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[Final Report]

Climate Finance for Carbon Neutrality in Thailand

CASE for Southeast Asia

Final Report

Climate Finance for Carbon Neutrality in Thailand

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In the context of

The programme “Clean, Affordable and Secure Energy for Southeast Asia” (CASE) is jointly implemented by GIZ and international and local expert organisations in the areas of sustainable energy transformation and climate change: Agora Energiewende and NewClimate Institute at the regional level, the Institute for Essential Services Reform (IESR) in Indonesia, the Institute for Climate and Sustainable Cities (ICSC) in the Philippines, the Energy Research Institute (ERI) and Thailand Development Research Institute (TDRI) in Thailand, and Vietnam Initiative for Energy Transition (VIET) in Vietnam.

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Implemented by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH; Agora Energiewende; New Climate Institute; Energy Research Institute; TDRI Thailand Development Research Institute; The Creagy

As part of “Clean, Affordable and Secure Energy for Southeast Asia Programme (CASE) funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK) in the framework of its International Climate Initiative (IKI) and implemented by GIZ Thailand, CASE Programme has developed the Long-term Energy Scenario to support Thailand’s energy transition and its target to achieve carbon neutrality by 2050 and net-zero emissions by 2065.

Aligned with the recommendation of Thailand’s Carbon Neutrality Scenario developed by CASE Programme, the study of Financial Instruments for the Carbon Neutrality Scenario in Energy Sector has been conducted with the main objective to recommend the financial mechanisms/ instruments to support decarbonization in the power, transport and industry subsectors. The outcome of the study is a set of financial policies, mechanisms, and instruments to support Thailand’s carbon neutrality pathway phasing into short-, medium-, and long-term

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Abbreviations

ACR	American Carbon Registry
ATF	Automotive Transformation Fund
BAU	Business-as-usual
CAPEX	Capital Expenditure
CBU	Completely Built Up
CCPs	Core Carbon Principle
CCS	Carbon Cature and Stroage
CCUS	Carbon Capture, Utilization, and Storage
CDM	Clean Development Mechanism
CIT	Corporate Income Tax
DEDE	Department of Alternative Energy Development and Efficiency
DEVEX	Developemnt Expenditure
DSM	Demand Side Management
E2F	Energy Efficiency Fund
ECFT	The Energy Conservation Foundation of Thailand
EEDP	Energy Efficiency Development Plan
EEP	Energy Efficiency Plan
E for E	Energy for Environment Foundation
ENCON Fund	Energy Conservation Fund
ESS	Energy Storage System
ETS	Emission Trading Scheme
FiP	Feed-in Premiums
FiT	Feed-in Tariff
GEC	Global Environmental Centre Foundation
GHG	Greenhouse Gas
GWp	Gigawatt-peak
HCFC	Hydrochlorofluorocarbon
ICP	Internal Carbon Pricing
IET	International Emission Trading
IETF	Industrial Energy Transformation Fund
LT-LEDS	Long-term low emissions development strategies
LULUCF	Land use, land-use change, and forestry
MACC	Marginal abatement Cost Curve
M&V	Monitoring and Verification
MRV	Measurement, Reporting and Verification
MtCO2	Metric tons of carbon dioxide
NDC	Nationally Determined Contribution
NFV	Non-Fossil Value Certificate
Ofgem	The Office of Gas and Electricity Markets
PPA	Power Purchase Agreement
REC	Renewable Energy Certificate
REDP	Renewable Energy Development Plan
REGO	Renewable Energy Guarantee of Origin
RPS	Renewable Portfolio Standard
SPV	Special Purpose Vehicle
ZEV	Zero Emission Vehicle

CASE for Southeast Asia

Input

Financial & economic policies, measures, and instruments

Countries

- International review
- Thailand

x

Energy sector

- Power Sector
- Transport Sector
- Industry Sector

CASE:

Carbon Neutral 2050 Scenario

from the report "Towards a collective vision of Thai energy transition: National long-term scenarios and socioeconomic implications"

Output

Gap analysis

- International VS Existing Practices
- Needs of each sector

Economic Analysis

- Size of fund from "**Carbon Neutral 2050 Scenario**"
- Policy/mechanisms/instruments to match with size of fund and technology development

Focus group

Outcome

Financial & economic policies, measures, and instruments to support Thailand's Carbon Neutrality Pathway

Final

Short term → Medium term → Long term → **Carbon Neutrality 2050**

Chapter 1:

Global landscape of Climate Finance in Power, Transport, and Industry Sectors

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Global landscape of Climate Finance in Power, Transport, and Industry Sectors

This chapter provides a global landscape of climate finance to promote decarbonization in power, transport, and industry sector. Global trend on decarbonization of each sector is presented at the beginning, followed by business model and financial and/or non-financial instruments to promote decarbonization. Then, there are summary of mechanisms in short-, medium- and long-term.

Global landscape:

Policy and Instrument to Promote Decarbonization

POWER

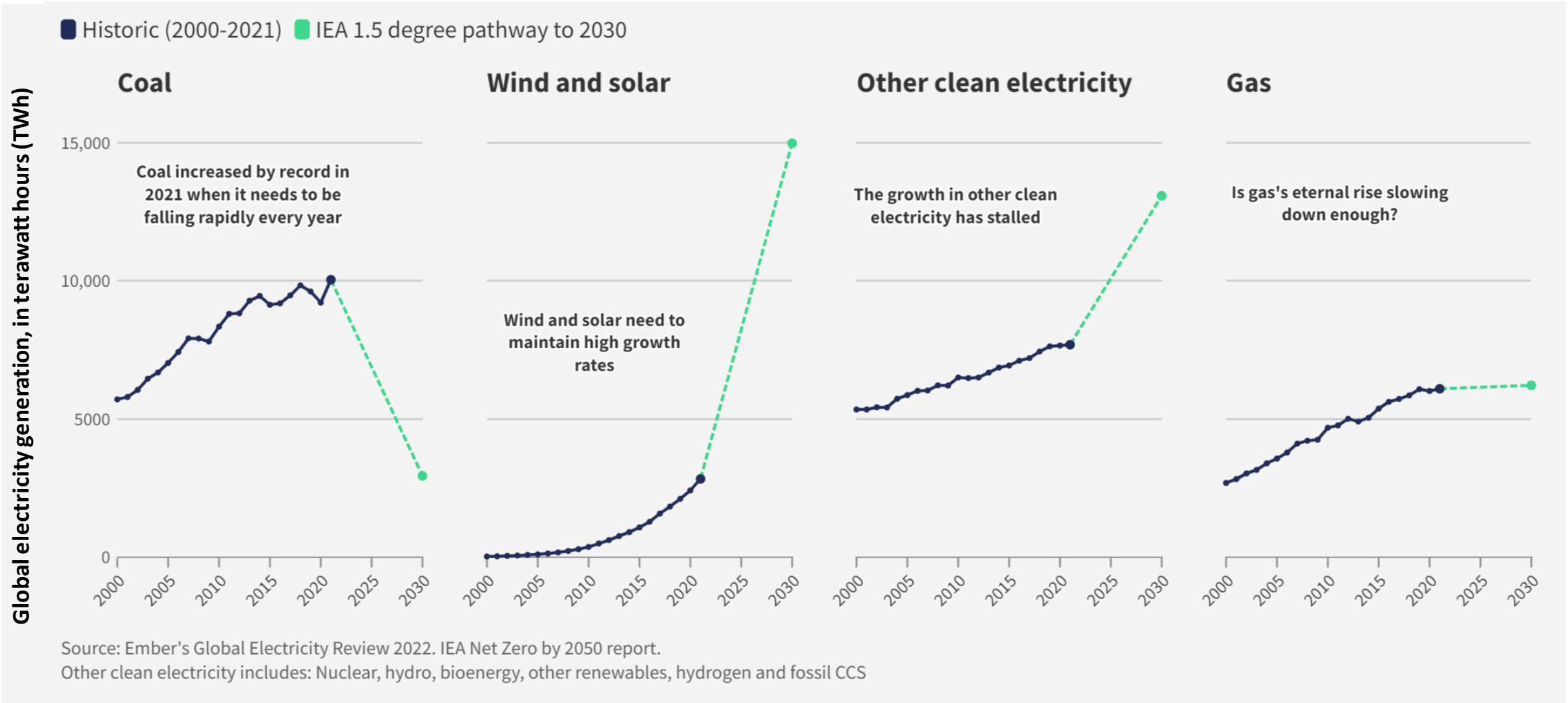
TRANSPORT

INDUSTRY

Key summary

- While electricity generation from coal have significantly increased from 2005 to 2021, it is expected to experience a rapid decline since 2021.
- Unlike to wind and solar and other clean electricity, those power sources are expected to experience upward trends in electricity generation. Meanwhile, electricity generation from coal relatively remains constant since 2021.
- There are a lot of business models appropriate to 3 main players in power sector: generators, consumers and facilitators. The potential financial instruments utilized in the models are designed to suitable to needs of each players.
- The target countries in the study are UK, US, Japan and Singapore. Each country has different mechanisms to promote decarbonization in power sector.
- Tradable REC is the only mechanisms that have been used in all target countries.
- While UK funds specifically target to each sector i.e., nuclear, hydrogen and CCS, the fund in US is more pay attention to overall technology that relates to climate action activities.
- For EU, they focus on ambitious target and improvement through revision such as promoting liberalisation and flexibility in power sector and market creation.

Global trend on decarbonization in power sector



Source: https://ember-climate.org/insights/research/global-electricity-review-2022/

Business models and financial instruments for promoting decarbonization in power sector

Business modelsa			Financial instruments
Generators	**Consumers**	**Facilitators**	
• Self-consumption • Wholesale PPA	• On-site private wire PPA • ESCO • Leasing (long-term PPA) • Direct off-site PPA • Sleeved PPA • Aggregated PPA • Mini-utility PPA	• Community Energy • Virtual power plant • Aggregation • Reverse auction	• Crowdfunding • Feed-in tariff scheme • Reneaawable Energy Certificate (REC) • Net-metering • On-tax bill financing • Tax incentives • Green bond • Pay as you go (off-grid)

- Wholesale PPA: term of contract that buyer will purchase electricity from generator at a fixed period of time and a fixed rate.
- On-site private wire PPA: Entities (buyers and sellers) are located on land adjoining energy generation assets. The assets generate power which is delivered directly to the offtaker, and not via the electricity distribution network.
- Off-site PPA (i.e., Direct off-site PPA, Sleeved PPA): contracts between a project developer (and likely backed by a financial counterparty) and a company, where the RE installation is not sited at the location of the company's electricity usage.
- Long-term PPA: contract between buyers and sellers up to 30 years
- Aggregated PPA: One project developers with multiple offtakers
- Utility PPA: contracts that can be closed between the owner of renewable energy assets and a utility/energy trader acting as the corporate buyer. However, a merchant PPA can also be completed between a corporate or public institution and a utility/energy trader working as a supplier

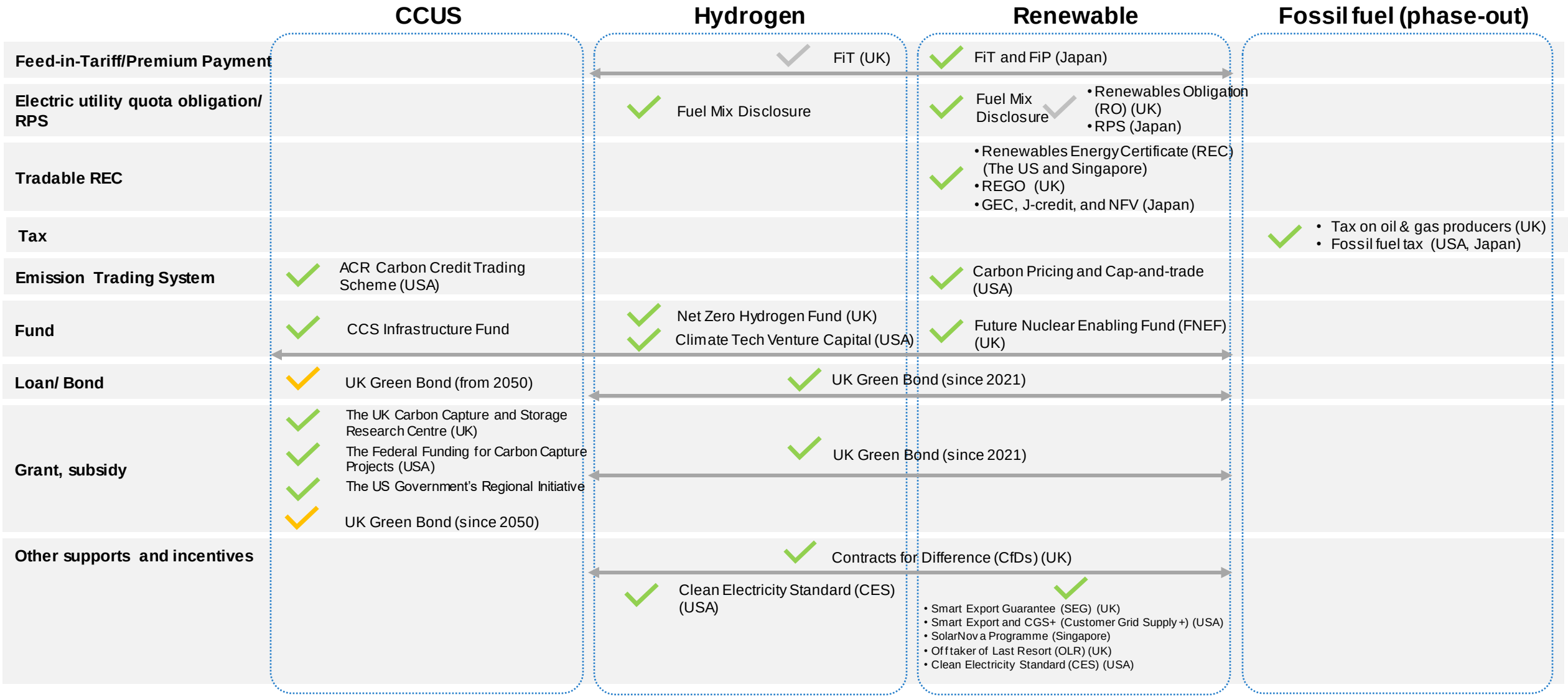
Source: https://ember-climate.org/insights/research/global-electricity-review-2022/

Mechanisms to promote decarbonization by country

	United Kingdom	USA	Japan	Singapore
Policies & Targets	• Zero-emissions power sector by 2035 • Increase the proportion of renewable energy production 40 GW offshore wind by 2030, plus onshore, solar, and other renewables - 1 GW of floating offshore wind by 2030 Secure a final investment decision on a large-scale nuclear plant and launch a new £120 million Future Nuclear Enabling Fund	• 100% clean electricity grid by 2035 • Increase in solar and wind generation while existing nuclear generation remains in operation and could see the growth in the 2030s and 2040s. • Unabated fossil generation (coal or gas generation without CCS technology) declines, and existing fossil fueled plants start to be fitted with carbon capture • Investing in technologies to increase the flexibility of the electricity system • Leveraging carbon capture and storage (CCS) and nuclear	• Decarbonization of the power sector through Increasing the share of renewables in the electricity mix to 22-24% by 2030 • In 2015, Japan set a goal of reducing its share of coal power in the electricity mix to 26% and phasing out inefficient coal power plants. • Utilize hydrogen and ammonia in power generation • Encourage the integration of CCS with fossil power plants	• To have at least 2 GWp of solar energy by 2030 • Increase an energy efficiency • Promote low-carbon technologies
Feed-in-Tariff/Premium Payment	✓ FiT		✓ FiT and FiP	
Electric utility quota obligation/RPS	✓ Fuel Mix Disclosure ✓ Renewables Obligation (RO)		✓ RPS	
Tradable REC	✓ REGO	✓ Renewables Energy Certificate (REC)	✓ GEC, J-credit, and NFV	✓ Renewables Energy Certificate (REC)
Tax				
Emission Trading System		✓ Carbon Pricing and Cap-and-trade		
Fund	✓ • Future Nuclear Enabling Fund (FNEF) • Net Zero Hydrogen Fund • CCS Infrastructure Fund	✓ Climate Tech Venture Capital		
Loan/ Bond				
Other supports and incentives	✓ • Contracts for Difference (CfDs) • Smart Export Guarantee (SEG) • Offtaker of Last Resort (OLR)	✓ • Clean Electricity Standard (CES) • Smart Export and CGS+ (Customer Grid Supply+)		✓ SolarNova Programme

■ = Active scheme/mechanism ■ = Inactive scheme/mechanism ■ = In the government plan

Mechanisms to promote decarbonization by technology



Learnings from the process of EU power systems' transition

Increased ambitions & perpetual improvements through revisions

Upwards revision of RES and decarbonation targets

Liberalisation & EU integration
- Unbundling: Generation – Network – Supply separated
- Network responsibility remains concentrated
- Creation of markets on regional scale

Power sector transition: policies targeting <u>Generation</u>
- Growth of Renewable Energy Sources (RES)
- Decommissioning of high-emissions assets
- Carbon pricing

Security of supply concerns
- Capacity markets development
- RES integration supervised

Revision of the schemes aiming to improve efficiency:
- Incentivise RES to contribute to the system functioning (eg support schemes evolution from FiT to CfD)
- Reduce RES public support cost (eg revision of support tariffs / instauration of tenders for mature RES

Rise of private PPAs
- Aim to finance transition without subsidies

Net-zero targets across all sectors

Systems-view shift
- Synergies can be derived
- Intersection of policies needs to be assessed

Flexibility needs
- Enhanced future role of consumers
- Flexibility enabling and remuneration?

Increased control on the trajectory
- Comeback of some subsidies, with pre-defined volumes
- Technology-specific RES tenders

Support for innovation and acceleration

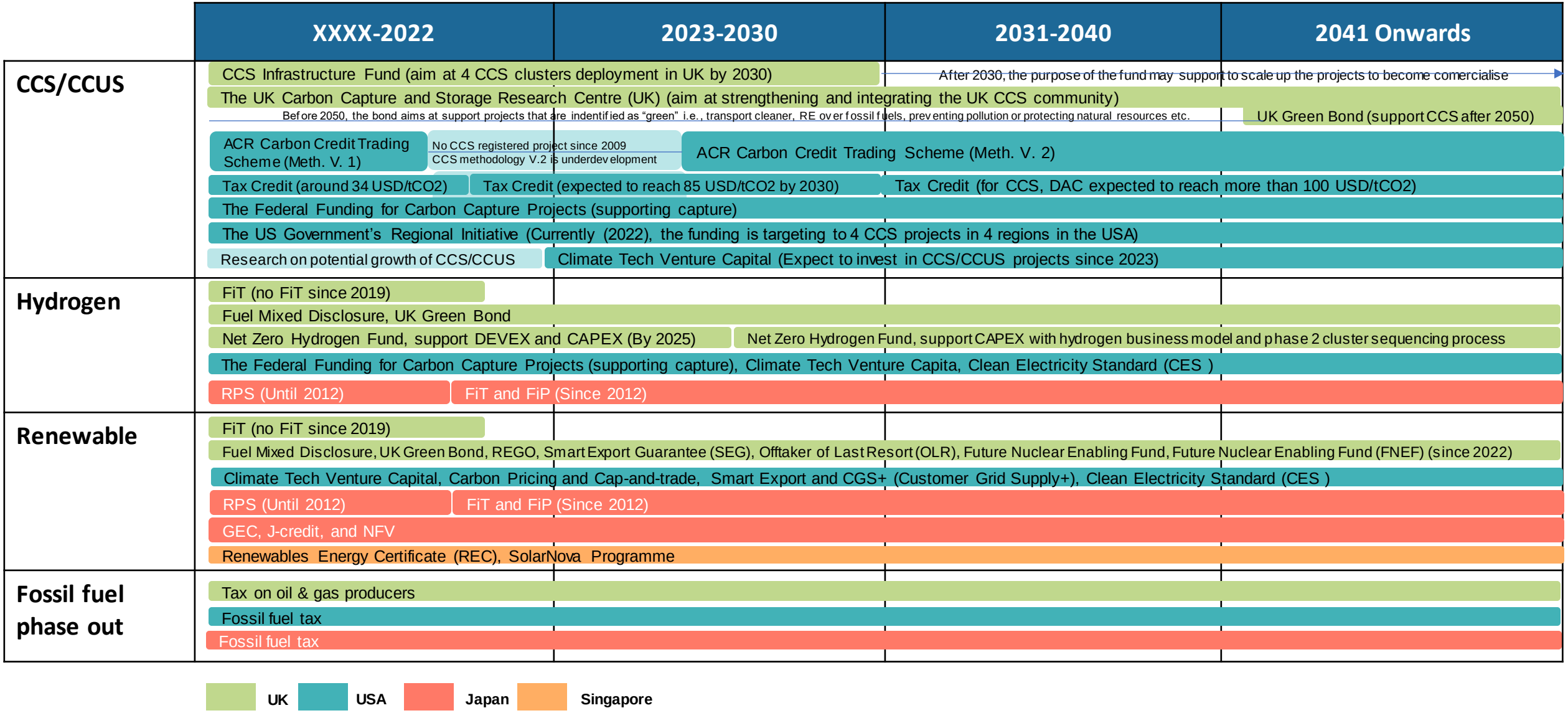
• Policy & Regulation development • Market creation (RES out of the market)	• Policy & Regulation improvements • Market(s) development	• Policy & Regulatory scope widening • Markets re-design/new creations?
• Utility evolutions	• TSO growing role in assessing the RES impact on the systems • Emergence of new business models	• Consumers to mobilise • Investors and innovative business-models needed

Source: FCDO, Carbon trust, Creagy (2022)

Power sector: Mechanisms to promote decarbonization

Summary of mechanisms in Short-, Medium-, and Long-terms

CASE for Southeast Asia



Global landscape:

Policy and Instrument to Promote Decarbonization

POWER

TRANSPORT

INDUSTRY

Key summary

- Regulatory and incentive instruments are commonly used globally to promote adoption of EVs.
- While providing grant and subsidy are generally used to promote transition to EVs adoption in a short-term, mechanisms such as taxation and regulatory enforcement are influent to EVs adoption in a medium-term.
- In a long-term, integration of EVs in a power sector i.e., decarbonization of electricity generation are in place.
- A lot of financing options i.e., lease, loan are utilized as mechanisms to promote vehicle electrification.
- To promote vehicle electrification, regulatory and incentives policies that target to vehicles, batteries and chargers such ZEV mandate or free public charging in urban areas are prevalent.
- UK, US, Japan and Singapore aim at declining (then phasing out) ICE vehicles. However, their goals and mechanisms to achieve the goals are different.
- Soft loan to promote purchase of decarbonization vehicle can be found in the four countries. However, there is a slightly different. While UK, Japan and Singapore provide soft loans for vehicle and charger facilities, only loan for vehicle exists in the US.
- Japan and Singapore offer mechanisms to promote both supply and demand side of vehicle and battery/charger.

Global Trend on EVs

Examples of policy drivers of EV adoption:

Regulatory instruments

- CO_2 emission regulation for cars and vans, China's New Energy Vehicle Mandate or California's Zero Emission Vehicle Mandate
- CO_2 emissions standards in the EU
- Requirement for new building to include charging points
- Preferential/prohibited circulation or access schemes such as low- and zero-emission zones (Oslo, Norway)

Incentive

- **Demand side incentive:** Purchase subsidies, and/or vehicle purchase and registration tax rebates.
- **Supply side incentive:** Direct investment to install publicly accessible chargers

Short term

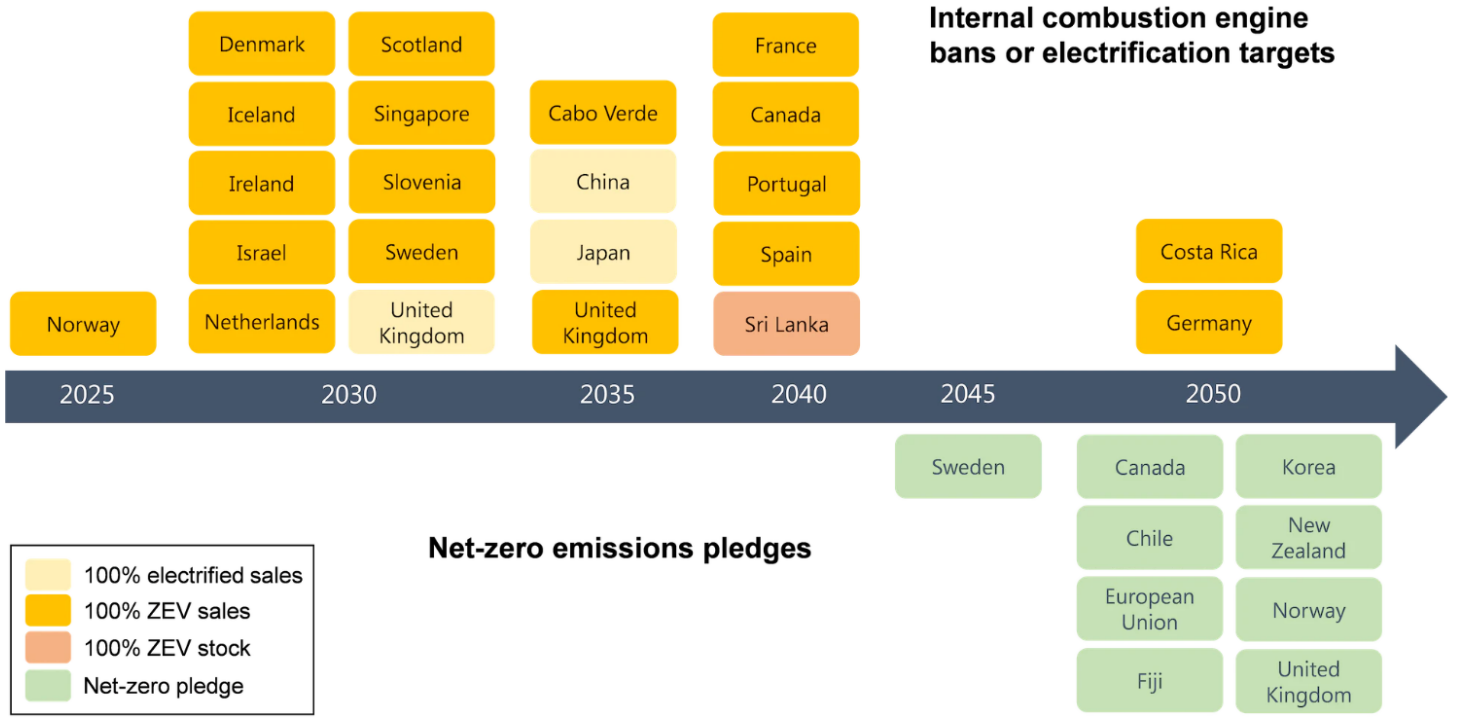
- Promote transition to EVs and installation of charging points in both public and private places
- Grant, subsidy are main mechanisms to drive demand of EVs

Medium term

- Focus on continuing to make EVs competitive
- Phasing out purchase grants/subsidies as sales expand, and replaced by taxation of vehicles and fuels and by reinforcing regulatory measures

Long term

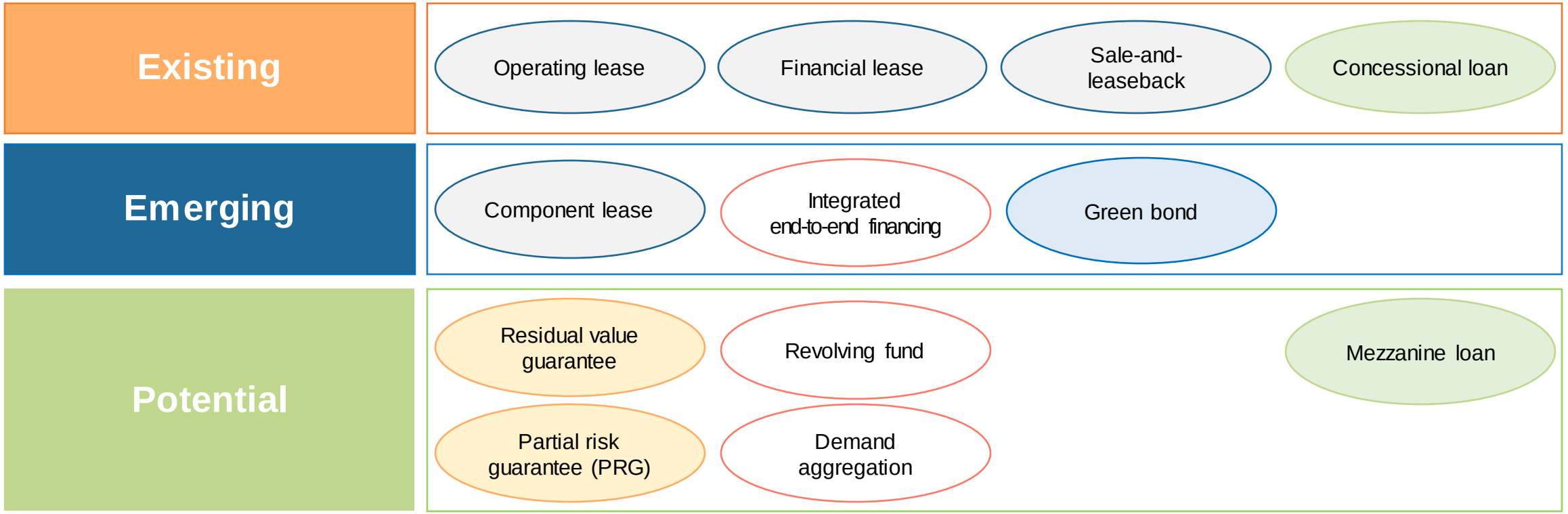
- Integration of EVs in power systems, decarbonization of electricity generation, deployment of recharging infrastructure and manufacturing of sustainable batteries
- Taxation and regulatory measures are in place



Countries where have electrification targets or ICE bans for cars, and countries plus the European Union that have announced net-zero pledges

Source: IEA. Global EV Outlook 2021. www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment

Global Financing Options for Promoting Public Bus Electrification



- The table above illustrates the status of global financing options.
- While operating/financial/sale lease and concessional loan are instruments that already exist, component lease, integrared end-to-end financing and green bond are instruments that are emerging.
- Meanwhile, guaranteee, revolving fund, demand aggregation and mezzanine loan are potential instruments to promote public bus electrification.

