment structure and the use of CTF funds.

Direct lending is justified due to the large size of the Program and is expected to provide an incentive to participating financial institutions towards encouraging the expansion of loan provision to local project developers, reducing the upfront transaction costs. In addition, the risk sharing facility to be provided by the Program and adapted to the local market conditions will significantly minimize perceived and actual risks, enhancing the access of project developers to financial support.

6. Risks and Conclusions

The components for successfully implementing the Program appear to be in place. The Program will provide significant demonstration impacts and has a high potential for scale-up and replication within the surrounding region, since it will pioneer the utilization of non-recourse financing for individual projects comprising the Program, which is consistent with the goals of CTF.

The main risks in this program are associated with the capacity of project sponsors, reliability of RE technology, project implementation, and the intermittency of RE resources. These risks appear to be manageable and may be addressed through policy assistance from the GoT.

Signed,

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United States – Progress Report on Fossil Fuel Subsidies

Part 1: Identification and Analysis of Fossil Fuel Provisions

There are a number of tax preferences, described below, available in the United States to producers of fossil fuels. The preferences below are all permanent provisions in the tax code. The annual revenue costs estimated for each provision are taken from the General Explanation of the Administration's Revenue Proposal, sometimes referred to as the Treasury Green Book, which is available here: http://www.treasury.gov/resource-center/tax-policy/Pages/general_explanation.aspx

Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Percentage depletion for oil and gas	Depletion is available to any person having an economic interest in a producing oil and gas property. There are generally two types of depletion--cost and percentage depletion. Cost depletion is limited to the taxpayer's basis in the property, whereas percentage depletion is not limited by the basis, but is subject to limitations based on net income derived from the property and taxable income. Percentage depletion for producing oil and gas property (15 percent rate) is available only to independent producers and royalty owners. For marginal properties, the taxable income limitation is suspended for taxable years ending before January 1, 2012.	Percentage depletion effectively provides a lower rate of tax with respect to a favored source of income. Cost depletion computed by reference to the taxpayer's basis in the property would place oil and gas producers on a cost recovery system similar to that employed by other industries and reduce economic distortions. The lower rate of tax provided by percentage depletion, like other oil and gas preferences the Administration proposes to repeal, distorts markets by encouraging more investment in the oil and gas industry than would occur under a neutral tax system. This market distortion is detrimental to long-term energy security and is also inconsistent with the Administration's policy of supporting a clean energy economy, reducing our reliance on oil, and cutting carbon pollution. Moreover, the tax subsidy for oil and gas must ultimately be financed with taxes that result in underinvestment in other, potentially more productive, areas of the economy.	None Suspension of taxable income limitation for marginal properties expired December 31, 2011.	$1,147

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Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Expensing of intangible drilling costs	Taxpayers may elect to currently deduct intangible drilling costs (IDCs) paid or incurred with respect to the development of an oil or gas property located in the United States. For an integrated oil company that has elected to expense IDCs, 30 percent of the IDCs on productive wells must be capitalized and amortized over a 60-month period.	The expensing of IDCs provides a tax preference to the oil and gas industry. Capitalization of IDCs would place the oil and gas industry on a cost recovery system similar to that employed by other industries and reduces economic distortions. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$1,390
Geological & geophysical expenditures	Geological and geophysical expenditures incurred by independent producers and smaller integrated oil companies in connection with domestic oil and gas exploration may be amortized over 2 years compared to 7 years for major integrated oil companies.	The accelerated amortization of geological and geophysical expenditures incurred by independent producers provides a tax preference to the oil and gas industry. Increasing the amortization period for geological and geophysical expenditures incurred by independent oil and gas producers from two years to seven years would provide a more accurate reflection of their income and more consistent tax treatment for all oil and gas producers. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$140

Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Percentage depletion for hard mineral fossil fuels	Percentage depletion is available for coal and lignite (10 percent rate) and oil shale (15 percent rate). The percentage depletion deduction is generally subject to the alternative minimum tax at a 20 percent rate to the extent it exceeds the adjusted basis of the property. The deduction may not exceed 50 percent of the net income from the mineral property in any year (the "net-income limitation").	Percentage depletion effectively provides a lower rate of tax with respect to a favored source of income. Cost depletion computed by reference to the taxpayer's basis in the property would place these fossil fuel industries on a cost recovery system similar to that employed by other industries and reduce economic distortions. The lower rate of tax provided by percentage depletion distorts markets by encouraging more investment in the fossil-fuel industry than would occur under a neutral tax system. This market distortion is inconsistent with the Administration's policy of supporting a clean energy economy and cutting carbon pollution. Moreover, the tax subsidy for coal and other hard-mineral fossil fuels must ultimately be financed with taxes that result in underinvestment in other, potentially more productive, areas of the economy.	None	$174

Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Royalty taxation of coal	Royalties received on the disposition of coal generally qualify for treatment as long-term capital gain and the royalty owner does not qualify for percentage depletion with respect to the coal. This treatment does not apply unless the taxpayer has been the owner of the mineral in place for at least one year before it is mined. The treatment also does not apply to income realized as a co-adventurer, partner, or principal in the mining of the mineral or to certain related party transactions.	The capital gain treatment of coal and lignite royalties provides a tax preference to these fossil fuel industries. Treating royalties as ordinary income would place taxpayers in that industry on a cost recovery system similar to that employed by other industries and reduce economic distortions. See percentage depletion for hard mineral fossil fuels for further analysis of the effects of fossil fuel tax preferences.	None	$42
Expensing of exploration and development costs for hard mineral fuels.	Mining companies may elect to deduct 70 percent of domestic exploration and development costs. The 30 percent of expenses that cannot be deducted must be capitalized and amortized over a 60-month period. Taxpayers may also elect to capitalize mine exploration and development expenses and amortize them over a 10-year period. If this election is made, the expenses will not be tax preference items under the alternative minimum tax.	The expensing of exploration and development costs relating to coal and other hard mineral fossil fuels provides a tax preference to the these fossil fuel industries Capitalization of exploration and development costs relating to coal and other hard mineral fossil fuels would place taxpayers in that industry on a cost recovery system similar to that employed by other industries and reduce economic distortions. See percentage depletion for hard mineral fossil fuels for further analysis of the effects of fossil fuel tax preferences.	None	$44

Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Passive loss exception for working interests in oil and gas properties	The passive loss rules limit deductions and credits from passive trade or business activities. Deductions attributable to passive activities, to the extent they exceed income from passive activities, generally may not be deducted against other income, such as wages, portfolio income, or business income that is not derived from a passive activity. A similar rule applies to credits. Suspended deductions and credits are carried forward and treated as deductions and credits from passive activities in the next year. An exception is provided, however, for any working interest in an oil or gas property that the taxpayer holds directly or through an entity that does not limit the liability of the taxpayer with respect to the interest.	The special tax treatment of working interests in oil and gas properties provides a tax preference to the oil and gas industries. Eliminating the working interest exception would subject oil and gas properties to the same limitations as other activities and reduce economic distortions. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$8
Deduction for tertiary injectants	Taxpayers engaged in petroleum extraction activities may generally deduct qualified tertiary injectant expenses incurred while applying a tertiary recovery method.	The deduction for tertiary injectants provides a tax preference to the oil and gas industries. Capitalization of tertiary injectants would place the oil and gas industry on a cost recovery system similar to that employed by other industries and reduces economic distortions. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$10

