UNFCCC Structure & Negotiations 9 & 10: Technology Transfer

11, January, 2011

JICA Expert Team
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Today's Agenda

1. What is "Technology" and "Technology Transfer"?
2. Major fields of "Technology Transfer" in Climate Change
3. History of "Technology Transfer" in UNFCCC
4. TT:CLEAR (Technology Transfer Clearing House)
5. Expert Group on Technology Transfer (EGTT)
6. "Technology Development and Transfer" in COP16
7. Newly created " Technology Executive Committee"
8. Newly created " Climate Technology Centre"
9. Major issues to be discussed in "Technology Transfer"
10. Examples of "Technology Transfer" by JICA : Semi-aerobic landfill
11. Exercises

What is "Technology" and "Technology Transfer"? -1-

"Technology"

is the usage and knowledge of tools, techniques, crafts, systems or methods of organization in order to solve a problem or create an artistic perspective.

"Technology Transfer"

is the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.

Source: Wikipedia

What is "Technology" and "Technology Transfer"? -2-

IPCC Special Report: Methodological and Technological Issues in Technology Transfer (2000)

"Technology Transfer"

is defined as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations (NGOs) and research/education institutions.

What is "Technology" and "Technology Transfer"? -3-

UNFCCC: Article 4: Commitments

1. All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

   .....

(c). Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;

What is "Technology" and "Technology Transfer"? -4-

UNFCCC: Article 4: Commitments

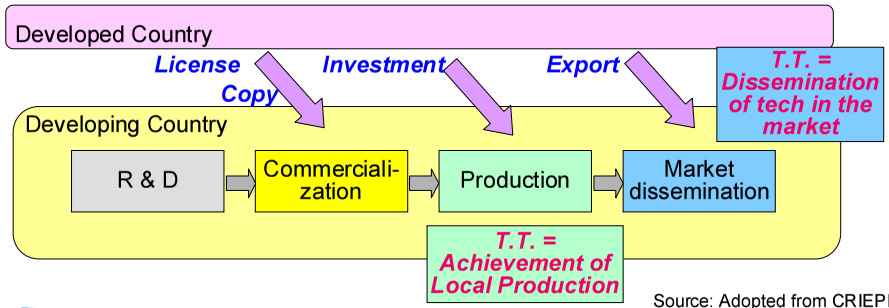
5. The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

What is "Technology" and "Technology Transfer"? -5-

"Technology Transfer": Issue

What are the technologies to be transferred?

- Difficult point to proceed the negotiation.



Source: Adopted from CRIEPI

Major fields of "Technology Transfer" in Climate Change -1- Mitigation

Technology sector	Developing world mitigation potential (2030/y)	Responsive technology examples	Methods of encouragement	International T.T. and investment: special issues
Renewable electricity sources	0.63GtCO2eq	Wind Photovoltaic	Private market Subsidy Regulation	Transfer of product or of industry?
Carbon-based energy production	0.39GtCO2eq	CCS	Regulation Research support	Public R&D
Biofuels	0.46GtCO2eq	Ethanol	Private market Regulation Subsidy	Market competition
Industrial efficiency	0.16GtCO2eq (Steel alone)	Steel and cement production	Regulation	Market competition
Consumer conservation	1.50GtCO2eq	More efficient appliances	Regulation Subsidy	Willingness to subsidize consumer?
Nuclear	0.72GtCO2eq	Nuclear facilities	Subsidy Research support	International security, Commercial competition

Source: Mitigating Climate Change Through Technology Transfer (Barton J. H., Chatam House)

Major fields of "Technology Transfer" in Climate Change -2- Adaptation

Technologies for adaptation in coastal zones

Protect	Retreat	Accommodate
•Hard structures – dykes, sea-walls, tidal barriers, detached breakwaters •Soft structures – dune or wetland restoration or creation, beach nourishment •Indigenous options walls of wood, stone or coconut leaf, afforestation	•Establishing set-back zones •Relocating threatened buildings •Phasing out development in exposed areas •Creating upland buffers •Rolling easements	•Early warning and evacuation systems •Hazard insurance •New agricultural practices, such as using salt-resistant crops •New building codes •Improved drainage •Desalination systems

Source: IPCC, UNFCCC, etc

History of "Technology Transfer" in UNFCCC

1995 **Various Issues**
- **Projects inventory, Financing, Networks of centres**

1998 **Consultative Process**
- **Regional workshops**

2001 **Implementation of the Technology Framework**
- **Tech Needs assessment, Tech information, Enabling environments, Capacity building, Mechanisms (EGTT: Expert Group on Technology Transfer)**

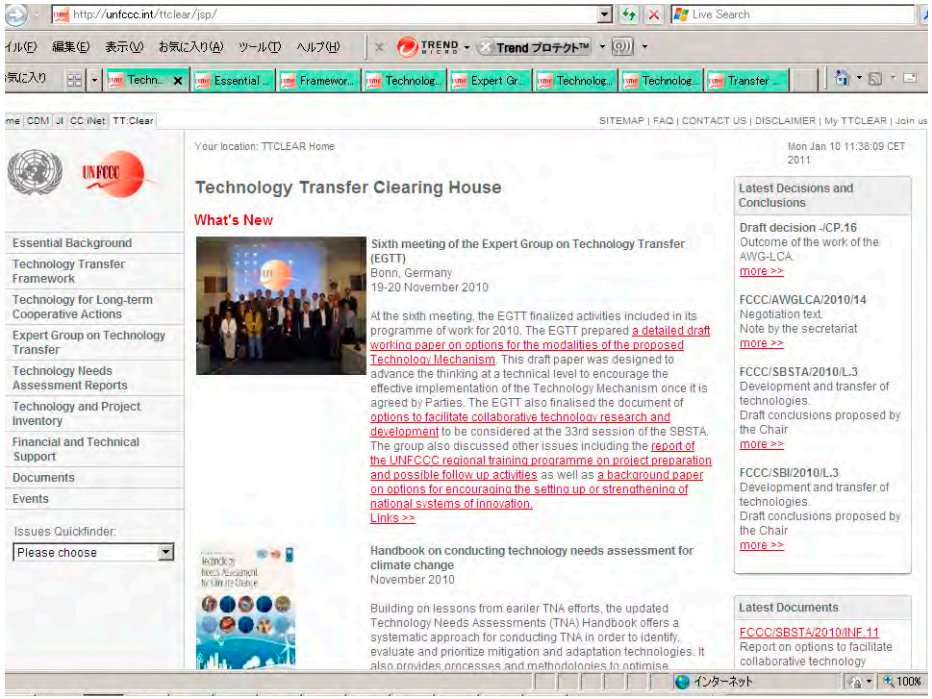
2006 **Enhancing the Implementation of the Technology Framework**

Source: The First Ten Years, UNFCCC (2004)

TT:CLEAR (Technology Transfer Clearing House)

- **To improve access to information on environmentally sound technologies, including:**
  - **Technology transfer projects and programmes,**
  - **Case studies of successful technology transfer,**
  - **Environmentally sound technologies and know-how,**
  - **Organizations and experts,**
  - **Methods, models, and tools to assess mitigation and adaptation options and strategies,**
  - **Relevant internet sites for technology transfer,**
  - **Ongoing work of the Parties and the Expert Group on Technology Transfer, such as issues under negotiation, documents and meetings, and implementation of the technology framework.**

Source: http://unfccc.int/ttclear/jsp/



Expert Group on Technology Transfer (EGTT) -1-

- Established at COP7 (2001)
- Objectives are to enhance the implementation of technology transfer framework and to advance the technology transfer activities under the Convention.
- Total members are 19, including 3 each from Africa, Asia & Pacific, Latin America & Caribbean, 1 from SIDs, 1 from other non Annex 1 Parties, and 8 from Annex 1 Parties. In addition, 4 resource persons are invited from international organizations.
- Main output

Expert Group on Technology Transfer (EGTT) -2-

- Function

(a) Analyze and identify ways to facilitate and advance the development and transfer of technology activities,

(b) Help implement results of technology needs assessments,

(c) a set of performance indicators to monitor and evaluate the effectiveness of the TT framework,

(d) Assess strategies and innovative funding opportunities or incentives for relevant stakeholders, etc.

"Technology Development and Transfer" in COP16

Main decisions

✓ Establishment of a Technology Mechanism:
- **Technology Executive Committee**
- **Climate Technology Centre**

✓ Priority areas in developing countries:
- To develop/enhance endogenous capacities and technologies;
- To deploy and diffuse **environmentally sound technologies and know-how**;
- To Increase **public and private investment** in technology development, deployment, diffusion and transfer;
- Deploy **soft and hard technologies** for the implementation of adaptation and mitigation actions;
- Strengthen national systems of **innovation** and technology innovation centres;
- Develop/implement **national technology plans** for mitigation and adaptation;

etc.

