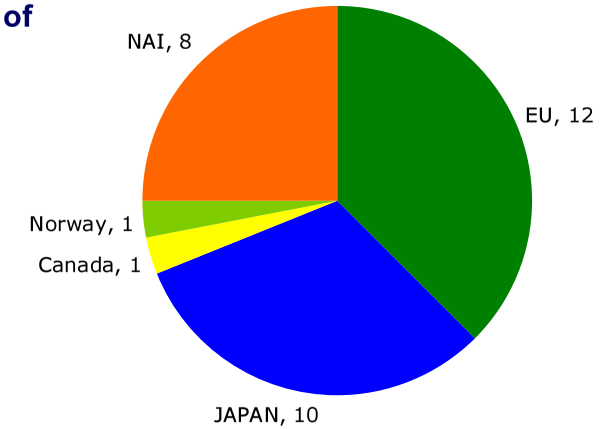
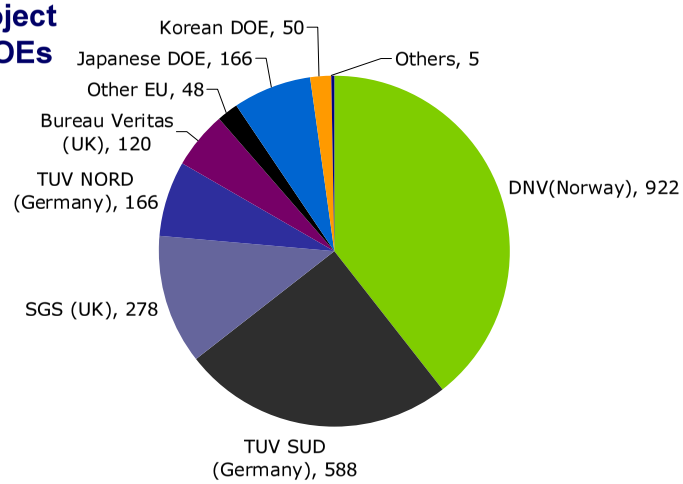
Present status of DOEs (2)

Numbers of DOEs (2)



Present status of DOEs (3)

Registered project numbers by DOEs



What is "VALIDATION & VERIFICATION"?

- Definition of Validation
  - the process of independent evaluation of a project activity against the requirements of the CDM on the basis of the PDD. [CMP/2005/8/Ad1, p14 para35]
- Definition of Verification
  - the periodic independent review and ex post-determination of the monitored GHG emission reductions. [CMP/2005/8/Ad1, p18 para61]

Validation and verification are carried out by a designated operational entity (DOE)

What is "VVM"?

VALIDATION AND VERIFICATION MANUAL(VVM)

- approved by CDM-EB at forty-fourth meeting(EB44), revised at EB55
- provides requirements to DOEs for their validation and verification work
- promotes quality and consistency in the preparation of their validations and verification reports

DOEs shall follow this Manual and shall integrate its provisions

Example of current reasons of request for review and rejected

- The DOE shall explain how it has validated the project emissions from processing the briquettes and pellets in the manufacturing facilities in line with VVM version 01.1 para 76. (request for review)
- The DOE should clarify how it has validated the common practice analysis in line with VVM para. 120 (c). (request for review)
- project participants and the DOE (DNV) have failed to substantiate that the methodology has been correctly applied in line with the requirements of VVM version 1.1, paragraph 70, (rejected)

Example of current reasons of request for review and rejected (detail info)

- The DOE shall explain how it has validated the project emissions from processing the briquettes and pellets in the manufacturing facilities in line with VVM version 01.1 para 76. (request for review)
- Project Title; Filmax Biomass Thermal Energy Project (Ref No. 3004)
- Host country; Malaysia
- Annual Emission Reduction; 22144 t-CO2
- Request for Review submitted at EB54

Example of current reasons of request for review and rejected (detail info)

- VVM version 01.1 para 76
  - For each applicability condition listed in the approved methodology selected, the DOE shall clearly describe in the validation report the steps taken to assess the relevant information contained in the PDD against these criteria.
  - The validation report shall include an unambiguous validation opinion regarding the applicability of the selected methodology to the proposed CDM project activity.
- Finally, This project was registered.

Example of current reasons of request for review and rejected (detail info)

- The DOE should clarify how it has validated the common practice analysis in line with VVM para. 120 (c). (request for review)
- Project Title; Hunan Xiaotan Hydropower Project (2842)
- Host Country; China
- Annual Emission Reduction; 76790 t-CO2
- Request for Review submitted at EB54

Example of current reasons of request for review and rejected (detail info)

- VVM version para 120
  - (c) If similar and operational projects, other than CDM project activities, are already "widely observed and commonly carried out" in the defined region, assess whether there are essential distinctions between the proposed CDM project activity and the other similar activities.
- Finally, This project was registered.

Example of current reasons of request for review and rejected (detail info)

- project participants and the DOE (DNV) have failed to substantiate that the methodology has been correctly applied in line with the requirements of VVM version 1.1, paragraph 70, (rejected)
- Project Title; Cimentos do Mozambique – Matola Gas Company Fuel Switch Project (3048)
- Host Country; Mozambique
- Annual Emission Reduction; 37153 t-CO2

Example of current reasons of request for review and rejected (detail info)

- VVM version para 70
  - The DOE shall determine whether the methodology is correctly quoted and applied by comparing it with the actual text of the applicable version of the methodology available on the UNFCCC CDM website.
- This project was rejected at EB55

Contents of VVM

Important Points of VVM: Validation -Methods of Validation-

The DOE shall apply standard auditing techniques to assess the correctness of the information provided by the project participants using following methods;

- Document review
- Follow-up actions (e.g. on site visit and telephone or email interviews),
- Reference to available information relating to projects or technologies similar to the proposed CDM project activity under validation
- Review of the appropriateness of formulae and correctness of calculations.

Important Points of VVM: Validation - CAR -

35. The DOE shall raise a corrective action request (CAR) if one of the following occurs:

(a) The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;

(b) The CDM requirements have not been met;

(c) There is a risk that emission reductions cannot be monitored or calculated.

Important Points of VVM: Validation - CAR - (example)

- Actual example of CAR 1
  - The project participants demonstrated the additionality of the project by means of "investment analysis". However, it is not sufficient and should be further elaborated and corrected.

Important Points of VVM: Validation - CAR - (example)

- Project owner response to CAR 1
  - Major barriers against the project realization is substantiated through an investment analysis with supported evidences such as high initial cost of co-generation system, low price of grid electricity and so on.
  - IRR of the project without CER revenue turned out to be 9.5%, then this value is obviously lower than the benchmark interest rate of 12.8%. When CER revenue is considered, the IRR value is expected to be 15.5% and go up beyond the benchmark.

Important Points of VVM: Validation - CAR - (example)

- Actual example of CAR 2
  - The project starting date is 10 January 2008 and expected operational lifetime is 30 years. The type of the starting date should be clarified. Evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

Important Points of VVM: Validation - CAR - (example)

- Project owner response to CAR 2
  - "Purchase requisition & order of the gas turbine of co-generation system" that was issued on March 5, 2008 is considered as the first actual implementation of the project activity and an evidence for the project starting date.
  - Based on a detailed feasibility study report, the management board of the project owner finally decided to invest in the project under the CDM scheme at January 10, 2008. This is considered as an evidence for the CDM prior consideration before the project starting date.

Important Points of VVM: Validation - CL and FAR -

36. The DOE shall raise a clarification request (CL) if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

37. The DOE shall raise a forward action request (FAR) during validation to highlight issues related to project implementation that require review during the first verification of the project activity. FARs shall not relate to the CDM requirements for registration.

Important Points of VVM: Validation -Compatibility with methodologies-

The DOE shall ensure that the baseline and monitoring methodologies selected by the project participants comply with the methodologies previously approved by the CDM Executive Board

(a) Project boundary;
(b) Baseline identification;
(c) Algorithms and/or formulae used to determine emission reductions;
(d) Additionality
(e) Monitoring methodology

Important Points of VVM: Validation -Compatibility with methodologies 1-

Baseline identification

The DOE shall determine whether the baseline scenario identified is reasonable by validating the assumptions, calculations and rationales used, as described in the PDD.

- All the assumptions and data including their references and sources;
- All documentation used is relevant for establishing the baseline scenario and correctly quoted and interpreted;
- Assumptions and data supported by evidence and can be deemed reasonable;
- Relevant national and/or sectoral policies and circumstances are considered and listed

Important Points of VVM: Validation -Compatibility with methodologies 2-

Algorithms and/or formulae used to determine emission reductions

The DOE shall verify the justification given in the PDD for the choice of data and parameters used in the equations.

- All assumptions and data are including their references and sources
- All documentation is correctly quoted and interpreted
- All values used in the PDD are considered reasonable
- The baseline methodology has been applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions;
- All estimates of the baseline emissions can be replicated using the data and parameter values provided

Important Points of VVM: Validation -Additionality of a project activity-

Prior consideration of the CDM

The DOE shall confirm that the start date of the project activity

- Describe the DOE's validation of the project activity start date
- Describe the evidence for prior consideration of the CDM (if necessary) that was assessed
- Provide a clear validation opinion regarding whether the proposed CDM project activity complies with the requirements of the latest version of the Guidance on prior consideration of CDM

Important Points of VVM: Validation -Additionality of a project activity-

Investment analysis

The PDD shall provide evidence that the proposed CDM project activity would not be:

- The most economically or financially attractive alternative; or
- Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs)

Important Points of VVM: Validation -Additionality of a project activity-

Reporting requirements

- Describe in detail how the parameters used in any financial calculations have been validated;
- Describe how the suitability of any benchmark applied has been assessed;
- Confirm whether the underlying assumptions are appropriate and the financial calculations are correct

Important Points of VVM: Validation -Monitoring plan-

The DOE shall apply a two-step process to assessing compliance with this requirement, as follows;

- Compliance of the monitoring plan with the approved methodology
- Implementation of the plan

Important Points of VVM: Validation -Monitoring plan-

Reporting requirements

- State the DOEs opinion of the compliance of the monitoring plan with the requirements of the methodology;
- Describe the steps undertaken to assess whether the monitoring arrangements described in the monitoring plan are feasible within the project design;
- State the DOEs opinion of the project participants ability to implement the monitoring plan

Important Points of VVM: Verification -Methods of Verification-

The DOE shall apply standard auditing techniques to assess the quality of the information,

- Desk review
- On-site assessment

The DOE shall ensure that there is a clear audit trail that contains the evidence and records that validate or invalidate the stated figures.

Important Points of VVM: Verification
-Compliance of monitoring with the monitoring plan-

Monitoring of reductions in GHG emissions shall be implemented in accordance with the monitoring plan

- All parameters have been sufficiently monitored and updated as applicable
- The accuracy of equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan

Conclusion

- In order to register CDM project candidate, PPs have to provide appropriate evidences and relevant transparent data to DOE based on correct understanding of VVM.
- In order to get CERs of CDM project, PPs have to monitor and record relevant activities according to the Monitoring Plan of in the PDD, and to provide the report to DOE based on correct understanding of VVM.

GHG Mitigation Measures in Waste Sector

23, November, 2010

Deputy chief advisor of JICA Expert Team
Kazuhito YAMADA

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Today's Agenda

- What is "GHG mitigation measures"?
- Anthropogenic GHG emissions in Thailand
- How to mitigate anthropogenic GHG emissions in each sector?
- GHG mitigation measures in waste sector
  - GHG emissions characteristics in Thailand and Japan
  - Major GHG mitigation measures in Thailand
  - Quantitative estimation of major GHG mitigation measures
- Exercises

What is "GHG mitigation measures"?

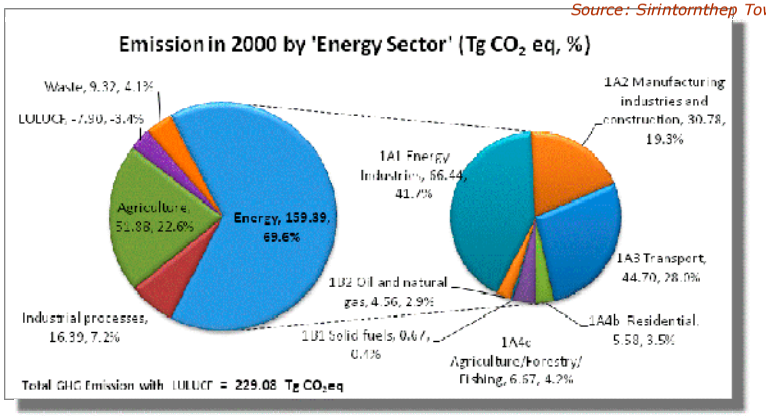
- Climate change **mitigation** is action to **decrease the intensity of radiative forcing** in order to reduce the potential effects of global warming;
- Mitigation may be achieved through the **reduction of GHG emissions** or through the **enhancement of sinks** that absorb GHGs, e.g., forests.

Source: Climate Change, Wikipedia

- It can be translated that "GHG mitigation measures " is the activities to reduce anthropogenic GHG emissions from **superfluous or savable human activities**.

Anthropogenic GHG emissions in Thailand

Source: Sirintornthep Towprayoon et al



- All sectors are related to anthropogenic GHG emissions.

How to mitigate GHG emissions in the sector?

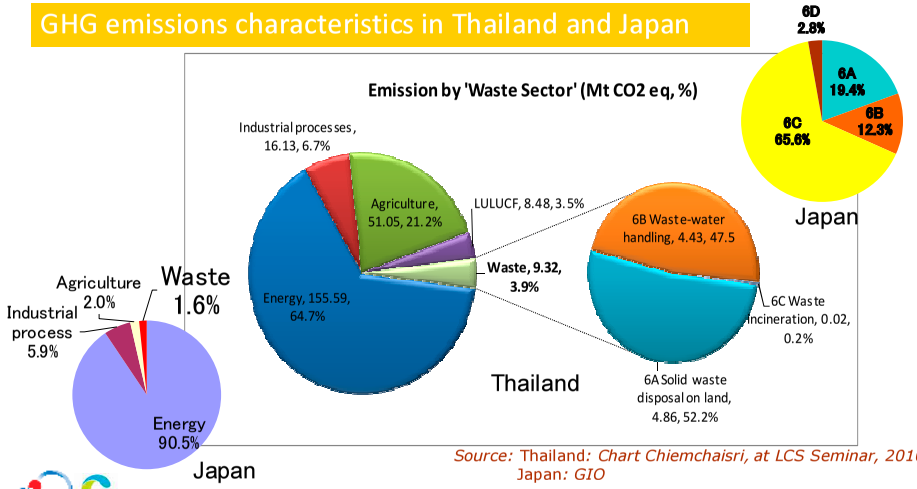
- Identify **main GHG emission sources** in the sector;

  Some activities in the sector will be related to GHG emissions, but some activities will be unrelated to them.
- Select **practical GHG mitigation measures** in the sector;

  If GHG emission sources are different, the mitigation measures may be different.
- Identify possible **financial resources** for the measures;
- Consider **possible schedule** for implementing the measures.

GHG mitigation measures in Waste Sector

GHG emissions characteristics in Thailand and Japan



Source: Thailand: Chart Chiemchaisri, at LCS Seminar, 2010
Japan: GIO

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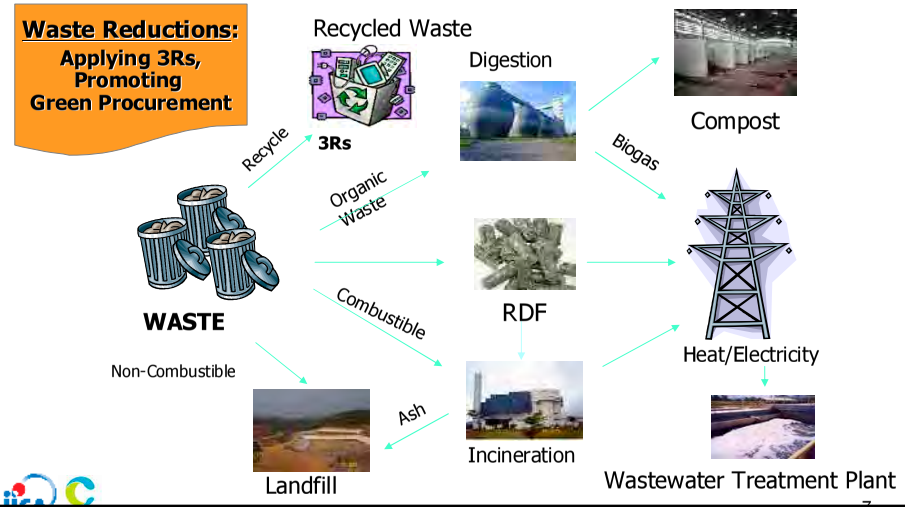
for your reference

Source: Rangsan Pinthong, PDC, at LCS Seminar, 2010

WTE Strategic Approaches



Integrated Waste Management System Specifically for Generating Renewable Energy

for your reference

Source: Rangsan Pinthong, PDC, at LCS Seminar, 2010

Criteria to Develop Cluster Size

Cluster Size	*Waste Loading to System (T/d)*
Large Cluster	*> 500*
Medium Cluster	
M1	***250 - 500***
M2	***100 - 250***
M3	***50 - 100***
Small Cluster	*< 50*

for your reference

Appropriate Technologies

L	Sorting + Bio-conversion Process + Incineration + Landfill
M1	Sorting + Anaerobic Digestion + Gasification/Pyrolysis/ Stoker Incineration + Landfill
M2	Sorting + Bio-conversion Process + Pyrolysis/ Gasification + Landfill
M3	Sorting + Bio-conversion Process + Pyrolysis/ Gasification + Landfill
S	Sorting + Bio-conversion Process + Landfill

Pollution Control Department

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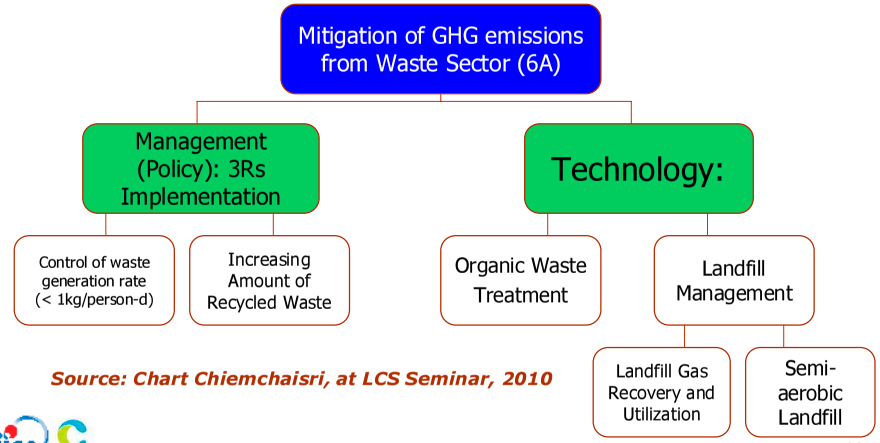
GHG mitigation measures in Waste Sector

Mitigation of GHG Emission from Waste Sector (6A)



Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

Potentials and Limitations of GHG Mitigation Technology Options

Option	Potentials	Limitation/constraints
Organic waste treatment	- High fraction of organic wastes/ moisture - Possible for both on-site and centralized application	- Poor segregation/ upstream management - Lack of public participation/ interest from local authorities
LFG recovery	- Pre/post construction possible -Financial return from electricity generation	- Economically feasible only in large landfills - Low yield and unreliable gas production in uncontrolled /poor operation
Semi-aerobic Landfill	- Simple operation - Low investment cost	- Facilitating aeration into landfill under extremely wet condition (?)

Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

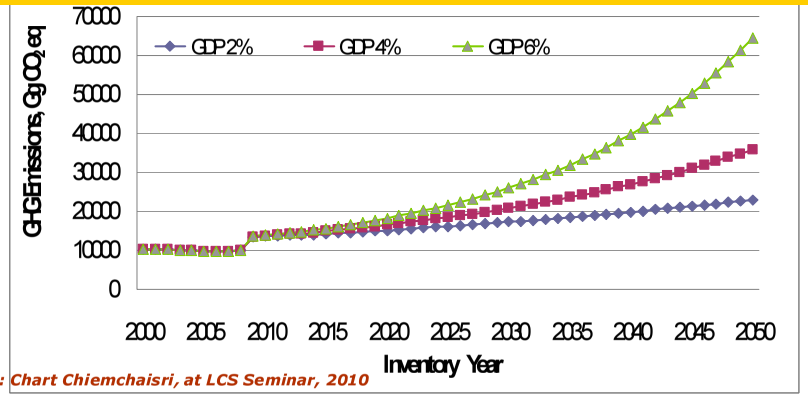
Assumption for Evaluation of GHG Emissions Reduction from Mitigation Measures

Policy	- Prevention	Control of waste generation < 1 kg/person-d
	- Recycling	Separation of usable and recyclable materials - Constant recycling rate of 30% - Increasing recycling rate (projection from current increasing trend)
Technology	Organic waste treatment (AD, Composting)	- Increasing trend to 30% of total waste amount - Technology combination (target: 70% composting 30% AD)
	LFG utilization	- Applied in large landfills (> 1 million tons of accumulated MSW) – 5 potential sites in 2005 assumed 75% recovery
	Semi-aerobic Landfill	- For other small and medium sized landfills where LFG utilization is not feasible assumed 50% GHG reduction

Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

Thailand's GHG emissions: BaU scenario (6A Solid Waste disposal on land)

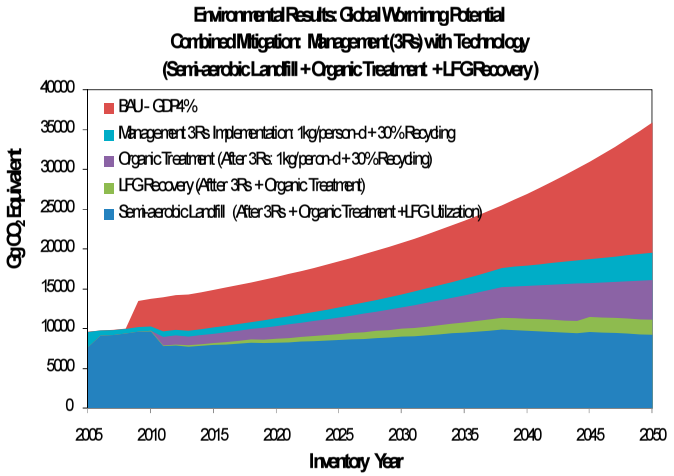


Source: Chart Chiemchaisri, at LCS Seminar, 2010

Remark: 1. based on GDP growth rate of 4% 2. MCF: LF=1.0, OD = 0.4
3. DOC = 0.14, DOC_F = 0.77 4. F= 0.53
5. R= 0 6. OX: LF = 0.17, OD = 0

GHG mitigation measures in Waste Sector

Thailand's project GHG emissions (from 6A): BaU vs mitigation options



Source: Chart Chiemchaisri, at LCS Seminar, 2010

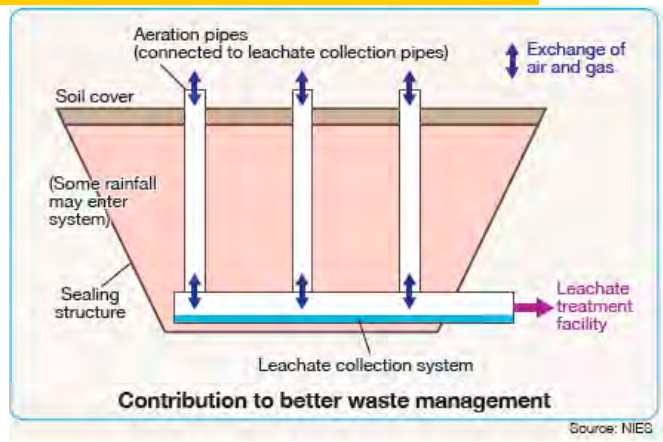
GHG mitigation measures in Waste Sector

Semi-aerobic landfill system

- Many developing countries are facing increasing waste management challenges.
- Open dumping and poorly managed landfill sites cause **serious environmental problems**, such as the release of odors, toxic leachate, and CH_4 emissions.
- The **semi-aerobic** "Fukuoka Method" developed in Japan is an economically viable and effective way to manage landfill sites.
- This method has multiple benefits, including the reduction of local environment impacts (odors, toxic leachate, etc.), stabilization of landfill sites, and reduction of CH_4 emissions.

GHG mitigation measures in Waste Sector

Semi-aerobic landfill system



GHG mitigation measures in Waste Sector

Semi-aerobic landfill system

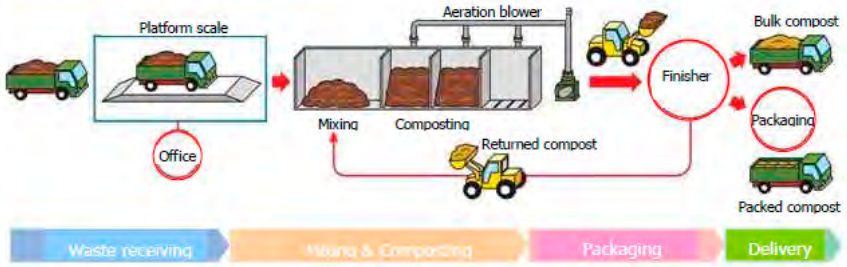
GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes

- The "**YM Aerobes**" including 16 bacterial species have developed by Japanese private company "San-Yuu" and performs key role in composting process.
- The temperature can reach not less than **100 degrees Celsius** in the central part of compost pile by YM Aerobes (General compost aerobes can reach around 70 degrees Celsius most). YM composting process can treat sewerage sludge, livestock manure, scallop waste , and municipal waste.

GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes



GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes

Mixing of received waste and returned compost including YM Aerobes. Both solid and liquid form organic waste can be decomposed.

Adjustment of temperature and moisture can be conducted by aeration operation for YM Aerobes' active fermentation

Turning over of compost pile by wheel loader is carried out during around 45 days corresponding to 6-7 times of turning over until composting process completion.

Completely processed compost with around 30 % moisture content is screened and packed for compost product delivery, or used for compost returning to next operation.

GHG mitigation measures in Waste Sector

MRV: Measurement

- CH_4 emissions from landfill site can not measure by in-situ analysis because the emissions may occur from vast area of the site.
- Therefore, we have a simple empirical formula with default parameters named "**First Order Decay** model (**FOD**)" to estimate CH_4 emissions from landfill site. This formula is used in many CDM methodologies.

GHG mitigation measures in Waste Sector

MRV: Measurement

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j (y-x)} \cdot (1-e^{-k_j})$$

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	=	Model correction factor to account for model uncertainties (0.9)
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	=	Decay rate for the waste type *j*
j	=	Waste type category (index)
x	=	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	=	Year for which methane emissions are calculated

You need to measure only this item.

GHG mitigation measures in Waste Sector

Exercise:

How to implement the " Waste to Energy" as a urgent GHG mitigation measures in Waste Sector?

- **What is the possible waste as a resource?**
- **Who are implementers?** municipalities/government/private companies?
- **How to implement the mitigation measures?**

  Possible tools: LFG collection and utilization/ composting/ incineration/semi-aerobic landfill/anaerobic digestion/RDF/etc.
- **What is the role of TGO?**

GHG 8 &9
GHG Mitigation Measures in Energy and Industry Sectors

18 January, 2011

Eiko Watatsu, Tetsuya Yoshida
JICA Expert Team

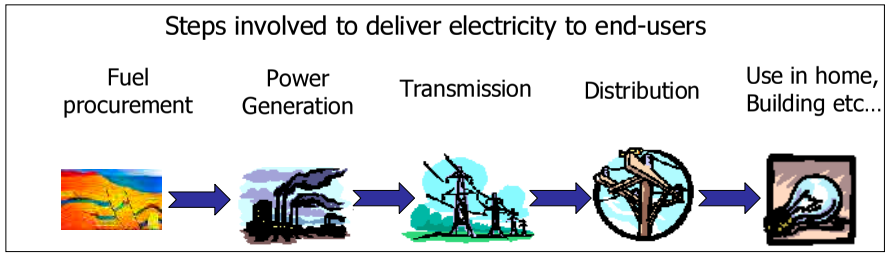
Energy Sector

Contents

- Introduction
- Characteristics of GHG missions from energy supply sector
- Mitigation Measures/Options in Energy supply sector
- Conclusion

Introduction

- Energy-related GHG emissions are a by-product of the conversion and delivery sector as well as the energy end-use sectors. (transport, buildings, industry, agriculture, forestry and waste)



Characteristics of GHG emissions in Energy Sector (WG.3, IPCC-AR4)

- Annual total greenhouse gas (GHG) emissions arising from the global energy supply sector continue to increase.
- Without the near-term introduction of supportive and effective policy actions by governments, energy related GHG emissions, mainly from fossil fuel combustion, are projected to rise by over 50% from 26.1 GtCO2eq (7.1 GtC) in 2004 to 37–40 GtCO2 (10.1–10.9 GtC) by 2030.
- Energy access for all will require making available basic and affordable energy services using a range of energy resources and innovative conversion technologies while minimizing GHG emissions, adverse effects on human health, and other local and regional environmental impacts.

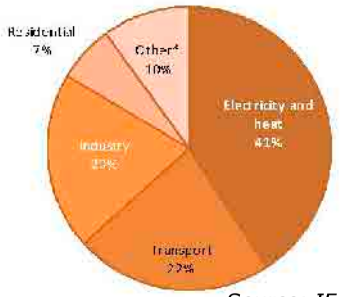
Status of sector (1)

-Energy-related GHG emission-

- Currently, energy-related GHG emissions, mainly from fossil fuel combustion for heat supply, electricity generation and transport, account for around 70% of total emissions.

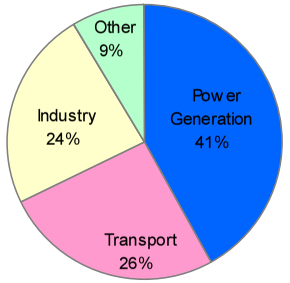
CO2 emissions by sector in 2008

- World -



Source: IEA

- Thailand -



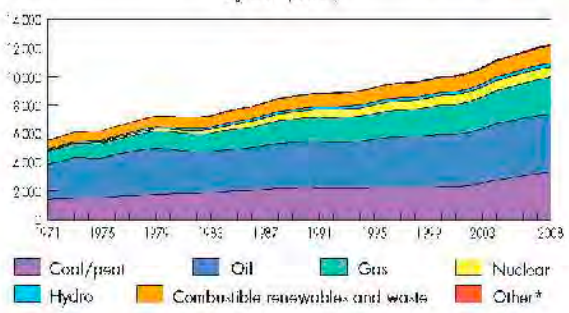
Source:EPPO

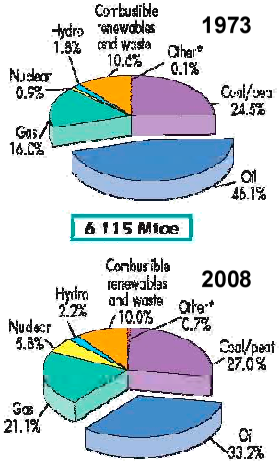
Status of sector (2)

- World Energy Supply -

- Fossil fuels provide almost 80% of World energy supply.

Evolution from 1971 to 2008 of world total primary energy supply by fuel (Mtoe)





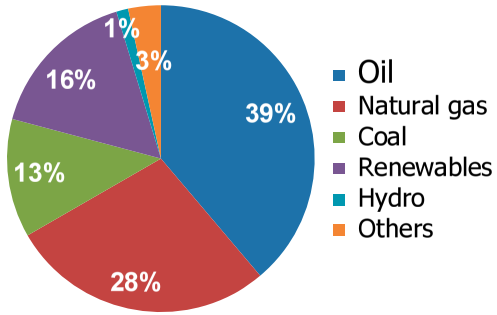
Source: IEA

Status of sector (3)

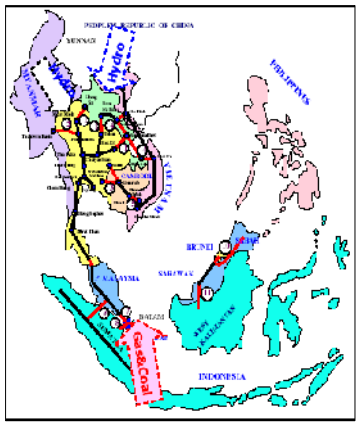
- Energy supply in Thailand -

- Natural gas use are promoted to use in Thailand.

Primary Energy Supply in 2008 (119,346 ktoe)



Source: LCS seminar



Comparison of value of by-product in fossil fuel combustion

Coal = 100

	Coal	Oil	Natural gas
CO_2 1)	100	80	57
So_x 1)	100	68	0
NO_x 2)	100	71	20-37

Source: 1) IEA, 2) The Institute of Applied Energy (IAE)

Keywords for GHG mitigation in energy sector (WG.3, IPCC-AR4)

- Fossil fuels
- Nuclear energy
- Renewable energy
- Energy carriers / Transmission, distribution, and storage
- Combined heat and power (CHP)
- Carbon dioxide capture and storage (CCS)
- Decentralized energy

Which options are suitable for Thailand?

Key Energy and Climate Security Challenges in Thailand

Reality – energy consumption and GHG emission will continue to grow with economic development

- Reducing energy intensity (Energy consumed / GDP)
- Reducing import dependence (currently > 50%)
- Mitigating energy price impacts without undue subsidies
- Reducing dependence on natural gas for power generation (currently 70%)
- Reducing reliance on fossil fuels (>80% for energy, and 90% for electricity)
- Increasing access to modern and clean energy in the rural sector

Source: LCS seminar

Option 1 Improving fuel type and efficiency in power generation

- Lowering carbon intensity in power generation
  - Increasing share of renewables
  - Introducing nuclear
  - Improving energy efficiency in power generation
    - Introducing modern high-efficiency technology, such as CCGT, USC, IGCC

Thailand Power Development Plan (PDP2010)

- Lowering carbon intensity in power generation from 0.47 to 0.37 $kgCO_2/kWh$ by 2030.
  - Introducing nuclear 11% (5,000 MW)
  - Renewables 6%
  - Hydro (import) 19%

Fuel type	2008	Share in 2030 BAU	Share in 2030 CM
Natural gas	66.0	71.4	39.0
Oil	2.0	6.6	-
Coal	21.5	15.1	23.6
Hydro	7.2	4.4	20.5
Nuclear	-	-	11.2
Renewable energy	1.7	2.5	5.7

Source: PDP 2010

Grid emission factors of Asian-Pacific countries

Country	Grid emission factor (kgCO2/kWh)	source
China	0.773 - **0.927**	Government (3/9/2009)
India	0.850 - 0.890	Government (1/11/2009)
Indonesia	0.743 - 0.891	Government (13/2/2009)
Malaysia	0.651 - 0.825	Government (1/3/2010)
Thailand	0.5812	Government (TGO)
Korea	0.610	Registered CDM (18/4/2010)
Vietnam	0.510	Registered CDM (2/4/2010)
Philippine	**0.482**	Registered CDM (4/9/2009)

CCGT; Combined Cycle, Gas Turbine

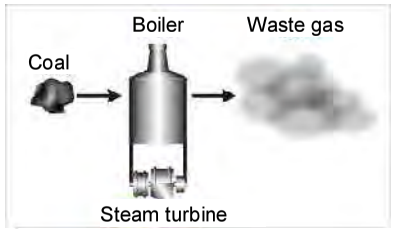
- CCGT plants produce less CO2 per unit energy output than coal or oil technologies .

Registered CDM projects of AM0029

Country	Number of projects	Reductions
China	22	23,188,667
India	6	4,112,265
Indonesia	2	29,836
The former Yugoslav Republic of Macedonia	1	54,623
Total	31	27,385,391

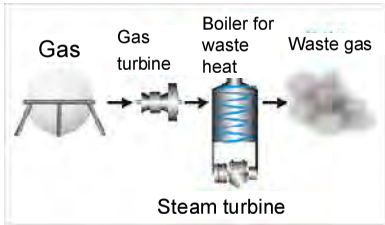
AM0029 :Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas

IGCC: Integrated coal Gasification Combined Cycle

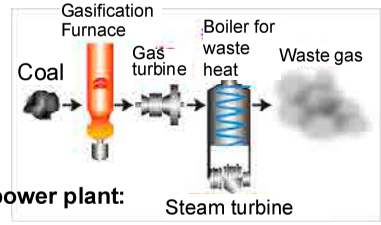


Conventional coal power plant:35%

Ultra supercritical coal power plant: 42%



Combined Cycle power plant: 48%



IGCC power plant: 50-%

Source: CLEAN COAL POWER R&D CO., LTD.

Option 2

Increasing Renewable Energy

- Renewable-energy can contribute to the security of energy supply and protection of the environment.
- Some of them are technologically mature with established markets in at least several countries.

Mature RE	Advanced RE
- Hydro (large, small, mini, micro) - Biomass, Biodiesel, biogas - Geothermal - Landfill gas, anaerobic digestion - Solar PV (crystalline silicon) - Wind - Bioethanol from sugars and starch etc…	-Thin-film PV -Tidal range and currents, wave -Biomass gasification and pyrolysis, -Bioethanol from ligno-cellulose etc…

Potential of RE in Thailand

Energy type	Potential	Existing		2008-2011			2023-2030		
Electricity	**MW**	**MW**	**GWh**	**MW**	**GWh**	**ktoe**	**MW**	**GWh**	**ktoe**
Solar	50,000	38.6	46	55	66	6	600	720	67.2
Wind	1,600	5.13	10	115	231	13	960	1,934	106.8
Small hydro	700	67	293	165	722	43	390	1,708	102
Biomass	4,400	1,644	11,521	2,800	19,622	1,463	4,400	30,835	2,319
Biogas	190	79.6	573	60	432	27	144	1,036	64.8
Waste	400	5.6	44.8	78	624	35	192	1,536	86.4
Total	**57,290**	**1,840**	**12,487.8**	**3,273**	**21,697**	**1,587**	**6,686**	**37,769**	**2,746**
Thermal	**ktoe**	**ktoe**				**ktoe**			**ktoe**
Solar	154	0.5				5			45.6
Biomass	7,400	3,071				3,660			7,400
Biogas	600	201				470			600
Waste		1.09				15			42
Total	**8,154**	**3,273**				**4,150**			**8,088**
Bioenergy	**ML/day**	**ML/day**		**ML/day**		**ktoe**	**ML/day**		**ktoe**
Ethanol	3.00	1.24		3.00		805	10.8		2,936
Biociesel	4.20	1.56		3.00		950	5.40		1,698
Total	**7.20**	**2.80**		**6.00**		**1755**	**16.20**		**4,634**
Required energy (ktoe)		66,248				70,300			112,868
Required renewable energy		4,237				7,492			15,468
RE share (%)		6.4%				10.6%			13.7%
NGV (M.cu./Day)		147		393.0		3,469	800		7,064
Alternative energy used (ktoe)						10,961			22,532
AE share (%)						16.6%			19.96%

Source: LCS seminar

Alternative Energy Development Plan (2008 – 2022)

- Introduced Alternative Energy Development Plan (2008 – 2022), with potential CO_2 emission saving of 42 Mt and 20% of the country final energy demand in 2022.
- Targets for 2022
  - Natural gas for vehicles (NGV) 8%
  - Renewables 12% (heat and power, and biofuels)

(*being revised to raise RE targets for 2030 to offset shortfalls from nuclear)*

Issue and challenge for RE use

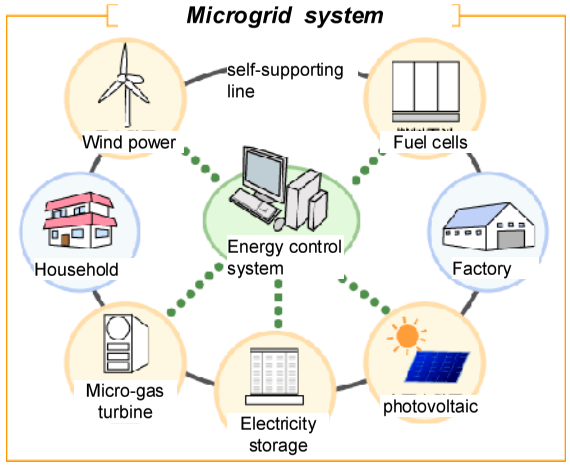
- Issue
  - Typical construction costs for new renewable energy power plants are high.
  - Many renewable energy sources are variable over hourly, daily and/or seasonal time frames.
- Challenge
  - Choice the best sites, low operation, maintenance and fuel costs
  - Energy-storage technologies
  - Use in small-scale decentralized energy system

Option 3: Improving efficiency and reducing loss in Energy carriers (Transmission, distribution)

- Reducing energy loss in energy carries
  - Shifting measure of energy carriers
    e.g. Solids to liquids, liquids to gases
    → Shipping tankers or Road tankers to NG pipeline
  - Introducing high-efficient equipment such as superconducting cables, sensors.
- Promoting small-scale decentralized energy system
  - Increasing power purchase from VSPP(<10MW), SPP (<90MW), using cogeneration system and renewable energy

Concept of micro-grid system

- The small energy network which has facilities to support energy supply and consumption.
- Renewable energy sources such as solar, wind and biomass can be used as energy resources.
- To meet energy demand and supply, energy control system are needed.