Policies to Promote Electric Vehicle Deployment

The following diagram shows overall regulations and incentives, categorized into regulations and incentives for vehicles, batteries, and chargers, that are currently implementing worldwide.

Vehicles

Regulations

- ZEV mandate: Canada, China, USA
- Fuel economy standard: EU, India, Japan
- Clean car import: New Zealand

Incentives

- Direct subsidies / tax credits for EV purchase
- Registration tax rebate
- Lower cost or free parking

Batteries

Regulations

- Battery regulations
- Global standards for environmentally and socially responsible batteries
- Setting minimum production capacities for battery manufacturers (ensure economies of scales)

Incentives

- Grants for battery manufacturing & Development
- Battery reuse and recycling

Chargers

Regulations

- Hardware standard
- Building regulations

Incentives

- Grants for installation of public and private chargers
- Funding & cost-sharing contribution agreements
- Free public charging in urban areas
- Tariff subsidy mechanism for fast charging stations

Source: www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment

Mechanisms to promote decarbonization

CASE for Southeast Asia

	United Kingdom	USA	Japan	Singapore
Policies & Targets 	• Phase out diesel buses • All double-deck buses were hybrid by 2019, and all single-deck buses were zero emissions by 2020. • By 2037, all 9,200 buses across London will be zero emission. • Increase share of non-ICE vehicles and charging infrastructure with electricity from renewable sources	• Reduce consumption, emission and reliance on petroleum, and reduce expenditures • 80% of trips on a sustainable mode (walking, biking, mass transit) by 2050, with remaining personal vehicle trips being zero emissions (NYC) • 100% electric city fleet by 2040 and 6,000 publicly accessible fast chargers by 2030 (NYC) • Additional benefit to those who purchase electric vehicles	• Contribute to build safe, secure, eco-friendly transportation networks • By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport • Investment to advance in electric vehicle manufacture and battery production	• Promote the spirit of innovation among partners and suppliers of the land transport industry in shaping Singapore's land transport development for the future • Promote the whole value chain of sustainable transport
Government spending (subsidy/grant)	✓ Budget allocated to projects	✓ Budget allocated to projects		✓ Budget allocated to innovation fund
Soft loan (vehicle and/or charger)	✓ Vehicle and charger	✓ Vehicle	✓ Vehicle and charger	✓ Vehicle and charger
Soft loan (vehicle and/or battery manufacturing)			✓ Vehicle and battery	✓ Vehicle and battery
State tax incentive		✓		
Public-private investment			✓ Co-financing	
Green bond			✓	
Equity investment			✓	
Green hire purchase				✓
Carbon Pricing	✓ Carbon tax on fossil fuels consumption according to contribution to GHG emission	✓ • Carbon tax on fuel consumption • Cap and trade: hold to the government one allow ance for every tCO2 emitted	✓ Carbon tax is currently around 289 yen (US$2.6) per ton tCO2, and aims at acquire government's financing resources	

= Active scheme/mechanism = Inactive scheme/mechanism = In the government plan

Global landscape:

Policy and Instrument to Promote Decarbonization

POWER

TRANSPORT

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Key summary

- Sources of industrial emission and technological pathways to reduce emission are taken into consideration.
- Regulatory and incentive policies are both mechanisms to promote decarbonnizarion in industrial sector.
- CCUS is the main target strategy to promote decarbonization in industrial sector in UK, US, Japand and Singapore.
- Funding to promote deployment are used in the four countries.
- For mechanisms to promote decarbonization by technology, public procurement i.e., Green procurement and green contract and demand side measure i.e., the EU-US carbon-based trade policies exist across technologies.

Global Trend on Decarbonization in Industry Sector

The major industry sector's sources of emissions includes cooling, heating, powering machineries, as well as light facilities and fossil fuels. Meanwhile, examples of technology to decarbonize industry sector include energy efficiency, low-carbon fuels, Capturing & utilizing or storing Carbon dioxide, and electrification.

Sources of industrial emissions

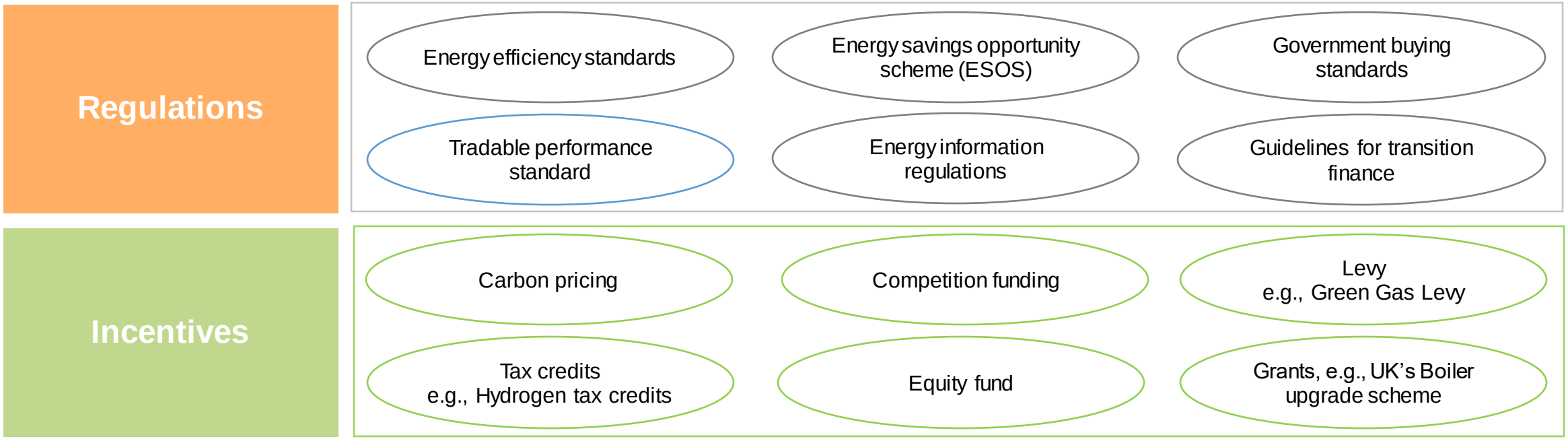
- Process cooling, heating, and powering equipment
- Heat, air condition, and light facilities
- Fossil fuels used as raw material inputs to manufactured products

Technology pathways

- Improving energy efficiency
- Low-carbon fuels & feedstocks substitution
- CCS/CCUS
- Increasing electrification

Source Office of Energy Efficiency & Renewable Energy. DOE Industrial Decarbonization Roadmap. www.energy.gov/eere/industrial-decarbonization

Policy Options for Decarbonization of Industry Sector



- The policies to promote decarbonization in industry sectors are categorized into 2 categories including regulations and incentives.
- Energy efficiency standard or information regulations etc. are examples of regulations enforcing decarbonization.
- Incentive policies such as carbon pricing, tax credit etc. are example of mechanisms that make decarbonization become more attractive and associate to competitiveness

Source:
Federal Climate Policy Toolkit: Industrial Sector.2021. www.resources.org/archives/federal-climate-policy-toolkit-industrial-sector/
CREDS. Industrial decarbonisation policies for a UK net zero target .2020. www.creds.ac.uk/wp-content/uploads/CREDS-Industrial-decarbonisation-policies-Dec2020.pdf

Mechanisms to promote decarbonization by countries

CASE for Southeast Asia

	United Kingdom	USA	Japan	Singapore
Policies & Targets	• Four of our major industrial regions linked up to the necessary decarbonisation infrastructure by 2030. • Around 3 MtCO2 of industry emissions captured each year by 2030. • 4 main strategies: Low carbon fuels, CCUS, efficiency, heat recovery and reuse	• Five sectors in focus: Cement, Iron & Steel, Chemicals, Food, Refining heat and power • 4 main strategies: CCUS, Low carbon fuels, feedstocks, and energy sources, EE, Industrial electrification	• Achieving carbon neutrality in 2050 for GHG-intensive industries • 5 main strategies: energy transition, renewable electricity for operation, CCUS, hydrogen direct reduction , amonia	• 5 main strategies: Energy efficiency, Low-carbon technologies, CCUS, transforming refining, hydrogen
Demonstration Funding	✓ Industrial Energy Transformation Fund, Industrial Decarbonisation Challenge, Energy Innovation Program, Energy Innovation Program	✓ Clean hydrogen electrolysis program Clean hydrogen manufacturing & recycling initiatives Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs	✓	
Deployment Funding	✓ RE Heat Incentives, Net Zero Hydrogen Fund, Clean Steel Fund, Industrial Heat Recovery Support, Green gas support scheme	✓	✓ Green innovation fund	✓ E2F, Energy efficiency financing program, resource efficiency grant for energy
Infrastructure	✓ CCUS infrastructure fund, Heat network improvement programme	✓ Regional Clean Hydrogen Hubs	✓	
Public Procurement	✓ Green paper on procurement reform	✓ Buy clean taskforce	✓ Green Procurement & Green Contract	
Carbon pricing	✓ Carbon Pricing, Climate change levy, Green gas levy	✓ Carbon pricing		✓ Carbon tax
Demand-side measures	✓ Product standards, Consolidated demand via buyers' alliances	✓ First movers' coalition EU-US carbon-based trade policies		✓ Min. Energy Efficiency Standards (MEES) Min. Energy Performance Standards (MEPS)
Tax Credits		✓ Tax credit for CCUS	✓ Tax credit for private investment over 10 years	
Others	• Financial relief for energy-intensive industries • Climate change agreements	• Better plants program • 7th Clean Energy Manufacturing Institute	• Guidelines for transition finance • Long-term funds with an interest subsidy	• Sustainable bond grant scheme

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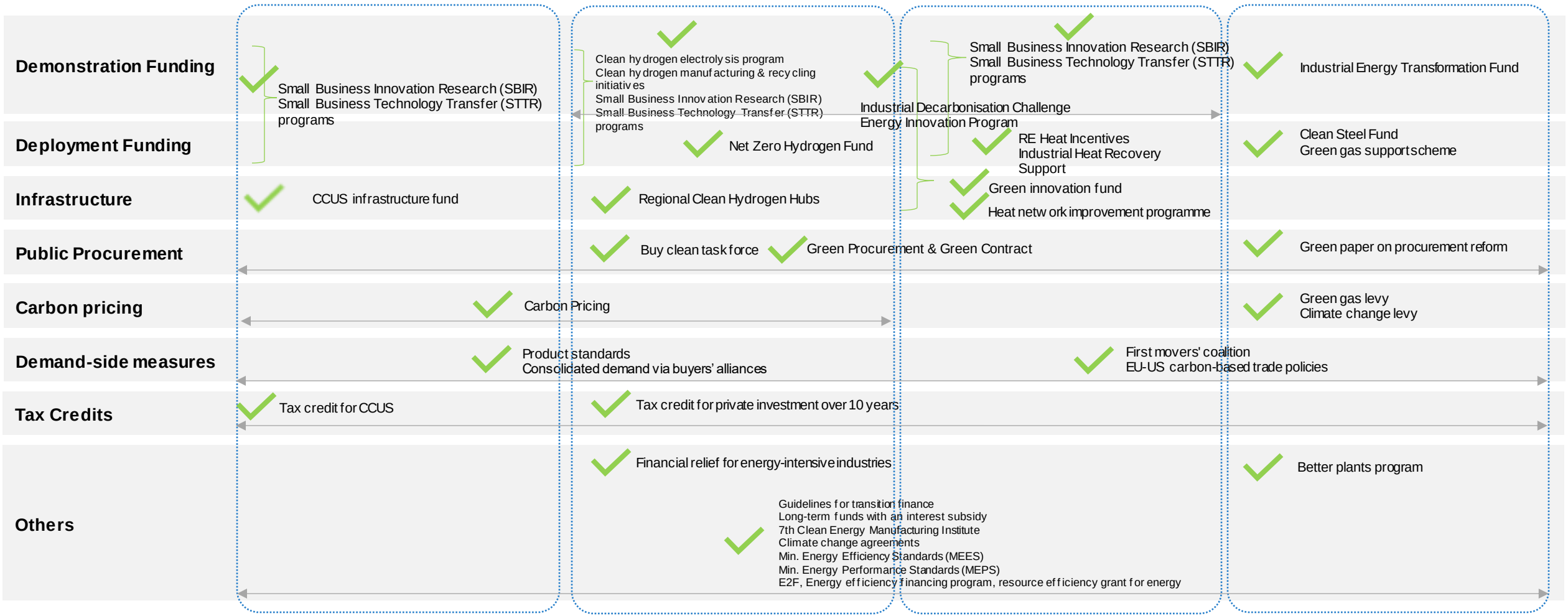
Mechanisms to promote decarbonization by technology

CASE for Southeast Asia



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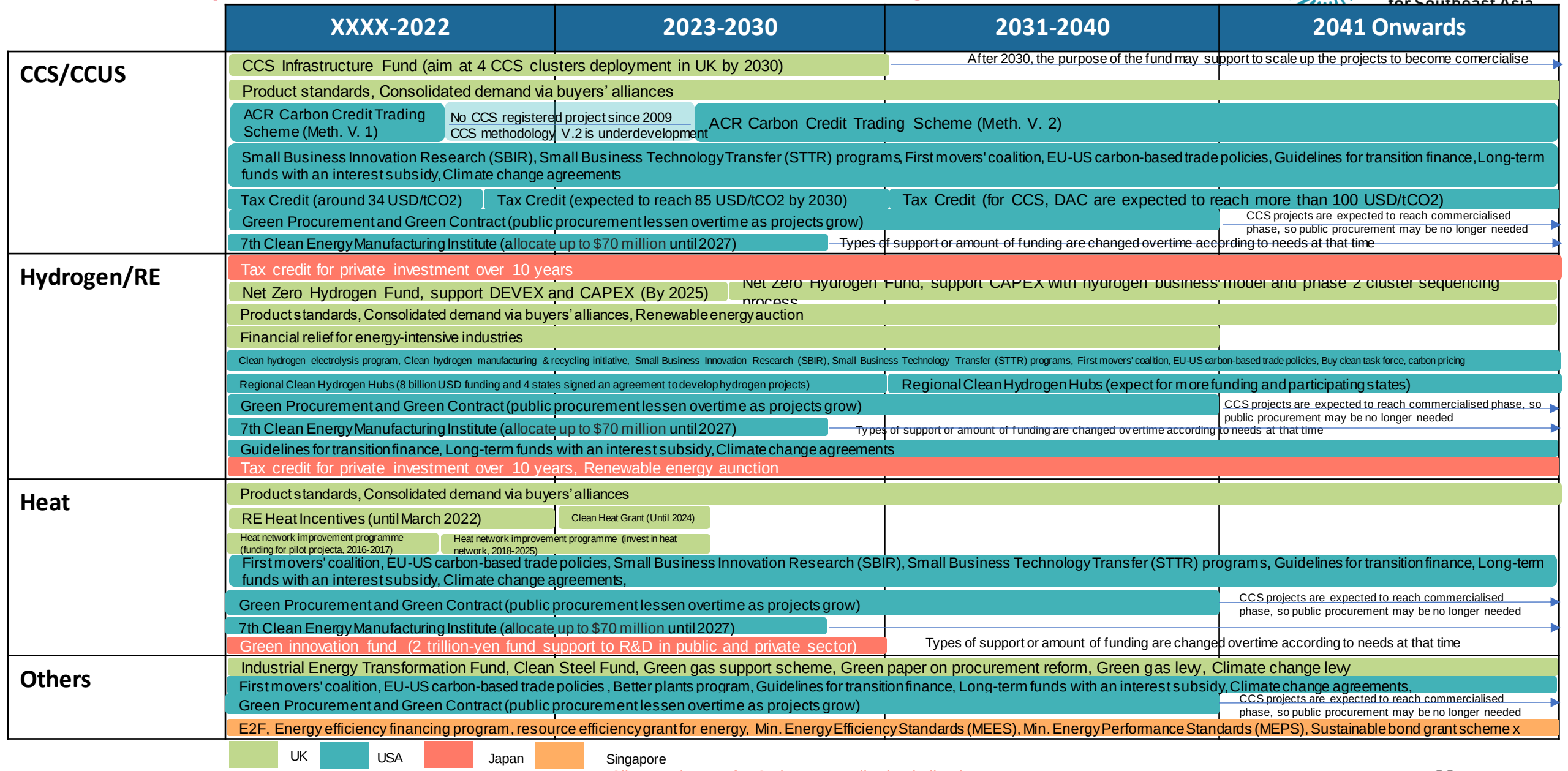
Industry sector:

Mechanisms to promote decarbonization over Short-, Medium-, and Long-term



Cross-cutting sector: Mechanisms to promote decarbonization

CASE for Southeast Asia

	United Kingdom	USA	Japan	Singapore
Policies & Targets	• To become energy efficient and energy saving (at least 20%) in buildings or plants of both public organization and private sector • Decrease GHG by 37,000 tonnes/year. • Accelerate investment in a sustainable and low-carbon future	• About 450 businesses that are responsible for around 85 percent of California's total greenhouse gas emissions must comply. (CAL) • Promote investment in green/sustainable business to generate impact to society	• Net zero carbon emissions and generate nearly $2 trillion a year in green growth by 2050 • Eliminate gasoline vehicles by mid 2030s. • Boost hydrogen consumption from 200 to 20 million tonnes by 2050. • Boost investment in climate related projects • Funds are allocated to projects which address environmental issues	• Carbon tax is generally be applied to upstream projects • Encourage start-up and SMEs innovation and business to enter the market • Promote competitiveness among small or medium size players • Attract depositors who aims at contributing to green activities.
Green Bond	✓ - Public-private sources of fund - Projects nust in line with UK Green Category		✓ - 4,900 million USD bond - Funds are allocated to projects in Japan and other countries	
Deployment Fund	✓ - Public-private sources of fund (£500 million) - Must be green or clearly defined as environmental benefits projects (public or private project)	✓ - Goldman Sachs's has raised more than 800 million USD fund - Private equity investment	✓ 2 trillion-yen green fund will support corporate investment in green technology.	✓ Fund and venture capital
Blend Instrument (equity and debt)	✓ Debt (at least 90% of fund) and equity (up to 10% of fund)	✓ Proportion of debt and equity investment depends on bank's decision base on lender and business profile		
Soft Loans	✓ - SME (fewer than 250 employees and turnover of less than €25m) - Must be sustainable/green projects		✓ 0% interest rate loan from BOJ causes banks lending out to green/sustainable projects at relatively low rate or longer repayment term	✓ For SMEs that hold sustainability certification awarded and must be green/sustainable projects
Emission Trading Scheme	✓ UK Emission Trading Scheme	✓ Revenues collected are deposited into the state's Greenhouse Gas Reduction Fund to implement low GHG emission projects		
Tax Incentive			✓ Tax incentive to companies with green investment	
Public Spending (Grant/subsidy)			✓ - Subsidy on cost of battery to reduce to 10,000 yen or less per kilowatt hour by 2030 - BOJ offered 0% interest loans that can be rolled over until 2030 to banks to boost green and sustainable loans	
Carbon Tax				✓ Mitigation measures to reduce carbon emissions, create green growth opportunities, and transition to an energy-efficient low-carbon economy

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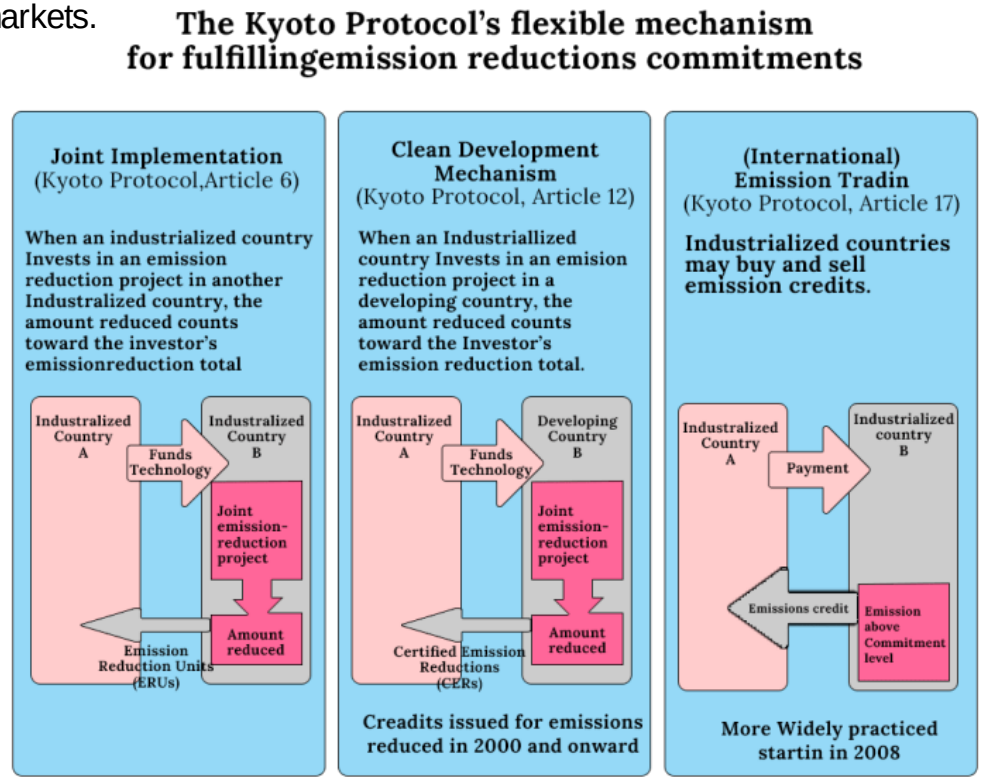
International carbon-related policy & regulation

International carbon pricing policy and regulation for regulated market International carbon pricing took off with the introduction of the flexibility mechanisms under the Kyoto Protocol. Adopted at the third Conference of the Parties (COP) to the UNFCCC held in Kyoto, Japan, in 1997, the Kyoto Protocol committed industrialized country signatories ("Annex I" countries) to collectively reduce their GHG emissions by at least 5.2 percent below 1990 levels on average over 2008-2012. Annex I countries could fulfil their commitments through domestic actions or the use of three flexibility mechanisms: IET (International Emissions Trading), JI (Joint implementation), and CDM (Clean Development Mechanism). The amendment adopted in Doha, Qatar, in December 2012 provided a basis for the three Kyoto mechanisms to continue for 2013-2020. The IET, JI, and CDM were of significant relevance in the creation of cross-boundary carbon markets.

The choice of carbon pricing type of each country is based on national circumstances and political realities. The most suitable initiative type depends on the specific circumstances and context of a given jurisdiction, and the instrument's policy objectives should be aligned with the broader national economic priorities and institutional capacities. ETSs and Carbon taxes are increasingly being used in complementary ways, with features of both types often combined to form hybrid approaches to carbon pricing. Some initiatives also allow the use of credits (i.e., Carbon Credits) from offset mechanisms as flexibility for compliance. This is called a compliance market.