Tax Provision	Description	Analysis	Expiration	Annual Revenue Cost (millions of $)[1]
Enhanced oil recovery (EOR) credit	Provides a 15 percent credit for expenses associated with an EOR project. Currently phased out due to high oil prices. An EOR project is generally a project that involves the use of one or more tertiary recovery methods to increase the amount of recoverable domestic crude oil.	The credit provides a tax preference to the oil and gas industries. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$0
Marginal wells credit	Production credit ($3-per-barrel of oil or $0.50-per-1,000-cubic-feet adjusted for inflation from 2004) for marginal wells or wells that have an average daily production of not more than 25 barrels per day. Currently phased out due to high oil prices.	The credit provides a tax preference to the oil and gas industries. See percentage depletion for oil and gas for further analysis of the effects of fossil fuel tax preferences.	None	$0
Domestic manufactur-ing deduction for fossil fuels	A deduction is allowed with respect to income attributable to domestic manufacturing and production activities. This deduction is widely available and not targeted at fossil fuel industries. The manufacturing deduction is equal to 6 percent of the lesser of qualified production activities, limited to 50-percent of the W-2 wages of the taxpayer. For taxable years beginning after 2009, the deduction is computed at a 9 percent rate, except that the deduction for income from oil and gas production activities is computed at a 6 percent rate.	The manufacturing deduction, which is widely available, effectively provides a lower rate of tax for income from certain activities, including the production of fossil fuels. This lower rate of tax distorts markets by encouraging more investment in the fossil fuel industries than would occur under a neutral tax system. This market distortion is detrimental to long-term energy security and is also inconsistent with the Administration's policy of supporting a clean energy economy, reducing our reliance on oil, and cutting carbon pollution. The manufacturing deduction must ultimately be financed with taxes that result in underinvestment in other potentially productive areas of the economy.	None	$1,188

[1] Nominal annual average figure based on the U.S. FY2013 Budget 10-year revenue estimate.

There is one consumption subsidy that is funded by the federal government in the United States. It is targeted at low-income households, and benefits are typically dispersed as a lump sum credit on a household's utility bill. Because the program is a targeted transfer that helps low-income households obtain essential energy services and does not encourage wasteful consumption, this program is not proposed for phase-out. Further information about the program can be obtained at: www.acf.hhs.gov/programs/liheap and http://liheap.ncat.org/

Consumption Subsidy	Description	Analysis	Expiration	Annual Cost
Low Income Home Energy Assistance Program (LIHEAP)	A discretionary block grant awarded to States, territories, and tribes and tribal organizations to provide home heating and cooling[1] energy assistance to low-income households. Grantees may use a portion of their LIHEAP funds for low-cost residential weatherization services and for program administration. Federal guidelines limit eligibility to households with incomes up to 150% of poverty or 60% of State median income[2]. The program typically reaches a small share (less than 20%) of eligible households and offsets a portion of participants' home heating and cooling expenses. In FY 2008, the average LIHEAP heating benefit (heating and winter crisis benefits combined) was $363, representing 43% of average home heating expenditures for LIHEAP households..[3]	LIHEAP assistance is targeted to vulnerable households (those with elderly, disabled or young children) and to the poorest (those with the highest energy burdens relative to their income). These households are targeted as they may face serious health and safety risks if they do not have adequate heating and cooling in their homes. Health risks can include death from hypothermia or hyperthermia and increased susceptibility to strokes and heart attacks. Safety risks may include the use of makeshift or faulty heating and cooling sources that can lead to indoor fires, sickness, or asphyxiation.[4] In FY 2008, 32% of LIHEAP households had an elderly member, 32% included a disabled member, and 21% had a child under 5 years old.[3] The average energy burden among LIHEAP recipient households was 17%, compared to 14% among all low-income households.[5]	Authorization expired at the end of FY 2007. Congress continues to provide annual appropriations.	$3,472 million for FY 2012

[1] Home heating and cooling accounts for about 42 percent of residential energy expenditures among low-income households. Source: LIHEAP Home Energy Notebook for Fiscal Year 2009, page ii.

[2] States have the flexibility to set lower income limits, define "income," and adopt other eligibility criteria within Federal guidelines (e.g. asset tests, living in non-subsidized housing, elderly, young child in household, utility disconnection notice).

[3] From LIHEAP Report to Congress for Fiscal Year 2008: Executive Summary, page vi. FY 2008 figures are from the most recent publically available report to Congress on LIHEAP.

[4] From LIHEAP Report to Congress for Fiscal Year 2006: Appendix E, page 86.

[5] From LIHEAP Report to Congress for Fiscal Year 2008, page 20.