Newly created " Technology Executive Committee" -1-

- 20 expert members (AN1:9, NA1:9 (Af, AP, LA), SIDs:1, LDCs:1)
- Decisions: consensus base
- Functions:

(a) **Provide** an overview of **technological needs** and analysis of policy & technical issues related to the development and TT for M&A;

(b) **Consider** and recommend **actions to promote TD&T** in order to accelerate action on M&A;

(c) **Recommend** guidance on **policies and programme priorities** related to TD&T with special consideration given to the **LDCs**;

(d) **Promote** and facilitate **collaboration** on TD&T for M&A between governments, the private sector, NPOs and academic and research communities;

Newly created
" Technology Executive Committee" -2-

- Functions (continue):

(e) Recommend actions to address the barriers to TD&T in order to enable enhanced action on M&A;

(f) Seek cooperation with relevant international technology initiatives, stakeholders and organizations, promote coherence and cooperation across technology activities, including activities under and outside of the Convention;

(g) Catalyse the development and use of technology road maps or action plans at international, regional and national levels through cooperation between relevant stakeholders, particularly governments and relevant organizations or bodies, including the development of best practice guidelines as facilitative tools for action on mitigation and adaptation;

Newly created
" Climate Technology Centre"

- **Objective:**

The Centre facilitates a Network of national, regional, sectoral and international technology networks, organizations and initiatives with a view to engaging the participants of the Network effectively.

- **Functions:**

(a) At the request of a developing country Party:

(i) Provide advice and support related to the identification of technology needs and the implementation of environmentally sound technologies, practices and processes;

(ii) Facilitate the provision of information, training and support for programmes to build or strengthen developing country capacity to identify technology options, make technology choices and operate, maintain and adapt technology;

(iii) Facilitate prompt action on the deployment of existing technology in developing country Parties based on identified needs;

Newly created
" Climate Technology Centre"

- **Functions (continue):**

(b) Stimulate and encourage, through collaboration with the private sector, public institutions, academia & research institutions, the development and transfer of existing and emerging environmentally sound technologies, as well as opportunities for N&S, S&S and triangular technology cooperation;

(c) Facilitate a Network of national, regional, sectoral and international technology centres, networks, organization and initiatives, etc.

Main issues to be discussed in "Technology Development and Transfer"

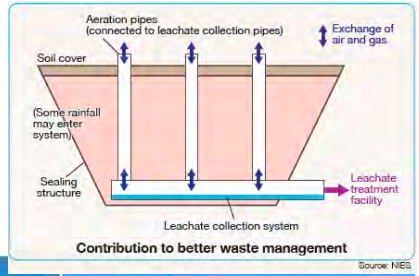
Main discussions:

- ✓ What kind of technology development and transfer is required in Thailand?
- ✓ Which sectors should be prioritized for technology development and transfer?
  - ✓ Mitigation,
  - ✓ Adaptation,
  - ✓ Others - cross cutting,
- ✓ What is the desirable training course for technology transfer?

Examples of "Technology Transfer" by JICA : Semi-aerobic landfill -1-

Semi-aerobic landfill

The semi-aerobic "Fukuoka Method" developed in Japan is an economically viable and effective way to manage landfill sites. This method has multiple benefits, including the reduction of local environment impacts (odors, toxic leachate, etc.), stabilization of landfill sites, and reduction of CH4 emissions.



An example of this "co-benefits" approach is currently under way as CDM projects in Malaysia and Thailand, in cooperation with the Ministry of the Environment, Japan.

Examples of "Technology Transfer" by JICA : Semi-aerobic landfill -2-

Training for Technology Transfer of Semi-aerobic Landfill:

- ✓ Target trainee: Technicians of landfill management
- ✓ Training period: 5.5 days

Days	Training hrs	Type	Program
1	3.0	practice	Assessment of major issues about landfill management in home country
	4.0	lecture	Introduction of case examples of present landfill management in developing countries
2	3.0	lecture	A Road to Sanitary Landfill - Semi-aerobic Landfill -
	4.0	practice	Classification of the landfills in home country
3	7.0	lecture	Introduction of improved case example of, and design/construction of semi-aerobic landfill in developing countries
4	7.0	site visit	Japanese successful examples
5	3.0	lecture	Significant points of concern for applying semi-aerobic landfill
	4.0	practice	Re-assessment of major issues about landfill management in home country
5.5	3.0	practice	Consideration of countermeasures to major issues about landfill management in home country

Commercial building and household Sector

Exercise:

What kinds of technology....

- **Who are implementers? owners/government/tourist?**
- **How to implement the mitigation measures?**

  Possible tools: regulation/economic incentives/carbon credits (T-VER)/carbon foot print/subsidies/etc.
- **What is the role of TGO?**

Attachment

Handbook for Conducting Technology Needs Assessment for Climate Change

(UNDP, November 2010)

Priority sectors for climate change mitigation and adaptation

- First, development priorities are identified for the country concerned.
- These priorities can be used as criteria for selecting strategic (sub) sectors for mitigation and adaptation.

Step 1 Initially identifying (sub)sectors

1. For mitigation: (sub)sectors with high GHG relevance based on IPCC sector categorization
2. For adaptation: (sub)sectors that provide the most effective actions for adaptation based on existing vulnerability assessments or National Adaptation Program of Action

Step 2 Describing (sub)sectors in terms of sustainable mitigation and adaptation priorities

1. For mitigation:
   - Review national GHG inventory to identify data gaps, collect information on new technologies, identify key GHG emitting (sub)sectors, and analyze their interrelationships
   - Assess sectoral and development plans to understand future trends
   - List (sub)sectors by their share of GHG emissions until a cumulative share of 75% of the country's overall GHG emission is reached
2. For adaptation:
   - Assess and discuss available information on climate change impacts on the country with stakeholder groups
   - Characterize the (sub)sectors, including existing technologies used and impacts on the country's sustainable development

Step 3 Finalizing a short list of prioritized (sub)sectors according to their maximum mitigation and adaptation benefits

1. Utilize simple performance matrix procedure for prioritizing (sub)sectors
2. Justify the scores given
3. Prioritize (sub)sectors in terms of mitigation and adaptation benefits

Example of performance matrix for prioritizing (sub) sectors

Subsector	Economic priorities	Social priorities	Environmental priorities	GHG reduction potential	Total benefit
Energy supply	5	5	5	5	20
Transport	4	4	3	2	13
Biological treatment of solid waste	4	2	3	4	13
Enteric fermentation	1	1	1	3	6
Other process use of carbonates	2	1	0	1	4

0 — no benefit
1 — faintly desirable
2 — fairly desirable
3 — moderately desirable
4 — very desirable
5 — extremely desirable.

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Training for Technology Transfer of Semi-aerobic Landfill:

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GHG mitigation measures 1: International trend in GHG mitigation measures

28th September 2010

Chief Advisor of JICA Expert Team
Masahiko FUJIMOTO

Training Program of GHG Mitigation Measures (1)

- Topic 1. International **trend in GHG mitigation measures**
- Topic 2. **Monitoring of contribution to the sustainable development** by mitigation measures, including **co-benefit approach**
- Topic 3. Importance of **low carbon society/low carbon city**
- Topic 4. Mitigation measures in **commercial building and residential sectors**
- Topic 5. Exercise: Quantification of GHG emission reduction with MRV (**commercial building and residential sectors**)
- Topic 6. Mitigation measures in **waste management sector**
- Topic 7. Exercise: Quantification of GHG emission reduction with MRV (**waste management sector**)

Training Program of GHG Mitigation Measures (2)

- Topic 8. Mitigation measures in **energy and industry sectors**
- Topic 9. Exercise: Quantification of GHG emission reduction with MRV (**energy and industry sectors**)
- Topic 10. Mitigation measures in **transportation sector**
- Topic 11. Exercise: Quantification of GHG emission reduction with MRV (transportation sector)
- Topic 12. Mitigation measures in **agriculture, land use change, and forestry sectors**
- Topic 13. Exercise: Quantification of GHG emission reduction with MRV (**agriculture, land use change, and forestry sectors**)
- Topic 14. Other issues (e.g., **aviation, maritime transport**, etc)

Contents

- Why should GHG mitigation measures be implemented?
- Current trend of GHG mitigation in Japan
- Group Practice

Why should GHG mitigation measures be implemented?