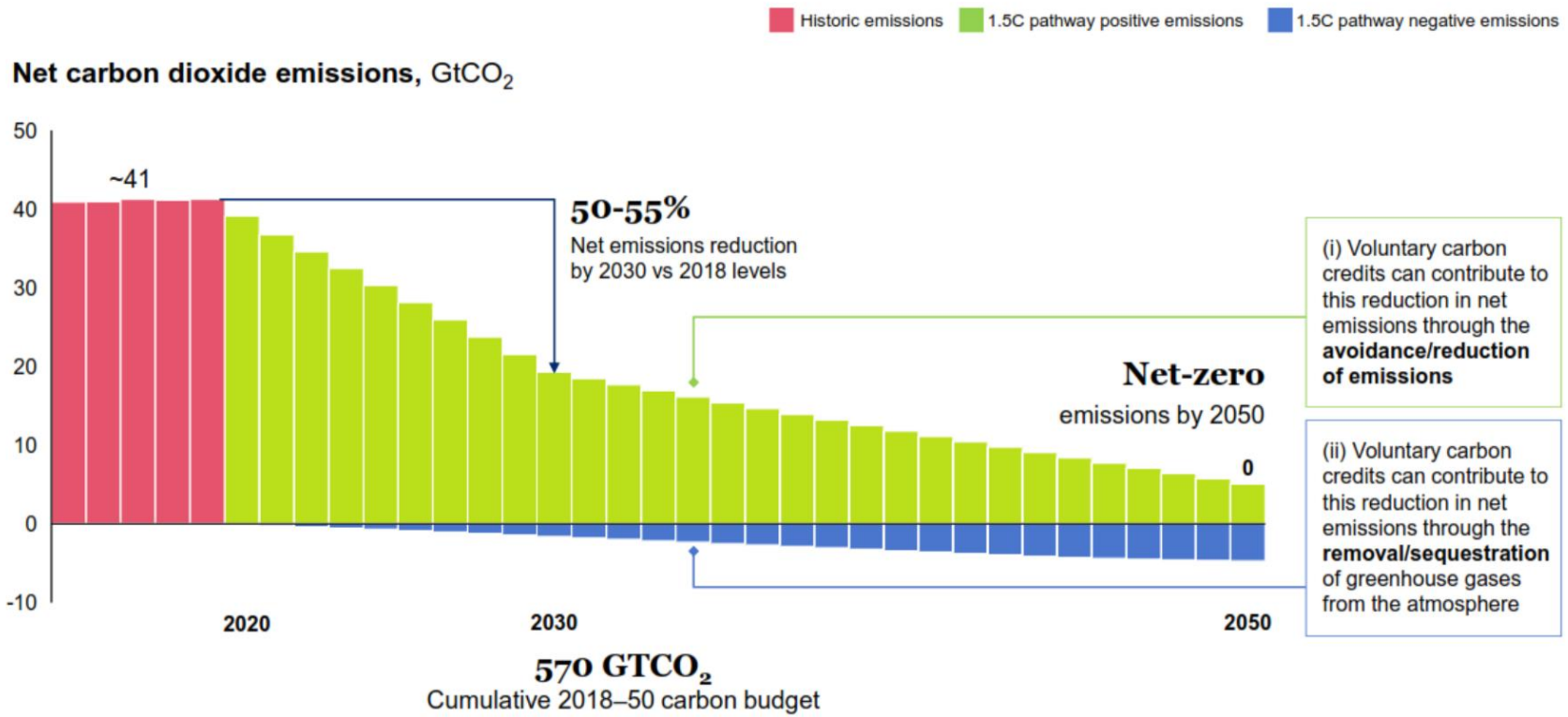
Most carbon prices remain far below to meet the goal of the Paris Agreement. The Stern Stiglitz Commission on Carbon Pricing found that carbon prices should rise to between $50 - 100 per ton of CO2e by 2030, to meet the Paris Agreement targets cost-effectively



Source:
UNFCCC. THE KYOTO PROTOCOL MECHANISMS. https://cdm.unfccc.int/about/cdm_kpm.pdf
High-Level Commission on Carbon Prices (2017), Report of the High-Level Commission on Carbon Prices, World Bank, Washington DC

Voluntary Carbon Market (VCM)

Voluntary carbon markets (VCMs) are currently highly fragmented, characterized by large numbers of buyers and sellers with different needs and value propositions. Credits are administered by schemes and are sold through exchanges or traders and brokers. Most credits are linked to specific supply projects. Third party auditing provides verification and validation. Exchange-based products are now emerging which pool credits from a single carbon standard that meet specific criteria, such as vintage (the year of creation) or types of co-benefits, to provid



Potential roles of carbon credits to support Net-Zero Pathway

Source: CleantechGroup. The Voluntary Carbon Offset Market. www.cleantech.com/the-voluntary-carbon-offset-market-can-we-support-rapid-growth/

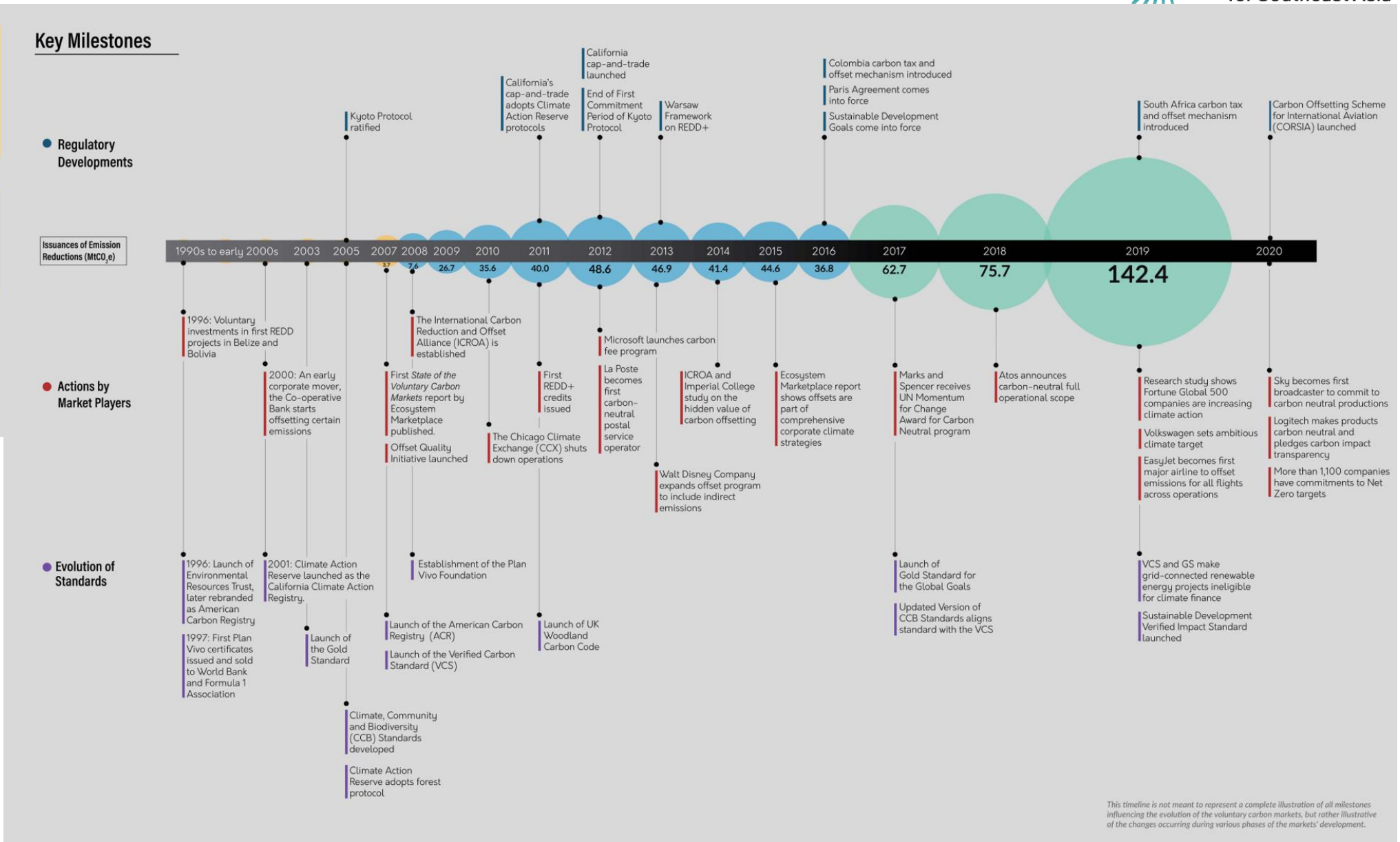
Evolution of Voluntary Carbon Market (VCM)

CASE for Southeast Asia

1 Early Market Formation & Innovation
- Pioneering new concepts
- Initial development of rules
- Establishment of standards & tools

2 Consolidation & Strengthening
- Evolution of best practices
- Private sector engaged
- New project types and methodologies proven
- Greater geographic diversity
- Increased links to sustainable development

3 Mainstream
- Market growth
- Corporate awareness
- Validation of VCM standards and innovations by compliance systems

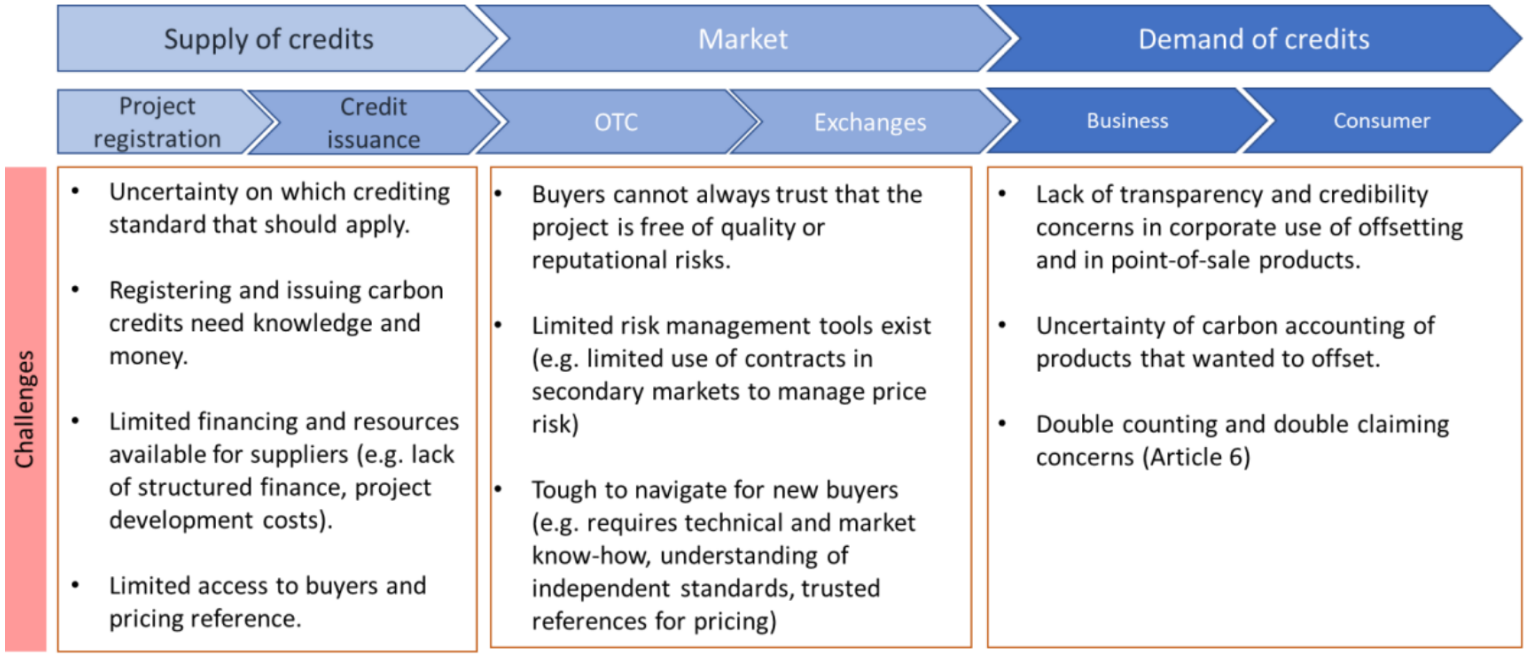


Source: https://voluntarycarbonmarket.org/docs/VCM-Interactive-PDF-Version-1-With-Introduction.pdf

Voluntary Carbon Market (VCM)

The VCM faces challenges to the quality and credibility of credits, including a skepticism in their emissions impact (additionality, prevention of leakage and double counting, and permanence). This is exacerbated by inconsistent MRV standards, as well as fragmentation of registries and registry standards.

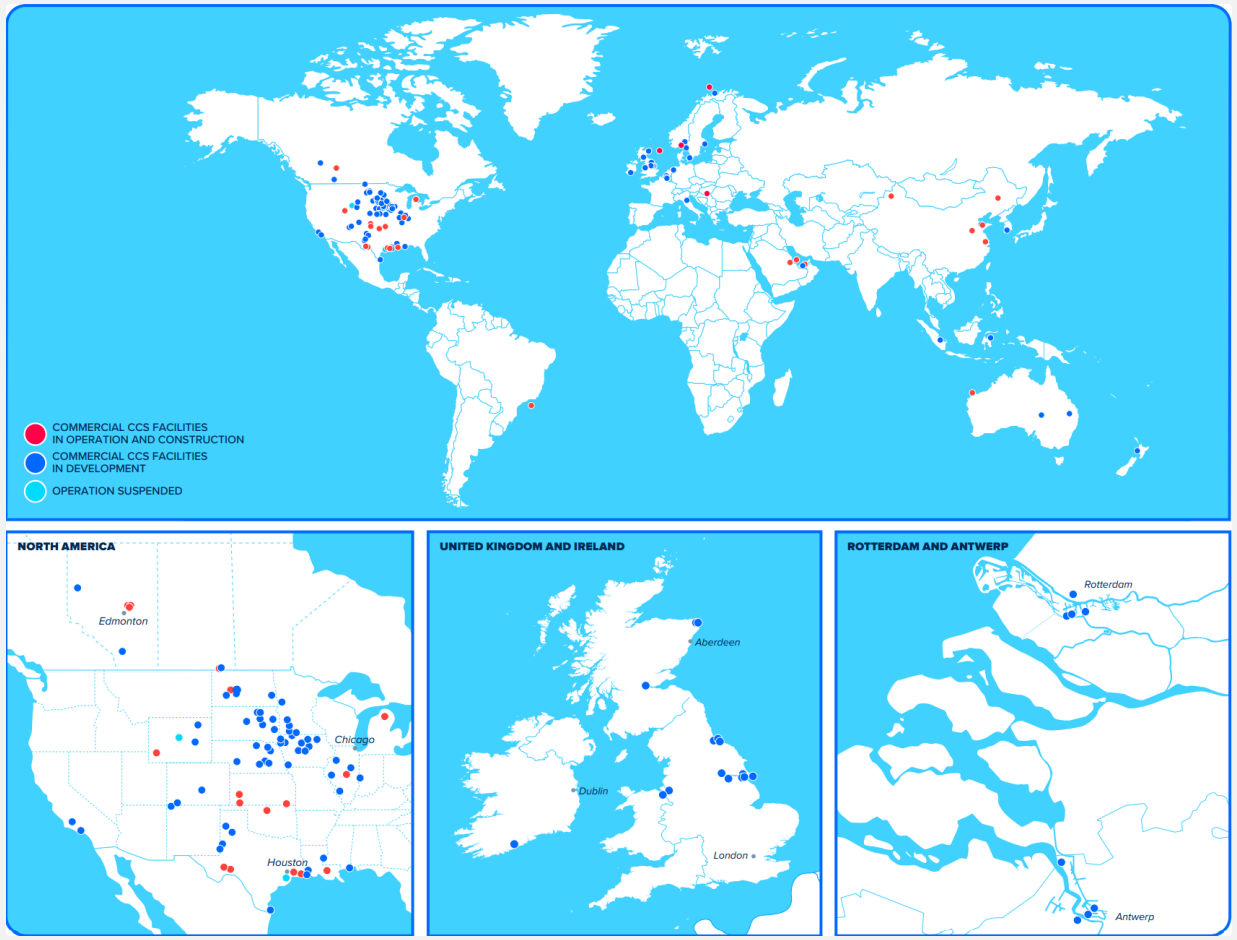
The VCM credits themselves are also heterogenous by nature given their wide variety of attributes, such as project type, credit type (removal vs. avoidance), vintage, co-benefits to other Sustainable Development Goals (SDGs), etc. The lack of a taxonomy to define these additional attributes leads to low transparency in the market regarding the credits being bought. Furthermore, the absence of a widespread reference index—that would represent a standard against which credits could be compared and consequently traded with spreads— also leads to limited trading in the market, making it mostly a buy-and-hold market with limited liquidity and velocity.



Challenges of voluntary carbon market from supply to market and demand

Global Status of Carbon Capture and Storage (CCS)

GLOBAL CCS FACILITIES UPDATE AND TRENDS



Commercial CCS Facilities In September 2021 By Number And Total Capacity

	OPERATIONAL	IN CONSTRUCTION	ADVANCED DEVELOPMENT	EARLY DEVELOPMENT	OPERATION SUSPENDED	TOTAL
Number of facilities	27	4	58	44	2	135
Capture capacity (Mtpa)	36.6	3.1	46.7	60.9	2.1	149.3

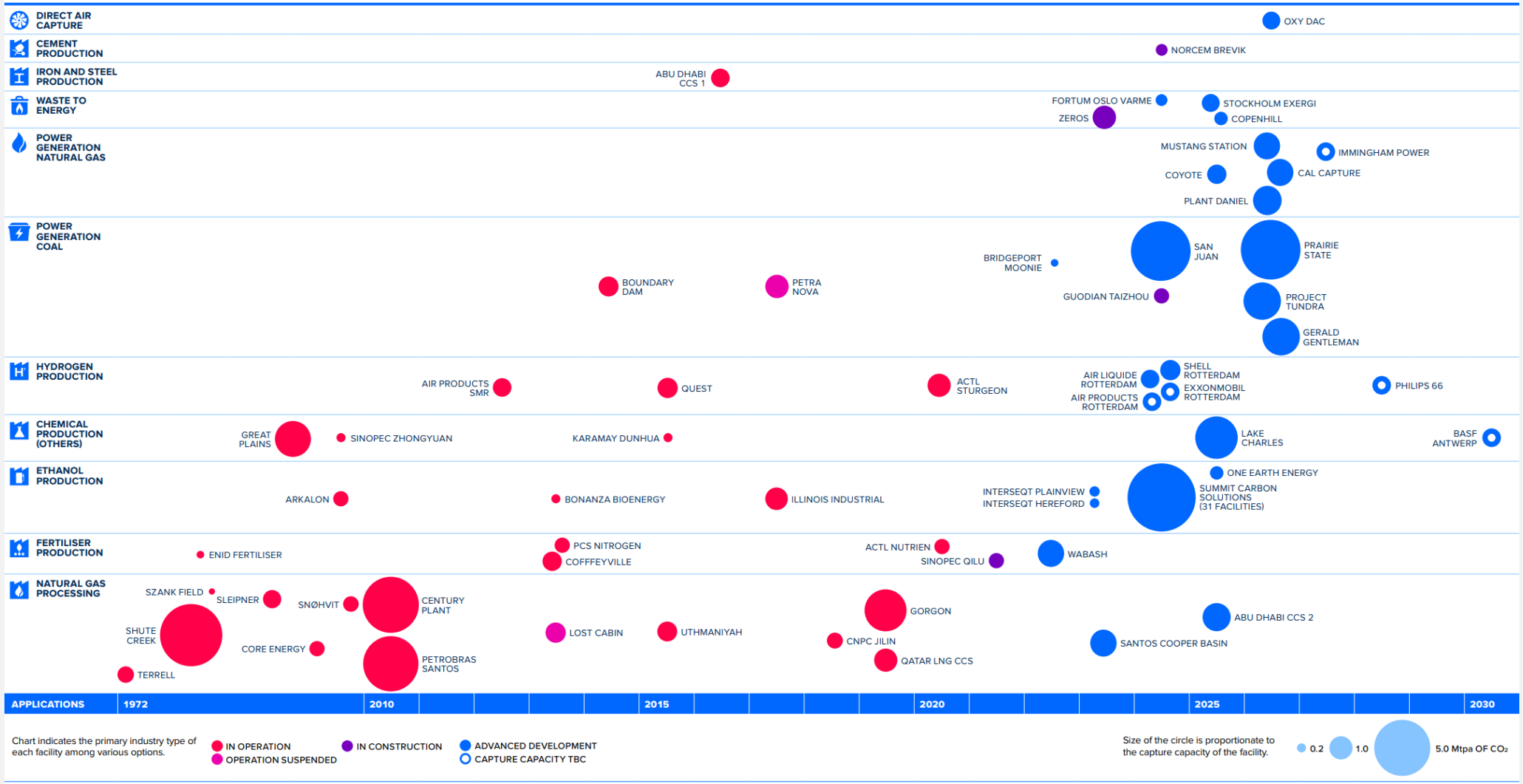
Largest Contributors to Growth of Projects in Development (as of 2021)

PLANT	INDUSTRY	COUNTRY	MEAN CO_2 CAPTURE CAPACITY (Mtpa)
EARLY DEVELOPMENT			
Dave Johnson Plant	Electricity generation	United States	4.00
G2 Net zero LNG	Natural gas processing	United States	4.00
NextDecade Rio Grande LNG	Natural gas processing	United States	5.00
Keadby 3 Power Station	Electricity generation	United Kingdom	2.10
Repsol Sakakemang	Natural gas processing	Indonesia	1.80
Barents Blue Clean Ammonia	Chemical production	Norway	1.60
ADVANCED DEVELOPMENT			
Shell Refinery Rotterdam CCS	Hydrogen production	Netherlands	1.20
Stockholm Exergi BECCS	Electricity and heat generation	Sweden	0.80
Air Liquide Refinery Roterdam CCS	Hydrogen production	Netherlands	0.80
Lawler Biorefinery CCS	Bioethanol production	United States	0.53
Copenhill (Amager Bakke) Waste to Energy CCS	Waste processing	Denmark	0.50
Casselton Biorefinery CCS	Bioethanol production	United States	0.47
Marcus Biorefinery CCS	Bioethanol production	United States	0.43

Source: www.globalccsinstitute.com/wp-content/uploads/2021/10/2021-Global-Status-of-CCS-Report_Global_CCS_Institute.pdf

Global Status of Carbon Capture and Storage (CCS)

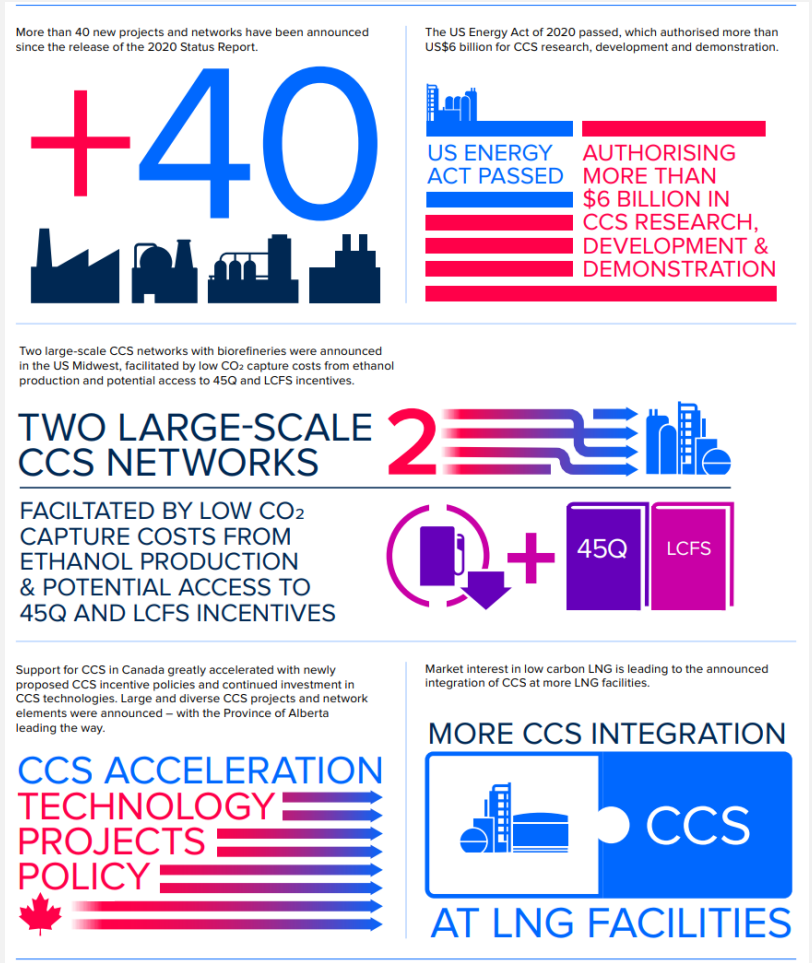
CCS Projects Are Becoming More Diverse

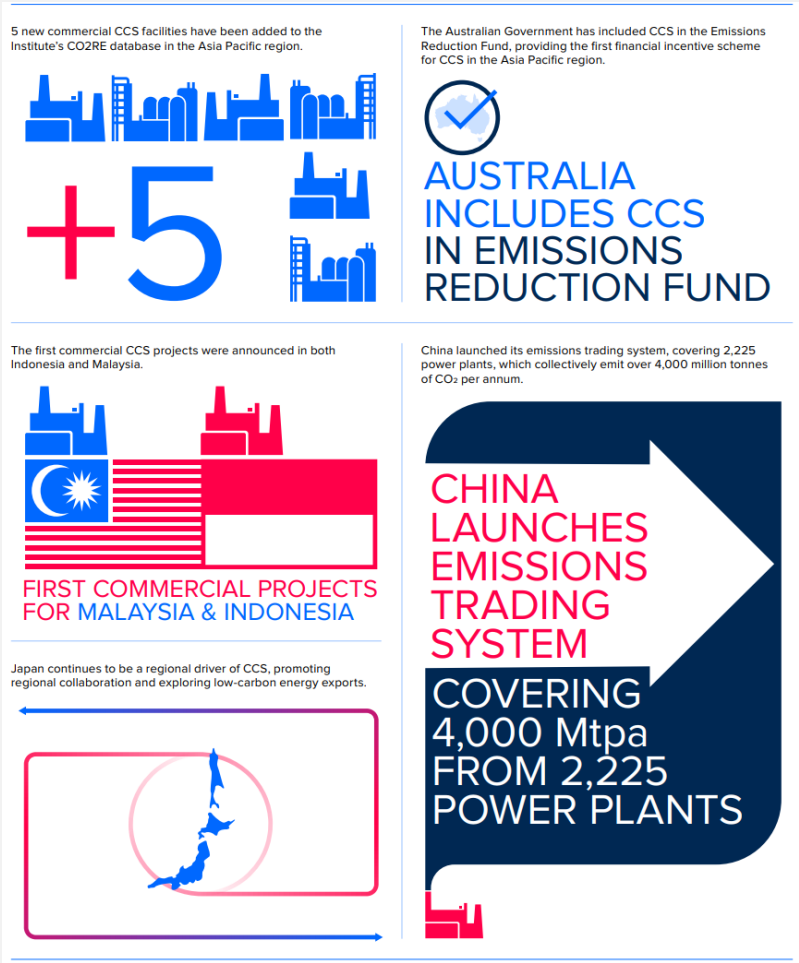


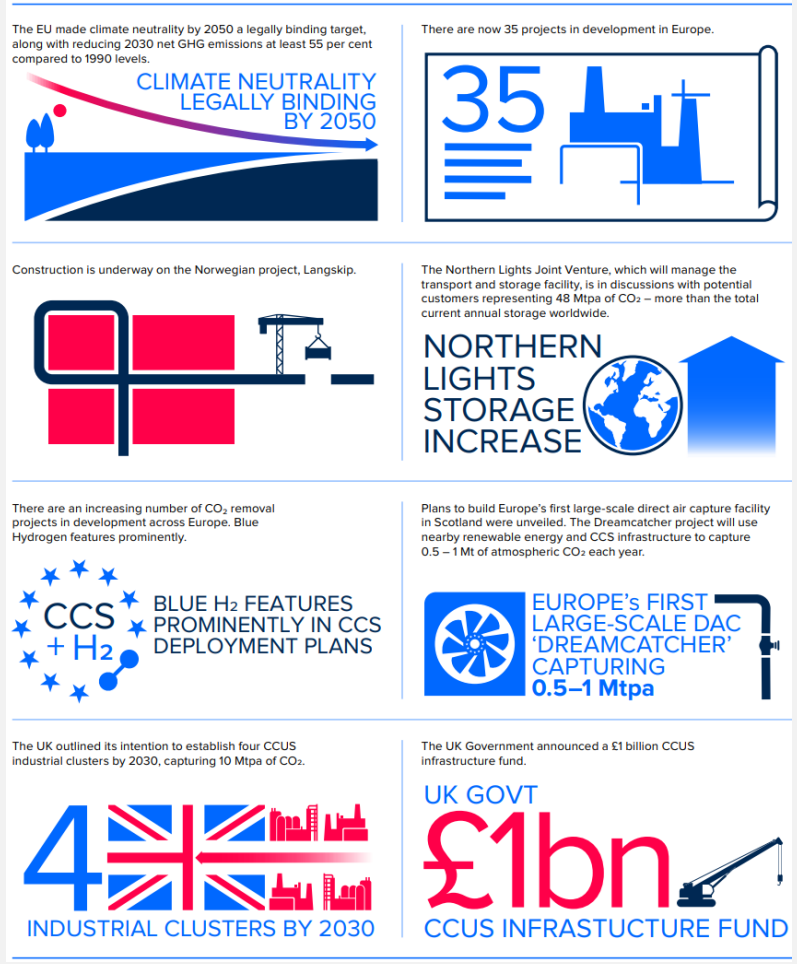
Source: www.globalccsinstitute.com/wp-content/uploads/2021/10/2021-Global-Status-of-CCS-Report_Global_CCS_Institute.pdf