Part 2: Implementation Strategies and Timeframes For Phase-Out of Fossil Fuel Tax Provisions

Tax Provision	Strategy and Timeframe	Implementation
Percentage depletion for oil and gas	The Administration's Fiscal Year 2013 Budget proposal would not allow percentage depletion with respect to oil and gas wells. Taxpayers would be permitted to claim cost depletion on their adjusted basis, if any, in oil and gas wells. The proposal would be effective for taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Expensing of intangible drilling costs	The Administration's Fiscal Year 2013 Budget proposal would not allow expensing of intangible drilling costs and 60-month amortization of capitalized intangible drilling costs would not be allowed. Intangible drilling costs would be capitalized as depreciable or depletable property, depending on the nature of the cost incurred, in accordance with the generally applicable rules. The proposal would be effective for costs paid or incurred after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Geological & geophysical expenditures	The Administration's Fiscal Year 2013 Budget proposal would increase the amortization period from two to seven years for geological and geophysical expenditures incurred by independent producers in connection with all oil and gas exploration in the United States. The proposal would be effective for amounts paid or incurred after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Percentage depletion for hard mineral fossil fuels	The Administration's Fiscal Year 2013 Budget proposal would not allow percentage depletion with respect to coal and other hard mineral fossil fuels. Taxpayers would be permitted to claim cost depletion on their adjusted basis, if any, in coal and other hard mineral fossil fuel properties. The proposal would be effective for taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Royalty taxation of coal	The Administration's Fiscal Year 2013 Budget proposal would repeal capital gain treatment of coal and lignite royalties and the royalties would be taxed as ordinary income. The proposal would be effective for amounts realized in taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Expensing of exploration and development costs for hard mineral fuels.	The Administration's Fiscal Year 2013 Budget proposal would not allow expensing and 60-month amortization of exploration and development costs relating to coal and other hard mineral fossil fuels. The costs would be capitalized as depreciable or depletable property, depending on the nature of the cost incurred, in accordance with the generally applicable rules. The proposal would be effective for costs paid or incurred after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.

Tax Provision	Strategy and Timeframe	Implementation
Passive loss exception for working interests in oil and gas properties	The Administration's Fiscal Year 2013 Budget proposal would repeal the exception from the passive loss rules for working interests in oil and gas properties. Deductions attributable to passive activities in oil and gas properties, to the extent that they exceed income from passive activities, generally could not be deducted against other income. The proposal would be effective for taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Deduction for tertiary injectants	The Administration's Fiscal Year 2013 Budget proposal would not allow the deduction for qualified tertiary injectant expenses. These costs would be capitalized as depreciable or depletable property, depending on the nature of the cost incurred, in accordance with the generally applicable rules. The proposal would be effective for amounts paid or incurred after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Enhanced oil recovery (EOR) credit	The Administration's Fiscal Year 2013 Budget proposal would repeal the investment tax credit for enhanced oil recovery projects beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Marginal wells credit	The Administration's Fiscal Year 2013 Budget proposal would repeal the production tax credit for oil and gas from marginal wells in taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.
Domestic manufacturing deduction for oil fossil fuels	The Administration's Fiscal Year 2013 Budget proposal would exclude from the definition of domestic production gross receipts all gross receipts derived from the sale, exchange or other disposition of oil, natural gas or a primary product thereof and of coal, other hard mineral fossil fuels, or a primary product thereof for taxable years beginning after December 31, 2012.	The U.S. Congress must pass enabling legislation for this proposal to become law.

Part 3: Current Status of Phase-Out Strategies

Tax Provision	Actions Implemented to Date	Remaining Actions to Fully Implement Phase-Out
Percentage depletion for oil and gas	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Expensing of intangible drilling costs	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Geological & geophysical expenditures	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Percentage depletion for hard mineral fossil fuels	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Royalty taxation of coal	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Expensing of exploration and development costs for hard mineral fuels	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Passive loss exception for working interests in oil and gas properties	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Deduction for tertiary injectants	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Enhanced oil recovery (EOR) credit	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Marginal wells credit	None	The U.S. Congress must pass enabling legislation for this proposal to become law.
Domestic manufacturing deduction for fossil fuels	None	The U.S. Congress must pass enabling legislation for this proposal to become law.