Conclusion

- Energy services are fundamental to achieving sustainable development.
- To reduce GHG emission from energy sector, the wide range of available low- and zero-carbon technologies can be utilized.
- For introduce these technologies in Thailand, both top-down approach and bottom-up approach are needed.

Industry Sector

Contents

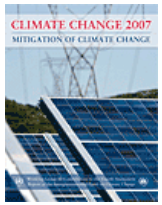
- Characteristics of World's GHG emissions from industrial sector
- Overview of Thailand GHG emissions from industrial sector
- Industrial Mitigation Measures
  - Sector-wide Measures
  - Sector-specific Measures
- Issues and future outlook

Characteristics of GHG emissions -1-
(findings by IPCC-AR4, WG3)

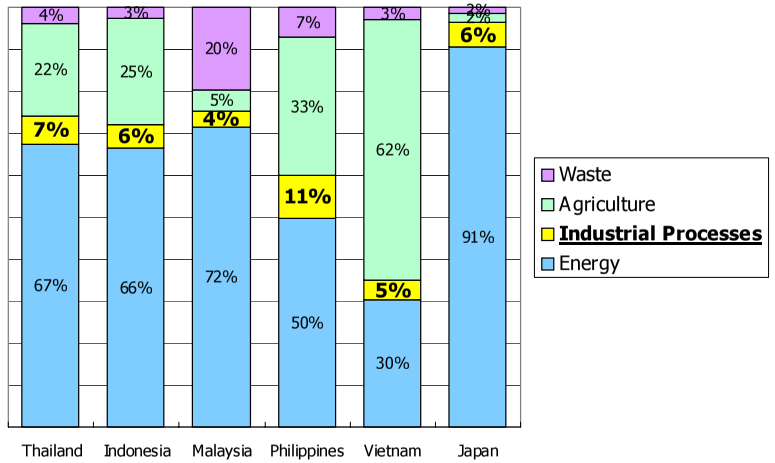
- Approximately 85% of the industrial sector's energy use in 2004 was in the energy-intensive industries:
  - iron and steel, nonferrous metals, chemicals and fertilizers, petroleum refining, minerals (cement, lime, glass and ceramics) and pulp and paper
- Many older, inefficient facilities remain in both industrialized and developing countries.
  - In developing countries, there continues to be a huge demand for technology transfer to upgrade industrial facilities to improve energy efficiency and reduce emissions

Characteristics of GHG emissions -2-
(findings by IPCC-AR4, WG3)

- Industry GHG investment decisions will continue to be driven by consumer preferences, costs, competitiveness and government regulation.
  - A policy environment that encourages the implementation of existing and new mitigation technologies could lead to lower GHG emissions.
  - Policy portfolios that reduce the barriers to the adoption of cost-effective, low-GHG-emission technology can be effective.
- Achieving sustainable development will require the implementation of cleaner production processes without compromising employment opportunities.

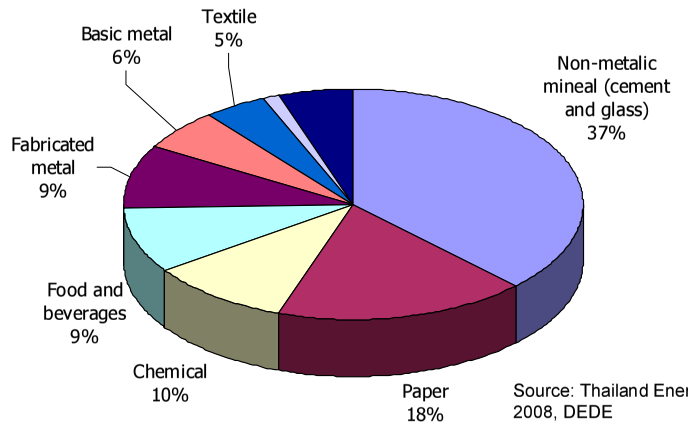


GHG emissions in Thailand and Asia



Source: UNFCCC, ONEP and JGSEE, 2010

Energy Consumption by Industry Sector in Thailand



Source: Thailand Energy Situation 2008, DEDE

Renewable energy is excluded

Based on ktoe, data from 2008

Industrial Mitigation Measures

Measure / Sector	Energy Efficiency	Fuel and Power	Product change
Sector wide	Energy/ GHG manage, electric motor/ boiler	Fuel switch, heat and power recovery, cogeneration	-
Cement	Roller mill	Power recovery, drying w/ gas turbine	Blended cement
Glass	Cullet preheating, oxyfuel furnace	Natural gas	High-strength thin-containers
Pulp & paper	Efficient pulping, efficient drying	Biomass and landfill gas, black liquor	Fiber orientation, thinner paper
Food	Efficient drying, membranes	Biogas, natural gas	-
Iron & steel	Smelt production, dry coke quenching	Top-gas pressure recovery	High strength steel

Source: IPCC

Sector-wide Mitigation Measures -1-

- Management practices
  - Energy management and audit system
  - GHG inventory and reporting system
    - Greenhouse gas protocol (www.ghgprotocol.org)
  - GHG management system
    - ISO 14001 (environmental management system)
  - Benchmarking
    - Companies compare their operations with industry average or best practice
      - Japan Top-Runner Program and EE labeling
      - Dutch industry is required to implement EE best practice in the world

Source: ECCJ

Sector-wide Mitigation Measures -2-

- Energy efficiency
  - Application of energy efficiency technologies
    - General maintenance of old, inefficient plants (10-20% saving)
    - Low-cost measures (use efficient electric motors, optimize combustion efficiency, recover and use waste gases, etc) (20-30% saving)
    - High-cost measures (use automatic combustion control, variable speed drive motors, automatic load control system) (40-50% saving)
- Fuel switch
  - Switch to less carbon-intensive fuels
    - Coal → oil or natural gas
    - Renewable energy, especially biomass
  - Incineration of wastes
    - E.g. cement kilns: municipal wastes, agricultural waste, sludge, waste tyres, etc.

Sector-wide Mitigation Measures -3-

- Heat and Power Recovery
  - Waste heat recovery and use
    - Reused onsite for other processes
    - Applied to preheat water/ combustion air
  - Cogeneration/ combined heat and power (CHP)
    - Use energy that is lost in power production process to generate heat;
      - Used for industrial processes
      - Used for district heating

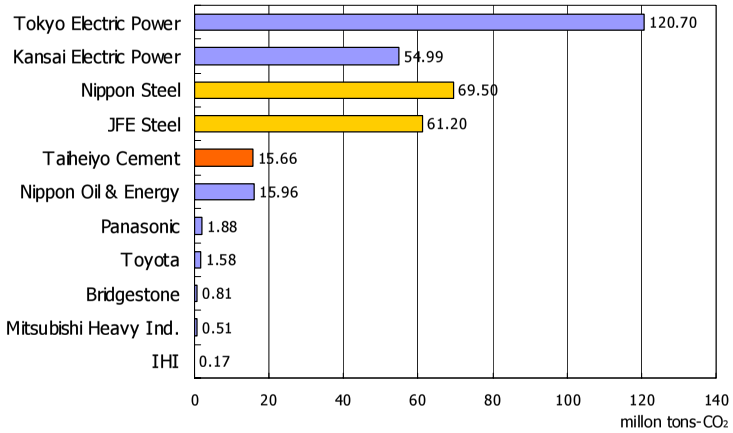
Source: UNFCCC

- Other technologies: CO_2 Capture & Storage (CCS)
  - High concentration of CO_2 is stored geologically
  - Petroleum refining, ammonia production, cement, pulp & paper (and thermal power plants)
  - High cost and associated risks

Source: IPCC

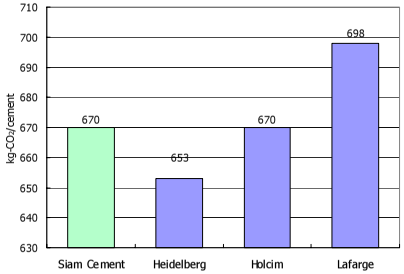
Sector-specific Mitigation Measures -Background-

CO_2 emissions from some of the major Japanese companies



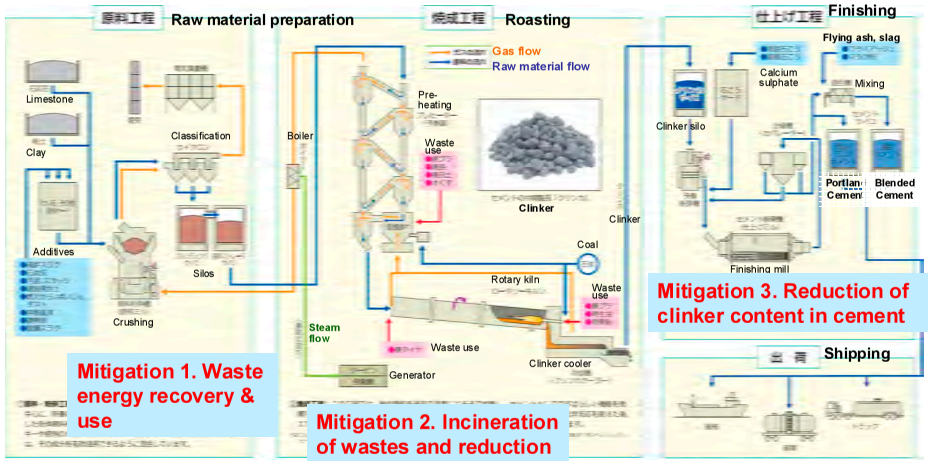
Sector-specific Mitigation Measures -Cement Industry-

- World Business Council for Sustainable Development
  Cement Sustainability Initiative
  - Voluntary CO_2 emission target
  - Siam Cement: 670 kg-CO_2/ ton-cement by 2010
    - Heidelberg (Germany): 653 kg
    - Holcim (Switzerland): 670
    - Lafarge (France): 698



Source: WBCSD

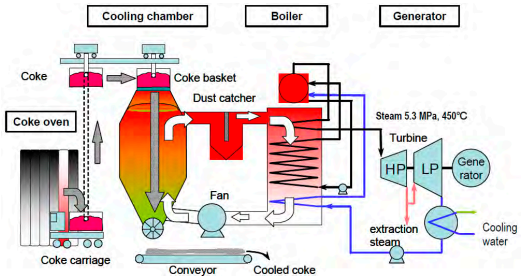
Sector-specific Mitigation Measures -Cement Industry-



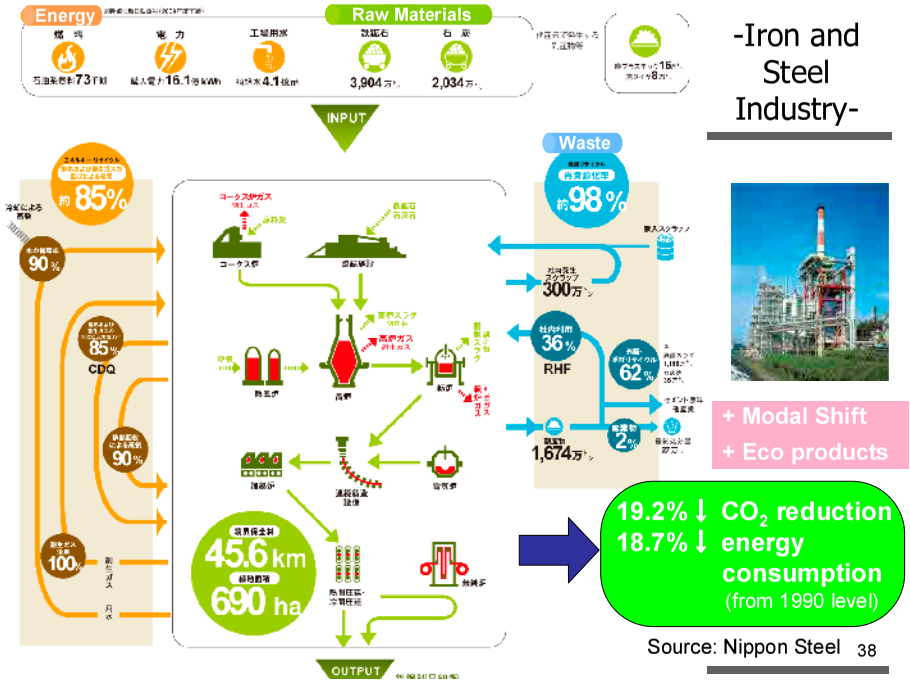
Source: Japan Cement Association

Sector-specific Mitigation Measures -Iron and Steel Industry-

- Waste heat recovery
  - Coke dry quenching (CDQ)
    - Coke from coke oven has high temperature of about 1,000 C
    - CDQ cools down the coke down to 200 – 250 C, using low-temperature gas in a CDQ plant
    - Heat exchanger heats the gas to 900 – 950 C
    - heat is used to produce steam in a boiler to generate electricity



Source: UNFCCC, "Installation of waste heat recovery system in a coking plant in Qian'an City, China"



-Iron and Steel Industry-

+ Modal Shift
+ Eco products

Source: Nippon Steel

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Issues and futures

- In many areas of the world, GHG mitigation is neither demanded nor rewarded by market or government
  - Companies invest only to the extent they can expect financial return or meeting corporate goal
- Although a variety of cost-effective GHG mitigation technologies exist, various economic barriers prevent their full realization
  - Slow rate of capital stock turnover
  - Reliability is essential for industry thus discouraging investing new technologies
  - A stable and transparent policy can help the industry

Source: IPCC analysis

- Technology transfer
  - Limited technical capacity to absorb new technologies
- Co-benefits
  - Air pollution, water pollution, waste management, company image

GHG mitigation measures in Energy and Industry Sector

Exercise:

To enhance the following GHG mitigation measures in power generation sector, what is the role of TGO and related organization?

- **To increase the use of renewable energy**
- **To introduce higher-efficiency technologies**

GHG 10
GHG Mitigation Measures in Transportation Sector

15th February 2011

JICA Expert Team
Masahiko FUJIMOTO and Kazuhito YAMADA

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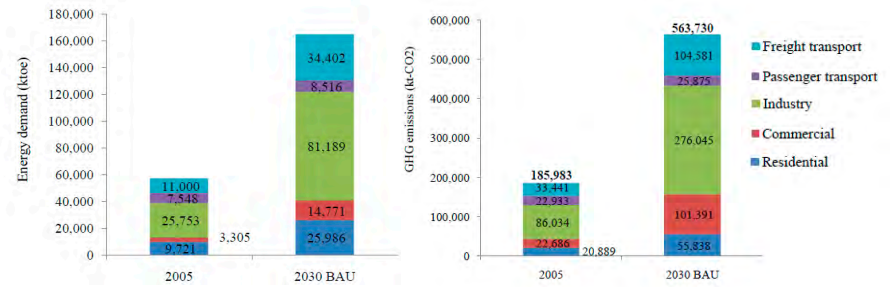
Contents

Characteristic of GHG emissions in Transportation Sector (WG.3, IPCC-AR4)

- Transport activity, which is a key of economic development and human welfare, is increasing around the world as economies grow.
- Transport relies on a single fossil resource, petroleum that accounts 95% of total energy use of world transport.
- If there is not a major shift away from current patterns of energy use, world transport energy use is projected to increase at the rate of about 2% per year, with the highest rates of growth in the emerging economies.
- Total transport energy use and carbon emissions is projected to be about 80% higher than current levels by 2030.

Status of Transportation Sector
- Share of Energy Demand & GHG emission -

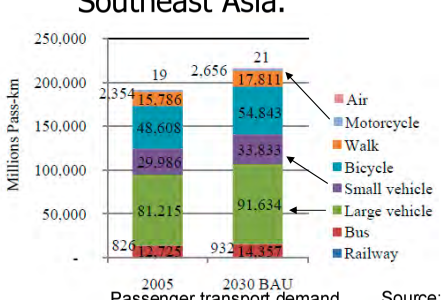
- Share of Energy Demand：32% in 2005, 26% in 2030, 2.3 times of 2005 in 2030
- Share of GHG emission：30% in 2005, 23% in 2030, 2.3 times of 2005 in 2030



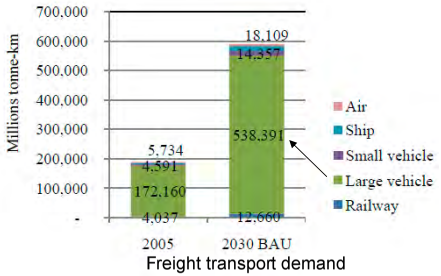
Source: Low-Carbon Society Vision 2030,Thailand,October, 2010

Status of Transportation Sector
-Share of Mode-

- Vehicles and motorcycle are the main mode of mobility in passenger transport in Thailand.
- The freight transport demand in Thailand is much greater than the passenger transport demand because Thailand is the largest market of pick-up vehicles in Southeast Asia.



Passenger transport demand



Freight transport demand

Source: Low-Carbon Society Vision 2030,Thailand,October, 2010

Key mitigation measures in Road Transport

- Reducing vehicle loads
- Improving drive train efficiency
- Alternative fuels
- Mode shifts
- Improving driving practices (eco-driving)

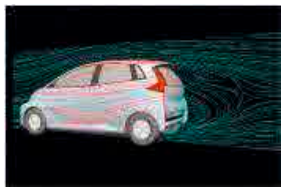
Source:WG.3,IPCC-AR4

Reducing vehicle loads

- Lightweight materials
  - Switching to High strength steels (HSS)
  - Replacing steel by lighter materials : Al, Mg, Plastic
  - Evolution of lighter design concepts and forming technologies

Example of lightweight using Aluminum

- Aerodynamics improvement
  - Adoption of curved surface shape and flush surfaced design by which air can flow effectively along surface of vehicle in order to reduce CD (coefficient of drag)

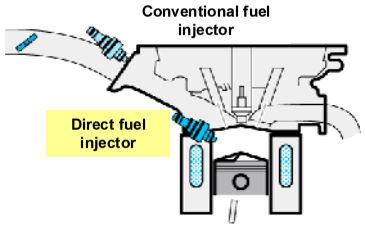


Simulation for CD reduction

JAMA (Japan Automobile manufactures Association)

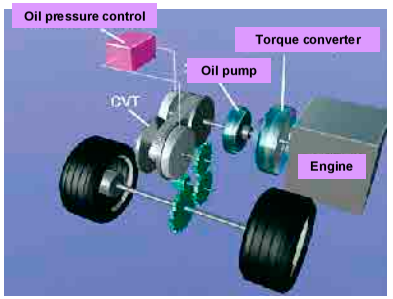
Improving drive train efficiency

- Advanced Direct Injection Gasoline/ Diesel Engines and transmissions



Direct injection Gasoline Engine

(18% fuel consumption is reduced)



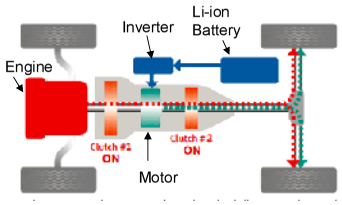
Continuous Variable Transmitter (CVT)

(Fuel economy is improved at 4-8% over a 4-speed automatic and at 13% over a manual)

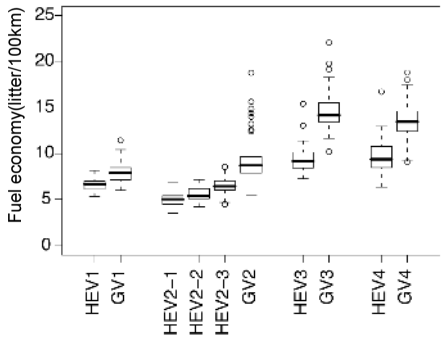
JAMA (Japan Automobile manufactures Association)

Improving drive train efficiency

- Hybrid-electric vehicle



Hybrid system



Fuel economy of hybrid-electric vehicle (HEV) and gasoline vehicle (GV)

"Statistical Analysis of Fuel Consumption of Hybrid Electric Vehicles in Japan", (The World Electric Vehicle Association Journal,2007)

- Hybrid-electric engine obtains 40% better fuel efficiency than conventional gasoline engine.