- Copenhagen Accord (2009, COP15)
  - Long term Goal
    - Increase in global temperature should be below 2 degrees Celsius
  - Mitigation Target/Actions by 2020
    - Report mitigation targets (developed countries) or mitigation actions (developing countries)
    - International MRV for supported mitigation action
    - Report GHG emission through national communication every 2 years with international consultation
  - The Accord is associated by more than 120 parties, and is regarded as an important step and good basis for further negotiation.

Targets/NAMAs for 2020

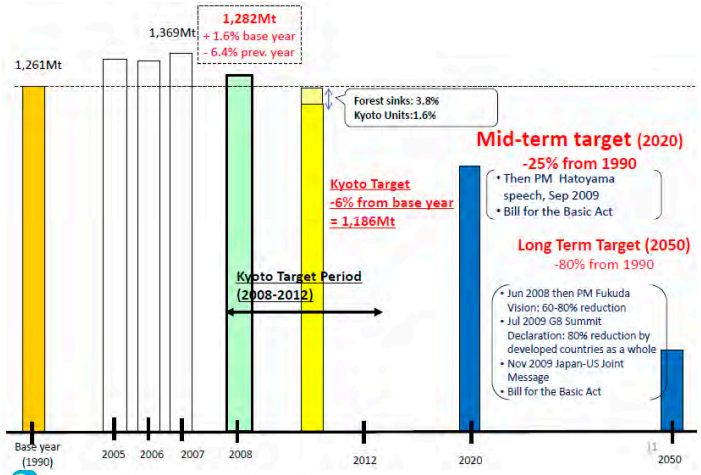
Nation	Base year	Emission Reduction in 2020	From 1990	From 2005
Australia	2000	-5 % ~ -25%	13%~-11%	-10%~-29%
Canada	2005	-17%	3%	-17%
EU	1990	-20%~-30%	-20%~-30%	-13%~-24%
Japan	1990	-25%	-25%	-30%
New Zealand	1990	-10%~-20%	-10%~-20%	-28%~-36%
Russia	1990	-15%~-25%	-15%~-25%	-18%~-33%
USA	2005	-17%	-4%	-17%
Brazil	-	-36.1%~-38.9%(from BAU)	-	-23%
Korea	-	-30%(from BAU)	-	-4%
China	2005	-40%~-45%(in GDP unit)	-	8% growth 1.9 times emission
India	2005	-20%~-25%(in GDP unit)	-	7% growth (until 2015) 6% growth (from 2015) 2.1 times emission

Question:

- Why Thailand has to implement GHG mitigation measures?
  - International contribution to climate change mitigation
  - Others?
  - Others?

Current trend of GHG mitigation in Japan

Japanese GHG reduction target in mid-term and long-term



Source: "Japan's Climate Change Policies and MRV Initiatives" (Ministry of environment, Japan)

Japanese Current Continuous Actions for GHG mitigation

- Revised Kyoto Target Achievement Plan in 2008
- Enhancement of energy efficiency legislations for vehicles, electric appliances and factories ("Top Runner System")
- Fossil fuel tax relief of E3 (Gasoline mixed with 3% Bio Ethanol)
- Transportation Management: Promotion of modal shifts and efficient transportation
- Forest Management: Urban planting, regeneration of forests which have been neglected

Bill of Basic Law on Climate Change

- The bill of Basic Law on Climate Change was decided by the Cabinet
  - submitted to the National Diet on March 2010.
- But it did not become law due to the election.
  - The Cabinet might submit the bill to the next Diet session.
- Law sets Mid and Long-term Goals
  - 25% CO2 reduction below 1990 level by 2020
  - 80% CO2 reduction below 1990 level by 2050
- Key Policy Measure
  - Introduction of Emissions Trading Scheme (ETS)
  - Global Warming Tax
  - Feed-in Tariff system for renewable energy

Challenge 25: Roadmap in middle-long term

- "Challenge 25" : middle-long term roadmap on GHG mitigation measures of Japan, MOE in Japan (March on 2010)
- GHG mitigation measures by 2020 (25% CO2 reduction target) in 5 sectors:
  - Manufacturing, Home, Industrial, Transport, Energy Supply
- Estimated economic effectiveness
  - Needed investment (approximately 60 - 100 trillion yen) for 2011-2020
  - Half of investment can be pay-backed by 2020, all of investment can be pay-backed by 2030 due to energy cost reduction
  - Approximately 0.4% of GDP and Employment will be increased
  - Demand (45 trillion yen) and Employment (1.25 million) will be increased in 2020

Major target of Challenge 25

- Daily Life (in home/ industrial/ transportation sector)
  - 100% achievement rate of a higher energy efficiency standard for all newly built homes and buildings by 2020
  - 2.5 million sales of next-generation vehicles (e.g. hybrid, plug-in, EV, etc.) by 2020
- Community Development
  - 10% reduction of per passenger automobile use by 2020
- Manufacturing
  - Energy consumption reduction by 30-40% by 2050
- Energy Supply
  - 10 % of primary energy supply to be renewable energy sources by 2020
- Core Social Systems for Creating a Low-Carbon Society
  - A cap and trade domestic emission trading scheme, Global Warming Tax

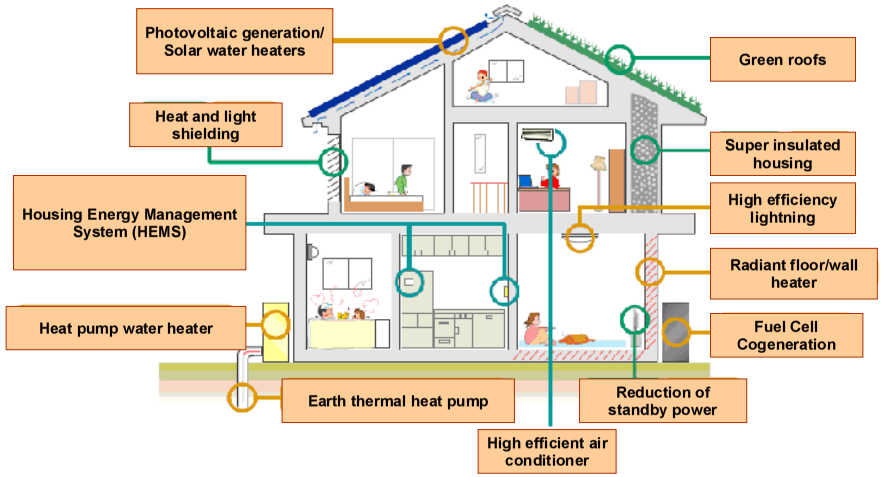
GHG mitigation measures in Home/Industrial Sector in Challenge 25

- Promotion of zero emission housing/building

GHG mitigation measures	Target in 2020
−Improvement of Environmental performance in housing/building	−100% Achievement Rate of a higher Energy Efficiency Standard for all newly built homes and buildings
−High efficient water heater	−Max 41 million units
−High efficient air conditioner in housing	−Max energy efficiency rate: up to COP6
−High efficient air conditioner in building	−Max energy efficiency rate: up to COP5
−High efficient lightings in housing/building	−Max energy efficiency rate: up to 80%
−Building Energy Management System	−Max penetration rate up to 80%
−Efficiency improvement of other electric appliances in housing	−Energy efficiency rate:35% will be increased
−Efficiency improvement of other electric appliances in building	−Energy efficiency rate:45% will be increased
−Solar power generation in housing	−Max 24.4 million kW(10 million housings)

COP:Coefficient performance, It is defined as the ratio of heat removal/delivered to energy input to the compressor in refrigerant based systems.

Measures in housing

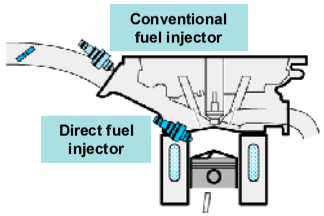


GHG mitigation measures in Transportation Sector in Challenge 25

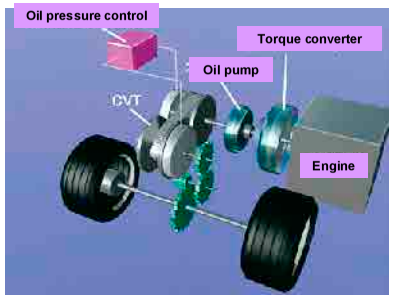
- Promotion of environment-responsive vehicles

GHG mitigation measures	Target in 2020
−Improvement of energy efficiency of existing passenger vehicle	−Max energy efficiency rate: up to 13%(compared with 2005)
−Hybrid vehicles promotion	−Annual sales: 1.2 million vehicles
−Plug-in hybrid vehicles promotion	−Annual sales: 400,000 vehicles
−Electric vehicles promotion	−Annual sales: 700,000 vehicles
−Promotion of eco drive to automobile drivers	−Energy efficiency rate:10% will be improved.