Global Status of Carbon Capture and Storage (CCS)

Major CCS Development by Region







Source: www.globalccsinstitute.com/wp-content/uploads/2021/10/2021-Global-Status-of-CCS-Report_Global_CCS_Institute.pdf

Global Status of Carbon Capture and Storage (CCS)

Financial Incentives for CCS by Countries

Canada:
- **Greenhouse Gas Pollution Pricing Act 2018 (GGPPA)** : Increase in Canada's carbon price from CA$40 per tonne of CO2 as of 1 April 2021 to a proposed CA$170 per tonne of CO2 by 2030

Europe:
- **Netherlands: Energy production subsidy scheme (SDE++):** $6bn in total & $2.4bn was granted to develop the large Porthos CCS facility
- **UK:** investing in RD&D, expanding infrastructure, and enhancing financial incentives
- **Germany:** a subsidy program to scale up CCS, direct air capture, and BECCS, with €105mn allocated for the year
- **Norway**: $1.2bn worth of funding to the Northern Lights CCS project that is led by Equinor, Shell, Total to capture 1.5 Mtpa of CO2 per year
- **Denmark:** €26mn to the Greensand project that is led by INEOS, as the pillar of a CCS network in Demark

USA:
- **CCS Tax Credits (since 2018)** : USD50/tCO2 for storage & USD35/tCO2 for utilization
- **$6bn** for CCS research, development, and demonstration (RD&D) from 2021 to 2025
- **$11bn** in CCS demonstration and networks

China:
- National emissions trading system (ETS) – applicable in long term

Japan:
- Guidelines for transition finance
- Long-term funds with an interest subsidy

Australia:
- $250mn dedicated to developing CCS hubs, expanding infrastructure, and backing RD&D projects
- $50mn allocated to funding six specific CCS projects

Global Status of Carbon Capture and Storage (CCS)

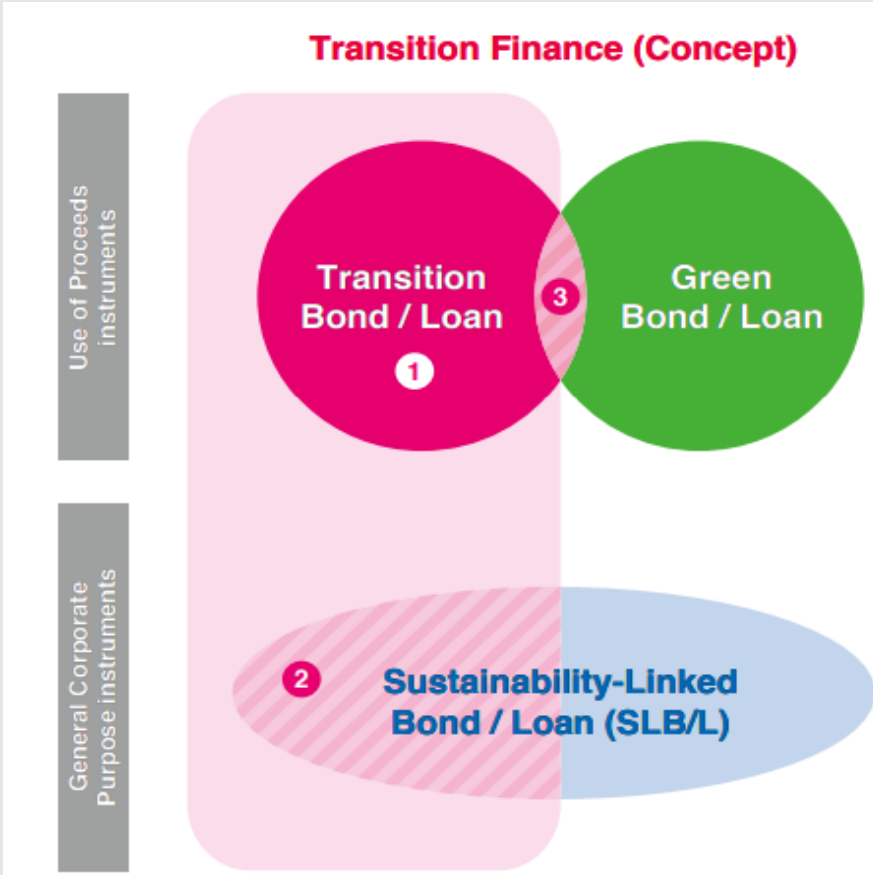
Highlighted Financial Scheme for CCS

US: Tax Credit for CCS

Equipment Placed in Service Before 2/9/2018	Equipment Placed in Service on 2/9/2018 or Later
Credit Amount (per Metric Ton of CO_2)*	
Geologically Sequestered CO_2	
$23.82 in 2020. Inflation-adjusted annually.	$31.77 in 2020. Increasing to $50 by 2026, then inflation-adjusted.
Geologically Sequestered CO_2 with EOR	
$11.91 in 2020. Inflation-adjusted annually.	$20.22 in 2020. Increasing to $35 by 2026, then inflation-adjusted.
Other Qualified Use of CO_2	
None.	$20.22 in 2020. Increasing to $35 by 2026, then inflation-adjusted.
Claim Period	
Available until 75 million tons of CO_2 have been captured and sequestered.	12-year period once facility is placed in service.
Qualifying Facilities	
Capture carbon after 10/3/2008.	Begin construction before 1/1/2026.
Annual Capture Requirements	
Capture at least 500,000 metric tons.	*Power plants:* capture at least 500,000 metric tons. *Facilities that emit no more than 500,000 metric tons per year:* capture at least 25,000 metric tons. *DAC and other capture facilities:* capture at least 100,000 metric tons.
Eligibility to Claim Credit	
Person who captures and physically or contractually ensures the disposal, utilization, or use as a tertiary injectant of the CO_2.	Person who owns the capture equipment and physically or contractually ensures the disposal, utilization, or use as a tertiary injectant of the CO_2.

Source: CRS analysis of IRC Section 45Q.

Japan's Transition Finance



What is labeled "Transition"?

(1) Use of Proceeds instrument (bond or loan) that meets the four elements of transition (when the Use of Proceeds does not fall under Green Projects (*) but the process follows the existing principles and guidelines)

(2) General Corporate Purpose instrument (bond or loan) that meets the four elements of transition, sets targets in line with the transition strategy, and changes its financial and/or structural characteristics depending on the achievement of predefined targets

(3) Instrument that meets the four elements of transition and follows the existing Green Bond Principles and the Green Bond Guidelines (when the Use of Proceeds falls under Green Projects*)

* Green Projects: Projects listed as Green Projects in the existing Green Bond Guidelines or those already issued.

Regardless of (1) through (3), financial instruments that fulfill the four elements of transition may be recognized as transition finance (however, they are not covered here given that there are no principles, etc. to conform to).

(Source) ICMA Climate Transition Finance Handbook

Global Status of Carbon Capture and Storage (CCS)

Fundings & Capacity building

United Kingdom	Funding: £1bn	Target: capture 20-30 $MtCO_2$ per year by 2030 in 4 industrial clusters (Transport and Storage, Industrial Carbon Capture, Power CCS, and Hydrogen)
The U.S.	Funding: $96m	Target: capture at least 95 percent CO_2 emissions generated
Australia	Funding: $50m	Target: compress, transport and store CO_2 for less than $20 per tonne of CO_2
European Union	Funding: €38bn (overall)	Objective: for the demonstration of innovative low-carbon technologies (Renewable Energy, CCS, Energy Storage, Energy-Intensive Industries)
ADB	Financial instruments: Grants, Insurance, In-kind contributions	
UKCCSRC	A flexible fund to support CCS research projects that contribute to the UK Government's net-zero objectives	
Asia CCS Network	A collaboration and cooperation on the development and deployment of CCS in the Asian region	

Policy landscape : Southeast Asia

CASE for Southeast Asia

	Capture	Transport	Storage
Level of acknowledgement	• Interest in deployment of CCS in coal to moving toward low carbon energy system • Only Singapore and Malaysia have indicated CCS strategies in their long-term climate change commitments		
Laws and regulations, acts, regulatory framework development	• Regulations have not yet developed in the region, but Indonesia has made significant progress. • Regulation on carbon capture and sequestration was under prepared by the Indonesian Centre of Excellence of CCS/CCS with inputs and supports from international experts. • For others, there is potential as existing oil and gas regulations could serve as a starting point.		
Financial Incentive	Singapore taxes for companies with annual GHG emissions exceeding 25,000 mt/year, encouraging capturing CO2		
	• No target policy to support CCS/CCS investment • International support funding to CCS/CCS projects in Indonesia i.e., Japan's JCM, ADB CCS Fund • Develop guidelines for CCS financing		
Market mechanism (Business Model)	Investment in CCS/CCS technology with technical and financial collaboration and partnership with others i.e., Japan or Australia	• Existing construction of gas pipeline link within the region could be potential of shared facility	Due to the compact geographical area of Southeast Asia and the existence of oil/gas infrastructure close to suitable geological sites, the region is well positioned to build a CCS storage hub
Technical support, Infrastructure development, Human capacity, Big data	Collaboration between entities either government or private entities within or between region for knowledge, experiences or funding support and sharing	Built up an extensive infrastructure plan to connect each country's oil/gas pipelines; the future CO2 pipeline network (the ASEAN MoU on the Trans-ASEAN Gas Pipeline (TAGP))	The Coordinating Committee on Geoscience Programmes (CCOP) supported storage identification and development through its CO2 Storage Mapping Programme (CCS-M). The participants are from Viet Nam, Malaysia, Thailand and Indonesia
	• Establishment of Asia CCS Network in June 2021 • Develop ASEAN Coal Database and Information System (ACDIS) to facilitate Clean Coal Technology (CCT) (i.e CCS) • Disseminate workshop on coal and related best practices		

Chapter 1: Key summary

- Regulations and incentive policies are mechanisms to promote decarbonization.
- In the initial pahse, grant and subsidy are appropriate to promote transition or shift in behavior. Later that, they will be replaced by taxation, regulatory enforcement or mechanisms that promote competitiveness in a particular market.
- Ambitious target from the government would be an influent factor to drive decarbonization.
- Mechanisms from private sector i.e., equity investment or private bank green financing are also significant to drive decarbonization.
- Carbon markets – both emission trading systems and baseline and credit systems – are an increasingly common policy instrument being introduced to address climate change mitigation. However, their design is crucial to ensure that they deliver cost-effective emission reductions while maintaining environmental integrity. (The Carbon Market Challenge, 2022)
- Carbon pricing has played a pivotal role to realizing the ambitions of the Paris Agreement and implement the Nationally Determined Contributions (NDCs). The Article 6 of the Paris Agreement provides a basis for facilitating international recognition of cooperative carbon pricing approaches and identifies new concepts that may pave the way for this cooperation to be pursued. The Adoption of the Paris Agreement recognizes the important role of providing incentives for emission reduction activities, including tools such as domestic policies and carbon pricing. Many of the plans submitted to the UNFCCC recognize the important role of carbon pricing, with about 100 countries planning or considering carbon pricing mechanisms in their intended NDCs.

Chapter 2:

Thailand’s current status

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Thailand's current status

This chapter provides review and analysis of national plans, policies, and targets to promote decarbonization in Thailand. Thailand net zero target will be presented followed by long-term GHG emissions development strategy and key measures/plans/ and/or supports to address the emission of each sector. Additionally, mechanisms to promote decarbonization in each sector are categorized into three categories: command and control, market-based and incentives and supporting mechanisms.

Thailand

- Nation plans, policies, and targets
- Mechanisms to promote decarbonization in Thailand (Public)
- Mechanisms to promote decarbonization in Thailand (Private)

Gen. Prayut Chan-o-cha
November 1, 2021,
at Cop26, Glasgow, United Kingdom

Carbon Neutrality in 2050 & Net Zero in 2065

PM affirms Thailand's willingness to be more aggressive in addressing climate chan challenges at COP26

UN CLIMATE CHANGE CONFERENCE UK 2021
IN PARTNERSHIP WITH ITALY

"Thailand's willingness to be more aggressive in addressing the climate change challenges in every way and every means possible, by ***aiming at reaching carbon neutrality in 2050***, *and* ***Net Zero Emission in or before 2065.*** With the adequate, timely, and equitable support of technology transfer and cooperation, and most importantly, the availability of and access to ample green financing facilities, Thailand ***can increase our NDC to 40%,*** and reach the Net Zero Emissions in 2050"

Gen. Prayut Chan-o-cha
November 1, 2021,
at Cop26, Glasgow, United Kingdom

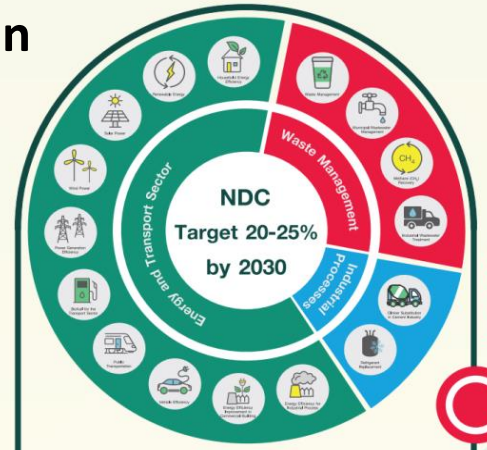
Source: EPPO, 2022

Thailand's Long-term GHG Emission Development Strategy

2018
Thailand's National Adaptation Plan (NAP)

VISION

Thailand is resilient with adaptive capacity to climate change impacts and moves towards sustainable development.



2021
- **NDC**
  Nationally Determined Contribution
  Implementing starts
- Submission of **LT-LEDS**
  Long-term Low Greenhouse Gas Emission Development Strategy
  Implementing towards achieving net zero GHG emission and Carbon Neutrality within this century

Improve Energy Efficiency and Promote Energy System Transformation through
- Decarbonisation
- Digitalisation
- Decentralisation
- Deregulation
- Electrification

2030
Aims to reduce GHG by 40% with international support

- Increase and Remain Primary Forest
- Regenerate Natural Forest Area
- Increase Economic Forest Area
- Increase and Remain Cropland
- Reduce Biomass Burning

Achievement of CO_2 removals of 120 $MtCO_{2eq}$

50% share of renewable electricity generation of new power generation capacity

Reduction of GHG emissions in various sectors:
- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture
- Waste
- Land Use, Land Use Change, and Forestry

2035
69% share of electric vehicles of new vehicles in the market

2037

2050
CARBON NEUTRALITY

2065
Achievement of **NET-ZERO GHG Emission** while looking forward to enhanced international cooperation and support on finance, technology, and capacity-building to achieve this ambition

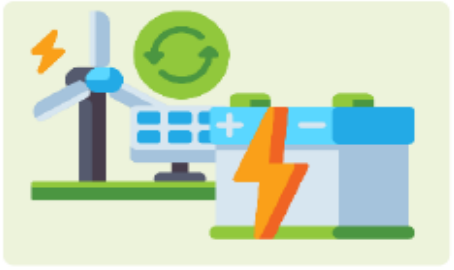
Source: ONEP, 2022

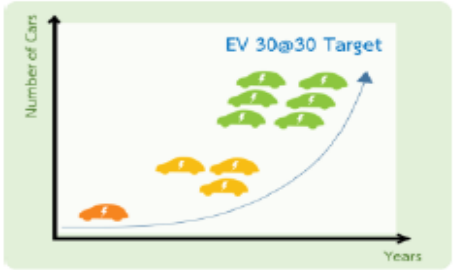
From *LT-LEDS* to *National Energy Plan*

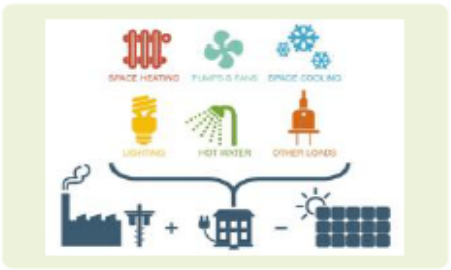
CASE for Southeast Asia

Carbon neutrality in 2050

RE >50% w ESS | **EV 30@30** | **EE >30%** | **4D1E**







- DIGITALIZATION
- DECARBONIZATION
- ELECTRIFICATION
- DECENTRALIZATION
- DE-REGULATION

Source: EPPO, 2022

Energy Policy and Planning Office
MINISTRY OF ENERGY

Updated National Energy Plan

PDP

- Increase the RE in the new power plant
- Reduce production from fossil fuels and low-efficiency power plants.
- Develop technology for utilization and storage
- Develop Grid Modernization and manage the electrical system with Smart Grid technology
- Decentralized power generation and infrastructure

EEP

- New EE targets
- NEW EE Technology & Infrastructure
- Develop technology to manage energy use efficiently
- Develop infrastructure to support energy efficiency in the future

AEDP

- Assess the renewable energy potential
- Promote and develop decentralized renewable energy generation mechanisms
- Develop RE Data & Control Center
- Set up measures to encourage more investment in renewable energy
- Promote investment in renewable energy technology market

GAS

- Promote the use of LNG in the industrial and transportation sectors instead of oil and coal
- Manage natural gas in the country efficiently
- Develop natural gas infrastructure to support the use of decentralized natural gas
- Liberalize the natural gas business by improving the barriers to regulations and developing the natural gas price structure and promoting full competition

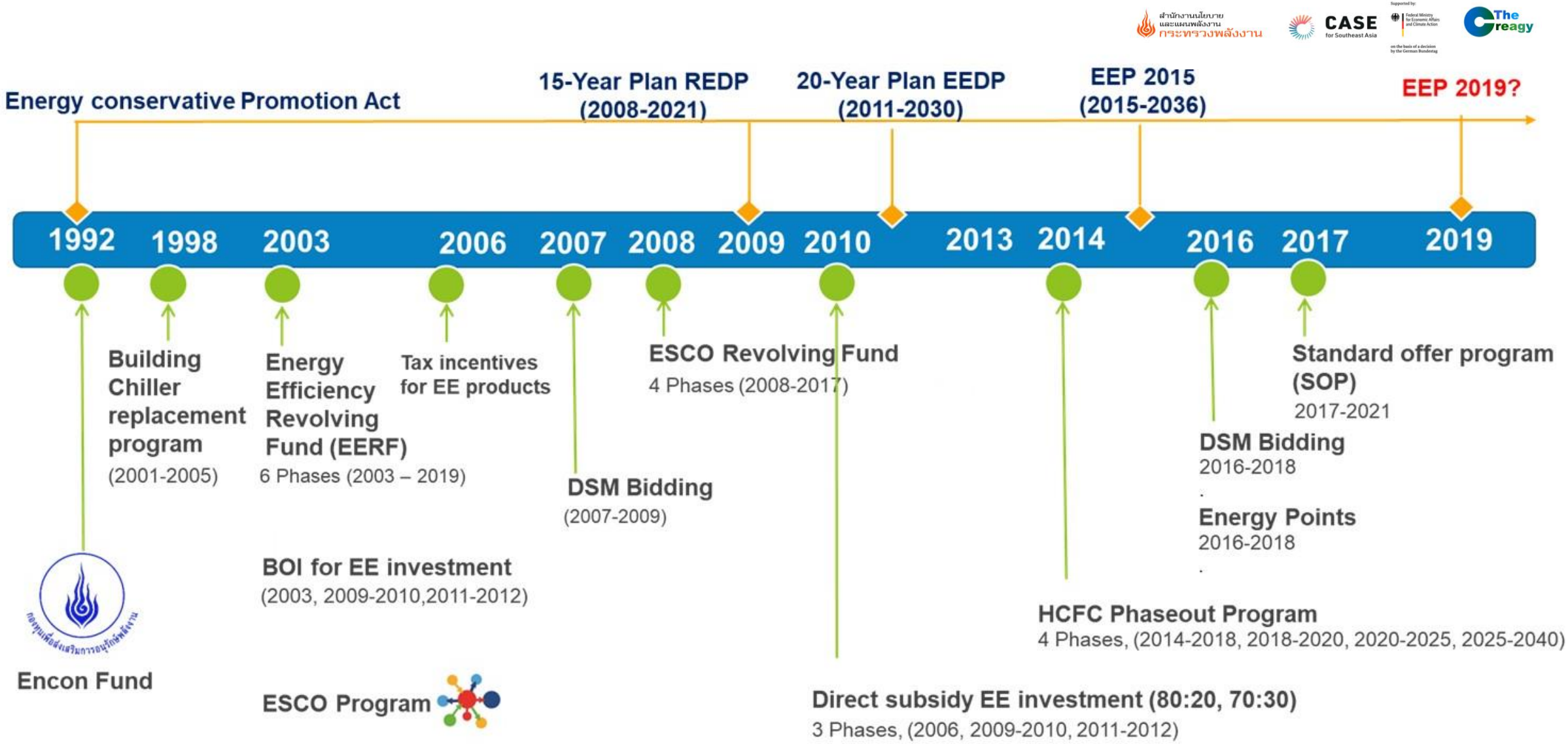
OIL

- Improve the refinery standards to meet quality of EURO5 and EURO6
- Promote the use of low-carbon fuels and biofuels
- Develop a system to control, supervise and collect fuel information with digital technology
- Promote the transformation of energy consumption in various energy sources into electricity

Source: EPPO, 2022

2.1 Power sector

Mechanisms to promote decarbonization in Thailand (Public)



Mechanisms to promote decarbonization in Thailand (Public)

CASE for Southeast Asia

= Active scheme/mechanism
= Inactive scheme/mechanism
= In the consideration/plan

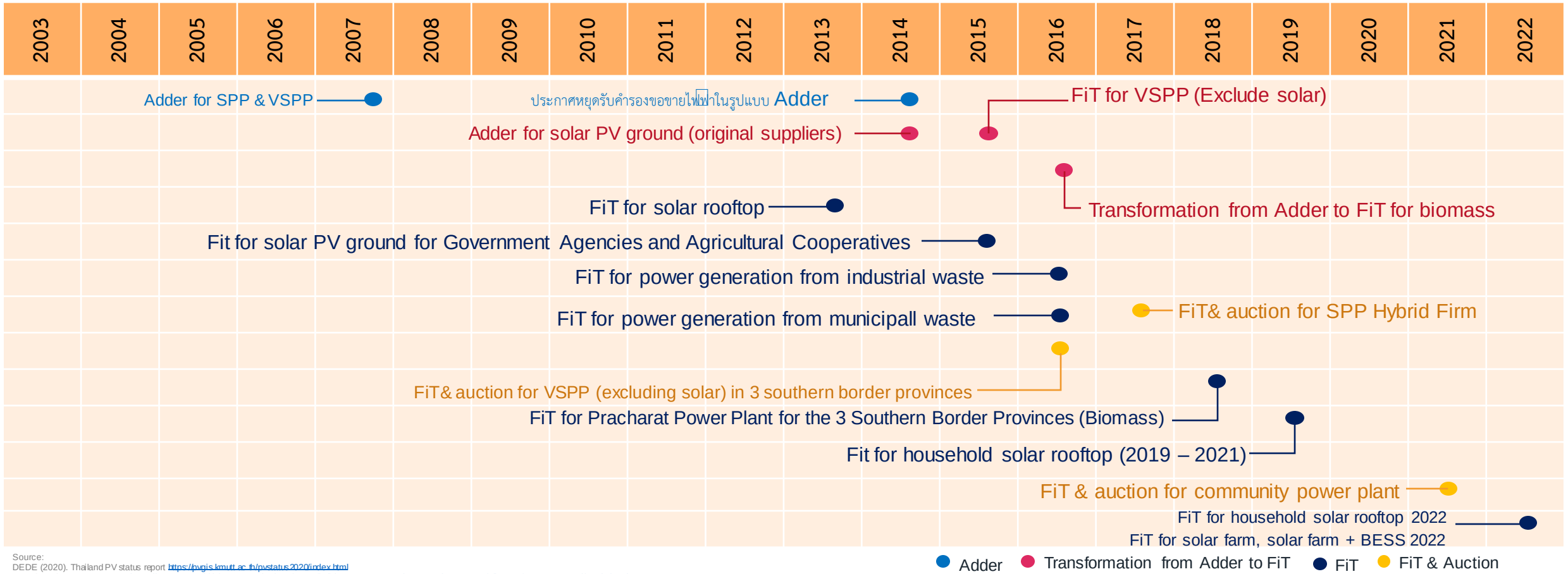
	Command & Control	Market-based	Incentives & supporting mechanism
Power	Carbon Tax for Fuel to Generate Electricity Renewable portfolio standards	peer-to-peer (P2P) scheme National Renewable Energy Certificates (RECs) RE Auction	Adder Feed-in Tariff Feed-in Premium Grant in Community-scale energy projects from ENCON fund
Transportation	Carbon Tax for Transport Fuel Parking fees/fees in heavy traffic areas vehicle excise tax		**EV Tax Incentive Package:** 1. Duty reduction privileges for CBU imported for market trial 2. excise tax reduction privileges 3. Excise Tax Subsidy Public transport Mechanism
Industry	Carbon Tax for Industrial Fuels Factory Energy Code (FEC)		Exemption of duty on raw materials for export EE Subsidy Program ESCO Revolving fund Energy Efficiency Revolving Fund (EERF)
Cross-cutting	Emission Trading Scheme (ETS) Energy Certificate Performance (EPC) Scheme	Bond (Government, BOT, SOE) DSM Bidding (Electricity, Thermal) T-VER	Climate Change Fund Internal Carbon Pricing: ICP Exemption of import duty on machinery Exemption of duty on raw materials for R&D corporate income tax exemption

Highlighted Scheme in Power Sector (Public)

Adder
Pay additional from the purchase price of electricity

Feed-in-Tariff (FiT)
purchase rate as a fixed fee or variable according to the formula specified.

Auction
setting the initial purchase rate of electricity and supplier auctions the electricity to be sold



Source:
DEDE (2020). Thailand PV status report https://pvgis.kmutt.ac.th/pvstatus2020/index.html
ERC (2022). โครงการโซ่ภ์กดประชาชน https://www.erc.or.th/th/power-purchasing3/2712?fbclid=IwAR06v8uYgEdUpNBw6miB5eH3AyEfolhCyYRfKEyU0NDOUodfH23Wb8HI8
ERC. การรับซื้อไฟฟ้าจากพลังงานหมุนเวียน (ไม่รวมพลังงานแสงอาทิตย์) ในช่วงเปลี่ยนผ่านจากแบบ Adder เป็น Feed-in Tariff (FiT) https://www.erc.or.th/th/adder-to-fit/
ERC. โครงการรับซื้อไฟฟ้า https://www.erc.or.th/th/power-purchasing3
ERC. โครงการประชารัฐสำหรับพื้นที่ 3 จังหวัดชายแดนภาคใต้ประเภทเชื้อเพลิงชีวมวล พ.ศ. 2561 https://www.erc.or.th/th/power-purchasing3/2727

Summary Highlighted Scheme in Power Sector (Public)

- Thailand brings renewable energy to increase the stability and reliability electricity
- In addition, Thailand's electricity purchasing was counted on an Adder rate, which means being payable on top of the prevailing wholesale price of electricity for 7 years
- Later, the Energy Policy and Planning Office (EPPO) has considered using FiT (Feed-in Tariff), meant that a fixed amount per kWh will be paid during the 20 years of support
- Since the support are non-firm power producer, the government is considering to firm producers by encourage the renewable energy power producers to sell the firm contract. This will reduce the cost of reserved electricity from Electricity Generating Authority of Thailand (EGAT)

Summary Highlighted Scheme in Power Sector (Public)

Peer-to-Peer (P2P) scheme

Introduction

The Thai Energy Regulatory Commission ("**ERC**") continues to adopt measures that will allow for increased participation by private parties in the energy sector. The ERC's latest pilot program is a new regulatory sandbox that will allow for limited-scale deployment of peer-to-peer ("**P2P**") electricity trading. If successful, this program may serve as a template for wider-scale adoption across the entire country.