Alternative fuels

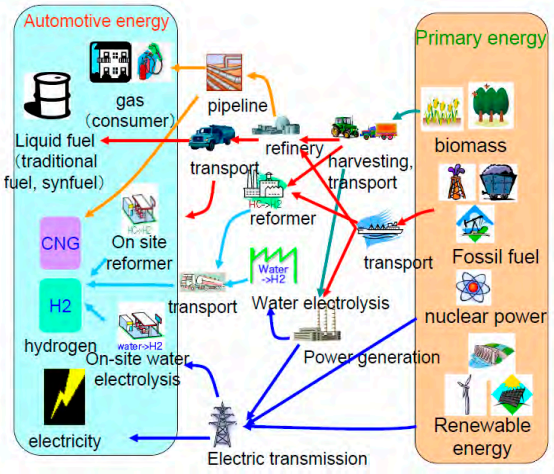
- Bio-fuels (Ethanol, Bio-diesel)
- Natural Gas (CNG / LNG / GTL / DME)
- Hydrogen / Fuel Cells
- Electric vehicles

Note: DME (Di-Methyl Esters), GTL (Gas To Liquids)

– It is important to consider Well-to-wheels CO_2 emission of each technologies.

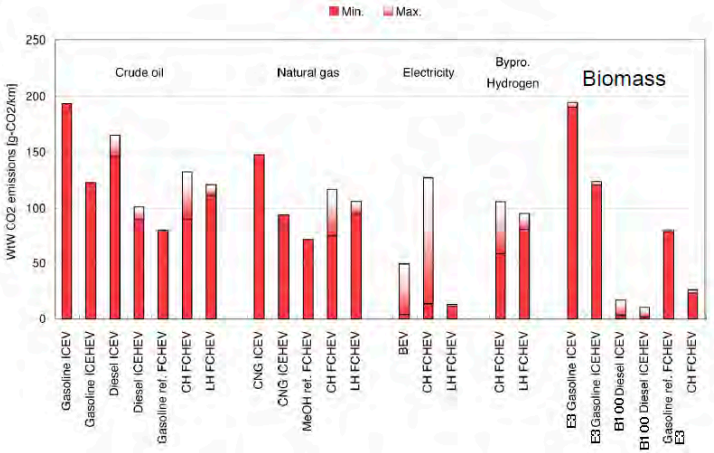
Overview of conversion routes from primary energy to automobile fuels

- Many paths exist to produce the final automobile fuels.



Source: "Transportation in Low Carbon Society", Yuichi Moriguchi, *"Path toward Low-Carbon Society: Japan and Asia1st session: "The results of 'Japan Low-Carbon Society Scenarios toward 2050'Project"(Feb. 12th 2009)"*

Well to Wheel CO_2 Emission by technology



ICEV: Internal Combustion Engine Vehicle

ICEHEV: Internal Combustion Engine Hybrid Electric Vehicle

FCHEV: Fuel Cell Hybrid Electric Vehicle

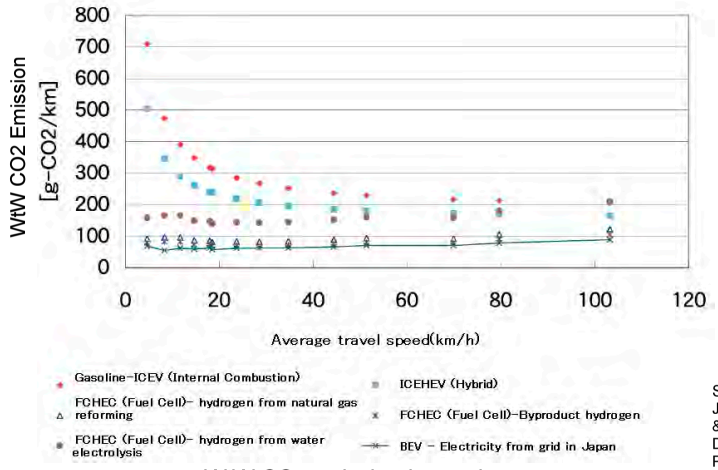
BEV: Battery Electric Vehicle(: electricity from Japan Grid)

CH: Compressed Hydrogen

LH: Liquid Hydrogen

Source: Japan Hydrogen & Fuel Cell Demonstration Project(2007)

Well to Wheel CO_2 Emission by travel speed



WtW CO_2 emission in running

Source: Japan Hydrogen & Fuel Cell Demonstration Project(2007)

Mode shifts

- Public transport (LRT, BRT)
  - Public transport can contribute to the social sustainability to give higher mobility to people who do not have access to car.
  - Public transport is more attractive economically because of providing more capacity at less marginal cost.

BTS

BRT

MRT

Source: global Transport Knowledge Partnership

Load factor and CO_2 emission of transportation mode

- It is better to change to high load factor (occupancy rate) type of transportation to reduce vehicle fuel consumption.
- For example, passenger car change to bus, railway

Type	Load factor (average occupancy)	CO2-eq emissions per passenger-km (full energy cycle)
Car (gasoline)	2.5	130-170
Car (diesel)	2.5	85-120
Car (natural gas)	2.5	100-135
Scooter (two-stroke)	1.5	60-90
Scooter (four-stroke)	1.5	40-60
Minibus (gasoline)	12.0	50-70
Minibus (diesel)	12.0	40-60
Bus (diesel)	40.0	20-30
Bus (natural gas)	40.0	25-35
Rail Transit	75% full	20-50

Source: Sperling and Salon,2002, WG.3,IPCC-AR4

Case of Bogota BRT Project

- TransMilenio phase II-IV (CDM registered)
- Expected number of passengers:
  - 147 mil. (2006) to 547 mil. (2012)
- Applied technology
  - Dedicated bus lanes
  - Euro II and Euro III new buses (160 persons capacity)
  - Equipped with GPS linked to the operation centre
  - Fare system using magnetic ticketing
- Completed Infrastructure (as of 2009)
  - Americas, NQS, Suba route in Phase II (Totally 42.3km)

Source: PDD of BRT Bogotá, Colombia: TransMilenio Phase II-IV, grütter consulting

Case of Bogota BRT Project

- Monitoring has been conducted from year 2006

year	Number of Passengers	Fuel consumption (litters)	CO2 reduction (tCO2e)
2006	94 million	14 million	59,020
2007	114 million	17 million	70,109
2008	118 million	19 million	68,813
2009	134 million	20 million	79,326

Source: Monitoring report of BRT Bogotá, Colombia: TransMilenio Phase II-IV, grütter consulting

- Monitoring items
  - Fuel consumption of bus measured in filling stations managed by operators
  - Actual travel distance of bus measured by GPS
  - Number of passengers measured by ticketing system
  - Baseline average trip distance of passengers measured by interview survey in station
  - Baseline share of passenger cars using fuel type measured by interview survey in station
  - Baseline share of transport mode used by passengers measured by interview survey in station

Improving driving practices (eco-driving)

- Fuel consumption of vehicles depends on driving practices.
- Following fuel-efficient driving practices can reduce fuel consumption.
  - Smoother deceleration/ acceleration
  - Keeping engine revolution low
  - Shutting off the engine when idling
  - Reducing maximum speeds
  - Maintaining proper tyre pressure

source: IEA,2001

How to estimate CO_2 emission in road transport

- Equation

$$\frac{CO_2}{capita} = \frac{TransServ}{capita} \times \frac{Pkm(Tkm)}{TransServ} \times \sum_{Mode}\left(\frac{Vkm}{Pkm(Tkm)} \times \frac{Fuel}{Vkm} \times \frac{CO_2EF}{Fuel}\right)$$

(a) (b) (c) (d) (e) (f)

Note: TransServ:transport-service, Pkm:passenger-km, Tkm:ton-km, Vkm:vehicle-km

Viewpoint of mitigation:

a) Demand management (ex. Information/communication technology to optimize the move for commuting, shopping, and freight transport)
b) Improve accessibility (ex. change to compact city)
c) Mode shift (ex. change to bus or railway from passenger car)
d) Improve load factor (ex. increase number of passenger/freight per one vehicle)
e) Improve fuel economy (ex. change to higher fuel economy car like hybrid-car, eco-driving)
f) Introduce low carbon energy (ex. change to bio-fuels, natural gas, electric car)

Source: "Transportation in Low Carbon Society", Yuichi Moriguchi, *"Path toward Low-Carbon Society: Japan and Asia1st session: "The results of 'Japan Low-Carbon Society Scenarios toward 2050'Project"(Feb. 12th 2009)"*

Let's try to estimate CO_2 reduction in Blue Line Project

- Project description:
  - Route: Hua Lamphong - Bang Kae (14km) and Bangsue - Tapra (13km)
  - Expected Traffic: 443,000 passengers/day in 2016
- Data/ information for estimation

Traffic mode	Emission Factor (gCO2/km) *1	Occupancy Rate (passengers) *2	Emission Factor per Passenger-Km (gCO2/PKM)	Share of mode (%)
Bus	1,034	40.59	25.47	53.4
Private car	192	1.93	99.48	23.9
Taxi	175	0.77	227.27	4.1
Motorcycle	49	1.37	35.77	5.4

*1 Based on measurement of chassis dynamo test study(2003)
*2 Based on JBIC interview survey

Electricity consumption of MRT per passenger	0.39	kWh/passenger (Based on current blue line)
CO2 EF of Thai National Grid	0.5812	tCO2/MWh

Source: PDD of blue Line, OTP, Khon Kaen University

Result of estimation

- Baseline emission

Traffic mode	Emission Factor per Passenger-Km (gCO2/PKM)	Number of Passenger (passengers/day)	Share of mode (%)	Baseline trip distance using traffic mode *1 (km)	BEy (tCO_{2e}/yr)
Bus	25.47		53.4	7.3	
Private car	99.48		23.9	7.3	
Taxi	227.27		4.1	7.3	
Motorcycle	35.77		5.4	7.3	
Total		443,000 (in year 2016)			

*1 Based on interview survey by MRTA

- Project emission
  $=443{,}000 \times 0.39 \times 0.5812 \times 365/1000$ = [ ] tCO_{2e}/y
- Emission reduction
  = [ ] − [ ] = _____ tCO_{2e}/y

Source: PDD of blue Line, OTP, Khon Kaen University

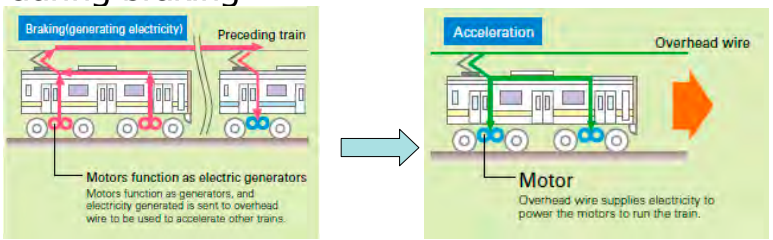
Key mitigation measures in Rail Transportation

- Reducing aerodynamic resistance
  - Optimum shape of train using computer simulation
- Reducing train weight
  - Aluminum car bodies, lightweight bodies and lighter propulsion equipment
- Regenerative braking
- Higher efficiency propulsion system

Source:WG.3,IPCC-AR4

Regenerative braking

- Regenerative brake system generates electricity during braking

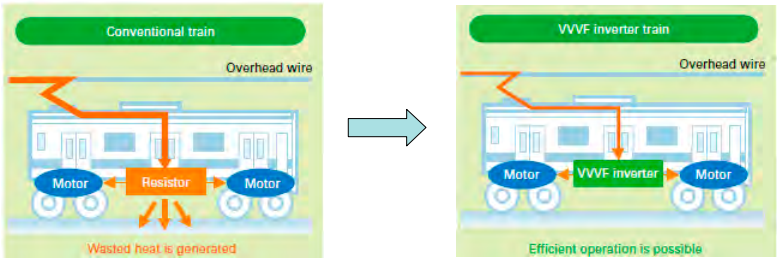


Motors of an energy-efficient railcar function as electric generators when brakes are applied, and electricity generated in this process is transmitted to the overhead wire, making more efficient use of this energy.
In case of a conventional railcar, energy generated by applying brakes is simply discharged as heat.

Source: JR East Group Sustainability Report 2009, Japan

Higher efficiency propulsion system

- VVVF (variable voltage/ variable frequency) inverter control



In train running, resistors control voltage for motor. It generates waste heat.

A VVVF (variable voltage/variable frequency) inverter can control electricity without generating waste heat.
It makes train operation more efficient.

Source: JR East Group Sustainability Report 2009, Japan

Case of low GHG emitting rolling stock in Delhi Metro

- Installing regenerative brake to 70 rolling stock
- CDM registered, Monitoring started from December,2007
- Monitoring items
  - Total Energy consumed in rolling stock (kWh) measured by TIMS (Train Integration and Management System)
  - Total energy regenerated in rolling stock (kWh) measured by TIMS
  - Total distance covered (km) measured by TIMS
- CO_2 emission reduction calculation
  = Total energy regenerated (kWh) * Emission Factor of grid (0.8tCO_2/MWh) /1000

Monitoring period	Total Energy consumed (kWh)	Total energy regenerated (kWh)	CO2 reduction (tCO2)
1st Feb 2008 – 31th Dec 2008	127,120,021	44,118,987	35,295
1st Jan 2009-31th Dec 2009	154,212,454	54,689,155	43,751

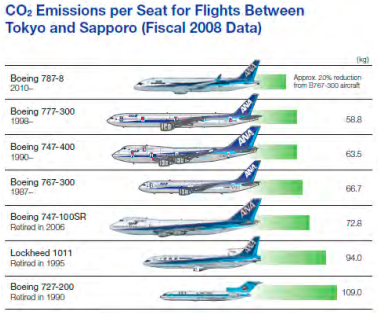
Source: Monitoring report of Installation of Low Green House Gases (GHG) emitting rolling stock cars in metro system, DELHI METRO RAIL CORPORATION (DMRC)

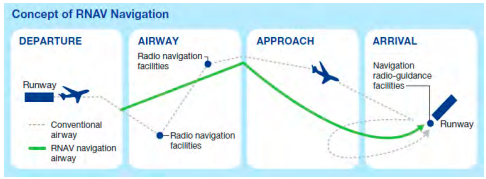
Key mitigation measures in Aviation

- Improving energy efficiency in engine and aircraft
  - introducing fuel-efficient engines with the latest technologies,
  - reducing air resistance through improved wing designs, and
  - reducing fuselage weight through the use of composite materials.
- Making flight more fuel efficient
  - taxiing with engines shut down
  - Use of ground sourced power and ground based air-conditioning (GPU)
  - Use of navigation system

GHG mitigation measures of Aviation

Source: JAL CSR Report 2009, Japan





Source: ANA CSR Report 2009, Japan

RNAV: aRea NAVigation)

Key mitigation measures in Shipping

- Improving energy efficiency in engine and ship:
  - Reuse of lost energy from the swirl flow
  - Reduction of abrasion resistance of ship body

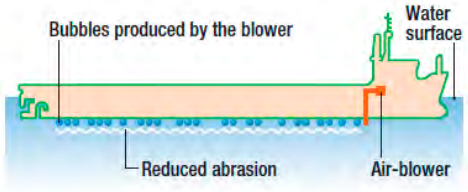
GHG mitigation measures of Shipping

MHI-ASI attached just forward of the propeller

Energy conservation device:
Multi blade device can be attached to the ship's hull just in front of the propeller.

It can catch the lost energy from the swirl flow generated by propeller rotation.

It can save 5% of fuel consumption.



Air lubrication system:

System has an air blower at the front of the ship's hull. It blows the air over the ship bottom.

The ship bottom is covered with bubbles that lubricate against the seawater and resultantly reduce abrasion resistance.

It can reduce CO2 on the order of 10%.

Source: NYK Group CSR Report 2010, Japan

International Shipping

- Implementation of mitigation measures of international shipping is in charge of the International Maritime Organization (IMO).
- IMO has started to consider the Implementation of mitigation measures of international shipping under UNFCCC/KP.
- However, there is no target setting for the international shipping until COP16.
- 870 mt-CO2/year in 2007 (2.7%)

International Shipping:

Technological operational potential for reduction of GHG emissions

- Improving energy efficiency by ship design
  - Hull and superstructure
  - Propeller
- Energy saving by operations
- Renewable energy sources
  - biofuels, LNGs

International Shipping:

Technological operational potential for reduction of GHG emissions

Figure A2.3 A CFD analysis of wind resistance (CFD Norway)

Source:
Second IMO GHG Study 2009

International aviation

- Implementation of mitigation measures of international aviation is in charge of the International Civil Aviation Organization (ICAO).
- ICAO has started to consider the Implementation of mitigation measures of international aviation under UNFCCC/KP.
- However, there is no target setting for the international shipping until COP16.
- 600 mt-CO2/year (domestic and international) in 2006 (2.0%)

International Shipping:

Technological operational potential for reduction of GHG emissions

- Improvement in fleet fuel efficiency
  - 0.8% per annum in the period to 2050
- Use of biofuels in aviation
- GHG management at airports
- Modal shift and videoconferencing.....

Carbon Footprint 1 and 2:

Overview of carbon footprint concept, current situation of the system in the world, and LCA related issues

12th October 2010

Deputy Chief Advisor of JICA Expert Team
Kazuhito YAMADA

JICA Expert Team
Mariko FUJIMORI

Objectives of this section

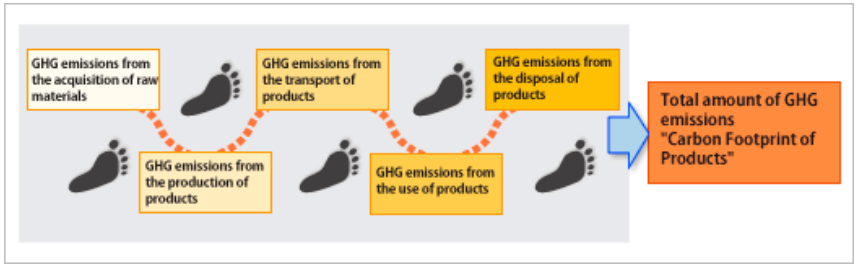
Objectives of this section are:

- To understand basic concept of carbon footprint,
- To understand applied carbon footprint systems in other organizations/countries,
- To understand carbon footprint system in Thailand,
  (by Ms. Phakamon Supappunt)
- To understand LCA related issues, and
- To discuss future issues to improve the carbon footprint system in Thailand.

What is "Carbon Footprint (CFP)"?

- Concept
  Lifecycle CO_2 (GHG) emissions of goods and services.
  - Lifecycle: from cradle to grave
  - Footprint: load (to the earth) by human activities
- Structure
  - Targeted product or service
  - Calculation methodology (Product Category Rules: PCR)
  - Certification
  - Label

What is "Carbon Footprint (CFP)"?



http://www.cfp-japan.jp/english/about/about.html

What is “Carbon Footprint (CFP)”?