Improvement of energy efficiency of vehicle



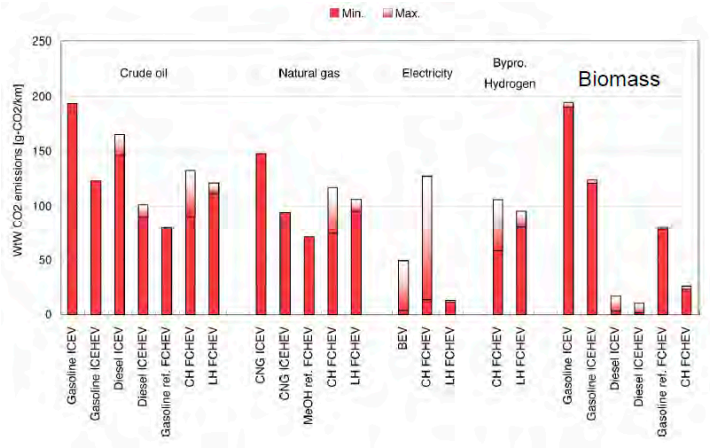
Direct injection Engine



Continuous Variable Transmitter (CVT)

JAMA (Japan Automobile manufactures Association)

Well to Wheel CO2 Emission by technology



ICEV: Internal Combustion Engine Vehicle

ICEHEV: Internal Combustion Engine Hybrid Electric Vehicle

FCHEV: Fuel Cell Hybrid Electric Vehicle

BEV: Battery Electric Vehicle

CH: Compressed Hydrogen

LH: Liquid Hydrogen

Japan Hydrogen & Fuel Cell Demonstration Project(2007)

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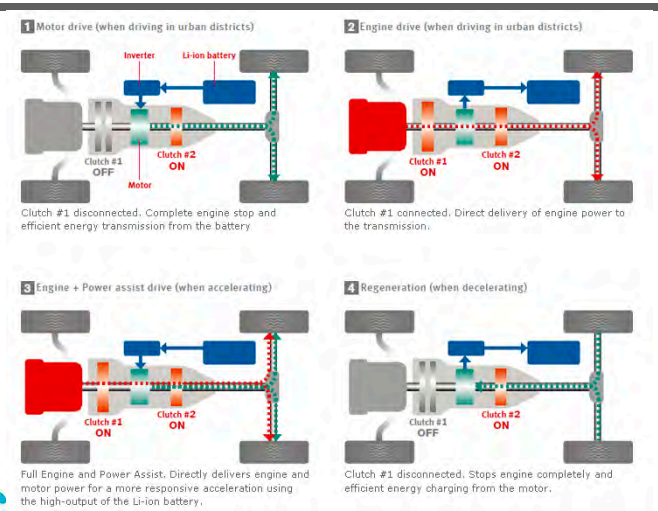
Overview of Hybrid system



Source: NISSAN

GHG mitigation measures in Transportation Sector in Challenge 25

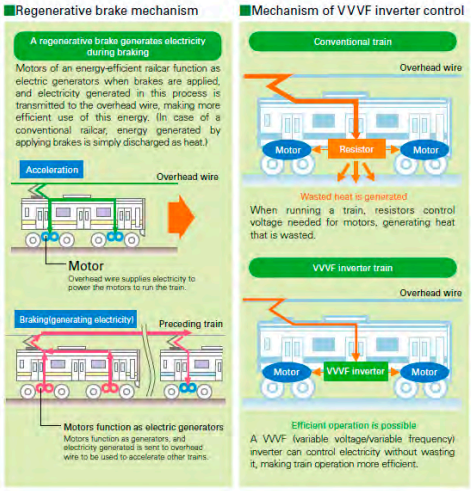
- Change to energy-saving railway rolling stocks, ships and aircraft

GHG mitigation measures	Target in 2020
–**Improvement of energy efficiency of railway rolling stocks** Installation of energy-saving rolling stocks with VVVF (variable voltage and variable frequency) and regenerative brake	–Energy efficiency rate will be improved by maximum 10% compared with 2005
–**Improvement of energy efficiency of ships** Introduction of technology such as friction reduction, improvement of propulsion system and weight saving	–Energy efficiency rate will be improved by maximum 20% compared with 2005
–**Improvement of energy efficiency of aircraft** Installation of low-fuel consumption aircraft and efficient navigation system, application of GPU (ground power unit)	–Energy efficiency rate will be improved by maximum 24% compared with 2005

GHG mitigation measures of Railways

E2 series, VVVF inverter railcars used for Shinkansen "Asama" and "Hayate" trains.

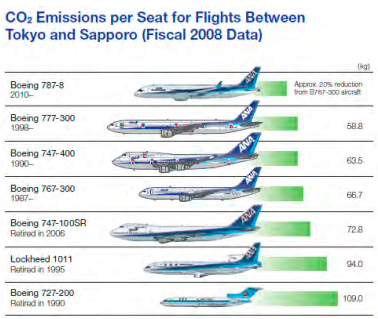
E231 series, VVVF inverter cars for commuter and suburban transportation.

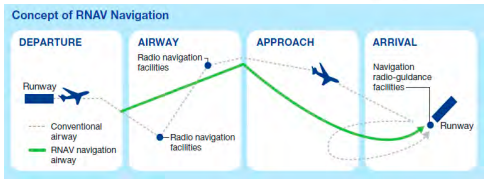


Source: JR East Group Sustainability Report 2009, Japan

GHG mitigation measures of Aircrafts

Source: JAL CSR Report 2009, Japan





Source: ANA CSR Report 2009, Japan

RNAV:aRea NAVigation)

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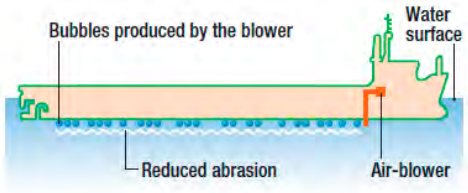
GHG mitigation measures of Ships

M-I-LASH attached just forward of the propeller

Energy conservation device:

Multi blade device that ca be attached to the ship's hull just in front of the propeller to catch the lost energy from the swirl flow generated by propeller rotation. It can save 5% of fuel consumption.



Air lubrication system:

System has an air blower at the front of the ship's hull that blows the air over the ship bottom. The ship bottom is covered with bubbles that lubricate against the seawater and resultantly reduce abrasion resistance. It can reduce CO2 on the order of 10%.

Source: NYK Group CSR Report 2010, Japan

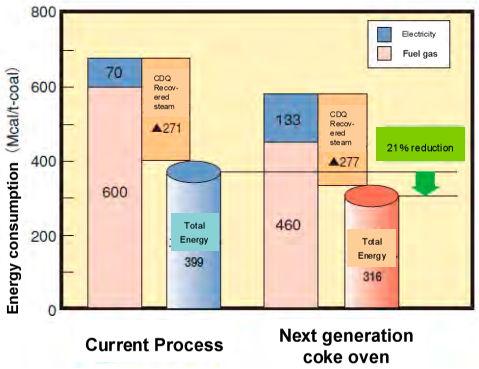
GHG mitigation measures in Manufacturing Sector in Challenge 25

- Promotion of energy saving measures

GHG mitigation measures	Target in 2020
–**Promotion of existing GHG mitigation measures**	
• Iron and steel：Next generation Coke oven	• 1 equipment (current) to 6 equipment
• Cement：Waste heat recovery power generation	• 77 % (current) to 88 %
• Chemistry：High efficiency cogeneration	• 0 % (current) to 100 %
• Pulp and paper：High performance re-pulping technology	• 17 % (current) to 71 %
–**Promotion of Cross-cutting technology to all manufacturing sectors**	• Reduction : 9.50million ton-CO2
• （High efficiency industrial furnaces, High efficiency boiler, Industrial heat pomp ）	
–**CFC's substitute (F gases) reduction measures**	• 24 % (current) to 60 %
• Rate of installing F gases removal equipment in semiconductor manufacturing	• 63 % (current) to 100 %
• Rate of installing F gases removal equipment in liquid crystal manufacturing	

Iron and steel : Next generation Coke oven

Next generation coke oven

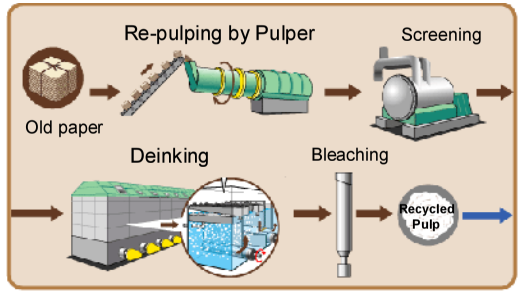


In current process, the temperature of coke oven is 1200 degree Celsius.
In next generation coke oven, coke will be pre-heated up to 350 degree Celsius and installed to 850 degree Celsius.
This results in lower energy consumption. 21% of total energy will be reduced.