Source: CMHM Newsletter, 2021

Enter the Sandbox

- In September 2021, the ERC granted its approval in principle for action plans to establish the ERC Sandbox to teat technologies involving electricity trading and supply.
- ERC selected 23 private entities to undertake their projects within the Sandbox environment.
- Within the sandbox environment, the selected private entities will be able to trade and supply electricity to other private entities through the transmission systems of the MEA or the PEA. Based on the action plans, the regulatory requirement which prevents the dispatch of electricity into the transmission system of either the PEA or the MEA would not apply to the projects within the Sandbox.
- The PEA or the MEA will be entitled to the payment of wheeling charges from the private entities in return for the selected private entities' use of their transmission systems. The wheeling charge approved by the ERC was Thai Baht 1.151 per unit.
- The trading of electricity under the Sandbox is expected to be made through a platform involving blockchain technology to increase security and efficiency of electricity trading.

2.2 Transport sector

Highlighted Scheme in Transport Sector (Public)

Categorized EV / Measures/mechanisms	EV manufacturers	EV charging station operators	EV consumers
Subsidy		1. Subsidy on electricity rate for charging station operators to remain at the rate 2.63 THB/unit until 2025	1. Subsidy on passenger cars and pick-ups at the rate around 70,000-150,000 THB/vehicle, and 18,000 THB/vehicle for motorcycle (for vehicle price less than 2 million THB)
Tax reduction or exemption	1. For manufacturing of BEV, if there is at least 5,000 million THB investment, corporate tax exemption will be 8 years and can be extended as long as there is investment in R&D. 2. If investment is less than 5,000 million THB, corporate tax exemption will be 3 years 3. Tax exemption on 9 imported EV parts for domestic assembly and manufacturing EV	1. If there are at least 40 chargers with at least 25% quick chargers (DC types), the operators are subjected to 5 years corporate tax exemption. Unless they are subjected to 3 years corporate tax exemption. 2. Exemption of import duty for machines and equipment	1. Reduce Excise tax on passenger cars from 8% to 2% and 0% for pick-ups 2. Reduce import duty on foreign manufactured vehicles or imported vehicle (CBU) up to 40% and 20% until 2023 for vehicle prices less than 2 million and between 2-7 million THB respectively
Technical support		1. BackEN; an online platform developed by EGAT helping charging station operators to manage their stations effectively. The platform service fee is 699 THB/month	

EV Tax Incentive Package

- Duty reduction privileges for CBU imported for market trial
- Excise tax reduction privileges
- Excise Tax Subsidy

Source:
https://home.kpmg/th/en/home/insights/2022/05/th-tax-news-flash-issue-130.html, https://www.scb.co.th/th/personal-banking/stories/home-car/package-of-incentives-ev-car.html
National News Bureau of Thailand (NNT). (2022). รถยนต์ไฟฟ้า **100%** มาแรง รัฐบาลเดินหน้าหนุนใช้- ผลิตในไทย หวังลดใช้น้ำมัน-ลดปัญหาสิ่งแวดล้อม. https://thainews.prd.go.th/th/news/detail/TCATG220401133608119
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การส่งเสริมการลงทุนอุตสาหกรรมยานพาหนะไฟฟ้าขั้นส่วน. https://khonkaen.boi.go.th/uploads/file_download/file/20210503/th-cimowxz01237.pdf

2.3 Industry sector

Highlighted Scheme in Industry Sector (Public)

EERF was established in 2003. The fund function works to overcome barriers within the Thai financial sector to stimulate adequate financing for EE and reduce the country's GHG emissions.

Energy Efficiency Revolving Fund (EERF)

Type of Project

- Energy Efficiency
- Renewable energy

Instruments

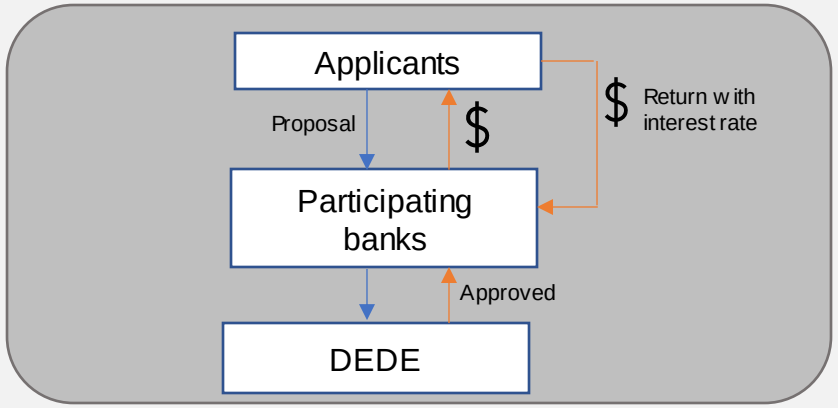
Soft Loan

- ≤ 50 mTHB/project
- Interest rate : ≤ 3.5%/yr

Applicants

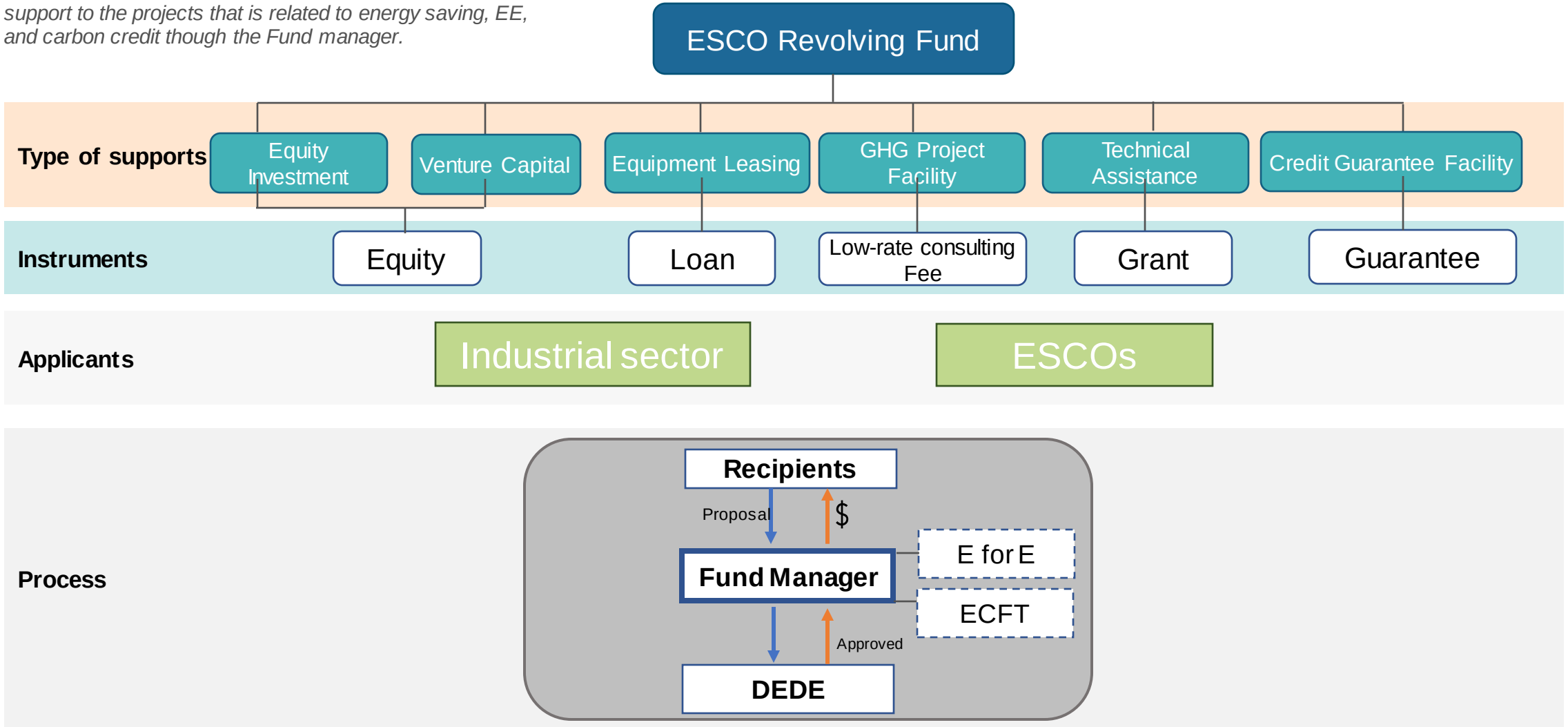
- Designated factory & Building
- ESCOs

Process



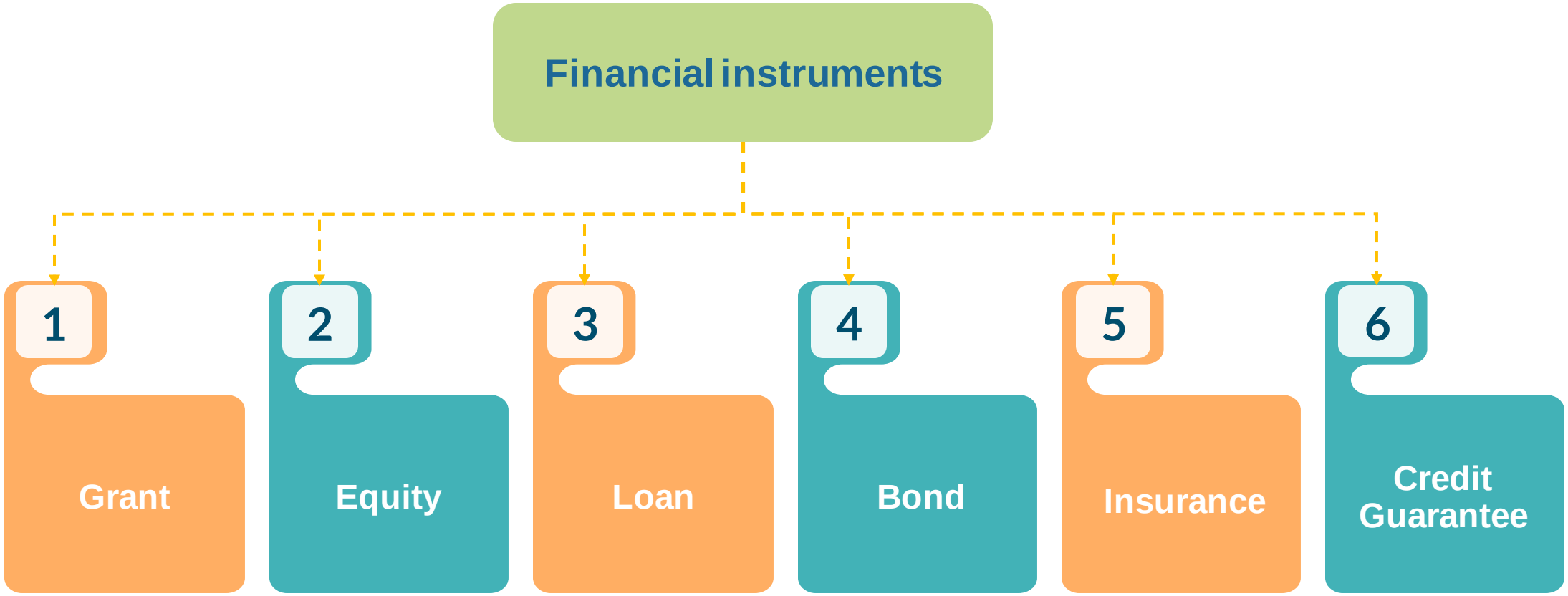
ESCO Revolving Fund (inactive)

ESCO Revolving Fund was established by DEDE. This fund support to the projects that is related to energy saving, EE, and carbon credit though the Fund manager.



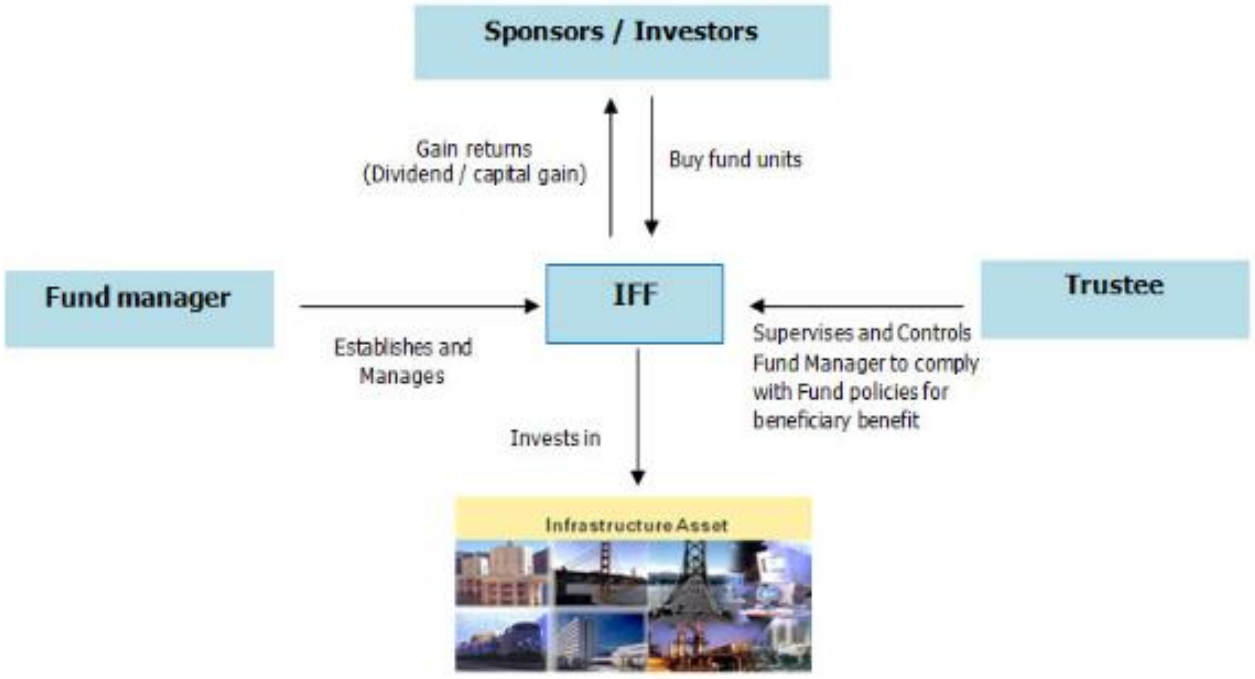
2.4 Private Financial Instruments

Private Financial Instruments



Infrastructure fund

Financial instrument for raising capital designed to raise fund to finance infrastructure projects



Example of several infrastructure funds in Thailand

Infrastructure fund	Investment Assets	Fund size at IPO
Thailand Future Fund (TFFIF)	Chalong Rat Expressway and Burapha Withi Expressway	upto 45,700 mTHB
Super Energy Infrastructure Fund (SUPEREIF)	Solar power plants	upto 5,150 mTHB
BURIRAM SUGAR GROUP POWER PLANT INFRASTRUCTURE FUND (BRRGIF)	Biomass power plants	upto 3,850 mTHB
Amata B.Grimm Power Powr Plant Infrt Fnd (ABPIF)	Power plants	upto 6,600 mTHB

Green Loan

Each green loan product of each bank provides different benefit of products

	Special loan product(s)	Key Features	Eligible criteria
ธนาคารกสิกรไทย KASIKORNBANK 泰华农民银行	K–Energy Saving Guarantee Program (Solar Rooftop)	Credit limit up to 100% of the total project investment, 12 years maximum loan term.	➢ Business with at least 3 years, ➢ obtained special purchase rates for electricity produced and supplied by the **solar rooftop project**
	Top-Up Loan for Energy Saving (Lighting Solution)	Credit limit up to 100% of the total project investment.	
ไทยพาณิชย์ SCB	SCB's SME Go Green	➢ Credit limit up to 150% of the collateral value. ➢ Installment periods of up to 7 years. ➢ grace period for principal payment in the first year ➢ Maximum fee capped at 1.5%.	Business with at least 4 years with the following projects: ➢ Energy Efficiency Improvement ➢ Clean transportation Fleet ➢ Pollution Treatment Equipment ➢ Female Entrepreneur in SME Segment
ธนาคารกรุงเทพ Bangkok Bank	Bualuang Green Loan	➢ High credit limit starting from 1 mTHB with unlimited credit ceiling, ➢ special interest rates of MLR per annum or lower ➢ Exemption for credit management fees	Invests in energy-saving measures, optimizing energy consumption or producing environmentally friendly products: ➢ energy-saving projects and activities ➢ alternative/renewable energy ➢ green label products ➢ waste management (turning waste into energy) ➢ bio-products (replacing chemical products)

Private Financial Instrument – Green Bond

Current status of operation

- Global : Global green bond and green loan issuance reached USD257.7bn in 2019
- Thailand : still new with limited numbers of green bond issuances. Several green bond issuances by Thai businesses with total value of over 1 billion USD

	bangchak	TMB BANK	B.GRIMM SINCE 1878	Energy Absolute	BTS GROUP
Issuance date	2015	June 2018	Dec 2018	July & Oct 2019	May 2019
Size and character	3 bnTHB or 82mTHB Tenor = 12-15 years	60 mUSD or 1,850 mTHB Credit rating = A Tenor = 7 years	5bnTHB or 165mUSD Interest rate =3.6% Tenor= 7 years Credit rating = A-	10bnTHB or 330mUSD Interest rate =2.744% Tenor= 7 years Credit rating = A	13 bnTHB or 408 mUSD. Interest rate =2.51%-3.86% Tenor= 2-10 years Credit rating = A
Use of proceeds	To expand renewable energy businesses	To finance renewable energy projects	To finance 9 operational solar power projects	To re-finance wind projects	To finance Bangkok's Pink & Yellow Monorail Line
Investor	Institutional investors.	IFC was the sole investor	ADB was the sole investor.		Institutional investors and High-Net-Worth Individual

Credit Guarantee

TCG drives BCG model to support and promote guarantees credit up to 100 million baht

Instrument/ Measure/ Mechanism	Key point	Target	Compliance or voluntary
PGS9 Program (โครงการค้ำประกันสินเชื่อ บสย. SMEs สร้างชาติ)	• SMEs entrepreneurs who are involved in energy conservation The use of alternative and renewable energy • Waiver of credit guarantee fee for 2 years • maximum guarantee amount per person 100 million baht • guarantee period of 10 years	SMEs	Voluntary

Source:
www.prachachat.net/finance/news-893223
www.tcg.or.th/customer_general_detail.php?customer_general_id=16

2.5 Carbon Market

Thailand's carbon pricing policy and regulation

At present, Thailand has no explicit mandatory carbon pricing scheme implemented in the country. However, there is a possibility that Thailand will introduce either Carbon Tax or ETS or both by 2030 to ensure that the country will have an effective tool to enforce and serve the country to meet the long-term carbon neutrality and net-zero emission targets.

In 2019, as part of the plan to achieve its NDC mitigation objective, the Thai government, with support from the World Bank's 'Partnership for Market Readiness (PMR)', conducted a study on the potential for carbon pricing instruments (CPIs). These CPIs could include a carbon tax and/or an emission trading system in one or more sectors, to complement other sectoral policies.

The PMR study assesses the economic, social and emission impacts of applying CPIs in Thailand to achieve the NDC targets and develops approaches to incorporate a CPI within Thailand's current policy landscape. The study shows that a carbon tax would have lower administrative costs for both participants and scheme administrators (i.e., the Thai government). A carbon tax's lower administrative costs are driven by the ability to use existing tax systems and institutions. However, it can be difficult to set the right tax rate in advance to achieve a desired emissions outcome. As a result, there is a risk that the tax rate is set too high or too low.

The ETS, on the other hand, would provide the Thai government with greater certainty about the emissions outcome and the ETS cap can be set in line with Thailand's NDC. Feedback from business stakeholders in Thailand has revealed a preference for an ETS because of the perceived flexibility it provides businesses to meet compliance obligations, and because of the negative perception of introducing a new tax. This may be a very important part of building the support necessary for successful policy reform. An ETS would also provide greater potential for Thailand to integrate with ETSs in other countries, including those that might be developed in the Asia-Pacific region. By providing access to a larger pool of abatement, such integration can serve to lower the costs of meeting Thailand NDCs.

While an ETS requires more infrastructure and institutional oversight than a tax, there is an opportunity to utilize existing and planned policies to minimize these costs and expedite the establishment of an ETS. In particular, Thailand's Voluntary Emission Reduction Program (T-VER) provides the framework for offsets as well as the foundations for facilitating intercompany carbon trading.

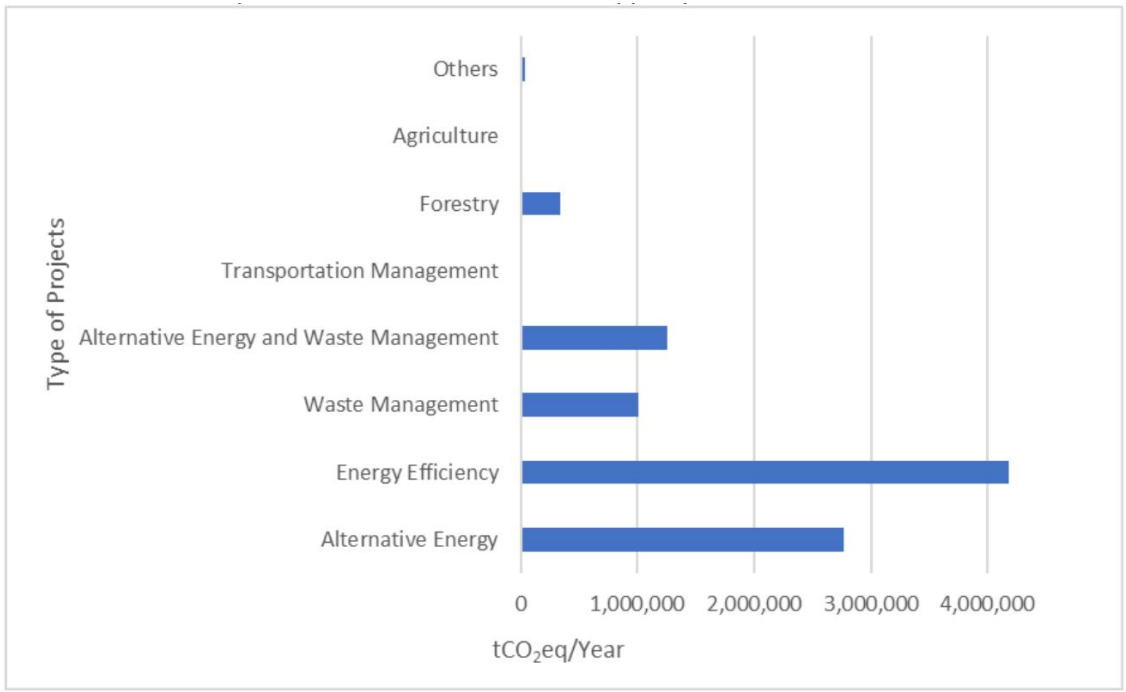
The use of offsets reduces carbon prices and improves the economic impacts associated with an ETS. The T-VER program could serve as the basis to provide business with access to offsets. Since T-VER convers agriculture, waste and forestry sectors, rural communities can benefit from selling offsets which can lead to better distribution outcomes. With relatively minor adjustments, in terms of its scope and eligibility criteria, T-VER can function as the basis for supplying domestic credits to the ETS compliance market.

Thailand's Voluntary Emission Reduction Program (T-VER)

Thailand Voluntary Emission Reduction Program (T-VER) is a greenhouse gas reduction program developed by Thailand Greenhouse Gas Management Organization (TGO) which aims at promoting and supporting voluntary greenhouse gas reduction participants from all sectors in Thailand. Participants will receive carbon credits called "TVERs" generated from their greenhouse gas reductions, and they can sell TVERs in Thailand's voluntary carbon market. TGO has set the rules and procedures for project development, greenhouse gas reduction methodologies, registration and certification of greenhouse gas reduction. To be eligible for receiving TVERs, the project must reduce greenhouse gas emission and it must be developed within the border of Thailand.

The development of T-VER projects consists of two main steps: 1) the registration process and 2) the greenhouse gas emissions reduction certification process. The project developer must prepare documents for registration and certification consideration. Projects that will be considered by the committee for registration must be domestic GHG mitigation projects.

For a T-VER project registration, the project developer has to prepare the project documentation as required by TGO. The project documentation must be validated by a third-party Validation and Verification Body (VVB). Then, project developer can submit the documents to TGO for registration as a T-VER project. Projects that have been registered as T-VER projects have to be monitored for their greenhouse gas emission reductions, then the result will go through the verification process before carbon credits can be issued. The T-VER program covers 6 sectors: Energy Efficiency, Alternative Energy/Renewable Energy, Waste Management, Transport Management, Forestry, and Agriculture. Besides, the T-VER program covers three types of greenhouse gases, including Carbon dioxide (CO2), Methane (CH4) and Nitrous oxide (N2O).