History

1990s: Ecological Foot Print (EF)

Footprints to: Cropland, Fishing grounds, Forest land, Built-up land, Grazing land, and Carbon

EFc(consumption)

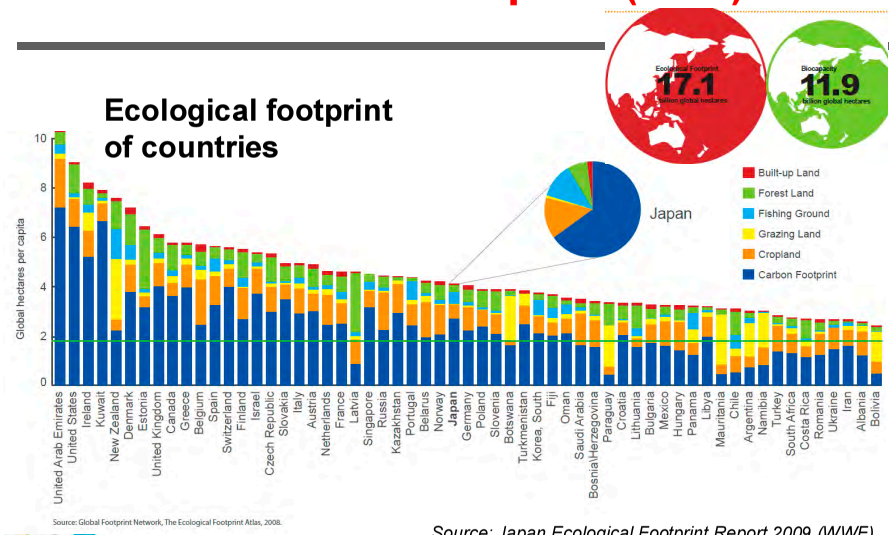
= EFp(production) + (EFi(import) - (EFe(export))

∨

Biocapacity (indicates the regeneration of resources and the waste absorption that land can provide)

Source: Japan Ecological Footprint Report 2009 (WWF)

What is “Carbon Footprint (CFP)”?



Source: Japan Ecological Footprint Report 2009 (WWF)

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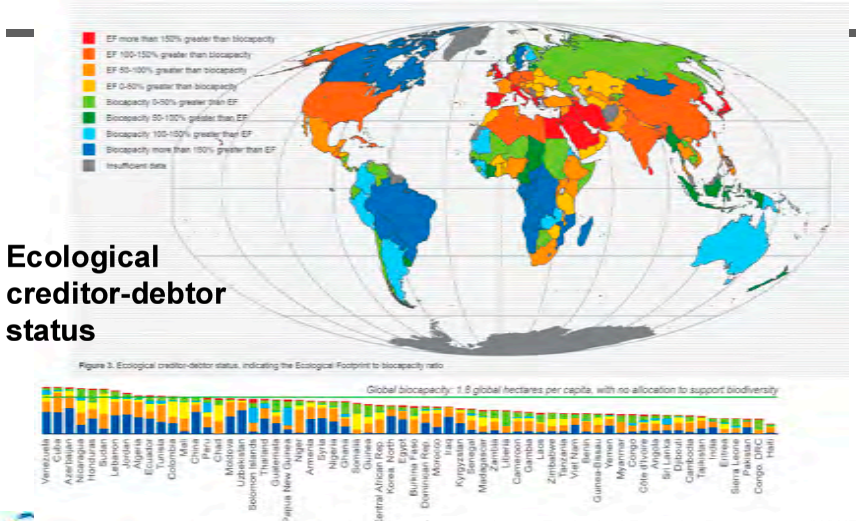
What is “Carbon Footprint (CFP)”?



Source: Japan Ecological Footprint Report 2009 (WWF)

What is “Carbon Footprint (CFP)”?

After 1997 (COP3), and until IPCC AR4 (2007):

- Difficulties of ecological footprint, including multi sectors,
- Awareness raising about the importance of climate change,
- - -

2006: DEFRA* in UK has established Carbon Trust (Non-profit company)

2007: DEFRA, Carbon Trust and BSI* have started Publicly Available Specification: PAS 2050

2007: ISO has started discussion for standardization

DEFRA: Department for Environment, Food and Rural Affairs
BSI: British Standards Institution

Present condition of CFP in the world

ISO

- ISO 14040/44: Environment management - LCA
- ISO 14025: Environmental labels and declarations
- ISO 14067: Carbon footprint of products (under Committee Draft)
- ISO 14069: Carbon footprint of organizations (under Working Draft)

--> They will be established until November 2011 or 2012.

NWIP: New Work Item Proposal
PWI: Preliminary Work Item
AWI: Approved Working Item
WD: Working Draft
CD: Committee Draft
DIS: Draft International Standard
FDIS: Final Draft International Standard

Source: http://www.iso.org/

Present condition of CFP in the world

PCF* World Forum

*PCF: Product Carbon Footprints

- A platform for the most notable of initiatives from Europe, the United States and Asia to come together and share their experiences,
- By developing standards for assessing carbon footprints and overall environmental performance of goods and services,
- By providing frameworks for reducing GHG emissions related to life cycles of goods and services,
- By working on suitable instruments for informing consumers and customers about climate-conscious consumption,
- Austria, EU, Germany, Japan, Korea, NZ, Sweden, Thailand, UK, USA, etc.

Source: http://www.pcf-world-forum.org/

Present condition of CFP in the world

United Nations

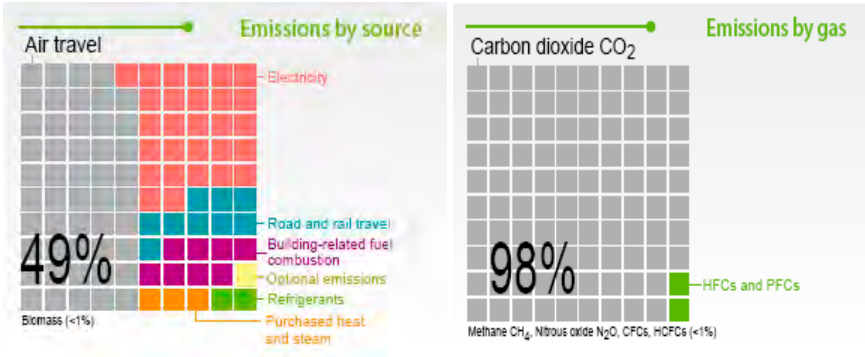
UN system facilities and travel

	key figures 2008
Total emissions	769'108 t CO_2eq
Emissions per staff member	8.3 t CO_2eq
Air travel per staff member	4.0 t CO_2
Number of staff	92'748

Source: Moving Towards a Climate Neutral UN The UN system's footprint and efforts to reduce it (UNEP, 2009)

Present condition of CFP in the world

United Nations



Source: Moving Towards a Climate Neutral UN The UN system's footprint and efforts to reduce it (UNEP, 2009)

Present condition of CFP in the world

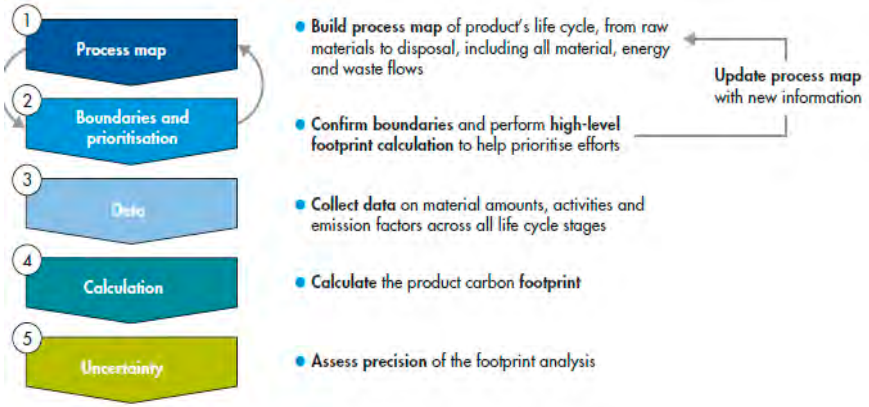
UNFCCC

Key figures	
Total emissions	1'687.2 t CO_2eq
Emissions per staff member	4.5 t CO_2eq
Air travel per staff member	3.6 t CO_2
Air travel per staff member	22'010 km
Office-related emissions per m²	0.5 kg CO_2eq

Source: UNEP, 2009

Present condition of CFP in the world

United Kingdom



Source: Guide to PAS 2050

Present condition of CFP in the world

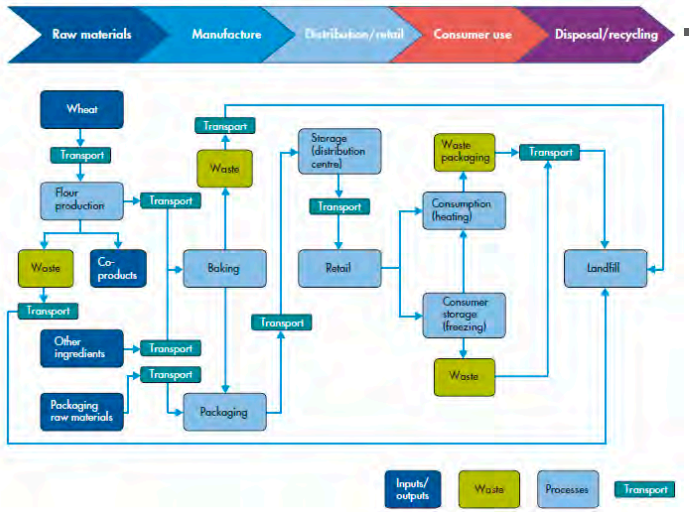
United Kingdom

Process map steps for business-to-consumer goods

Process map steps for business-to-business goods

Source: Guide to PAS 2050

Present condition of CFP in the world



Source: Guide to PAS 2050

Present condition of CFP in Japan (1)

2008
- June; Cabinet decision "Japan As a Low-Carbon Society"
- METI started the pilot project

2009
- National Pilot Project has started
  "Basic Guideline of the Carbon Footprint of Products"
  "Guide of Establishing Product Category Rules"

2010
- 2nd year of the Pilot Project - revision of the general instructions.

2011
- Final year of the Pilot Project.

Source: Prof. Inaba: Carbon Footprint of Products in Japan (2010)

Present condition of CFP in Japan (2)
- How to apply for CDP label

Phase 1: Application for Registration of Draft PCR Development Plan

- PCR defines the criteria for the CFP calculation and labeling method.
- A company propose a PCR development plan and submit it to the secretariat.
- If it is registered, the plan is released through the website.

http://www.cfp-japan.jp/english/about/about.html

Present condition of CFP in Japan (3)
- How to apply for CDP label

Phase 2: Application for PCR Approval

- A company propose a developed PCR.
- The PCR will be approved through public comment and review by the PCR committee.
- The approved PCR is released on the website.

http://www.cfp-japan.jp/english/about/about.html

Present condition of CFP in Japan (4)
- How to apply for CDP label

Phase 3: Application for PCR Verification

- A company calculates the CFP based on the approved PCR, and applies for the verification.
- The PCR Committee verifies the submitted results.

http://www.cfp-japan.jp/english/about/about.html

Present condition of CFP in Japan (4) - *How to apply for CDP label*

Phase 4:

- If it is considered appropriate, the permission to use the CFP label is granted to the applicant.
- The CFP label can be used for the product in the market.

Present condition of CFP in Japan (4) - *How to apply for CDP label*

Support tools:

- CFP Calculation Kit: Programme and Operation Manual
- Database of GHG Emission Factors for the CFP Pilot Project

Results as of September 2010:

- Registered PCR Plans: 83
- Approved PCRs: 72
- Permitted products/services: 94

Present condition of CFP in Thailand

Please enjoy the presentation by Phakamon-san!

Agenda of LCA Part

- What is Life Cycle Assessment (LCA) ?
- What is the relationship between LCA and Carbon Foot Print (CFP) ?
- Examples of LC-CO_2

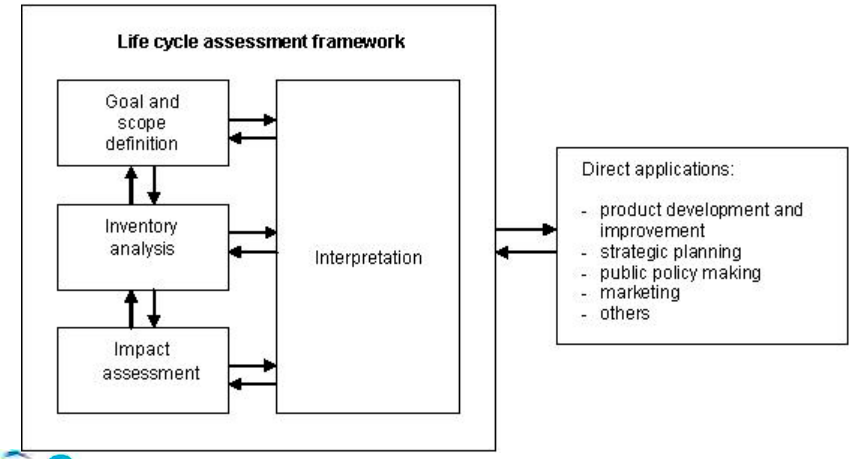
What is LCA ? (1)

- Life Cycle Assessment (LCA) is method to compare **environmental impacts** of products/ technologies or services with a view to their whole life cycle;
- The emissions to all components of environment such as **SO_2**, **COD**, **hazardous wastes**, and **CO_2** during product production, use and disposal are considered;
- Processes of raw material mining, energy/material production, additional processes or sub-processes are also involved.

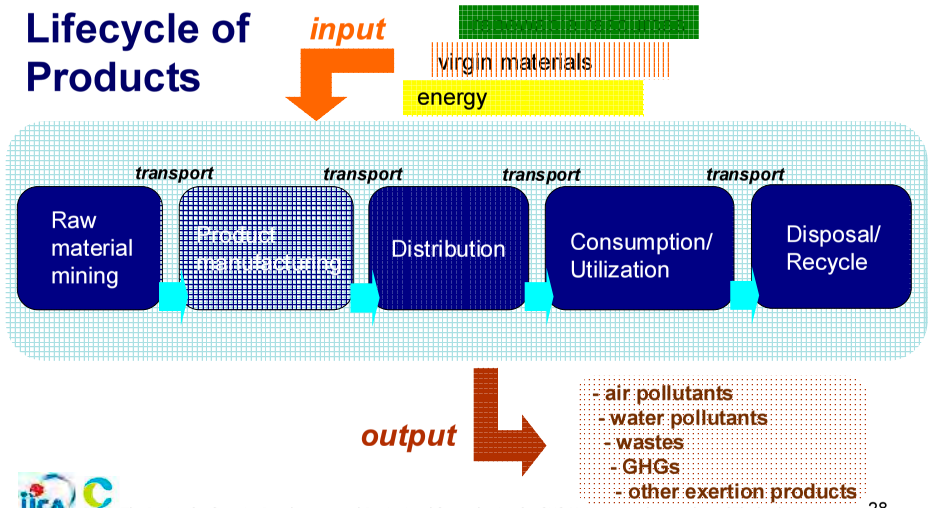
What is LCA ? (2)

- First LCA was implemented by Coca Cola in the USA, as a comparison of returnable bottle with PET-bottle.
- LCA method has fixed structure and is practiced according to international standards **ISO 14040 and 14044** from 2006.
- The LCA method is one of the most important information tools of environmentally sound product policy.

What is LCA ? (3)



What is LCA ? (4)

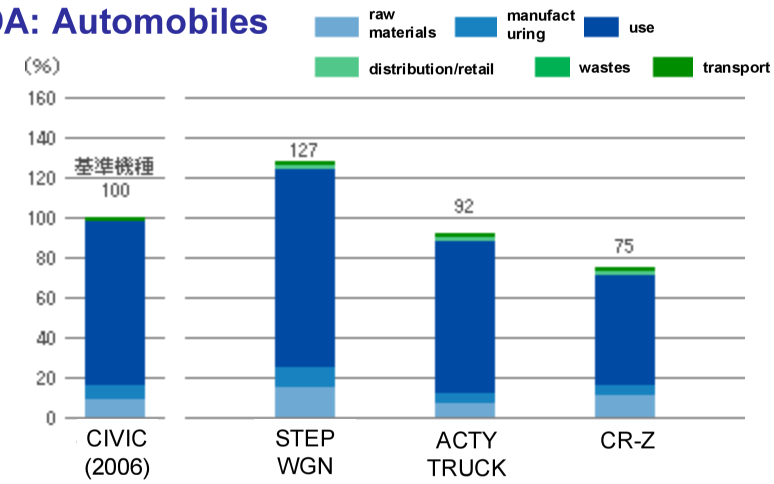


What is the relationship between LCA and CFP ?

- LCA includes **inventory analysis** of the emissions to all components of environment such as SO_2, COD, hazardous wastes, and CO_2;
- In general, inventory analysis work of CO_2 in LCA is called '**LC-CO_2**';
- In the processes of LC-CO_2, the emissions to all components of CO_2 during raw material mining, product production, transport, use and disposal are considered;
- Therefore, we can consider the **LC-CO_2 as a part of technical work of 'Carbon Foot Print'**.

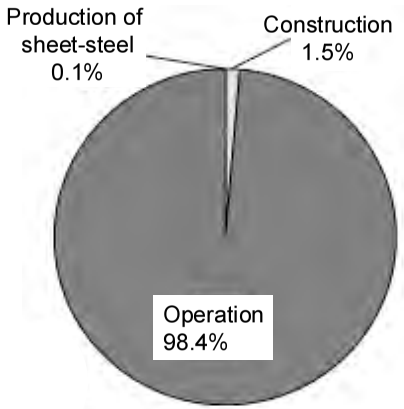
Examples of LC-CO_2 (1)

HONDA: Automobiles



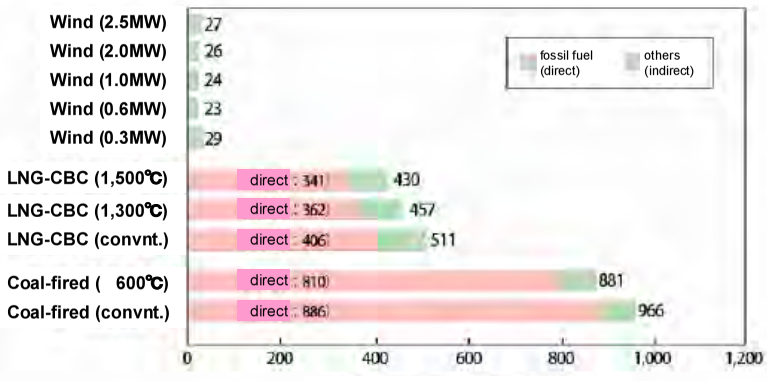
Examples of LC-CO_2 (2)

Ships:



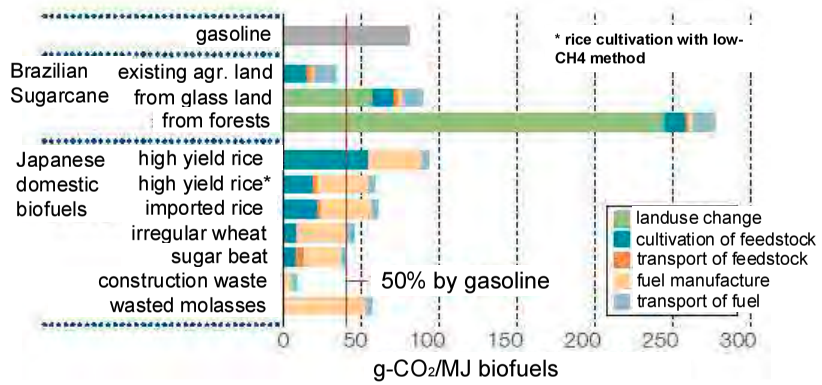
Examples of LC-CO_2 (3)

Power Plants:



Examples of LC-CO_2 (4)

Biofuels:



Carbon Footprint 3: Calculation of Carbon Footprint

12th October 2010

Chief Advisor of JICA Expert Team
Masahiko FUJIMOTO

Contents

Guideline of Carbon Footprint Calculation

- **General Principles for the Assessment and Labeling of Carbon Footprint of Products (TS Q 0010) in Japan**
  - "Basic Guideline of the Carbon Footprint of Products (CFP)" which provides the calculation and communication method of the CFP etc. was compiled by the Ministry of Economy, Trade and Industry (METI) in Japan.
  - The guideline was issued as TS Q 0010 by the Japanese Industrial Standards Committee (JISC) in April 2009.