Source: Nippon Steel Cooperation

Pulp and paper : high performance re-pulping technology

High performance re-pulping technology



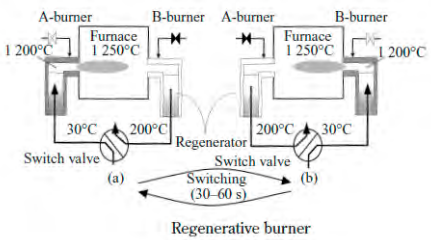
Source: Oji Paper Group

The old paper moves by conveyor to a Pulper, which contains water and chemicals. The high efficient Pulper breaks the paper down more efficiently into tiny strands of cellulose called fibers than the conventional type. It results the energy reduction.

A1-141

High efficiency industrial furnaces

- Regenerative Burner
  - Pre-heated combustion air temperature: increased to 1200-1250℃
  - Fuel consumption: 15-25% reduced
  - NOx concentration: reduced to 30ppm



Source: JFE steel

Fukuyama Steel Works in JFE Steel

F gases removal in semiconductor/liquid crystal manufacturing

F gases removal facility

It enables removal of PFC, SF 6, and NF 3 as HF during semiconductor dry etching processes at low temperature (less than 600 degree Celsius) with a high decomposition rate.

Source: Syowa Denko

F gases recovery and recycle system

Recovered HF + Ca(OH)2 ⇨ CaF2

Fluorite: CaF2

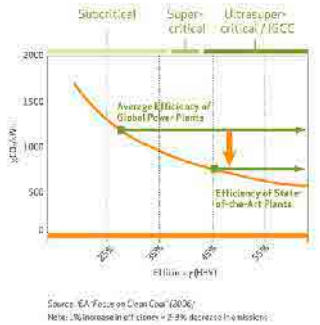
GHG mitigation measures in Energy Supply Sector in Challenge 25

- Installation of high efficiency electricity generation technology to thermal power plant
- Rate of smart meter installation will be increased up to over 80% by 2020
- 10% of primary energy supply to be renewable energy sources by 2020

GHG mitigation measures	Target in 2020
–Solar power generation (excluding housing)	–Max 25,600 MW
–Wind power generation	–Max 11,310 MW
–Hydro power generation(large scale)	–Max 21,560 MW
–Hydro power generation(middle and small scale)	–Max 6,000 MW
–Geothermal power generation	–Max 1,710 MW
–Biomass power generation	–Max 7,610 MW

High efficiency electricity generation technology

CO2 emission from Ultra-supercritical Coal Power Plant



Ultra-supercritical Coal Power Plant

Conventional coal-fired power plants, which make water boil to generate steam that activates a turbine, have efficiency of about 20-35%.

Supercritical (SC) and ultra-supercritical (USC) power plants operate at higher temperatures and higher pressures above the critical point of water, i.e. above the temperature and pressure at which the liquid and gas phases of water coexist in equilibrium.
This results in higher efficiencies – above 45%.

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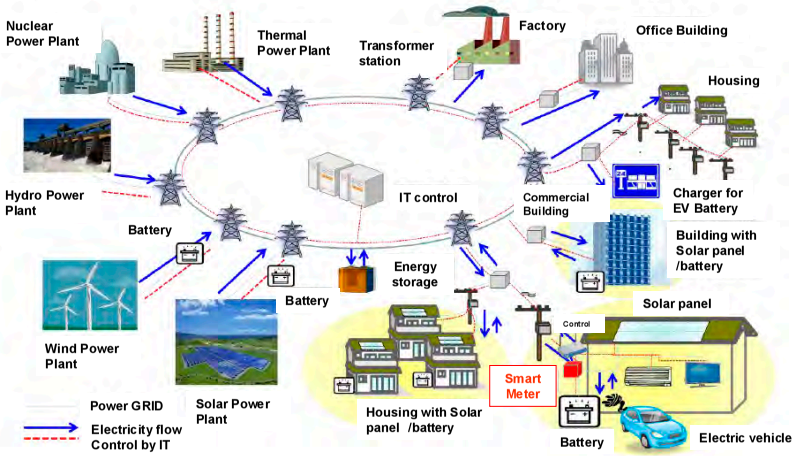
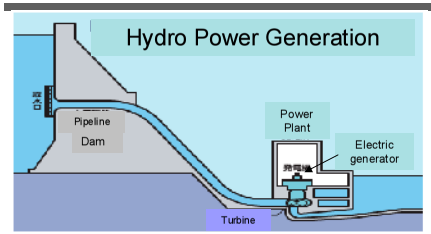
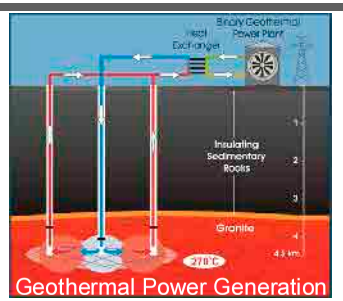
Image of Smart Grid



METI,Japan(2010)

Renewable Energy





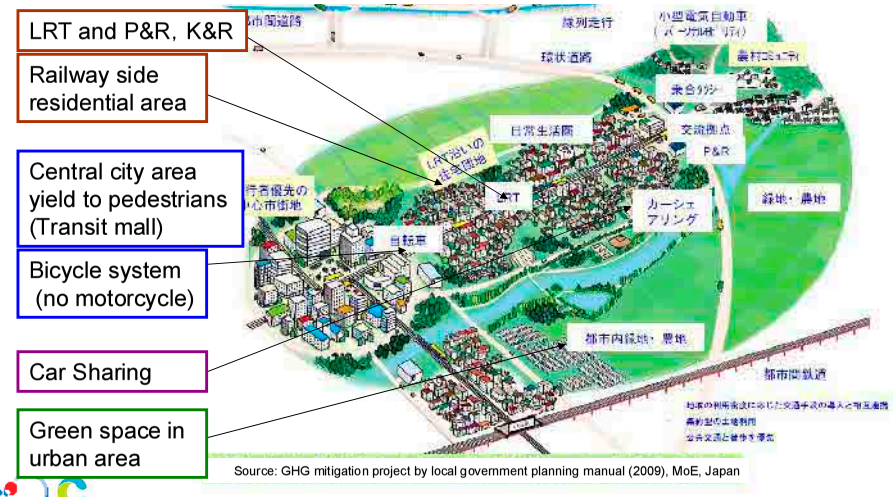
Source: Treehuger

GHG mitigation measures in daily life and community development in Challenge 25

- For urban community

GHG mitigation measures	Targets in 2020
−**Reduction the vehicle travel amount by one passenger** • Increase of population density in DID (densely inhabited district) • Increase of public transportation utilization • Extension of LRT and BRT	−10% Reduction compared with 2005 • 60 to 80 persons/ha in 2030 • Increase up to twice compared with 2005 • Improved distance: 1,500km in 2030
−**Reduction of share of automobile transportation**	−50 to 60% decrease in 2020
−**District heating system(Usage of urban waste heat)**	−Reduction potential : 1 million ton-CO2

Development of land use and transportation system for low-carbon compact city



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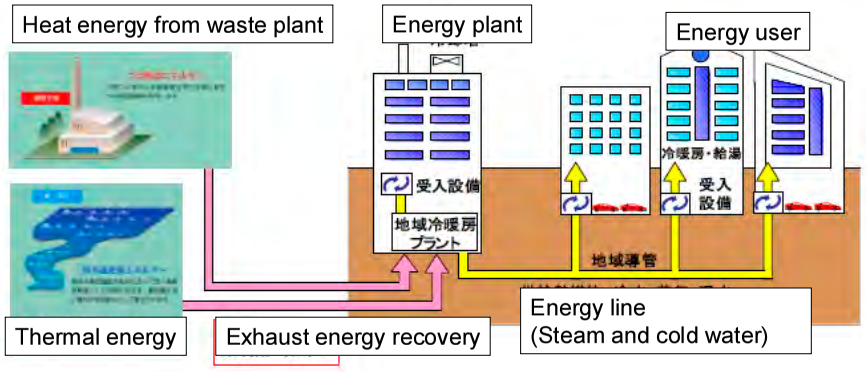
Light Rail Transit in Toyama city (movie)

Toyama city, Toyama Pref.
Old route of Japan Railway switched to new LRT services from Apr.2006.
Length of route:7.7km, 13 stations, every 10 minutes in the morning
People uses new LRT service to commute to the companies and schools etc.
For the people from outer area, feeder bus services are available.