From 2014-2021, 257 projects have been registered as T-VER projects with the expected GHG emissions reduction potential of 9,582,052 tCO2eq per year

Source: Thailand Greenhouse Gas Management Organization (TGO)

2.6 Carbon Capture and Storage (Policy landscape)

CCS Policy landscape

	Capture	Transport	Storage
Level of acknowledgement	• Established CCS task force under Ministry of Energy • Lay out Thailand's CCS Roadmap (2011-2030)		
Laws and regulations, acts, regulatory framework development	• Currently in the process of identifying governmental agency that can be responsible for CCS development and defining principles for Thailand CCS regulations within international context • Consideration to establish Thailand CCS regulations		
Financial incentives	Petrochemical production facilities and natural gas separation plants that are implementing CCS technologies will be granted 8 years corporate income tax exemption.		
	Currently developing potential national financial incentives and seeking for international funding opportunities and supports		
Market mechanism (Business Model)	Existing carbon pricing system could play key roles in increasing the attractiveness of equipping industrial and power generation facilities with CO2 capture.		
Technical support, Infrastructure development, Human capacity, Big data	Be a member in Asia CCS Network		

Sources:
Kongphetsak. W. (2020). Carbon Capture and Storage; CCS, in Thailand. https://www.asiacleanenergyforum.org/wp-content/uploads/2020/07/wuttipong-kongphetsak-carbon-capture-and-storage-in-thailand.pdf
Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy (2021) https://unfccc.int/sites/default/files/resource/Thailand_LTS1.pdf
BOI. Thailand BOI Approves Measures to Support Carbon Reduction. https://www.boi.go.th/index.php?page=press_releases_detail&topic_id=129254

2.7 Lesson learnt & key takeaways

Mechanisms to promote decarbonization of Thailand

Sector	Mechanisms	Key takeaways
Power sector	✓ Adder ✓ FiT ✓ Competitive bidding ✓ T-VER ✓ I-REC ✓ Exemption of import duty on machinery ✓ Exemption from corporate income tax ✓ Encon Fund ✓ Green Bond / Green loan	**Key Takeaways** • Thailand has adopted the adder scheme and it was replaced by the FiT and Competitive bidding schemes until present. These are considered as mechanisms that support increasing the RE share in power generation especially promoting small and very small power producers. • The ENCON fund also plays an important role in providing investment subsidies for prototype projects or the demonstration of technology. In addition, the fund's low interest loan has increased confidence of the financial institution to provide a credit service to RE or EE projects. • A current power purchase agreements (PPAs) with EGAT requires RE installations to either provide steady power generation by embedding energy storage (in the case of firm PPAs) or to enter into non-firm PPAs where offtake volumes, and therefore revenue, are uncertain. Existing regulations also prohibit export of privately generated electricity from RE installations to the grid and impose a high wheeling charge for export through EGAT. These constraints increase the investment cost and risk premium of RE projects that deter further private investment • A reform to the enhanced single buyer model, accompanied by clear policy and regulations is necessary to enable private players to compete on both the generation and supply sides. The transition from this model is currently unclear. • Several laws (Greenhouse Gas Reporting Law and Emission Trading System Law) have been developed to be considered for inclusion in Thailand's draft Climate Change Act. However, the official establishment of a carbon pricing mechanism is unclear, increasing the uncertainties relating to the economics of RE projects • Thailand's power system infrastructure needs to offer increased flexibility, especially from existing assets, be planned through a whole-system view that ensures a fair distribution of cost and integrate digital tools

■ = Active scheme/mechanism ■ = Inactive scheme/mechanism ■ = In the government plan

Mechanisms to promote decarbonization of Thailand

Sector	Mechanisms	Key takeaways
Transport sector	✓ Vehicle excise tax ✓ EV Tax Incentive Package	**Key Takeaways** • The most directly relevant policy targets on electromobility in Thailand is the EV roadmap and the ZEV 30@30 targets, which aims at reaching 30% of EV sales in the total domestic vehicle sales by 2030, with a further expansion of 100% EV sales by 2035. • On the production side, the EV promotion package offered by the Board of Investment (BOI) is the most comprehensive support to EV development in Thailand, which is mainly composed of fiscal incentives to the eligible manufacturers of a variety of vehicles, auto parts, and charging facilities. • On the demand side, fiscal benefits are granted to selected types of EVs through subsidy of EV purchase, differentiated reductions in vehicle excise taxes and vehicle registration taxes. • Meanwhile, several supports were identified for charging infrastructure development, standardisation of EV systems and end-of-life management for EV batteries
Industry sector	✓ Exemption of duty on raw materials for export ✓ Energy Efficiency Revolving Fund (EERF) ✓ EE subsidy Program ✓ Ministry of Industry's green industry program	**Key Takeaways** • In the energy sector, policies and financial instruments have been implemented through the ENCON fund to provide soft loans in various programs. With the objectives of energy conservation or renewable energy investment promotion, a large number of clean energy projects had been developed. • The GHG emission reduction in the industry sector is being pressured by customers or trading partners or country's regulations, such as the demand for low-carbon products, CBAM, etc. These are a key factor in accelerating the GHG emission reduction in this sector. • There are still limitations for SMEs because they have to consider the company's survival, profitability and sales as a primary concern; coupled with the issue of credibility in accessibility to funds or financial sources, which resulted in lack of investment's capability in energy efficiency or RE investment. Therefore, financial instruments are still required to support the SMEs. • If businesses pass "Green Industry Program" criteria, they will be eligible for green productivity loan (SME entrepreneurs), 5 years annual fee waving etc. Thus, this can be an incentive to do business in "green" manner

Source: Ministry of Industry. Green indsutry Manual: The Guidline for Green Industry Promotion and Development. https://greenindustry.diw.go.th/webgi/wp-content/uploads/2022/06/GREEN-INDUSTRY-ENG.pdf

■ = Active scheme/mechanism ■ = Inactive scheme/mechanism ■ = In the government plan

Chapter 3:

Analysis of appropriate financial and economic policies, measures, and instruments for Thailand to achieve the national target in accordance with the Carbon Neutral 2050 scenario

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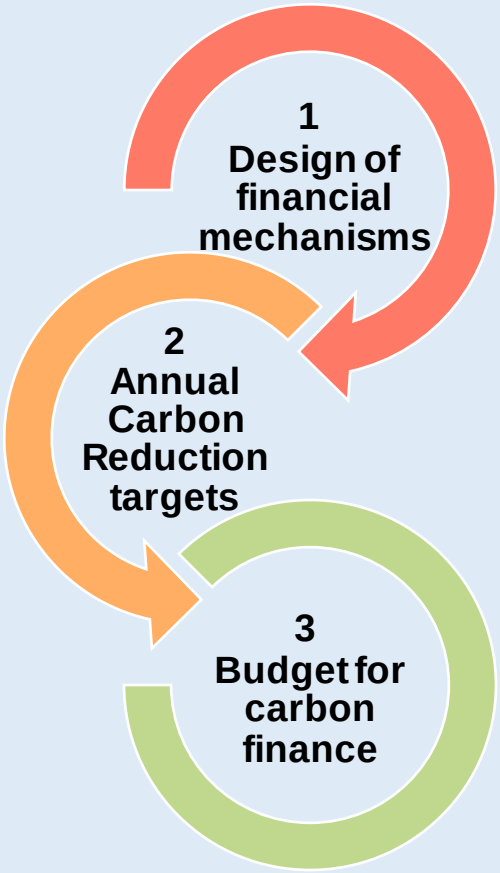
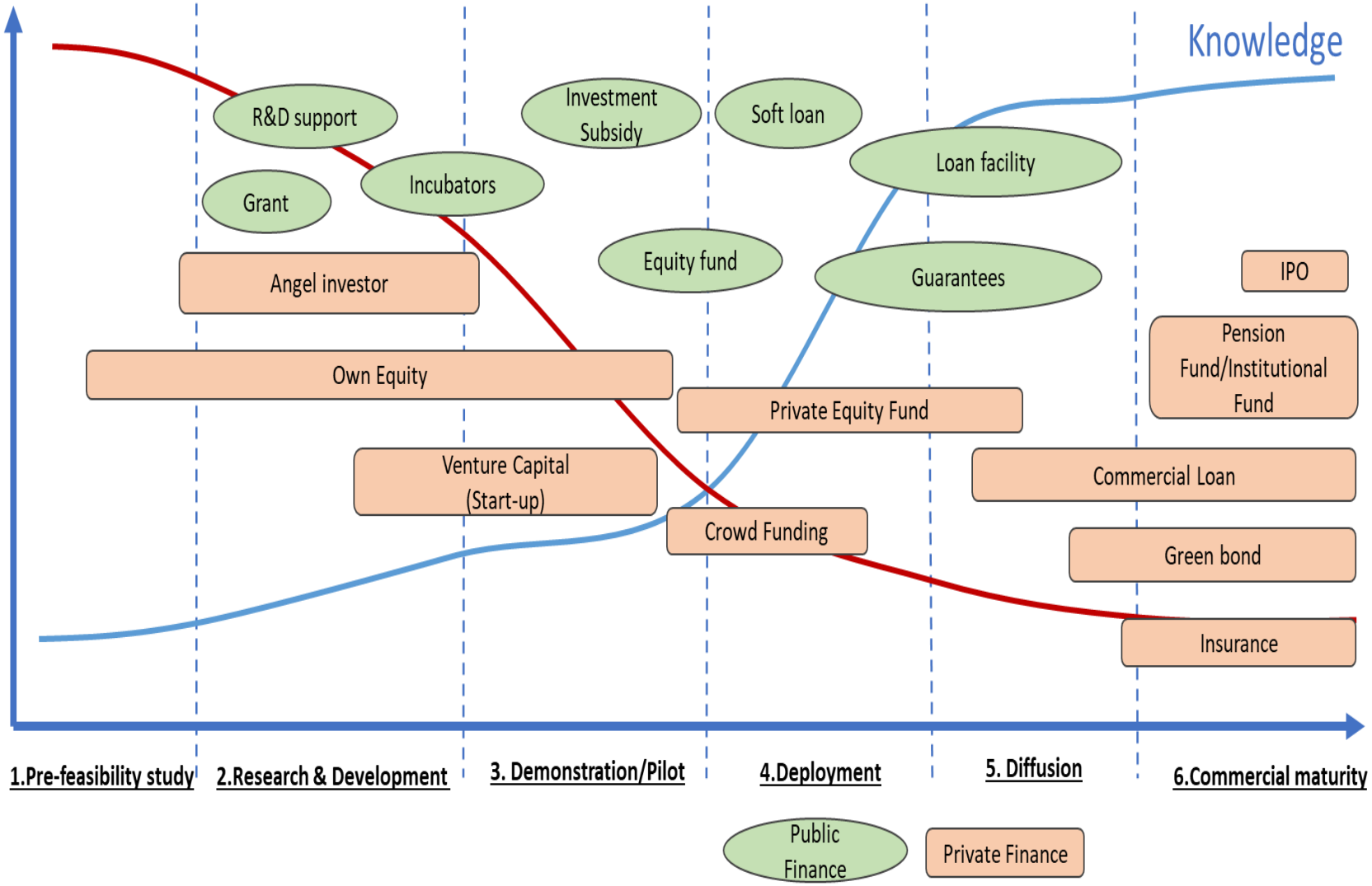
Analysis of appropriate financial and economic policies, measures, and instruments for Thailand to achieve the national target in accordance with the Carbon Neutral 2050 scenario

To recommend the appropriate financial and economic policies, measures, and instruments for Thailand to achieve the national target in accordance with the Carbon Neutral (CN) 2050 scenario focusing in the energy sector, the following processes were conducted:

- Analysis of levelized cost of energy was conducted and applied for the identification of the level of technologies.
- Public financing which matches the level of technologies was selected.
- After that, the selected public financing instruments were designed, and the co-financing ratio of each instrument was estimated.
- Finally, the budget for each instrument was allocated to ensure that they can generate the total investment required in the short-, medium-, and long-terms of the scenario.



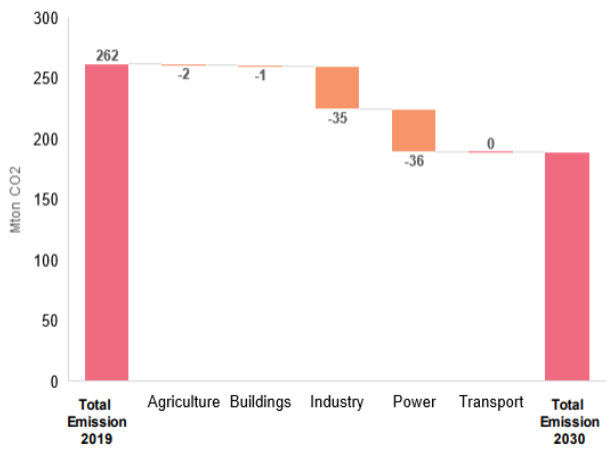
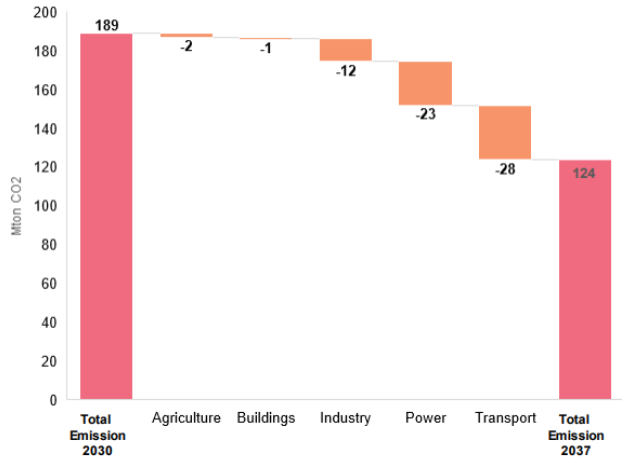
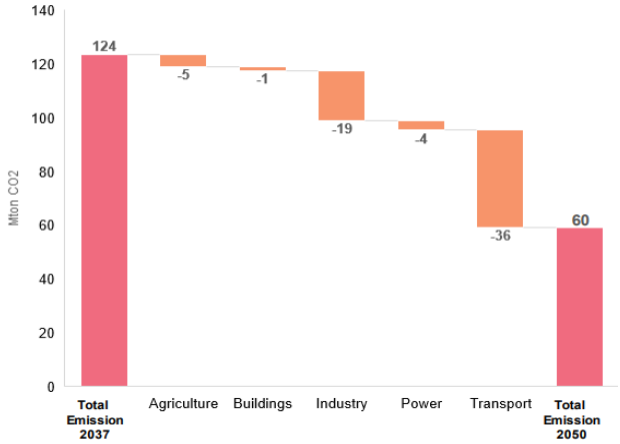
Financial instruments by level of technology development



- The figure describes different public and private financial instruments which are appropriate at each level of technology development.
- In the early stages of technology development especially R&D and pilot, the risks are so high that extensive public finance is needed in the form of R&D grants or investment subsidy while private finance includes an angel investor, own equity, or venture capital for start up companies.
- During the deployment stage when the technological risks are getting much lower, public finance including equity fund and soft loan is adopted while private finance include crowd funding or private equity fund.
- Transitioning to the diffusion stage, public finance turns into loan facilities and guarantees. Once the technology is commercially mature, various financial instruments on private sectors play crucial roles.

Short-, Medium, and Long-term Targets for the CN2050 scenario

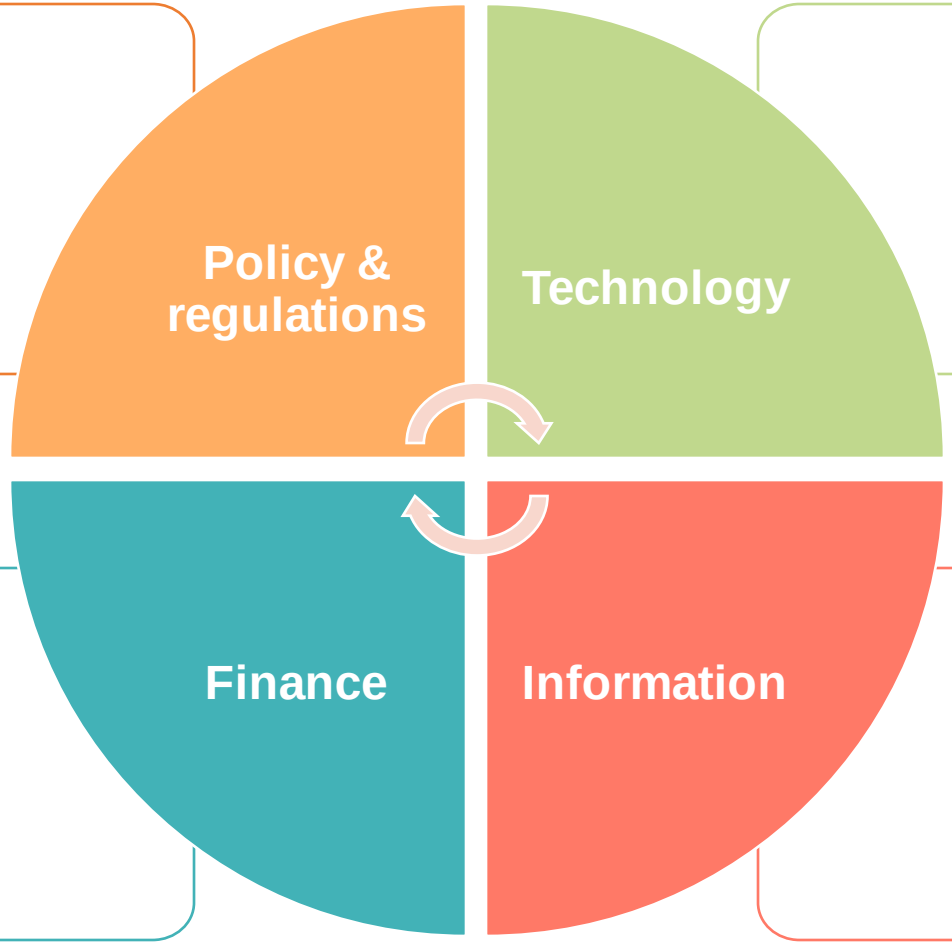
CASE for Southeast Asia

	Now to 2030 Reduce 30% from 2019 level	2030 – 2037 Reduce 50% from 2019 level	2037 – 2050 Reduce >78% from 2019 level
Power	• 44 GW of solar PV (5 GW/year) • 20 GW of wind (2.3 GW/year) • No new coal power plant	• Solar and battery system storage around 50% of power supply • No new coal power plant	• Increase to 80% RE from **solar, wind, and biomass** • **Coal generation** phase out during 2045-2050 • **Hydrogen** starting in 2045
Transport	• **Modal shift** to public transport service • Increase **biofuel blending** to 20% in 2025 and gradual increase of **EV sales**	• Increase EV sales to 100% in 2035, resulting in 10 million land-based EV • **Fuel economy** improvement	• Increase of EV stock and retirement of ICE • Increase of rail freight transport • Decrease share of conventional jet kerosene
Industry	• Continue using biomass • Low hanging fruit; replacing oil with electric heat pump in low temperature heat application	• Ramp up **electric heating** • **Biomass** allocation across sub-industry sector	• Gradual **coal phase out** • Increase use of **hydrogen**
Total Emission			

3.1 Power sector

Barriers to public investment in decarbonization of the power sector

- Unclear policy
- Lack of continuity
- Ineffective enforcement



- Lack of trust in technology
- Technology is unavailable in Thailand

- Unworthy of investment
- Lack of access to funding
- Lack of seed capital
- Lack of collateral

- Lack of information for investment decision-making
- Lack of technological knowledge
- Lack of skilled workers
- Lack of monitoring and evaluation methods

Barriers to public investment in renewable energy

Type of RE	Investment opportunity/ potential	Investment limitations/challenges				
		Policy	Regulation	Technology	Finance	Knowledge
Fossil fuel phase out	N/A					
Solar energy	High				SME	
Wind energy	Low-Medium					
Biomass energy	High					
CCUS	Low					
Hydrogen	Low					

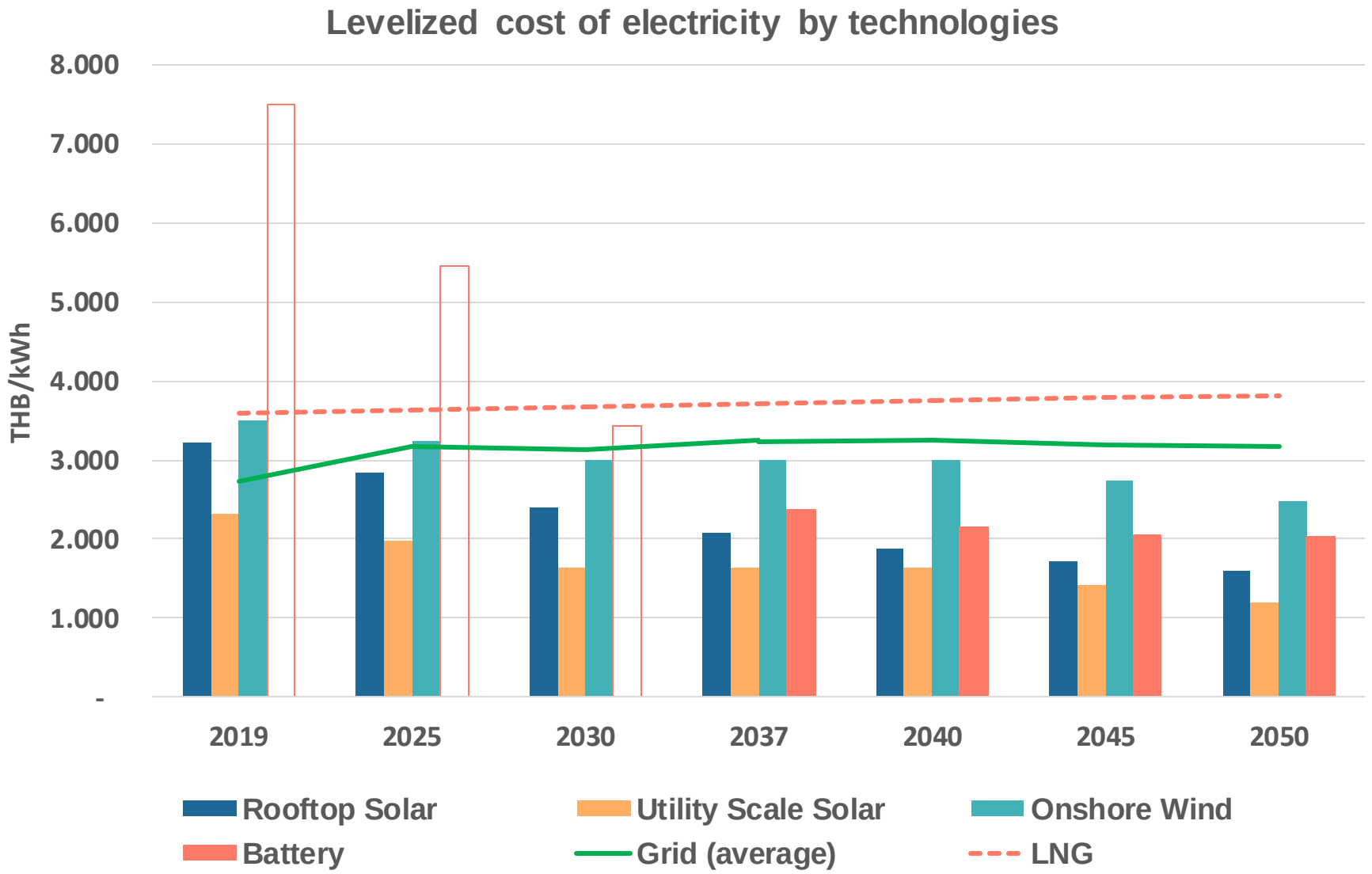
High
A lot of limitations and urgent solution is needed

Medium
Some limitations found and solution is needed

Low
No limitation/challenge found

Source: The Creagy, 2021

Levelized cost of electricity 2019 - 2050

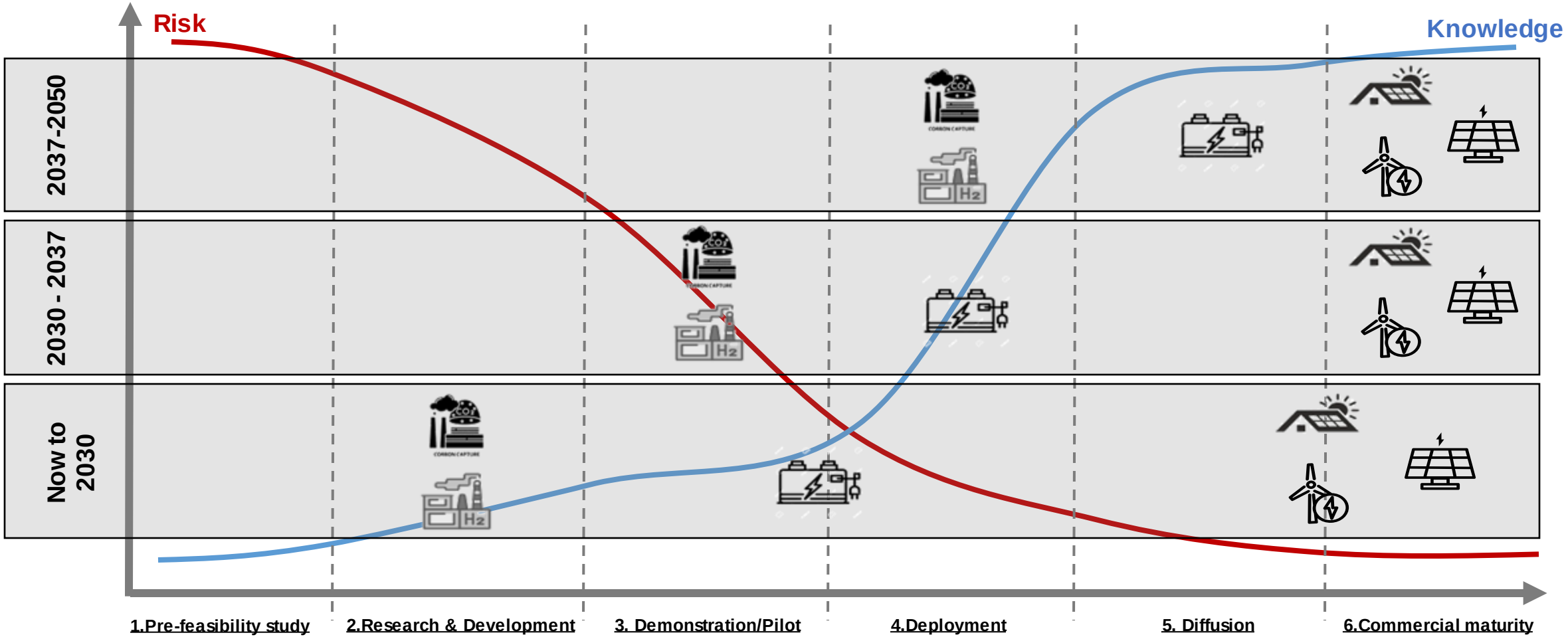


- Compared to ***the avoided cost of LNG power plants***,
  - LCOE of **all RE options** are competitive except the LCOE of battery during 2019 – 2025.
  - Due to a decreasing trend of battery, **LCOE of battery** become more competitive from 2030 onwards.
- Compared to ***the grid-average LCOE***,
  - LCOE of ***solar rooftop*** becomes competitive from 2025 onwards.
  - LCOE of ***onshore wind*** becomes competitive from 2030 onwards.
  - LCOE of ***battery*** becomes competitive from 2030 onwards.

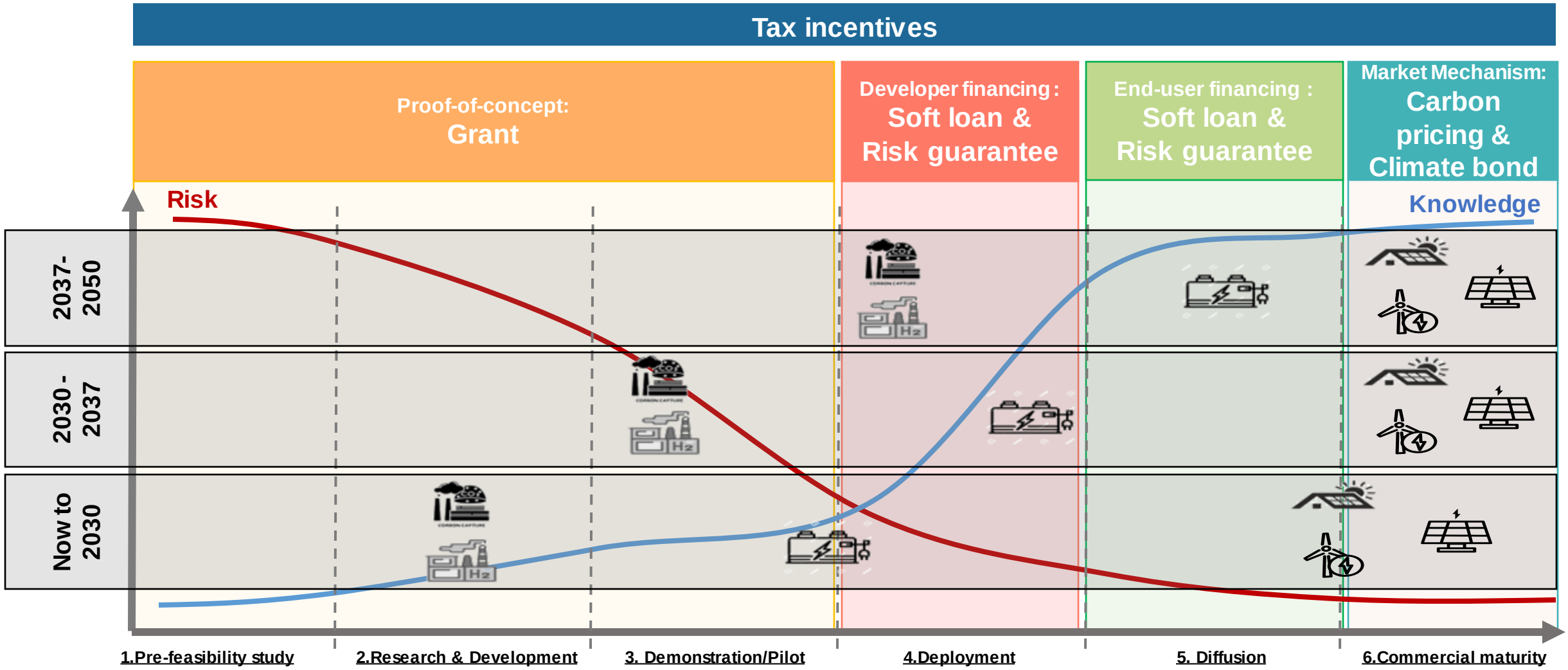
Remark: Battery will be added to the grid from 2037 onwards.