Target GHGs

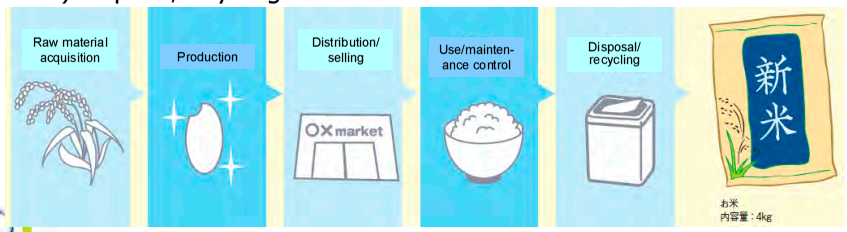
- Target GHGs:
  6 types of GHGs covered by the Kyoto Protocol, i.e.
  - CO_2,
  - CH_4,
  - N_2O,
  - HFCs,
  - PFCs,
  - SF6
- Emission source: all anthropogenic emission sources
- GWP (global warming potential): a 100-year time horizon of Second Assessment Report (SAR, IPCC)

Source: METI, Japan

Calculation Coverage

- A calculation shall be basically made on throughout the whole life cycle.
  - a) Raw material acquisition,
  - b) Production,
  - c) Distribution/selling,
  - d) Use/maintenance control and
  - e) Disposal/recycling

A calculation coverage should cover the process that might be included in a range of functional unit of a product and could not be ignored from the viewpoint of the effect to whole GHG emissions.



Calculation Method

- Equation

  GHG emissions = Σ (activity $_i$ × GHG emission factor $_i$)
  - where "I" stands for a process
- Activity Amount
  - Primary data should be collected.
  - If unavailable, secondary can be used.
    - primary data, which are collected by organization
    - secondary data, which are referred to the common data, reference data and other LCA studies
- GHG emission factor (in case of Japan)
  - Existing LCA Database can be used.
    - LCA Japan forum, LCA database
    - JEMAI, LCA database
    - Eco leaf, emission factor data (Japan environmental management association for industry)

Source: METI, Japan

Example Activity and Emission Factor

Calculation stage	Example Activity	Example Emission Factor
Raw material acquisition	Quantity of material consumption	GHG emission factor to produce material per kilogram
Production	Weight as assembled	GHG emission factor to assemble material per kilogram.
	Consumption of electricity	GHG emission factor to generate electricity per kilowatt hour (kWh)
Distribution/ selling	Car loadings (kg × km) = transport distance × load ratio × loading capacity	GHG emission factor for product transport per kilogram × kilometer (kg × km)
Use/ maintenance control	Electricity consumption of usage	GHG emission factor to generate electricity per kilowatt hour (kWh)
Disposal/ recycling	Reclaimed mass/ recycled mass	GHG emission factor to reclaim per kilogram GHG emission factor to recycle per kilogram.

Source: METI, Japan

Calculation Procedure

1. Life Cycle Flow Preparation:
   Describe the life cycle flow and clarify each process in stage
2. Activity Data Collection in Each Process in Stage:
   Collect Input/output data in each process in stage, clarify prior condition
3. CO2 Emission Calculation in Each Process in Stage:
   Calculate CO2 emission in stage by multiplying activity data in each process by emission factor
4. Total CO2 Emission Calculation in whole Life Cycle:
   Calculate Total CO2 Emission in whole Life Cycle.

Source: METI, Japan

Basic Calculation Rules (1)

- **Data Collection**
  - The following items should be identified in primary data collection.
    - Target process in stage
    - Boundary of data
    - Sites (farm, field, factory, market, disposal site, etc)
    - Periods(day, month, year, season)
  - If secondary data is used, data source should be described.
  - If there are difficulties in obtaining primary and secondary data, the analogous or estimated data can be adopted with its reasonableness carefully.

Source: METI, Japan

Basic Calculation Rules (2)

- Criterion relating to procurement of raw materials from two or more suppliers
  - In case organizations collect primary data of a specific raw material procured from two or more suppliers, the data should be collected from all the suppliers.
  - If it is difficult to do so, in case the primary data collected from a principal supplier is more than 50% of total suppliers data, it may be used as another supplier's secondary data.
- Handling of regional differences and seasonal variations
  - In case there are regional differences and seasonal variations in activity, the weighted average of primary regional and seasonal data should be applied.
  - If impossible, secondary data can be used.

Source: METI, Japan

Basic Calculation Rules (3)

- Handling of information related to production equipment
  - The information related to production equipment should be collected only in the sections directly involved in production (direct sections).
  - In case the related indirect sections, such as an office, R&D section, etc exist at the same site of direct sections, and there are some difficulties in being cut out of emission of direct sections from all sections emission, organizations can allocate the emission of direct sections from the total emissions of site.

Source: METI, Japan

Basic Calculation Rules (4)

- Recycled materials and reused products
  - If recycled materials or reused products are used as inputs, the GHG emissions accompanying the recycling processes (collection, preprocessing, regeneration, etc.) and reuse processes (collection, washing, etc.) should be included in the GHG emissions related to the recycled materials and reused products in the raw material acquisition stage.
  - Any emissions from recycling process and reuse process should not be double-counted in the calculation coverage.

Source: METI, Japan

Basic Calculation Rules (5)

- Cut-off Criteria
  - The parts and materials of a certain product may be omitted from the calculation coverage, considering that they do not have a significant impact on a result of calculating GHG emissions as a whole (Cut-off Criteria)
  - A cut-off criteria is less than 5% of total CO2 emission of each stage.
- Handling of biomass
  - CO2 emissions, which are emitted upon combustion of the biomass like wood or agricultural waste, should not be included.
  - GHG emissions emitted from biomass production, transport, etc should be included.

Source: METI, Japan

Basic Calculation Rules (6)

- Scenario setting
  - If a variety of cases in activity is assumed in stage, the common scenario can be set up in considering the following points.
    - In setting common scenario related to transportation of raw materials, products, waste, recycled materials and reused materials, it is needed to clarify the means of transport and transport distance, loading ratio by the transportation route.
    - In setting common scenario related to sales, it is needed to clarify the selling form and selling hours, turnover ratio of products.
    - In setting common scenario related to the use and maintenance control, it is needed to clarify the use and maintenance form and used hours and years, use and maintenance periods.
    - In setting common scenario related to the disposal/recycling, it is needed to clarify the method and ratio of disposal/recycling/reuse.

Source: METI, Japan

Basic Calculation Rules (7)

- Allocation
  - In case products of two or more categories are handled in same stages of production and distribution/selling, organizations should allocate the emission of an individual product from the total emissions in each stage.
  - Allocation method is to be established according to a product and process characteristic.

    For example,
    - Physical quantity (weight) should be used for allocating energy.
    - If it is difficult to measure only the quantity (weight) of an individual product , the energy may be allocated by the sales amount.

Source: METI, Japan

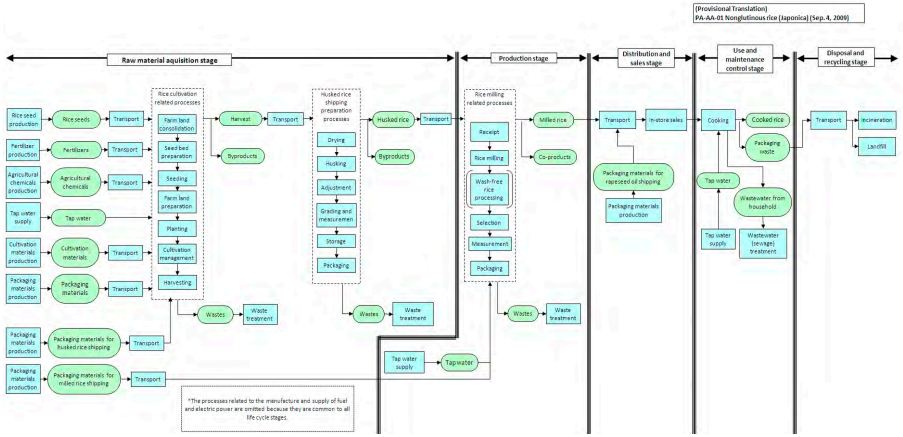
Sample Calculation Non-glutinous Rice

- Non-glutinous rice (Japonica), AEON Co., Ltd.
  - Name of product: milled rice
  - Production site: Akita prefecture
  - Rice variety: Akita-komachi (100%)
  - Net weight: 4kg
  - Style: bagged in a plastic bag

stages	Emission
Raw material acquisition	3.54kg CO2e
Production	0.227kg CO2e
Distribution/sales	1.37kg CO2e
Use/maintenance control	1.23kg CO2e
Disposal/recycling	0.0516kg CO2e
Total	**6.4kg CO2e**

Source: Detailed Information (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Life Cycle Flow
(for non-glutinous rice)



Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 1
(for non-glutinous rice)

- Raw Material Acquisition Stage

Process	Primary Data Items		
1.Rice cultivation related processes	<Input> 1. Rice seeds input amount 2. Fertilizer input amount 3. Agricultural chemicals input amount 4. Tap water input amount 5. Cultivation materials input amount 6. Packaging materials input amount 7. Fuel and electric power input amount	< Output and discharge> 8. Husked rice (before adjustment) production output 9. By-product production output 10. Waste materials discharge amount	<Others> 11. Farm land area
2.Husked rice shipping preparation process	<Input> 1. Husked rice (before adjustment) input amount 2. Fuel and electric power input amount 3. Packaging materials input amount	< Output and discharge> 4. Husked rice (after adjustment) production output 5. Byproduct production output 6. Wastes discharge amount	
3.Husked rice transport process	7. Husked rice (after adjustment) transport amount 8. Fuel method: Fuel input amount 9. Fuel cost method: GHG emissions by fuel consumption per distance covered		

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 2
(for non-glutinous rice)

Process	Primary Data Items
4.Waste treatment processes	10. Wastes discharge
5.Common	Life cycle GHG emissions related to the supply and use of fuel and electric power for in-house production

Items	Primary or Secondary Data Items
1. Emissions from rice cultivation related processes	1. Methane (CH4) from soil 2. Nitrous oxide (N2O) from nitrogenous fertilizer
2.GHG emissions by fuel consumption at the husked rice transport process	3. Improved ton-kilometer method: GHG emissions by fuel consumption per transport ton kilometer 4. Improved ton-kilometer method: Loading ratio 5. Common: Transport distance
3.Life cycle GHG emissions related to the manufacture and transport of inputs to the rice cultivation related processes	6. Life cycle GHG emissions related to the manufacture and transport of rice seeds 7. Life cycle GHG emissions related to the manufacture and transport of fertilizers 8. Life cycle GHG emissions related to the manufacture and transport of agricultural chemicals 9. Life cycle GHG emissions related to the supply of tap water 10. Life cycle GHG emissions related to the manufacture and transport of cultivation materials (wooden, plastic, metallic, and stone materials)

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 3
(for non-glutinous rice)

Items	Primary or Secondary Data Items
4.Life cycle GHG emissions related to the manufacture and transport of inputs to the shipping preparation processes	11. Life cycle GHG emissions related to the manufacture and transport of packaging materials for shipping husked rice
5.Life cycle GHG emissions related to the manufacture and transport of inputs to the rice milling related processes at the production stage	12. Life cycle GHG emissions related to the manufacture and transport of packaging materials for shipping milled rice
6.Life cycle GHG emissions related to the treatment of discharge	13. Life cycle GHG emissions related to the treatment of wastes

Process	Secondary Data Items
Common	Life cycle GHG emissions related to the supply and use of fuel and electric power acquired from outside

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 4 (for non-glutinous rice)

- Production Stage

Process	Primary Data Items		
Common	<Input> 1. Husked rice input amount 2. Packaging materials input amount 3. Fuel and electric power input amount 4. Tap water input amount 5. Other materials input amount	< Output and discharge> 6. Milled rice production output 7. Co-product (cracked rice, etc.) production output 8. Wastes discharge 9. Wastewater discharge amount	<Others>

Process	Primary or Secondary Data Items
Common	Life cycle GHG emissions related to the supply of tap water Life cycle GHG emissions related to the treatment of wastes Life cycle GHG emissions related to the treatment of sewage

Process	Secondary Data Items
Common	Life cycle GHG emissions related to the supply and use of fuel and electric power acquired from outside

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 5 (for non-glutinous rice)

- Distribution and Sales stage

Process	Primary Data Items
Transport process	- Common: Milled rice transport amount - Fuel method: Fuel input amount - Fuel cost method: GHG emissions by fuel consumption per distance covered - Common: Usage of materials used for transport
Store sales process	- Waste materials used for transport generation amount

Process	Primary or Secondary Data Items
Transport process	-Improved ton-kilometer method: GHG emissions by fuel consumption per transport ton kilometer -Improved ton-kilometer method: Loading ratio -Common: Transport distance -Common: Life cycle GHG emissions related to the manufacture and transport of materials used for transport
In-store sales process	-Life cycle GHG emissions related to the supply of fuel and electric power necessary for the in-store sales process -GHG emissions accompanying the transport and disposal of packaging waste

Process	Secondary Data Items
Common	Life cycle GHG emissions related to the supply and use of fuel and electric power

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 6 (for non-glutinous rice)

- Use and Maintenance Control Stage

Process	Primary Data Items
Common	1. Milled rice input amount

Process	Secondary Data Items		
Common	<Input> 2. Power input amount to rice cooker 3. Water input amount (washing) 4. Water input amount (cooking)	< discharge> 5. Discharge amount (washing)	<Others> 6. Life cycle GHG emissions related to the supply of tap water 7. Life cycle GHG emissions related to the treatment of household wastewater 8. Life cycle GHG emissions related to the supply and use of power

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data Collection Items 7 (for non-glutinous rice)

- Disposal and Recycling Stage

Process	Primary Data Items
Common	1. Amount of packaging waste disposed of at home

Process	Primary or Secondary Data Items
Common	2. GHG emissions related to the transport of packaging waste to treatment facilities 3. Amount of packaging waste incinerated at treatment facilities 4. Amount of packaging waste landfilled at treatment facilities 5. GHG emissions derived from packaging waste by incineration

Process	Secondary Data Items
Common	6. GHG emissions related to the incineration of wastes at treatment facilities 7. GHG emissions related to the landfill of wastes at treatment facilities

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Data collection method (for non-glutinous rice)

- **Primary data** can be obtained by the following two methods:
  - (a) Collecting data of the input and output items in each process and calculating their emissions by the unit of work or equipment/facilities operation (operating hours, area, distance, etc.)
    - (e.g., Agricultural machine operating time by produce x fuel consumption/hour = fuel input amount)
  - (b) Allocating total amount of the input and output items in each process in a specified period among products
    - (e.g., Allocating the total amount of annual fuel input among harvested produces)

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Transportation Scenario Setting (for non-glutinous rice)

Stage	Scenario
Raw material Acquisition stage	1.Manufacturer of input for rice cultivation to Rice cultivator (e.g., Fertilizer manufacturer to Farmer) <Transport distance> 500 km <Means of transport> 10-ton truck (Light oil) <Loading ratio> 62 %
	2. Rice cultivator to Drying and adjustment facilities <Transport distance> 50 km <Means of transport> 2-ton truck (Light oil) <Loading ratio> 58 %
	3.Drying and adjustment facilities to Rice mill <Transport distance> 500 km <Means of transport> 10-ton truck (Light oil) <Loading ratio> 62 %
	4. Manufacturer of input (other than husked rice) for rice milling to Rice mill (e.g., Manufacture of packaging materials for shipping to Rice mill) <Transport distance> 500 km <Means of transport> 10-ton truck (Light oil) <Loading ratio> 62 %

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Transportation Scenario Setting (for non-glutinous rice)

Stage	Scenario
Distribution and sales stage	Transport from rice mill to stores or consumers <Transport distance> 1,000 km <Means of transport> 10-ton truck (Light oil) <Loading ratio> 62 %
Disposal and recycling stage	Transport from garbage dump place to treatment facilities <Transport distance> 50 km <Means of transport> 10-ton truck (Light oil) <Loading ratio> 62 %

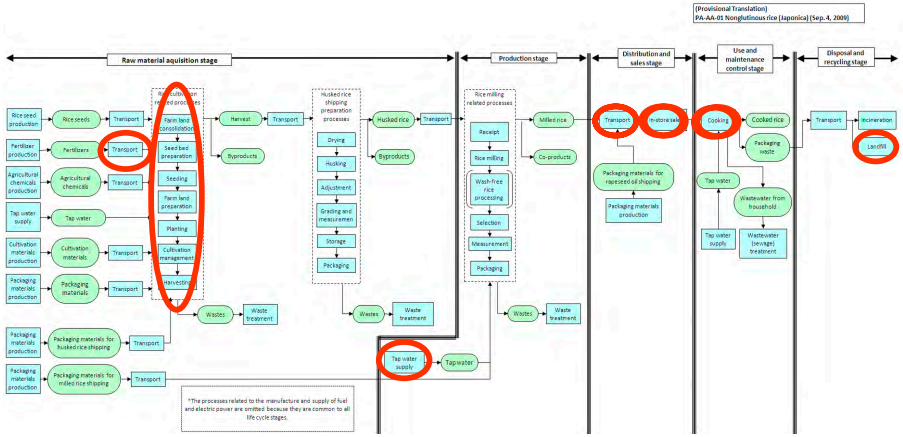
Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Emission Factors (examples for non-glutinous rice: abstract)

Stage	Description	Emission Factor
Raw material acquisition	**Rice cultivation related processes** (rice seed production through rice harvesting)	0.403 kg-CO2e/ kg (of rice seed)
	Transport of fertilizer (from fertilizer manufacturer to rice cultivator; 10-ton truck at 62% load)	0.174 kg-CO2e/ tkm
Production	**Use of tap water for rice milling**	0.000211 kg-CO2e/ kg
Distribution/ sales	**Transport of rice product** (from rice mill to stores; 10-ton truck at 50% load)	0.174 kg-CO2e/ tkm
	Sales of rice product at stores (related to electricity/ fuel consumption at stores)	0.556 kg-CO2e/ 1,000 yen (sales of rice product)
Use/ maintenance control	**Cooking of rice** (related to electricity consumption by rice cooker)	0.484 kg-CO2e/ kWh
Disposal/ recycling	**Landfill of rice packaging waste** (at managed landfill site)	0.00364 kg-CO2e/ kg (of waste)

Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009
http://www.cfp-japan.jp/common/pdf/nintei/nintei_001.pdf (Japanese)

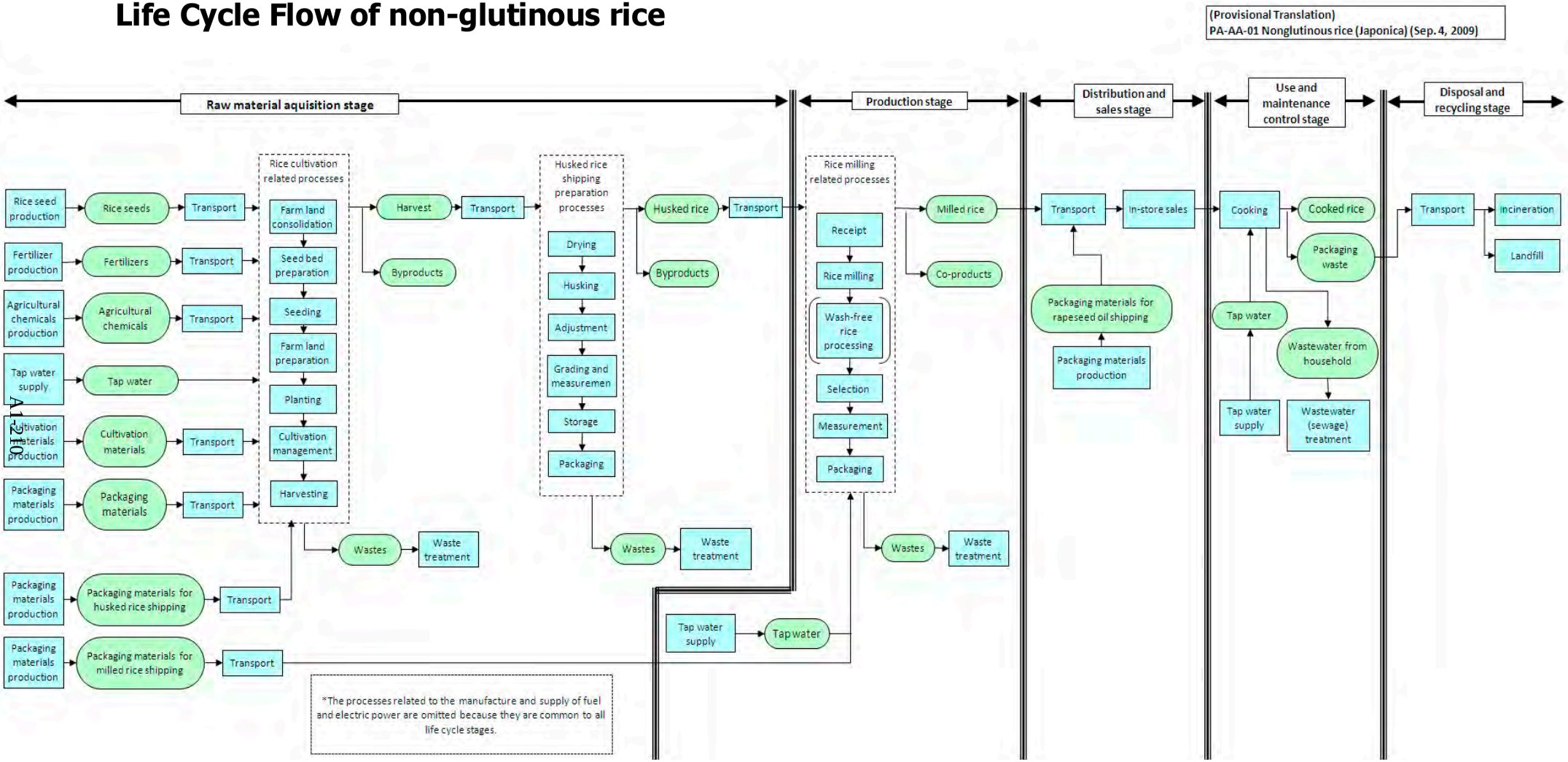
Emission Factors
(examples for non-glutinous rice: abstract)



Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

CF03 Appendix

Life Cycle Flow of non-glutinous rice



Source: Product Category Rules (PCR) (Approved PCR ID: PA-AA-01) AEON Co., Ltd. 2009

Carbon Footprint 4: Issues in Implementation & Dissemination of Carbon Footprint System

20, October, 2010

JICA Expert Team

Mariko FUJIMORI

Objectives of this section

Objectives of this section are:

- To understand benefits and barriers of carbon footprint system,
- To understand examples of benefits, barriers, and ways to overcome the barriers, and
- To discuss future issues to improve the carbon footprint system in Thailand.