Urban heat system (movie)



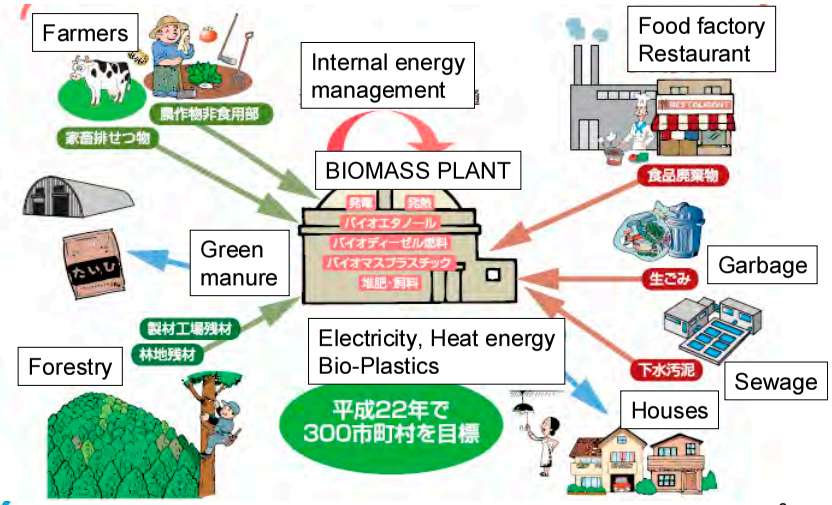
Osaka Cosmo-square (seawater thermal system)
Koraku-en area (sewage thermal system)
Temmabashi area (river water thermal system)
Marunouchi, Sinagawa-station, Shinjuku-station etc.

GHG mitigation measures in daily life and community development in Challenge 25

- For rural community

GHG mitigation measures	Targets in 2020
–Utilization of unused biomass for energy generation **–Installation of renewable energy facilities** **–Utilization of forest and farmland as sink**	–Utilization of unused lumber in forest, unused farm waste and manure –Installation of small scale hydro power plant in irrigation ditch, solar panel in unused land
• Forest management • Farmland management	• Tree thinning : 550 thousand ha/year • Increase of area with green manure from 98 thousand ha to 216 thousand ha
• Wood products	• Increase products made with national wood

Biomass Town Strategy in Japan



Hita Biomass recycle energy plant

Place : Hita city, O-ita Pref. from 2006
Biomass energy from waste and manure : 50 tons/day (max 80tons/day)
Bio-methane fermentation

Small scale civic hydro in Tsuru city (movie)

Place : Kachu-river, Tsuru city, Yamanashi Pref. from 2005
Small hydro energy plant (GENKI-KUN No.1 and GENKI-KUN No.2)
Investment program with citizen of the city
15% reduction of power usage of the city office

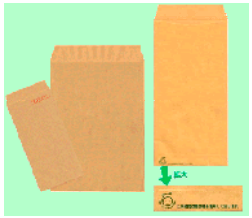
Forest management and tree thinning

- Forest management

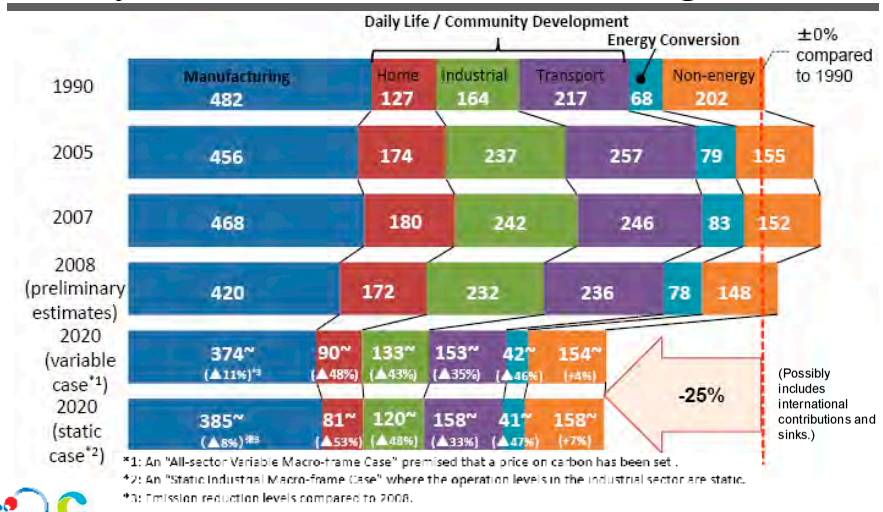
Donation, voluntary activities

Forestry cooperative

Utilization of forest thinning



A Look at Greenhouse Gas Emissions by Sector in 2020 in Challenge 25



Group Practice

- Let's make up the charts of GHG mitigation measures
  - Group Discussion and fill out blank of Figure (40min)
  - Presentation from each group (20 min)

GHG Mitigation 2: Monitoring of contribution to the sustainable development by mitigation measures including co-benefit approach

20, October, 2010

Deputy Chief Advisor of JICA Expert Team
Kazuhito YAMADA

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Today's Agenda

- What is sustainable development (SD)?
- Contribution of CDM to SD
- SD criteria in major host countries: Mexico, Brazil, India, China, and **Thailand**
- What is 'Co-benefit Approach'?
- Examples of Co-benefit Approach
- Examples of estimation of 'Co-benefit'

What is SD ? (1)

- Believing that **sustainable development**, which implies meeting the **needs of the present without compromising the ability of future generations to meet their own needs**, should become a central guiding principle of the United Nations, Governments and private institutions, organizations and enterprises,
- Agrees further that an **equitable sharing of the environmental costs and benefits of economic development** between and within countries and between present and future generations is **a key to achieving sustainable development**;

Source: Report of the World Commission on Environment and Development

What is SD ? (2)

- SD is essential concept not only for developing countries, but also for developed countries;
- However, the concept of SD is too ambiguous to translate it into reality;
- For example, the targeted actions for SD in China will be completely different from those in Tuvalu;
- In other words, we can not express SD by only simple and uniform concept;
- Therefore, we need to translate SD into materialized concepts by each country in order to discuss it.

What is SD ? (3)

- **Top-down approach:**

  CDM-SD approach

- **Bottom-up approach:**

  Co-benefit approach

Contribution of CDM to SD (1)

Decision 3/CMP.1

- Bearing in mind that, in accordance with Article 12, the purpose of the CDM is to assist Non-Annex I Parties in achieving **sustainable development** and in contributing to the ultimate objective of the Convention, and to assist Annex I parties in achieving compliance with their quantified emission limitation and reduction commitments under Article 3 of the Kyoto Protocol,

Decision 17/CP.7

- Affirming that it is the **host Party's prerogative** to confirm whether a CDM project activity assists it in achieving **sustainable development**,

Contribution of CDM to SD (2)

- In the CDM, we don't have any official method to evaluate or monitor the contribution of CDM-PJ to SD because it is the host Party's prerogative;
- Therefore, many host Parties developed their own system to confirm the contribution of CDM-PJ to SD of each country;
- CDM-EB didn't express any comment about this matter.

SD criteria in major host countries: Mexico

- **Contribution of environmental aspects**: conservation of biodiversity, decrease of waste and pollutants, improvement of soil and waster quality
- **Contribution of economic aspects**: improvement of economic condition and competitiveness of Mexico by investment, employment creation, technology transfer, etc.
- **Contribution of social aspects**: improvement of living level of local community by creating stable employment, constructing necessary infrastructure

SD criteria in major host countries: Brazil

- Contribution to SD in **local environment**
- Creating of **employment**, improvement of the condition of employment
- Improvement of **income distribution**
- Contribution to **capacity building** and **technological development**
- Contribution to **local economy** and partnership among sectors

SD criteria in major host countries: India

- **Social welfare**: poverty alleviation by creation of employment, improvement of living level
- **Economic welfare**: promotion of additional investment which meets the needs of local people
- **Environmental welfare**: consideration of sustainability of natural resources, adverse impacts to local people
- **Technical welfare**: promotion of technology transfer to contribute environmental improvement, technical innovation

SD criteria in major host countries: China

- Complement national economic and environmental strategy;
- Transfer of technology and financial resources;
- Sustainable ways of energy production;
- Increasing energy efficiency and conservation;
- Poverty alleviation through income and employment generation;
- Local environmental co-benefits

SD criteria in major host countries: Thailand

Dr. Paweena Panichayapichet will make a presentation about

'SD criteria in Thailand'

Thank you very much!