Mapping technologies in power sector to the level of development

- ***The risk and knowledge of technologies selected for the Carbon Neutrality Pathway in the power sector are mapped in each period of the pathway***, taking into account the level of technological development as well as the levelized cost of electricity as shown in the previous slide.



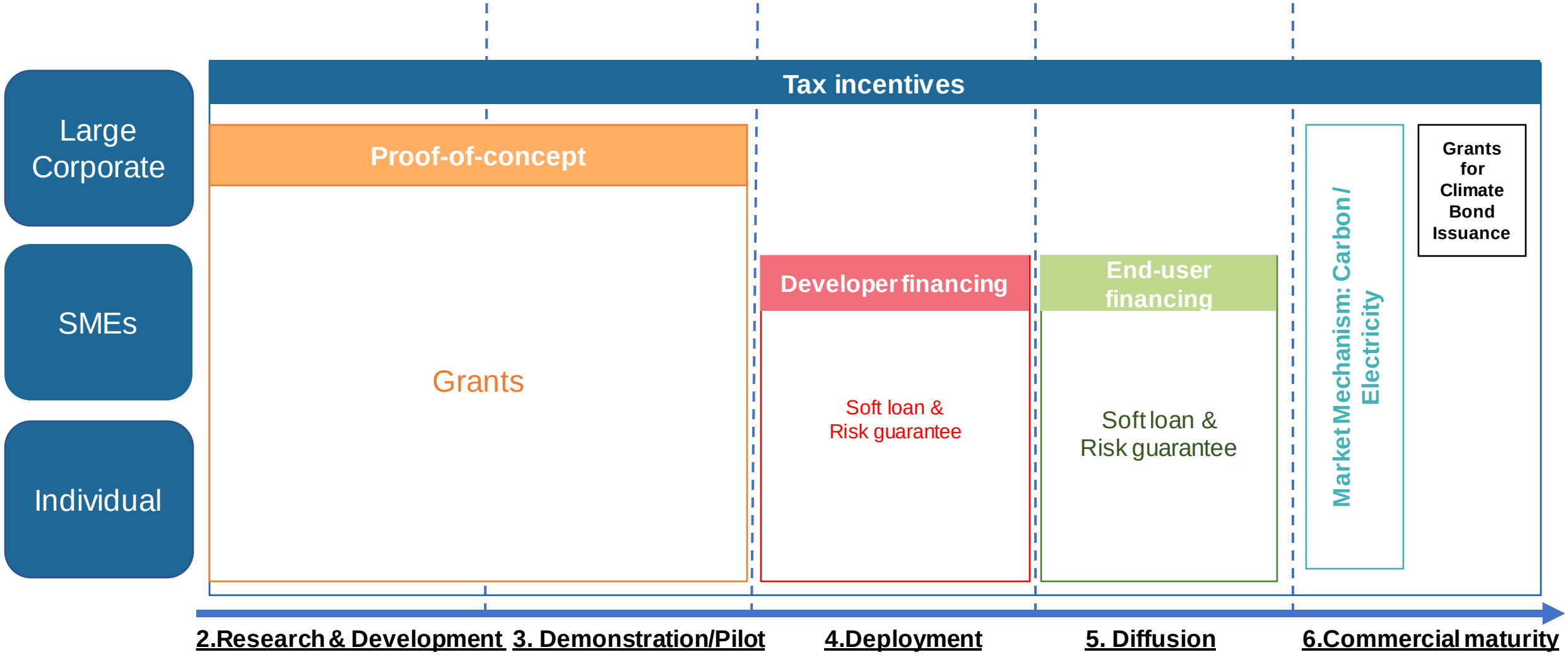
Proposed public financial instruments for power sector



Proposed model of public finance for supporting the CN2050 Scenario in power sector

Financial instruments	Co-financing Ratio	Now - 2030		2030 - 2037		2037 - 2050	
		Size of support	Investment	Size of support	Investment	Size of support	Investment
Tax	1 : 10	20,000	200,000	2,000	20,000	6,000	60,000
Soft loan	1 : 25	43,000	1,075,000	4,000	100,000	12,000	300,000
Climate Bond	1 : 250	20	5,000	20	5,000	100	25,000
Carbon	1 : 350	2,909	1,018,308	3,426	1,199,159	11,764	4,117,352
Total		**65,929**	**2,298,308**	**9,446**	**1,324,159**	**29,864**	**4,502,352**
Total investment needed (MB)		2,286,661		1,310,439		4,501,936	
Average co-financing ratio		1 : 35		1 : 139		1 : 151	
Cumulative GHG emission reduction (MtCO2)		291		343		784	
Support per GHG emission reduction (THB/tCO2)		227		28		38	

Selected public finance by scale of project



Characters & co-financing ratio of selected public finance

Grant

- To mitigate the investment risk of low carbon technologies during the R&D, demonstration & piloting phases
- The grant can be provided at different level, .e.g 50% - 100% for R&D, 20% - 30% for demonstration & piloting projects.

Co-Financing Ratio	1 : 3

Soft loan & risk guarantee

- To allow SME and end-users access finance for developing low carbon projects
- The government can provide compensation or risk guarantee premium so that the commercial banks can provide low-interest loan to SME and end-users.

Co-Financing Ratio	1 : 25

Climate bond

- To promote climate bond by providing grants for the issuance of the bond
- Cost of issuing climate bond is about 3-5 Million THB higher than other bonds since it requires monitoring, validation, verification process.
- 2 million THB grants for the climate bond issuer for issuance of at least 500 million THB climate bond

Co-Financing Ratio	1: 250

Tax incentives

- To support investment of low-carbon technologies through tax exemption.
- A number of BOI packages already exists. These include exemption of corporate income tax, exemption of import duties on machinery, exemption of import duties for R&D purpose.
- The future tax exemption may include tax credits for buying low carbon products.

Co-Financing Ratio	1 : 10

Carbon pricing

- To support GHG emission reduction by applying carbon pricing policy
- Carbon market can be developed for incentivizing GHG emission reduction project
- During the development of carbon market, Government can provide the floor carbon price at 100THB/tCO2

Co-Financing Ratio	1 : 350

Estimation of financial support from government to encourage private financing in power sector

	Now to 2030 Reduce 30% from 2019 level	2030 – 2037 Reduce 50% from 2019 level	2037 – 2050 Reduce >78% from 2019 level
Measures	• 44 GW of solar PV (5 GW/year) • 20 GW of wind (2.3 GW/year) • No new coal power plant	• Solar and battery system storage around 50% of power supply • No new coal power plant	• Increase to 80% RE from **solar, wind, and biomass** • **Coal generation** phase out during 2045-2050 • **Hydrogen** starting in 2045
Cumulative GHG Reduction	**291 $MtCO_2$**	**343 $MtCO_2$**	**784 $MtCO_2$**
Total Investment	**2,286,661 Million THB**	**1,310,439 Million THB**	**4,501,936 Million THB**
Estimated support from gov.*	**65,929 Million THB**	**9,446 Million THB**	**29,864 Million THB**
Support / tCO2 reduced	**227 THB/tCO_2**	**28 THB/tCO_2**	**38 THB/tCO_2**

3.2 Transport sector

Barriers to public investment in transport sector

Type of transport	Investment opportunity/ potential	Investment limitations/challenges				
		Policy	Regulation	Technology	Finance	Knowledge
EV Car	High	Medium	Medium	Low	Medium	Low
EV Bus	Medium	Medium	Medium	Low	High	Medium
EV Truck	High	Medium	Medium	Low	Medium	Medium
EV Motorcycle	High	Medium	Medium	Low	High	High
Charging Station	High	Medium	High	Low	High	Medium

High
A lot of limitations and urgent solution is needed

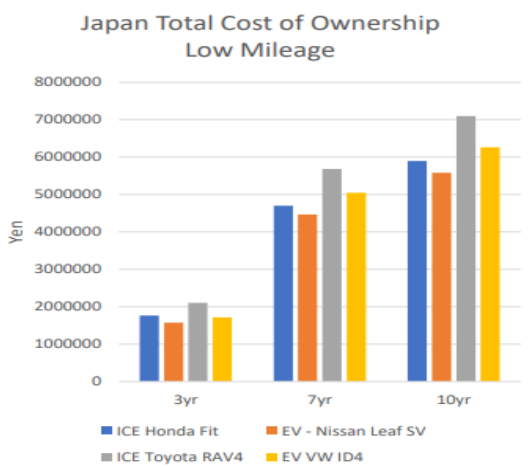
Medium
Some limitations found and solution is needed

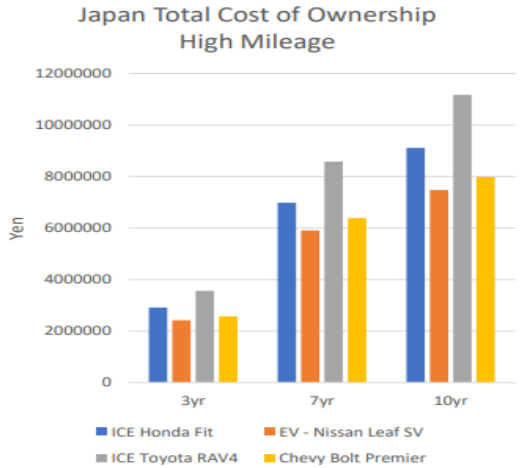
Low
No limitation/challenge found

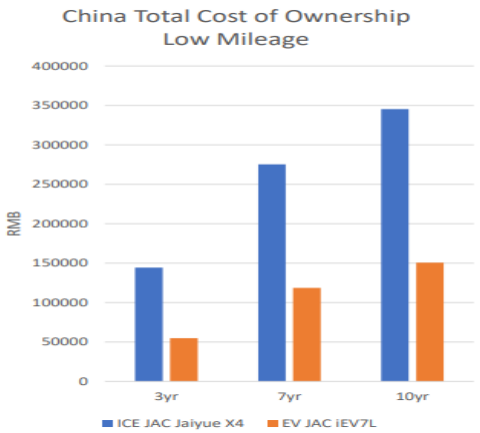
Source: The Creagy, 2021

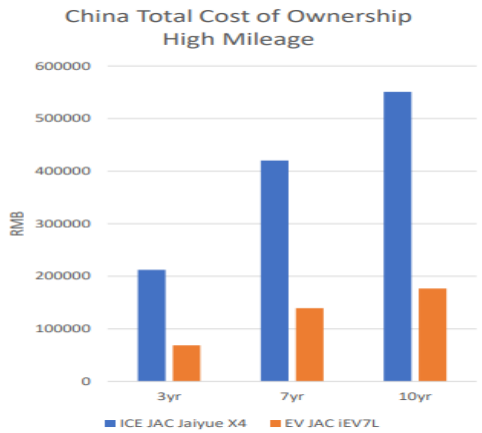
Total cost of ownership

Personal land transport: Total cost of ownership (THB/km)



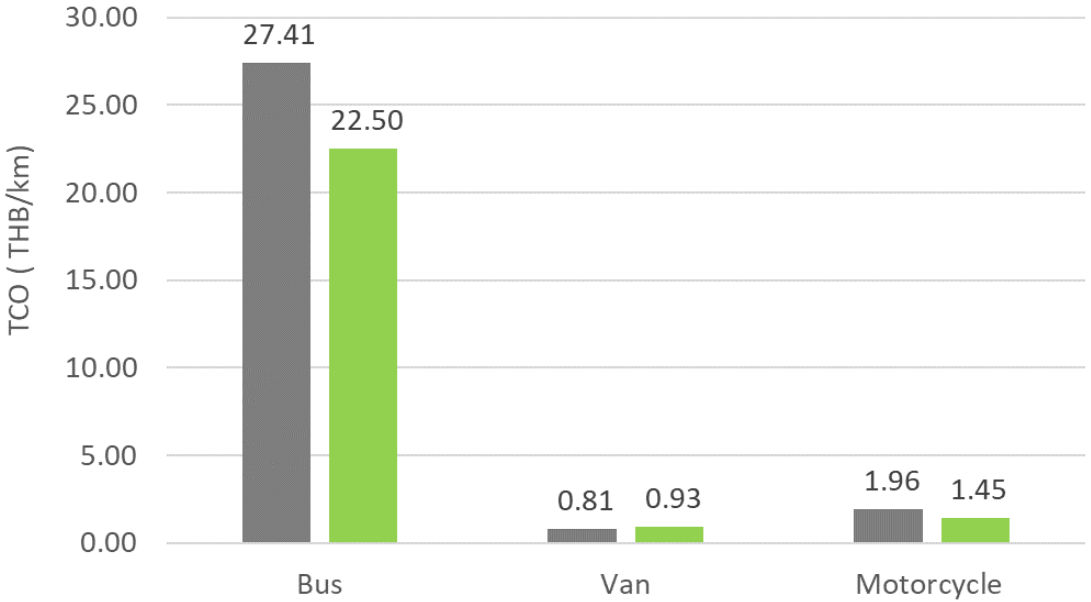






Source: https://nickelinstitute.org/media/8d993d1b8165b23/tco-asia-pacific-automotive.pdf

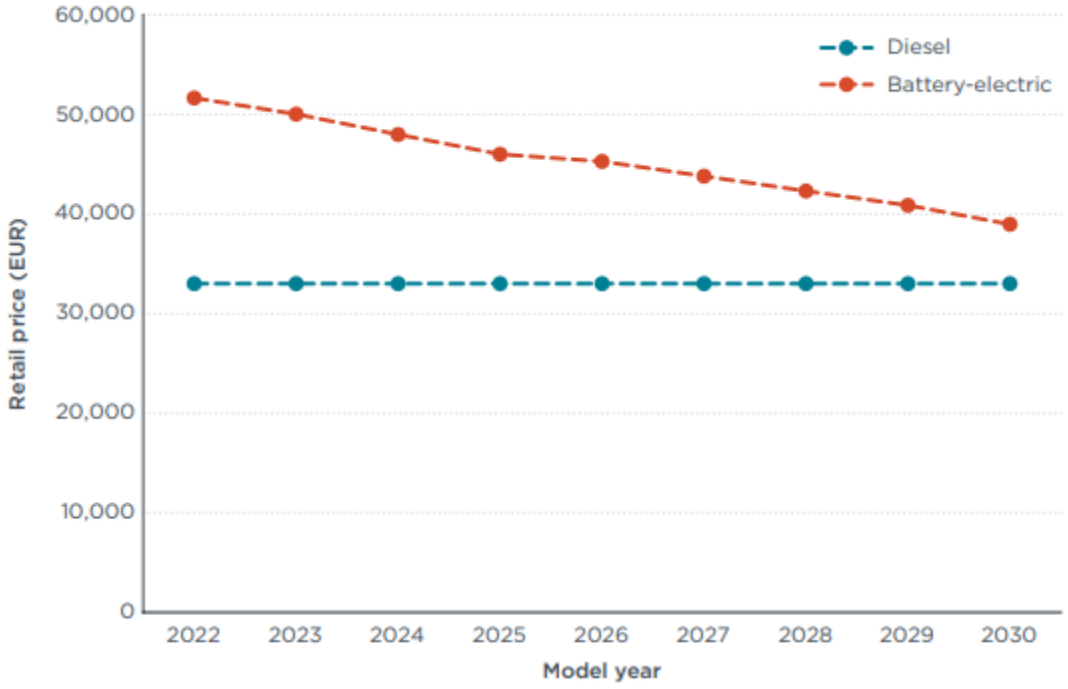
Public transport: Total cost of ownership (THB/km)



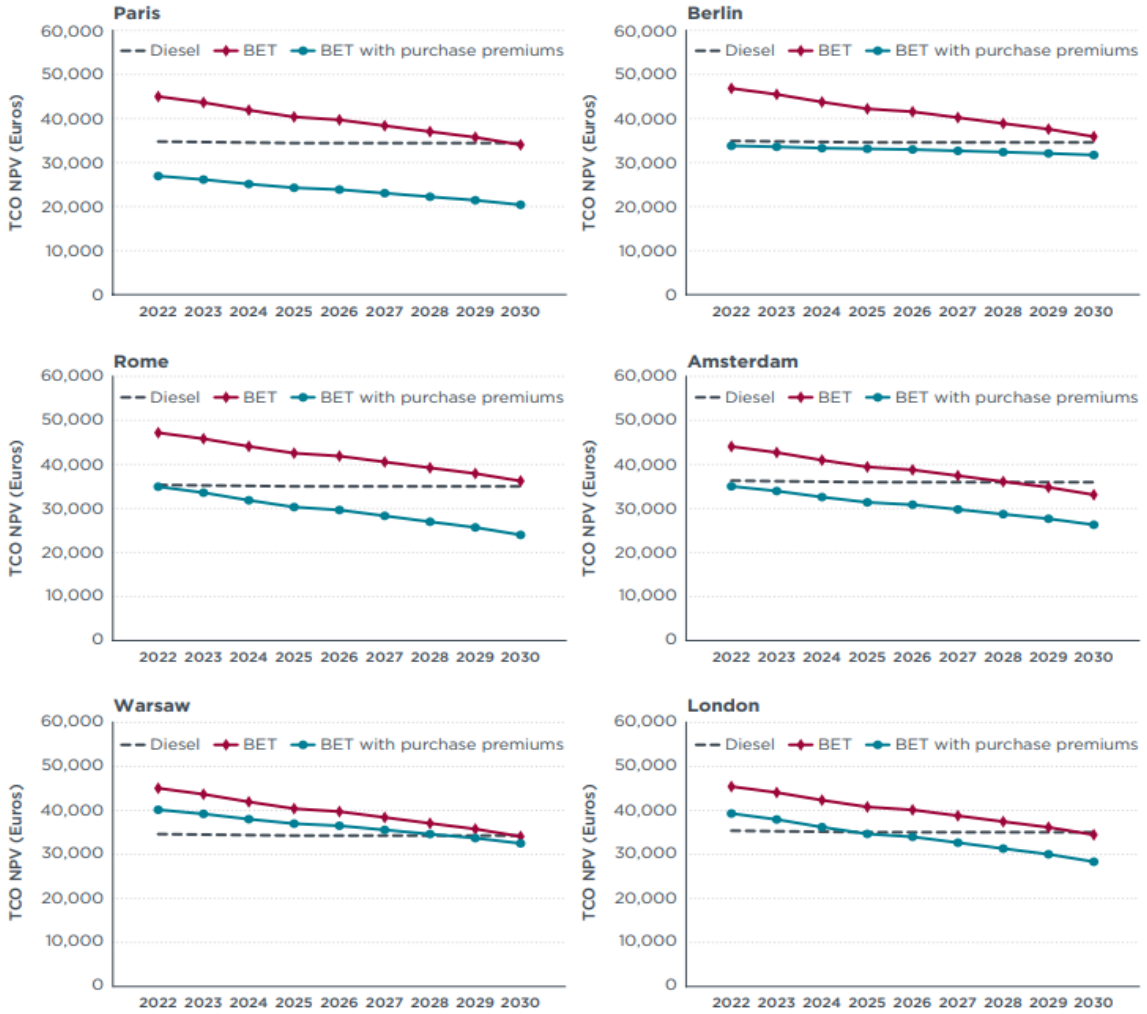
Source: GIZ, 2022

Total cost of ownership

Retail price evolution of last mile parcel delivery diesel & battery-electric truck



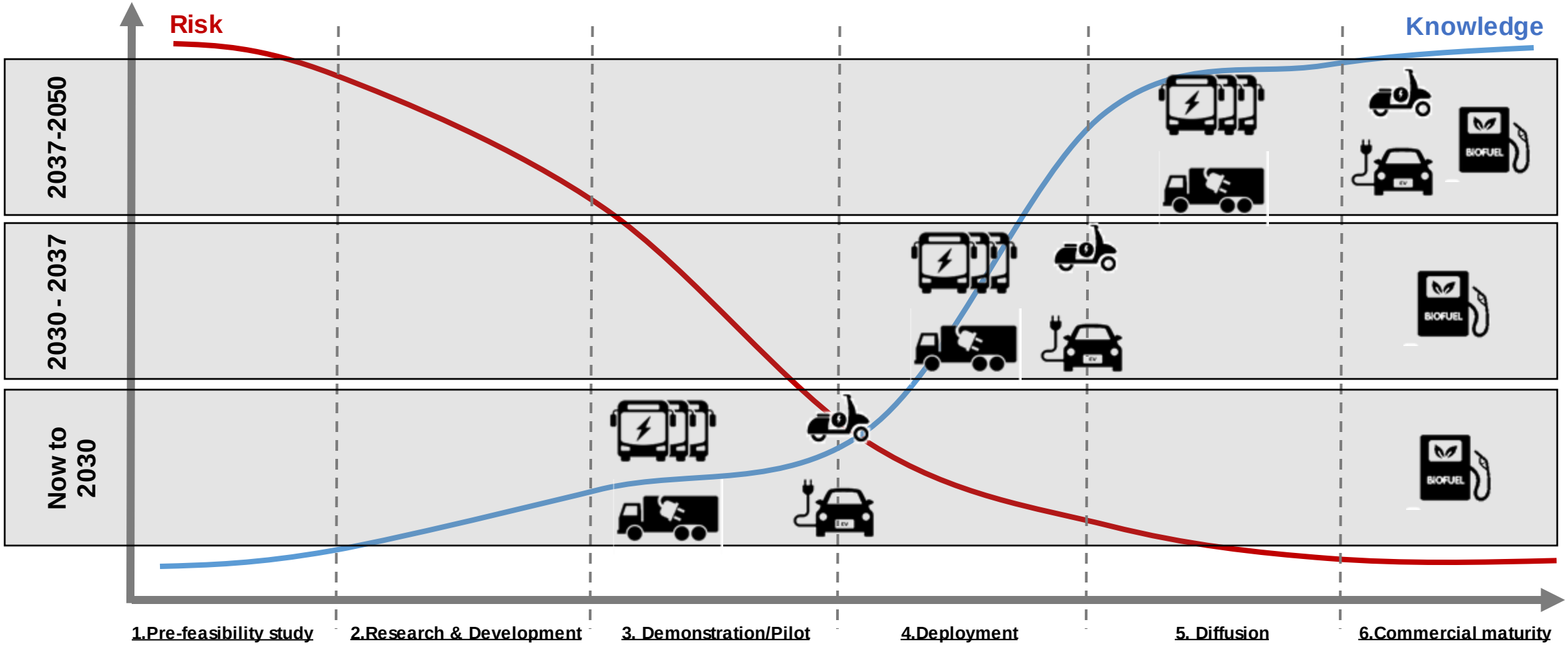
TCO of diesel & battery-electric truck



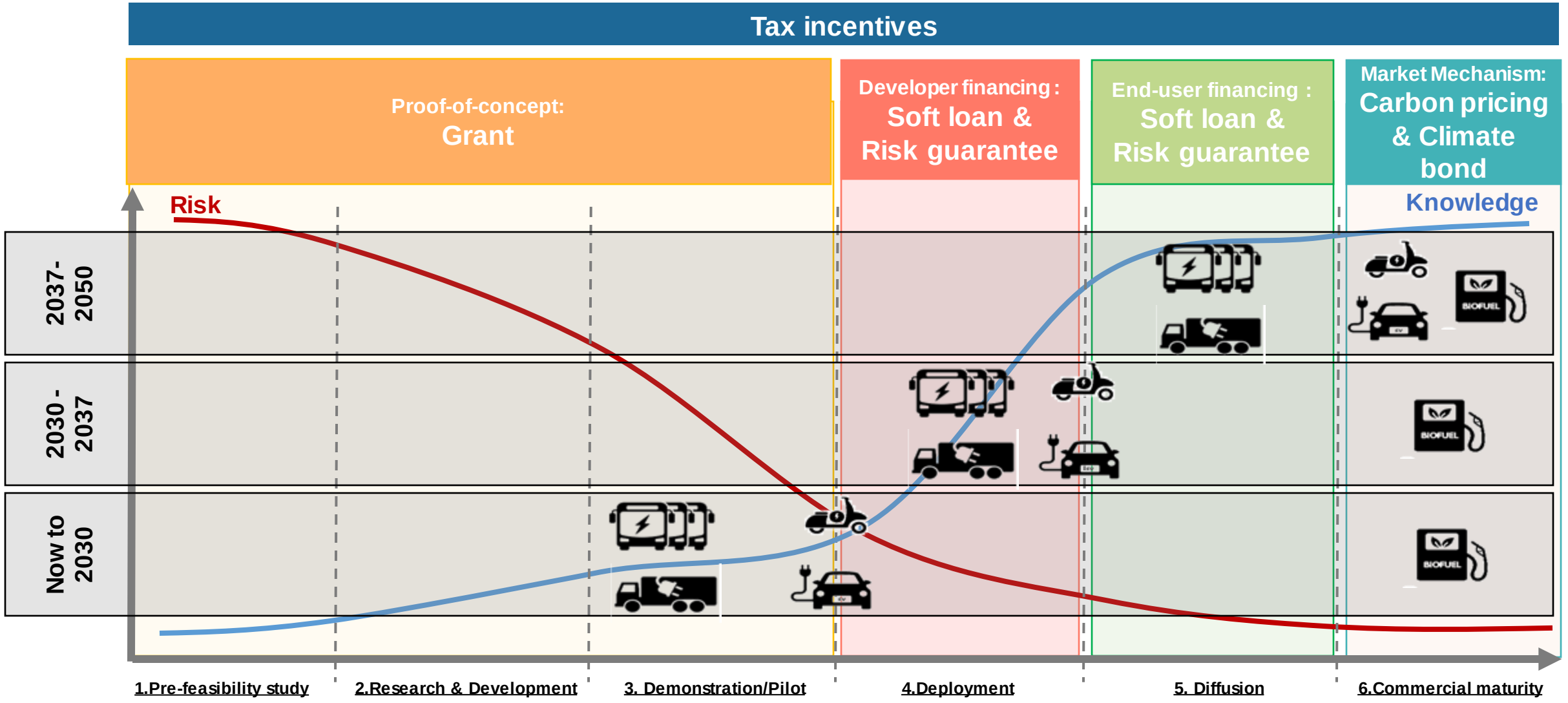
Source: https://theicct.org/wp-content/uploads/2022/06/tco-battery-diesel-delivery-trucks-jun2022.pdf

Mapping technologies in transport sector to the level of development

- ***The risk and knowledge of technologies selected for the Carbon Neutrality Pathway in the transport sector are mapped in each period of the pathway***, taking into account the level of technological development as well as the TCO as shown in the previous slides.