Benefits by Carbon Footprint (CFP)

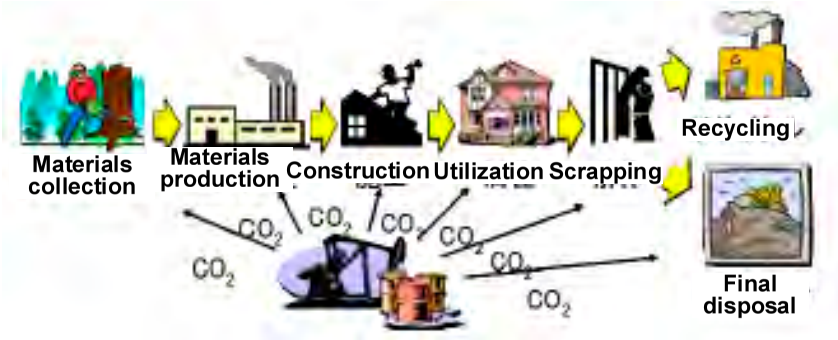
- What would have occurred if there is no CFP system? (--> Baseline scenario)
- What are the benefits by CFP?
  - Manufacturer: We have high concern to environment!
  - Consumer: We hope to select environmental-friendly products!
- CFP and price - Where is the critical limit of price, if products with CFP are higher than normal one?
  - Food, clothes, TV, car, house, etc...

Issues of Carbon Footprint (CFP)

- How does CFP contribute to CO_2 reduction?
- What are the differences between CFP and other low-carbon activities?
  - Energy efficiency laws/regulations, CDM, T-VER, etc.
  - National/local, public/private, organization/person, etc.
- Do CFP and other activities have consistency?
- If such consistency is required, how can we achieve it?
- **What kind of CFP system is ideal?**

Example of CFP: Low Carbon Houses

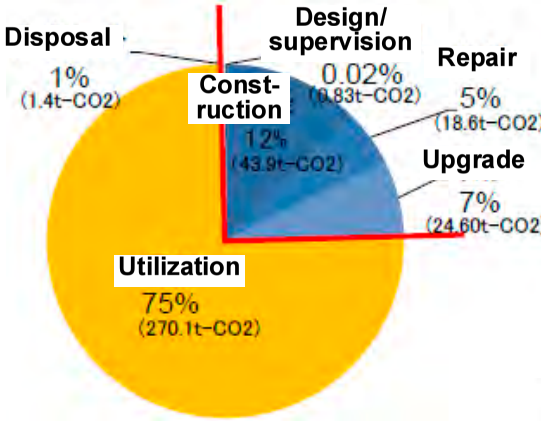
- Energy consumption at households



Source: METI, Japan 2010

Example of CFP: Low Carbon Houses

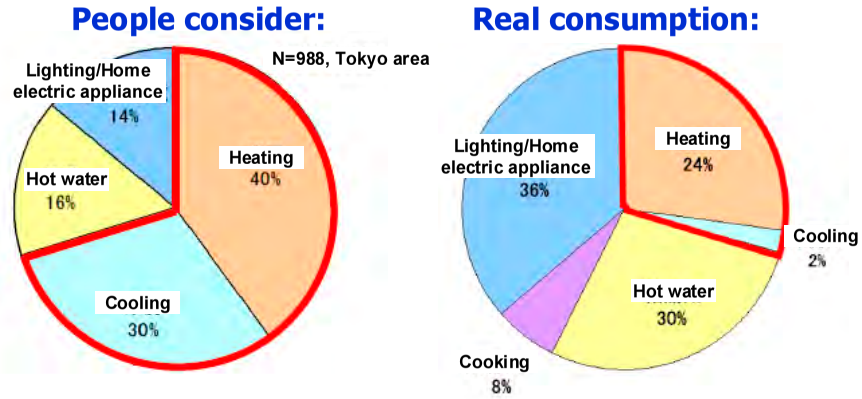
- LCCO2 for a detached house



Source: METI, Japan 2010

Example of CFP: Low Carbon Houses

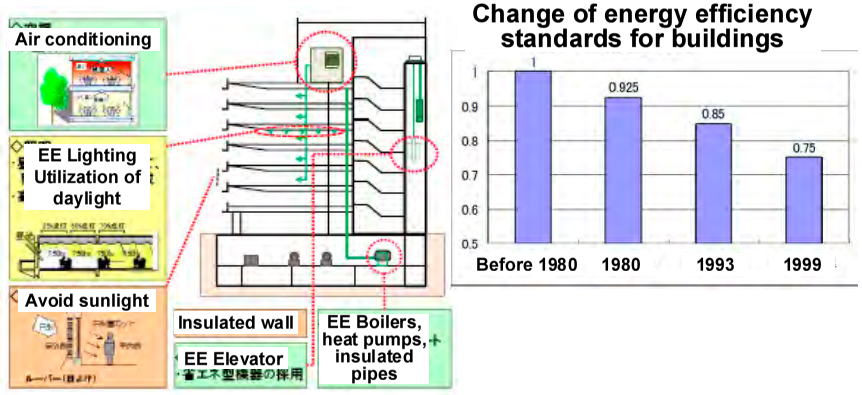
- Energy consumption at households



Source: METI, Japan 2010

Example of CFP: Low Carbon Houses

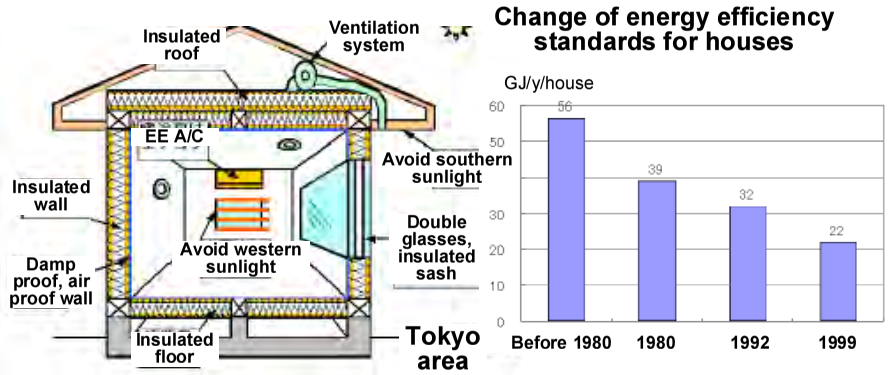
- Energy Efficiency Standard for Buildings



Source: METI, Japan 2010

Example of CFP: Low Carbon Houses

- Energy Efficiency Standard for Houses



Source: METI, Japan 2010

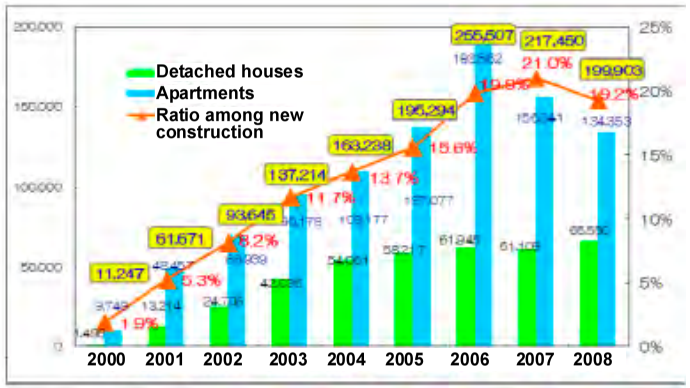
Energy Efficiency Label for Houses

	Assessed by third party	Self assessment only
Conform to both self judgment by client and EE standard		
Conform to self judgment by client only		

Source: METI, Japan 2010

Energy Efficiency Label for Houses

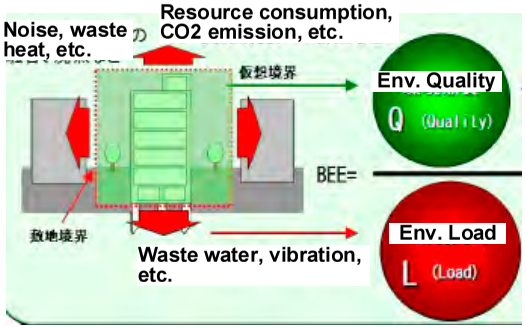
- Past record of the system



Source: METI, Japan 2010

Comprehensive Asssessment System for Houses

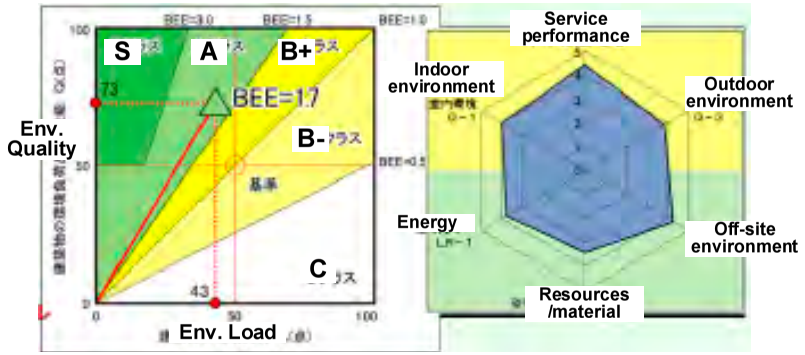
- CASBEE: Comprehensive Assessment System for Building Environmental Efficiency



Source: METI, Japan 2010

Comprehensive Assessment System for Houses

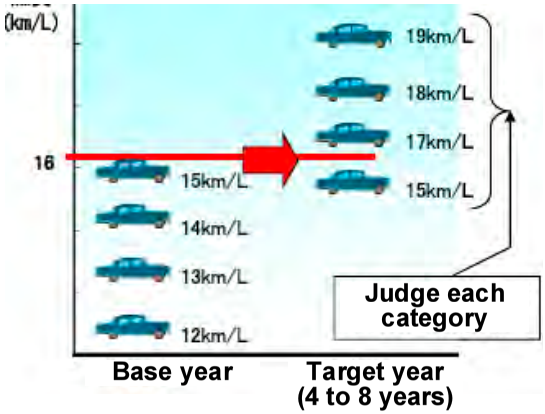
- CASBEE: Comprehensive Assessment System for Building Environmental Efficiency



Source: METI, Japan 2010

Top Runners Approach (1998-)

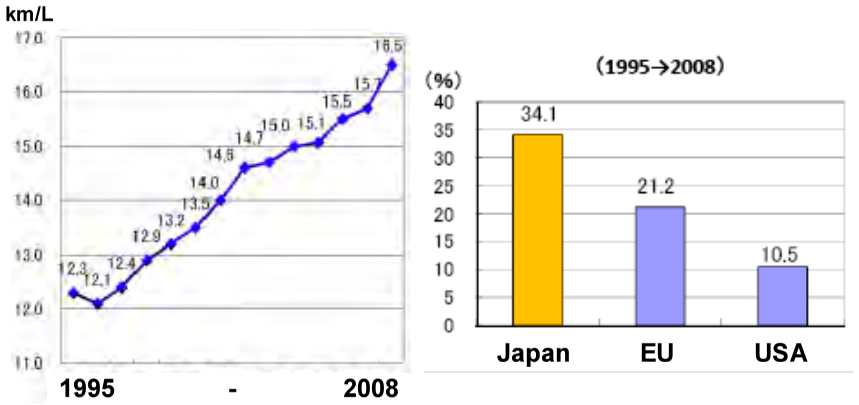
- Select the EE of best product as target for all manufacturers (Covered products:23)



Source: METI, Japan 2010

Top Runners Approach (1998-)

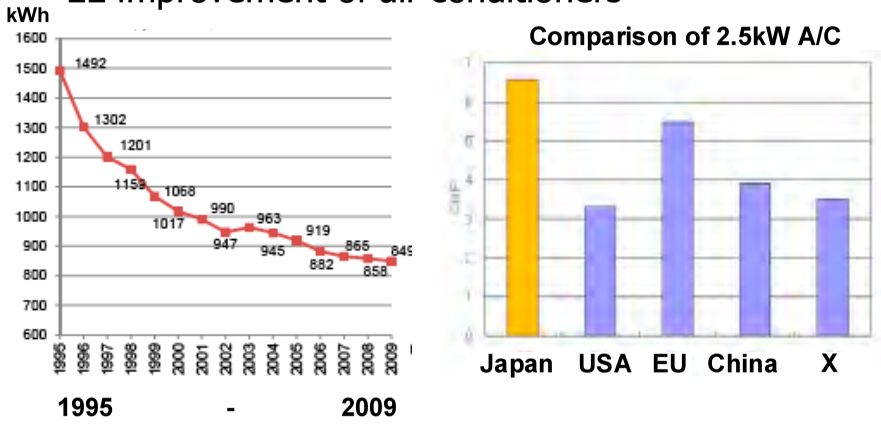
- EE improvement of passenger cars



Source: METI, Japan 2010

Top Runners Approach (1998-)

- EE improvement of air conditioners



Source: METI, Japan 2010

Issues of Carbon Footprint (CFP)

- How does CFP contribute to CO_2 reduction?
- What are the differences between CFP and other low-carbon activities?
  - Energy efficiency laws/regulations, CDM, T-VER, etc.
  - National/local, public/private, organization/person, etc.
- Do CFP and other activities have consistency?
- If such consistency is required, how can we achieve it?
- **What kind of CFP system is ideal?**

Carbon Footprint 5: Issues in carbon footprint (CFP) system for services - Example of printing services -

22, February, 2011

JICA Expert Team

Mariko FUJIMORI

A1-216

CFP for services

- What is the difference between CFP for "goods" and "services"?
  - Goods: Carbon emission of goods = final products.
  - Services: Carbon emission from the process to produce goods or the process itself.
- For which points should we be cautious?
  - Structure of the process: How does the process work?
  - Boundaries: What kind of activities are included to calculate the CFP?
  - Basis (standard) of comparison: How will the CFP be used?

CFP for paper printing services

Please refer to the Annex A

- Process of printing:

(Material acquisition)
1: Raw material acquisition
2: Prepress
3: Printing
4: Surface Treatment
5: Cutting and binding, and Packaging
6: Disposal at production stage
(Distribution)
(Use)
(Disposal & recycling)

CFP for paper printing services

Please refer to the Annex A

- Process of printing:

1: Raw material acquisition
2: Prepress
  - DTP process
  - Plate making process
  - Press plate factory process
3: Printing
4: Surface Treatment
5: Cutting and binding, and Packaging
6: Disposal at production stage

CFP for paper printing services

Please refer to the Annex A

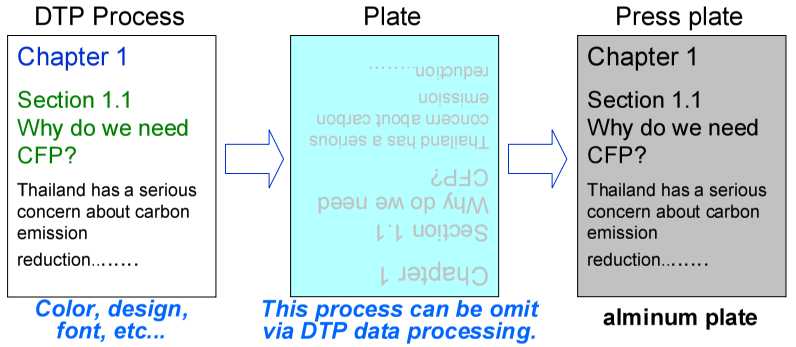
Example: Prepress

- DTP process
  - Design and edit the products
  - Using computers, electricity, paper, ink, water, etc.
- Plate making process
  - Providing layout paper (transparent film)
  - DTP can skip this process
- Press plate factory process
  - Expose layout papers to press plates (alminum plates)

CFP for paper printing services

Please refer to the Annex A

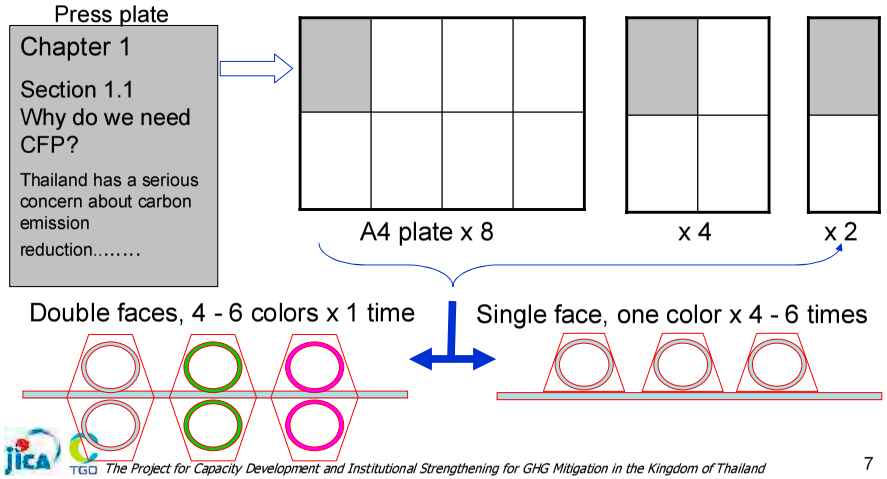
Prepress stage



CFP for paper printing services

Please refer to the Annex A

Printing stage



CFP for paper printing services

Please refer to the Annex A

- Who can do all of these processes?