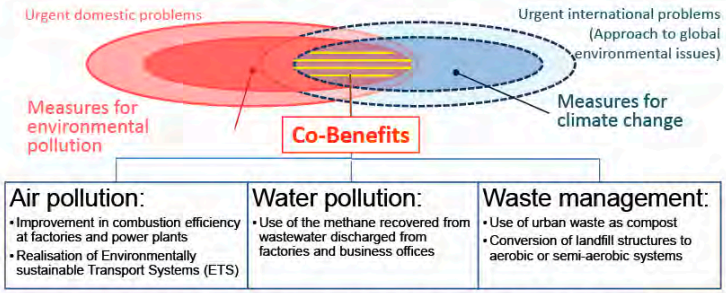
What is 'Co-benefit Approach'?

- A **co-benefits approach** is an approach aimed at achieving highest synergies between climate mitigation actions and sustainable development actions.
- This approach can address developing countries' **urgent developmental needs** while achieving climate change mitigation, by the most efficient use of extremely scarce resources available for them.
- For such purpose, quantitative measurement, reporting, and verification of co-benefits are extremely important.

Source: Taka Hiraishi's presentation in COP15

What is 'Co-benefit Approach'?

An Approach aimed at reducing greenhouse gas emissions and preventing environmental pollution at the same time



- Achieving highest synergies between climate change mitigation actions and sustainable development actions
- Addressing developing countries' urgent developmental needs while achieving climate change mitigation

Source: MOE's presentation in COP15

Examples of Co-benefit Approach

- **Utilization of Solar Energy in Nigeria**

This project contributed to the reduction of poverty in rural areas. The residents' quality of life was improved through electrification by means of effective use of solar energy which is abundantly available in these areas. Such use of renewable energy serves as an effective countermeasure for global warming.

Children gathering under a street light which has freed them from the threat of assaults, snakes and scorpions.

Source: JICA

Examples of Co-benefit Approach

Non-Revenue Water Reduction in Jordan

As the water demand increases in proportion to its population growth, Jordan faces constant water shortages. Water supplied from the water works for which fees cannot be collected is collectively called non-revenue water. Leakage, illegal connection and inaccurate meter installation are the main factors of high non-revenue water. Non-revenue water was over 50% of the total water supply across Jordan in 2002, leading to an increased deficit for the Water Authority of Jordan (WAJ). JICA provides support for capacity development of WAJ on-the-job training in pilot areas and raising public awareness.

The WAJ will be able to supply more water using the same power consumption. This will result in reducing the emissions of GHGs from power generation.

Source: JICA

Examples of Co-benefit Approach

- **Treatment of Sewage Sludge using Composting Technology in Kagoshima, Japan**

Examples of estimation of 'Co-benefit' (1)

Pollution Control Plan in Panzhihua City in China

- Goal for 5 years during 2006-2010
  - 22% energy consumption reduction
  - **SO_2 emission reduction 33,741t/year**

Source: OECC

Examples of estimation of 'Co-benefit' (2)

Methodologies

Sorting out pollutant emission reduction measures in Panzhihua's plan

Identifying methodologies for calculation of pollutant emission reduction measures
- -Goal of pollutant emission reduction for 5years
- -Methodologies for calculation
- -Guidance for pollutant control and reduction (published in 2008)

Source: OECC

Converting to methodologies for GHG emission reduction from methodologies for calculation of pollutant emission reduction

Examples of estimation of 'Co-benefit' (3)

Case Study: **Closure of Power Generation Unit (50MW)**

Pollutant Emission Reduction

- SO_2 Emission Reduction = SO_2 Emission from the facility

$$E(SO_2) = M \times S \times 1.6 \times 10^2$$
$$= 11.14 \times 0.72 \times 1.6 \times 10^2$$
$$= 1{,}283\ (t\text{-}SO_2)$$

- $E(SO_2)$: SO_2 emission from the facility
- M: Coal consumption for power generation 64,000t
- S: Average sulfur content of coal 0.44%

Source: OECC

Examples of estimation of 'Co-benefit' (4)

GHGs Emission Reduction

- CO_2 Emission Reduction =
  CO_2 Emission from the facility

$$E(CO_2) = M \times C \times (44/12 \times 0.8) \times 10^2$$
$$= 11.14 \times 50 \times (44/12 \times 0.8) \times 10^2$$
$$= 163{,}281 \text{ (t-}CO_2\text{)}$$

- $E(CO_2)$: CO_2 emission from the facility
- C: Average nitrogen content of coal 50%
- 44/12: Mass ratio between C and CO_2
- 0.8: Combustion efficiency of coal 80%

Source: OECC

Conclusion

- SD is essential concept not only for developing countries, but also for developed countries;
- However, the concept of SD is too ambiguous to translate it into reality;
- There are two approaches to translate the concept of SD into reality; top-down approach and bottom-up approach;
- In CDM world, host countries have translated SD into several key actions using top-down approach. In ODA world, co-benefit approach tries to relate SD to climate change using bottom-up approach;
- Unfortunately, it may be rare case to monitor the contribution to the SD by mitigation measures in both approaches;
- We have to consider how to monitor the contribution to SD by mitigation measures, if possible, by establishing quantitative assessment methodology.

GHG Mitigation 3: Importance of Low Carbon Society

20th October 2010

Chief Advisor of JICA Expert Team
Masahiko FUJIMOTO

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Contents

- What is a Low-Carbon Society?
- Necessity of implementing Low-Carbon Society
- Procedure to create an Low-Carbon Society scenario
- Introduction of Low-Carbon Society Scenario (Thailand in 2030)
- Introduction of Activities of Low-Carbon Society in Japan
  - Tokyo Metropolitan Government
  - Kyoto City
  - Shiga Prefecture
  - Fukuoka Prefecture
  - Kita-Kyushu City

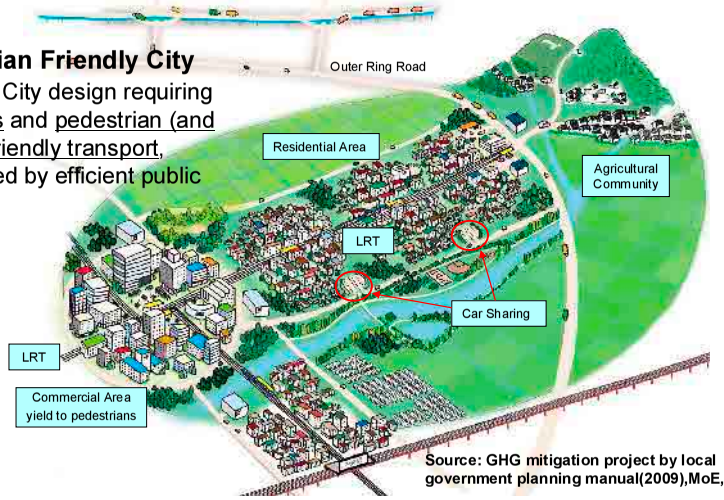
What is a Low-Carbon Society?

- A low-carbon society means the society which:
  - i) Takes actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups within society are met.
  - ii) Makes an equitable contribution towards the global effort to stabilize the atmospheric concentration of CO2 and other GHG such as CH4 at a level that will avoid dangerous climate change, through deep cuts in global emissions.
  - iii) Demonstrates a high level of energy efficiency and use low-carbon energy sources and production technologies.
  - iv) Adopts patterns of consumption and behavior that are consistent with low GHG emissions.

Source: Japan-UK Joint Research Project "Developing Vision Developing Vision for a Low-Carbon Society through Sustainable Development"

One of Images of a Low-Carbon Society

Pedestrian Friendly City Design: City design requiring short trips and pedestrian (and bicycle) friendly transport, augmented by efficient public transport.