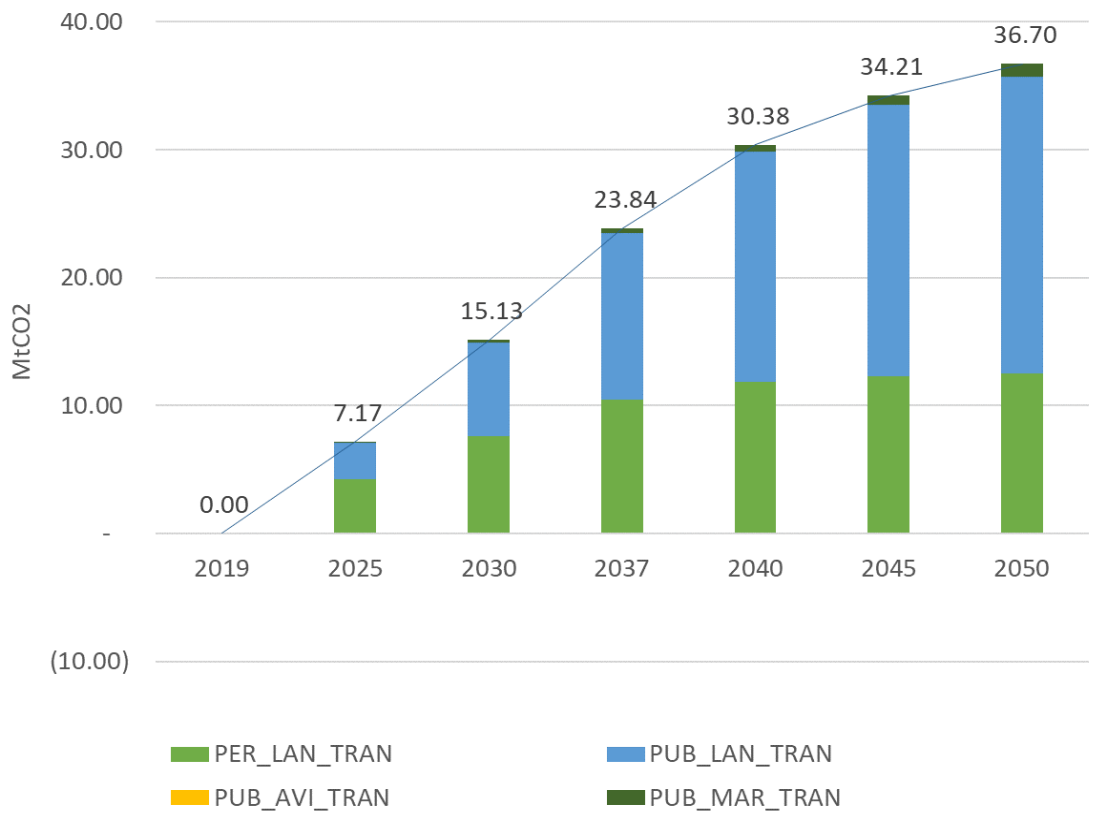


Proposed public financial instruments for transport sector



Decarbonization of transport sector

Shares of GHG emission reduction by mode of transportation



Key barriers

Type	Barriers
Financial	**All modes:** • High investment cost of EV and charging infrastructure • Lack of confidence of commercial banks and insurance sectors • No residual value of EV for reference for financial institutions **Public Transport:** • Limited investment capacity of public operators • Regulated fares of public transport
Technical	**All modes:** • Lack of skilled capacity to maintain and repair e-vans • Lack of confidence on sufficient charging stations • Availability of land or space for charging infrastructure **Public Transport:** • Uncertain demand of EV • Overlapping of routes in service

Proposed model of public finance for supporting the CN2050 scenario in transport sector

Financial instruments	Co-financing Ratio	Now - 2030		2030 - 2037		2037 - 2050	
		Size of support	Investment	Size of support	Investment	Size of support	Investment
Grants	1 : 3	20,000	60,000	50,000	150,000	10,000	30,000
Tax	1 : 10	40,000	400,000	50,000	500,000	10,000	100,000
Soft loan	1 : 25	40,000	1,000,000	110,000	2,750,000	20,000	500,000
Climate Bond	1 : 250	-	-	-	-	100	25,000
Carbon	1 : 350	-	-	-	-	12,710	4,448,475
Total		**100,000**	**1,460,000**	**210,000**	**3,400,000**	**52,810**	**5,103,475**
Total investment needed (MB)		1,534,655		3,404,695		5,059,136	
Average co-financing ratio		1 : 15		1 : 16		1 : 96	
Cumulative GHG emission reduction (MtCO2)		-24		111		635	
Support per GHG emission reduction (THB/tCO2)		n/a		1,886		83	

Estimation of financial support from government to encourage private financing in transport sector

	Now to 2030 Reduce 30% from 2019 level	2030 – 2037 Reduce 50% from 2019 level	2037 – 2050 Reduce >78% from 2019 level
Transport	• **Modal shift** to public transport service • Increase **biofuel blending** to 20% in 2025 and gradual increase of **EV sales**	• Increase EV sales to 100% in 2035, resulting in 10 million land-based EV • **Fuel economy** improvement	• Increase of EV stock and retirement of ICE • Increase of rail freight transport • Decrease share of conventional jet kerosene
Cumulative GHG Reduction	**-24 $MtCO_2$**	**111 $MtCO_2$**	**635 $MtCO_2$**
Total Investment	**1,534,655 Million THB**	**3,404,695 Million THB**	**5,059,136 Million THB**
Estimated support from gov.*	**100,000 Million THB**	**210,000 Million THB**	**52,810 Million THB**
Support / tCO2 reduced	**N/A**	**1,886 THB/tCO_2**	**83 THB/tCO_2**

3.3 Industry sector

Gaps and challenges for Carbon Neutrality Pathway in industrial sector

CASE for Southeast Asia

Policy	Technology	Knowledge	Finance
P1: Energy performance tracking and benchmarking are subpar	**T1:** There is a lack of direction for EE technology and innovation	**K1:** The readiness of personnel responsible for energy is limited	**F1:** Limited amount of financial support to each facility each year
P2: The stringent standard for designated factories are yet to be enforced	**T2:** Highly Efficient Heat and steam technology	**K2:** Lack of efficient information management systems	**F2:** M&V of energy savings from government budget are not robust
P3: Policy measures are mostly incentive-based	**T3:** Industrial digital technologies (for data collection and monitoring)		**F3:** Lack of capital and access to finance to undertake EE investments for SMEs

Source: GIZ, 2022

Barriers to public investment in energy efficiency

Type of building	Investment opportunity/ potential	Investment limitations/challenges				
		Policy	Regulation	Technology	Finance	Knowledge
Factory/Industry	Medium-High				SME	
Commercial/Business	Low-Medium				SME	
Residence	Low-Medium					

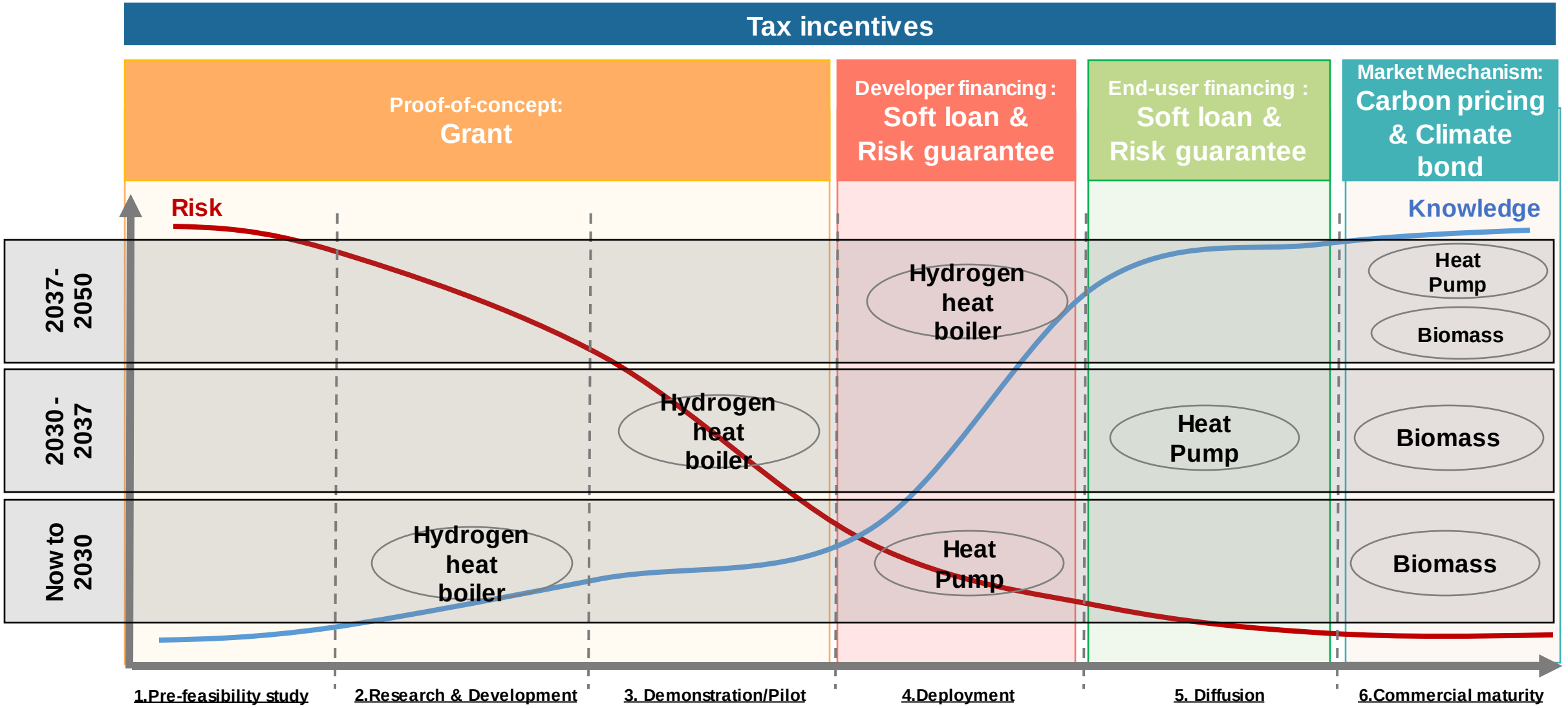
High
A lot of limitations and urgent solution is needed

Medium
Some limitations found and solution is needed

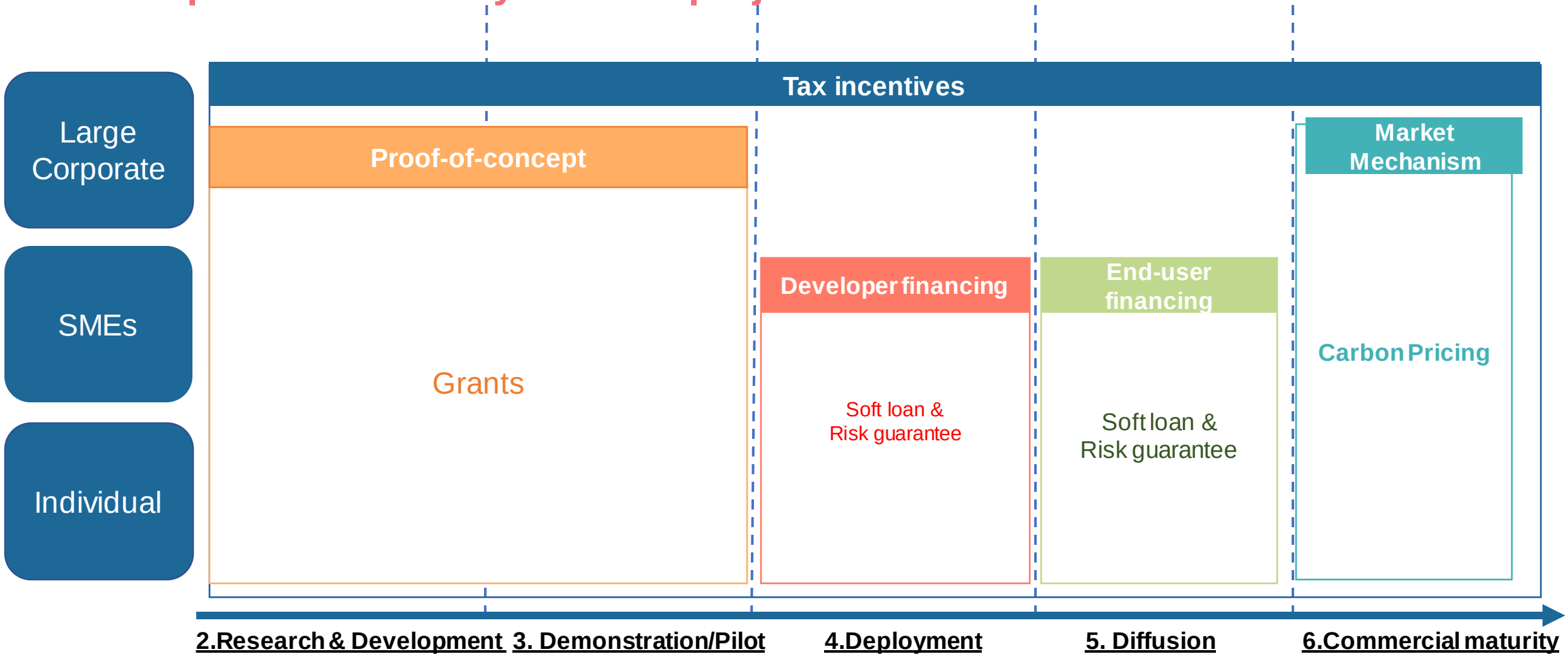
Low
No limitation/challenge found

Source: The Creagy, 2021

Proposed public financial instruments for industrial sector

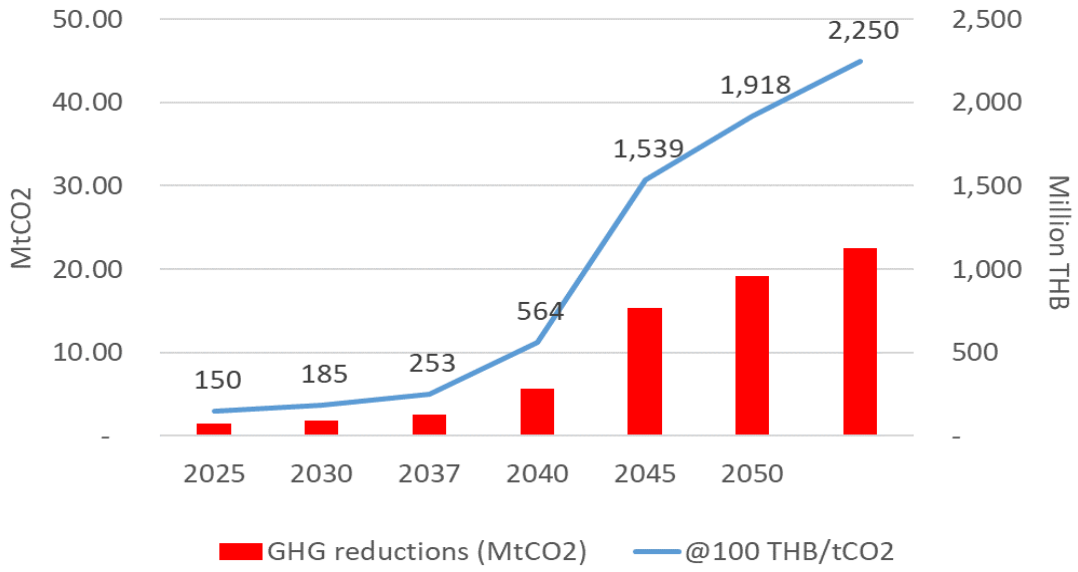


Selected public finance by scale of project

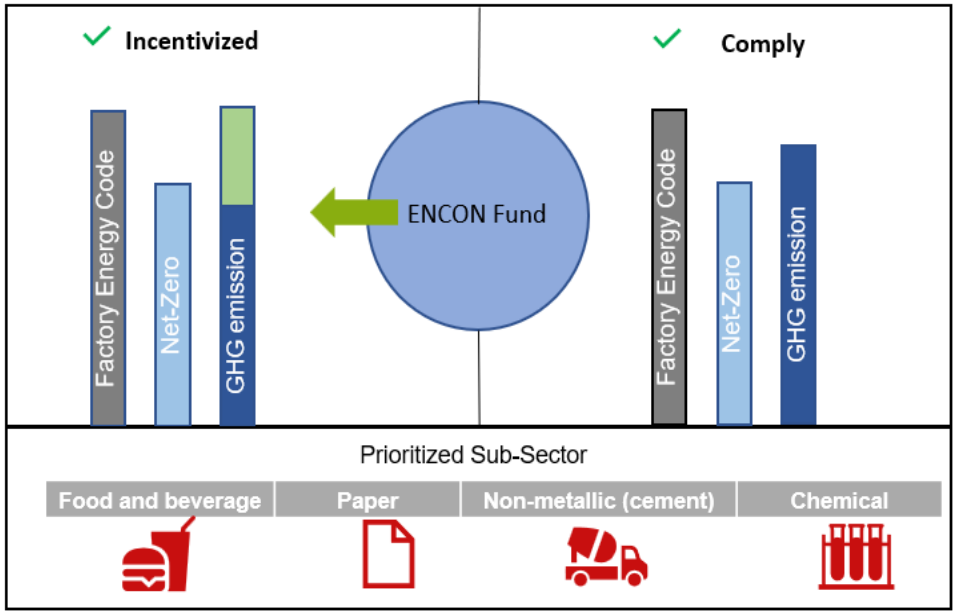


Proposed scheme for carbon pricing in industrial sector

- Thailand has conducted a wide ranges of financial instruments to promote voluntary energy efficiency in industrial sector.
- To achieve carbon neutrality targets, the compulsory measures must be enforced in the future.
- During the transition, **Cap-and-Reward Approach can be introduced.**
  - Cap-and-reward scheme is similar to the cap-and-trade approach. The key difference is there is no penalty imposed for factories and provide incentive when factories can reduce energy consumption lower than their baseline
  - Opportunity to prepare the industry to be ready and develop digital MRV reporting of energy consumption and GHG emission for future mandatory schemes



Estimated budget for supporting industrial decarbonization



Proposed cap and reward approach

Proposed model of public finance for supporting the CN2050 scenario in industrial sector

Financial instruments	Co-financing Ratio	Now - 2030		2030 - 2037		2037 - 2050	
		Size of support	Investment	Size of support	Investment	Size of support	Investment
Grants	1 : 3	10,000	30,000	15,000	45,000	5,000	15,000
Tax	1 : 10	10,000	100,000	15,000	150,000	5,000	50,000
Soft loan	1 : 25	24,000	600,000	50,000	1,250,000	10,000	250,000
Carbon	1 : 350	2,364	827,533	5,812	2,034,169	15,219	5,326,794
Total		46,364	**1,557,533**	**85,812**	**3,479,169**	**35,219**	**5,641,794**
Total investment needed (MB)		1,534,655		3,404,695		5,059,136	
Average co-financing ratio		1 : 33		1 : 40		1 : 144	
Cumulative GHG emission reduction (MtCO2)		236		291		761	
Support per GHG emission reduction (THB/tCO2)		196		295		46	

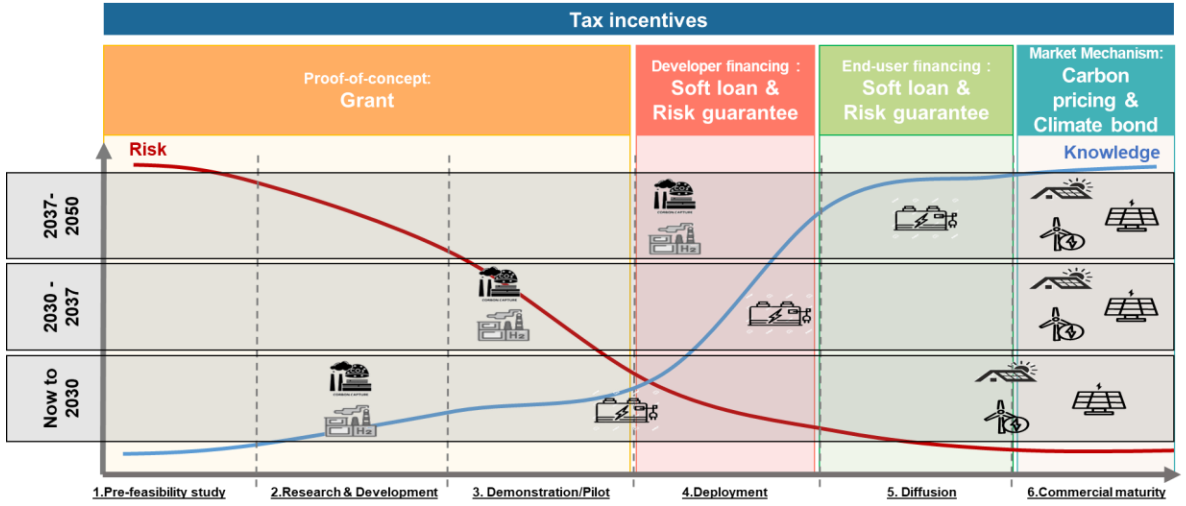
Estimation of financial support from government to encourage private financing in industrial sector

	Now to 2030 Reduce 30% from 2019 level	2030 – 2037 Reduce 50% from 2019 level	2037 – 2050 Reduce >78% from 2019 level
Industrial	• Continue using biomass • Low hanging fruit; replacing oil with electric heat pump in low temperature heat application	• Ramp up **electric heating** • **Biomass** allocation across sub-industry sector	• Gradual **coal phase out** • Increase use of **hydrogen**
Cumulative GHG Reduction	**236 $MtCO_2$**	**291 $MtCO_2$**	**761 $MtCO_2$**
Total Investment	**1,534,655 Million THB**	**3,404,695 Million THB**	**5,059,136 Million THB**
Estimated support from gov.*	**46,364 Million THB**	**85,812 Million THB**	**35,219 Million THB**
Support / tCO2 reduced	**196 THB/tCO_2**	**295 THB/tCO_2**	**46 THB/tCO_2**

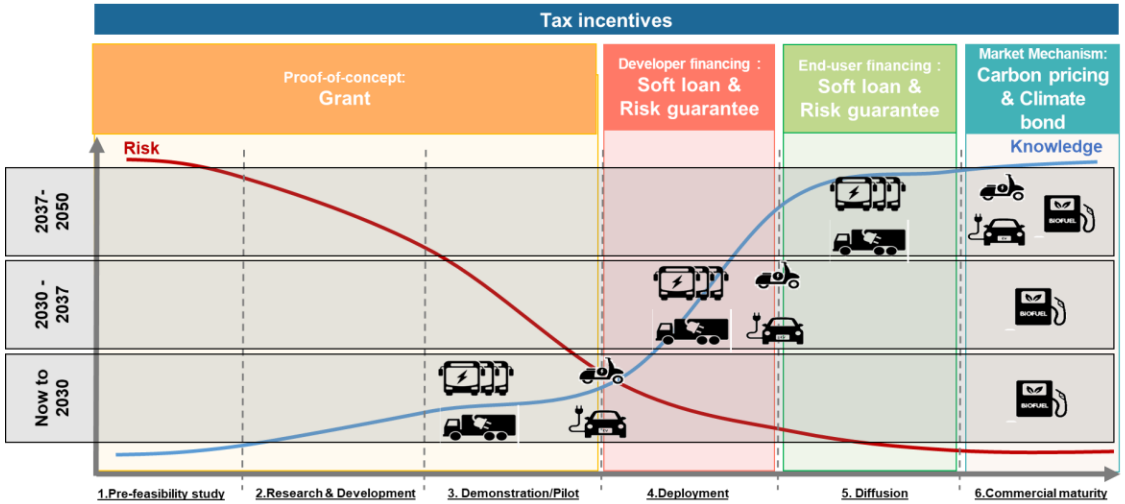
Key takeaways

- The analysis of LCOE, TCO, and levelized cost of heat can identify the level of technology development as shown in the figures.
- The financial instruments will be applied differently at different level of technology.
- Selected public financial instrument for each level of technologies can be concluded as follows:
  - **Tax incentives** for all phases,
  - **Grants** for pre-feasibility, R&D, demonstration & pilot phases,
  - **Soft loan & risk guarantee** for the deployment and the diffusion phases,
  - **Carbon pricing & climate bond** for commercial maturity phase

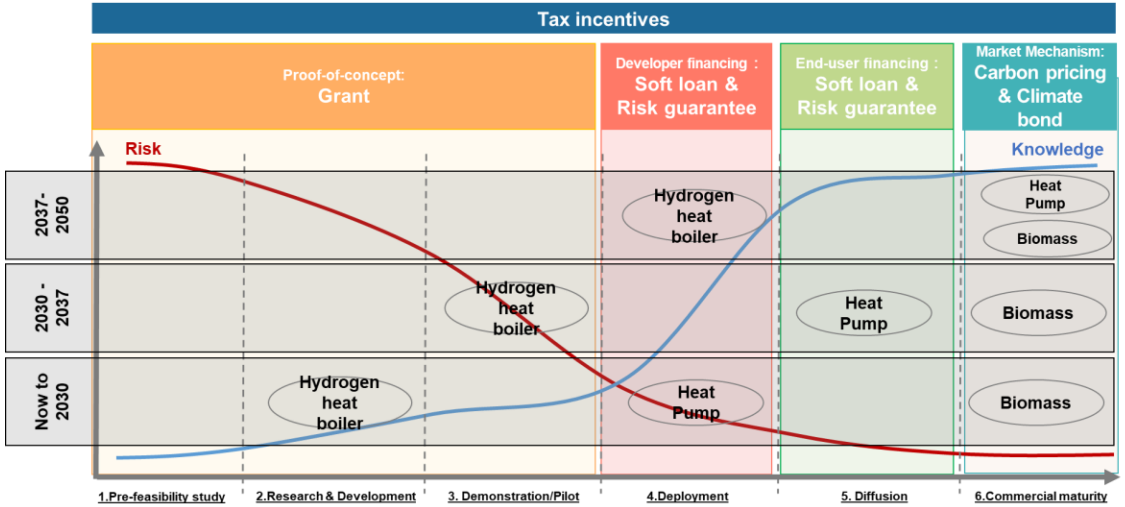
- **Power sector**



- **Transport sector**



- **Industrial sector**



Key takeaways

CASE for Southeast Asia

- The consultant has proposed the model of public finance for supporting Carbon Neutrality Pathway combining six public financial instruments for three sectors. Total support needed, total investments generated, total GHG emission reductions are shown in the tables

Financial instruments	Co-financing Ratio	Now - 2030		2030 - 2037		2037 - 2050	
		Size of support	Investment	Size of support	Investment	Size of support	Investment
Grants	1 : 3	30,000	90,000	65,000	195,000	15,000	45,000
Tax	1 : 10	70,000	700,000	67,000	670,000	21,000	210,000
Soft loan	1 : 25	107,000	2,675,000	164,000	4,100,000	42,000	1,050,000
Climate Bond	1 : 250	20	5,000	20	5,000	200	50,000
Carbon	1 : 350	5,274	1,845,840	9,238	3,233,328	39,693	13,892,621
Total		**212,294**	**5,315,840**	**305,258**	**8,203,328**	**117,893**	**15,247,621**
Total investment needed (MB)		5,355,971		1,310,439		4,501,936	
Average co-financing ratio		1 : 25		1 : 4		1 : 38	
Cumulative GHG emission reduction (MtCO2)		503		745		2181	
Support per GHG emission reduction (THB/tCO2)		422		410		54	

Final Report

Climate Finance for Carbon Neutrality in Thailand

Prepared by

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