1: Raw material acquisition
2: Prepress
3: Printing
4: Surface Treatment
5: Cutting and binding, and Packaging
6: Disposal at production stage

- Each process has professional entities.
- Only huge companies can cover all processes.

CFP for paper printing services

Please refer to the Annex A

What are the differences between big companies and small/medium entities?

- Compared to small/medium entities, major big companies tend to have latest (efficient) facilities.
- Major printing services are "divided work" or "team work" processes by small/medium entities, who have expertise to their own processes.
- These professionals select partners according to the goods/products they are going to produce.
- What should be the criteria of "effort" process to produce best quality goods?

PCR for paper printing services

PCR: Product Category Rule

- Common rule to calculate the CO2 emission by a certain category
- Proposal - experts input and public comments - evaluation - authorization - utilization - revision
- Processes included in the flow chart and emission from each process should be clarified and calculated very carefully.
- Decision of the boundary is one of the most important points.

PCR for paper printing services

In case of establishing PCR for printing in Japan:

- Meeting and input from member companies of printing associations
- Committee decision under the association
- Proposal to the national authority (METI)

PCR for paper printing services

Agreed issues:

- Continuous data collection/upgrading
- Revision of PCR according to necessity
- Avoid too much load to companies
- Avoid misleading information to consumers
- Raise awareness of consumers about relationship of CO2 emission and recycled material.

PCR for paper printing services in Thailand

What should be noticed in the case of Thailand?

- Simple
- Transparent
- Fair
- Realistic/practical

How can we establish/evaluate such PCR?

Appropriate expert input is essential to consider "challenging" PCR.

Carbon Footprint 6: Carbon Footprint for Organization

10th, May 2011

JICA Expert Team

Mariko FUJIMORI

A1-220

Objectives of this section

Objectives of this section are:

- Current status and trend of CFP (Carbon Foot Print) in the world, in major countries and in Japan
- GHG Protocol: Scope 3 and Product standards
- Discussions in Japan about these standards
- Discussion: What kind of conditions are required for implementing Carbon Footprint for Organizations in Thailand?

Present condition of CFP in the UK (1)

PAS 2050 (Publicly Available Specification)

- Developed in 2008 (revision until early 2011)
- Established by:
  - DEFRA (Department of Environment, Food and Rural Affairs)
  - BSI (British Standards) and
  - Carbon Trust
- Sales of the goods with the label in 2010

  → 200 billion pounds (99 billion THB)

Source: METI CFP Report (in Japanese)

Present condition of CFP in the UK (2)

PAS 2050 (cont.)

- Application of PAS 2050: within and outside of the UK
  - Australia and New Zealand: Olive oil and wine, from 2010
  - Korea: MOU in 2009 between Carbon Trust and KEITI (Korea Environmental Industry & Technology Institute) to apply the Carbon reduction label to goods exported from Korea to UK
- Incentive for private entities by the UK government:
  - Preparation of user friendly guidance, free access to standards and data, etc.
  - Funding only to Carbon Trust but not to the private entities – dissemination based on market mechanisms
- Consumers who know about the CFP: **60%** knows about the "word" only.

Source: METI CFP Report (in Japanese)

Present condition of CFP in Germany (1)

Product related climate protection strategies: Understanding and using Product Carbon Footprints

- Developed in 2010 by:
  - BMU (Federal Ministry of Environment) and
  - BDI (Federation of German Industries)
- Neither beneficial nor reliable for communication with consumers (technical issues, inconsistency of data and conditions, lack of standard methodologies)
- CO_2 label for consumers: Not very useful/meaningful (without standard for comparison, any suggestion for the use of goods, lack of information about impact to other environment, confusion by too much labels)

Source: METI CFP Report (in Japanese)

Present condition of CFP in Germany (2)

Blue Angel

- Developed in 1978
  (11,500 goods in 90 categories as of 2010)
- Lead by Federal Minister of Interior
- Operation by one independent review committee, two governmental organizations and a private entity
- Comprehensive environmental performance
- Four priority target: Climate, Health, Resource, Water

Source: METI CFP Report (in Japanese)

Present condition of CFP in Japan

2008
- June; Cabinet decision "Japan As a Low-Carbon Society"
- METI started the pilot project

2009
- National Pilot Project has started
  "Basic Guideline of the Carbon Footprint of Products"
  "Guide of Establishing Product Category Rules"

2010
- 2nd year of the Pilot Project - revision of the general instructions.

2011
- Final year of the Pilot Project.

Source: Prof. Inaba: Carbon Footprint of Products in Japan (2010)

Japan's Carbon Footprint of Products Pilot Project

Four Main Activities
1. CFP calculation and labeling pilot program
2. Database construction
3. Building verification scheme
4. Contribution to international standardization
   → Harmonization with ISO 14067 (under development)

New Approach
- Demonstration project of CFP calculation and verification study by using "Broadly-applicable PCR"
- Considering verification schemes
- Considering various communication methods for CFP
- Launching discussions on CFP of services

Source: Material for METI Committee Special Session

Present condition of CFP in the world

ISO

- ISO 14040/44: Environment management - LCA
- ISO 14025: Environmental labels and declarations
- ISO 14067: Carbon footprint of products (under Committee Draft)
- ISO 14069: Carbon footprint of organizations (under Working Draft)

--> They will be established until November 2011 or 2012.

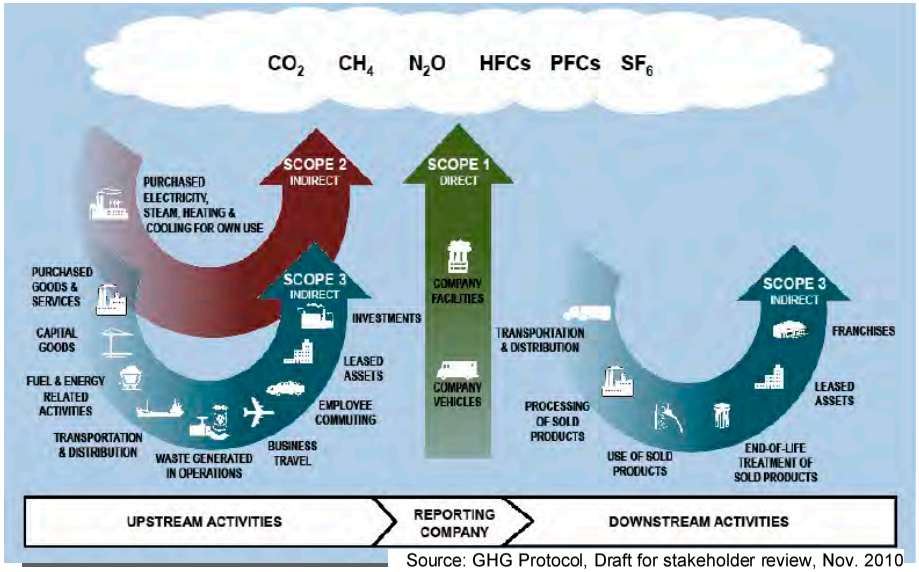
NWIP: New Work Item Proposal
PWI: Preliminary Work Item
AWI: Approved Working Item
WD: Working Draft
CD: Committee Draft
DIS: Draft International Standard
FDIS: Final Draft International Standard

Source: http://www.iso.org/

Present condition of CFP in the world

GHG emissions through the supply chain

GHG emissions through the supply chain



Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

GHG Protocol

Greenhouse Gas Protocol Initiative

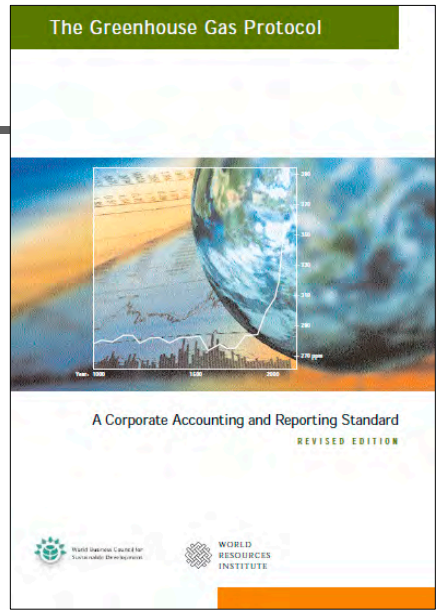
- Established in 1998 by:
- WRI (World Resource Institute) and
- WBCDS (World Business Council for Sustainable Development)
- Multi-stakeholder partnership of businesses, NGOs, governments and others

Source: Material for METI Committee Special Session

GHG Protocol

The GHG Protocol
Corporate Standard
Released in 2001
Revised in 2004

Available free on:
www.ghgprotocol.org



GHG Protocol Corporate Standard

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Programs Based on GHG Corporate Protocol

- Carbon Disclosure Project (CDP)
- The Climate Registry
- California Climate Action Registry
- Chicago Climate Exchange
- Dow Jones Sustainability Index
- EU Emissions Trading Scheme
- French REGES Protocol
- Global Reporting Initiative
- METI, Japan
- Mexico GHG Program
- Respect Europe Business Leaders Initiative for Climate Change
- International Trade Associations (Aluminum, IPIECA, ICFPA, Cement, Iron and Steel)
- UK Emissions Trading System
- U.S. EPA Climate Leaders Initiative
- World Wildlife Fund Climate Savers
- World Economic Forum Global GHG Registry
- ISO 14064 Part 1
- U.S. Department of Energy

- Many programs apply the Protocol
  → ***It's framework has worldwide impact.***

GHG Protocol Corporate Standard

Chapter 4: Setting Operational Boundaries

- Introducing the concept of "scope"

Scope 1: Direct GHG emissions

Emissions from sources owned or controlled by the company, i.e., combustion in owned or controlled boilers, furnaces, vehicles, etc.

Scope 2: Electricity indirect GHG emissions

Emissions from the generation of purchased electricity consumed by the company.

GHG Protocol Corporate Standard

Scope 3: Other indirect GHG emissions

An optional reporting category,

Emission by the activities of the company, but occur from sources not owned or controlled by the company, i.e., extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Option → Standard.....

New Standards under Development

Scope 3 (Value Chain) Accounting and Reporting Standard

- Corporate value chain GHG emissions (Scope 3)

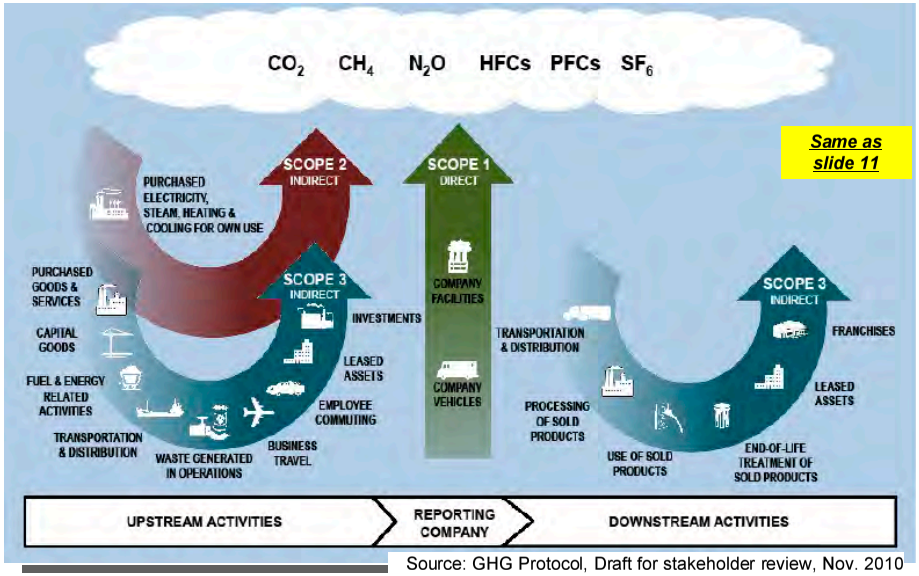
→Build on the GHG Protocol Corporate Standard

Product Life Cycle Accounting and Reporting Standard

- Product life cycle GHG emissions

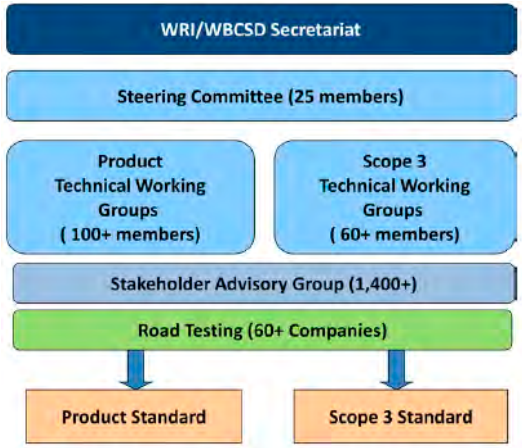
→Build on existing life cycle assessment methods (ISO 14044)

Scope 1, 2 and 3



Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

Structure for the development



Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

Source: Material for METI Committee Special Session

Scope 3: Categories

Upstream Activities

1. Purchased goods & services
2. Capital goods
3. Fuel & energy related activities
4. Transport & distribution
5. Waste generated in operations
6. Business travel
7. Employee commuting
8. Leased Assets
9. Investments

Downstream Activities

10. Transport &distribution
11. Processing of sold products
12. Use of sold products
13. Disposal of sold products
14. Leased assets
15. Franchises

Source: Material for METI Committee Special Session

Scope 3: Second draft

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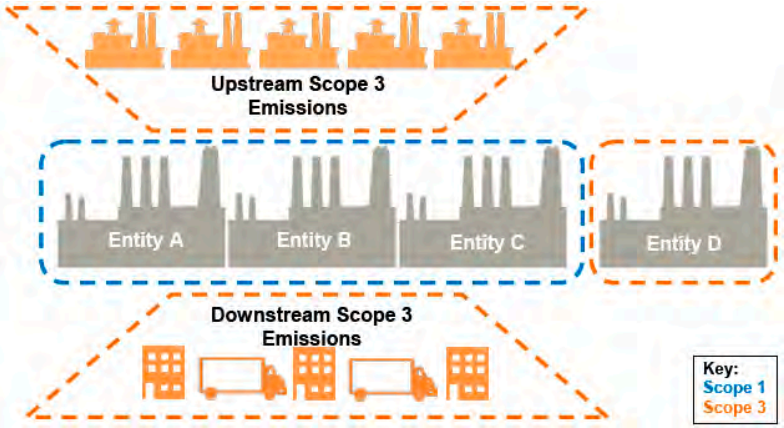
Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

Scope 3: Organizational boundary

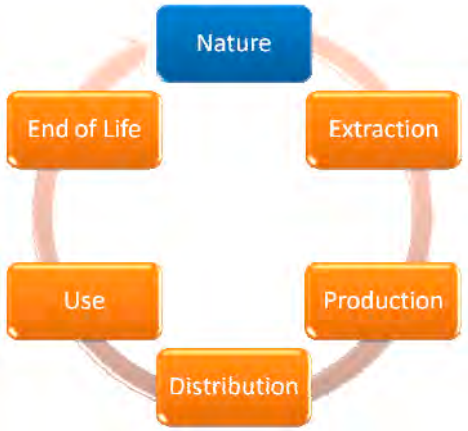
With (blue) or without (orange) operational control



Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

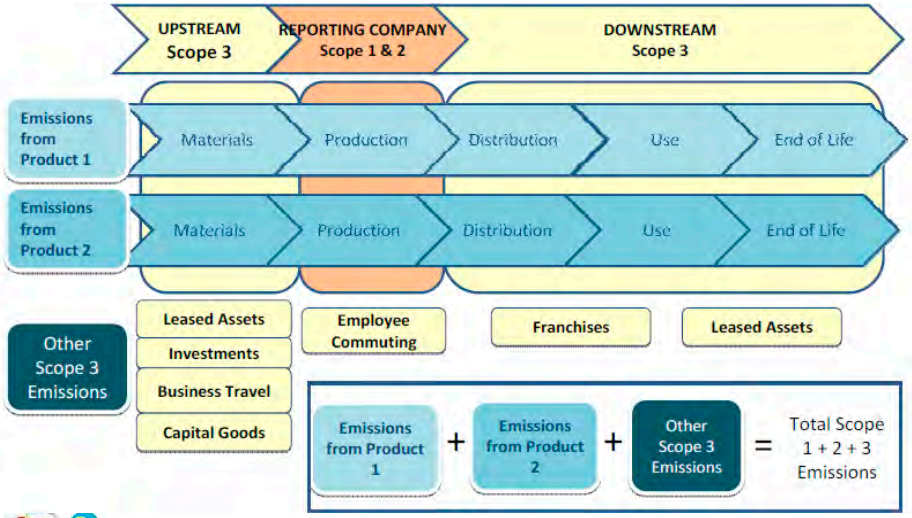
Product Standard

- Quantify GHG emissions of a product over its lifetime
- Understand, manage, and publically report the life cycle GHG emissions associated with individual products



Source: Material for METI Committee Special Session

How the Standards Work Together



Source: GHG Protocol, Draft for stakeholder review, Nov. 2010

Schedule in near future

January – March, 2011

Revision of drafts based on public comments and steering committee feedback

April, 2011

Text of the standards finalized

May – July, 2011

Editing and publishing

September, 2011

Official launch of new standards

Source: Material for METI Committee Special Session

Issues and problems of Scope 3

- Why Scope 3 is necessary?

  → To avoid carbon leakage in the world
- Is it possible to collect such a huge amount of data?

  → To collect all related carbon footprint will be most reasonable way *(if they are available)*
- Is it applicable to all types of businesses?
- How is the consistency with ISO 14069?

Source: Material for METI Committee Special Session

Discussions in Japan about Scope 3

Research/Study Committee on Standards for Accounting and Reporting Organization's GHG emissions throughout the Supply Chain

Objectives:

For a successful response to the standards to be finalized under the GHG Protocol in 2011, the Committee aims to discuss possible issues in applying such standards to Japanese companies, and to share information and opinions related to the standards, including challenges and means to use them.

Source: Material for METI Committee Special Session

Issues regarding Scope 3 standard - Raised in Japan (1)

Examples of opinions provided by the Committee and its working groups members

Chapter 3: Business Goals & Inventory Design

- It is good that the second draft suggests benefits for companies to estimate Scope 3 emissions, by giving examples such as:
  - "to understand opportunity/risk associated with GHG emissions from entire value-chain,"
  - "to recognize potentials to reduce GHG emissions," etc.

Issues regarding Scope 3 standard - Raised in Japan (2)

Examples of opinions provided by the Committee and its working groups members

Chapter 4: Overview of Scope 3 Emissions

- Capital Goods

→ GHG emissions associated with capital goods should be evaluated by comparison between emissions from construction and mitigations through operation. What's the purpose to add up emissions from construction only?

- Transportation & Distribution (Upstream)

→ Would it really be possible to estimate this category other than transport services for which reporting companies pay.

Issues regarding Scope 3 standard - Raised in Japan (3)

Examples of opinions provided by the Committee and its working groups members

Chapter 4: Overview of Scope 3 Emissions

- Business Travel
- Employee Commuting

→ Estimation is possible for this category if approximation based on payment amount is acceptable.

→ For heavy industry, this category is negligible in overall Scope 3 emissions. Coverage of this category should be determined depending on industries.

Issues regarding Scope 3 standard - Raised in Japan (4)

Examples of opinions provided by the Committee and its working groups members

Chapter 4: Overview of Scope 3 Emissions

- Processing of Sold Products

→ It seems not realistic for intermediaries to request their clients to provide data for processing the sold products.

- Use of Sold Products

→ GHG emission reductions by using sold products should also be covered in estimation. For companies, the biggest opportunity to cut their emissions other than Scopes 1 & 2 is by replacing existing products with their own products.

Issues and problems of Scope 3

- Why Scope 3 is necessary?

  → To avoid carbon leakage in the world

  Same as slide 27

- Is it possible to collect such a huge amount of data?

  → To collect all related carbon footprint will be most reasonable way *(if they are available)*

- Is it applicable to all types of businesses?
- How is the consistency with ISO 14069?

Discussion

What kind of conditions are required

for establishing and implementing the scheme

of Carbon Footprint for Organizations in Thailand?