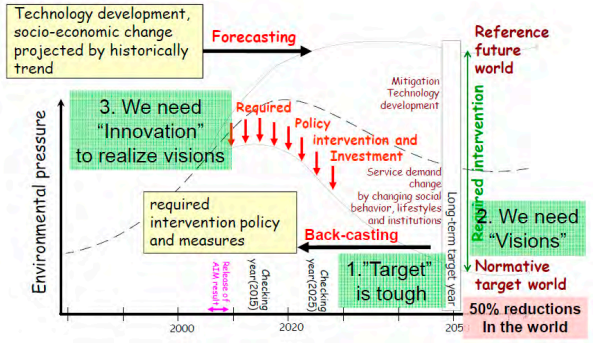
Source: GHG mitigation project by local government planning manual(2009),MoE,Japan

Necessity of implementing Low-Carbon Society

- The overconcentration of GHGs is producing global warming that affects long-term climate, with negative impacts on humanity in the future.
- Therefore, the society needs to adopt a lifestyle that makes more use of energy efficient devices and renewable energy technologies.
- A low-carbon society (LCS) is proposed as a means to avoid catastrophic climate change, and as a pioneer to the more advanced, zero-carbon society and renewable-energy economy.
- Co-benefits of LCS
  - Reduction of energy procurement risk
  - Promotion of low carbon related business
  - Improvement of local air/water quality

Procedure to create Low-Carbon Society scenario

- In order to create a local low-carbon society scenario, the method of "back casting" is used, which sets a desirable goal first, and then seeks a way to achieve it.



Source: Japan and Asian Low-Carbon Society Scenarios and Actions (Dr.Fujino, CTC2010)

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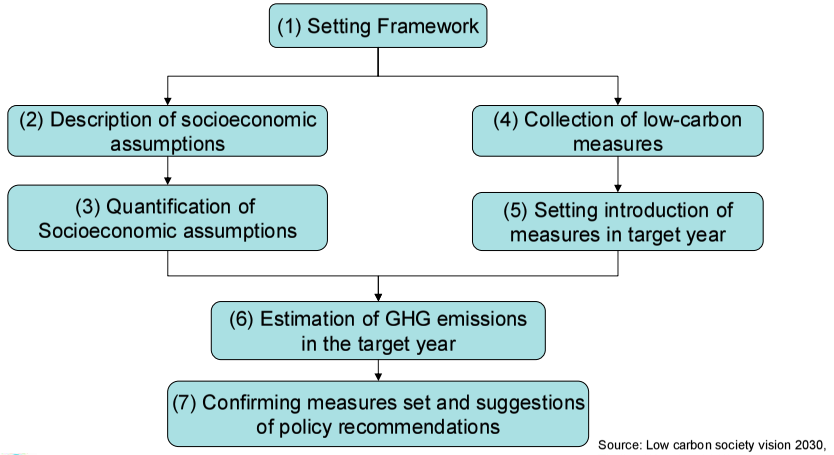
Procedure to create Low-Carbon Society scenario



Source: Low carbon society vision 2030, Thailand(October,2010)

Procedure to create Low-Carbon Society scenario

(1) Setting framework
- The framework of an LCS scenario includes; target area, base year, target year, environmental target, and number of scenarios.

(2) Description of socioeconomic assumptions
- Before conducting quantitative estimation, a qualitative future image should be written. It is an image of lifestyle, economy and industry, land use, and so on.

(3) Quantification of socio-economic assumptions
- Socio-economic indices of the target year such as population, GDP, output by industry, transport demand, and so on are estimated using a macroeconomic model.

(4) Collection of low-carbon measures
- Counter measures are used which are thought to be available in the target year, for example, high energy efficiency devices, transport structure such as public transport, use of renewable energy, energy saving behavior, and carbon sinks

Procedure to create Low-Carbon Society scenario

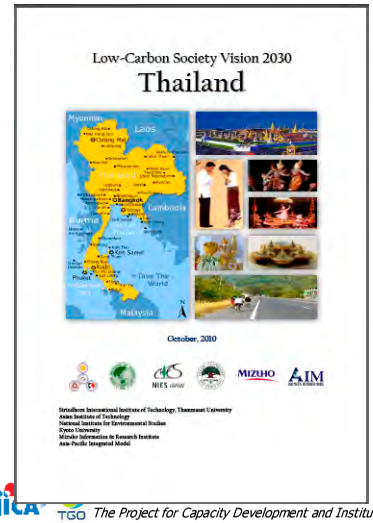
(5) Setting introduction of counter measures
- Since there can be various portfolios of the measures, one must choose appropriate criteria. For example, cost minimization, acceptance to the stakeholders, or probability of technological development.

(6) Estimation of GHG emission in the target year
- Based on socio-economic indices and assumption of measures, GHG emissions are calculated.

(7) Confirming measures set and suggestions of policy recommendations
- A policy is set to introduce the measures. Available policies depend on the situation of the municipality or the country in which it belongs.

Source: Low carbon society vision 2030, Thailand(October,2010)

Introduction of Low-Carbon Society Scenario (Thailand in 2030)



This scenario is one of the joint research outcomes of support and collaboration among
- Sirindhorn International Institute of Technology (SIIT) Thammasat University Thailand,
- Asian Institute of Technology,
- the National Institute for Environmental Studies (NIES) Japan,
- Kyoto University, and
- Mizuho Information and Research Institute Japan.

Source: Low carbon society vision 2030, Thailand(October,2010)

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Introduction of Low-Carbon Society Scenario (Thailand in 2030)

- Estimated socio-economic indicators in 2030

	2005	2030	2030/2005
Population (persons)	60,991,000	68,815,004	1.13
No. of households	19,016,784	36,265,390	1.91
GDP (million Baht)	8,016,595	30,802,306	3.84
GDP per capita (Baht/capita)	131,439	447,610	3.41
Gross output (million Baht)	18,755,884	68,456,651	3.65
Floor space for commercial (million m^2)	88	394	4.47
Passenger transport demand (million p-km)	191,520	216,088	1.13
Freight transport demand (million t-km)	188,524	589,859	3.13

- Summary of GHG mitigation measures in 2030

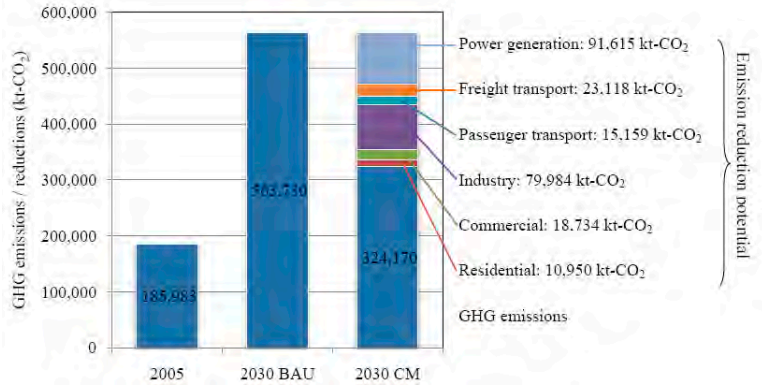
Unit:kt-CO2e

Mitigation Measures	GHG emission reduction
1. Energy efficiency improvement (EEI) in households	10,950 (1.94%)
2. Energy efficiency improvement in buildings	16,384 (2.91%)
3. Building codes	2,350 (0.42%)
4. Energy efficiency improvement in industries	38,648 (6.86%)
5. Fuel switching in industry	41,336 (7.33%)
6. Fuel economy improvement in transportation	10,739 (1.90%)
7. Fuel switching in transportation	9,983 (1.77%)
8. Modal shift in transportation	17,556 (3.11%)
9. Efficiency improvement and fuel switching in the power sector	91,614 (16.25%)

Source: Low carbon society vision 2030, Thailand(October, 2010)

Introduction of Low-Carbon Society Scenario (Thailand in 2030)

- Results of GHG emission reduction forecast



BAU: Business as usual
CM: Counter measure

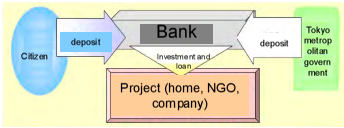
Source: Low carbon society vision 2030, Thailand(October,2010)

Introduction of Activities of Low-Carbon Society in Japan

Case of Tokyo Metropolitan Government

- **Target: 25% reduction of GHGs by 2020** (compared with 2000)
  (Approximately 15million ton)
- **Mitigation Measures within next 3 years:**
  - Tokyo cap and trade system for large scale business/industrial facilities(2010)
  - Climate change mitigation report for middle-small scale business/industrial facilities(2010)
  - Solar Power Plant in 6,700 kilowatt
  - Promotion of Solar Energy Utilization Facilities in households（until 2020）
    - Photovoltaic electricity generation 100,000 yen per kilowatt
    - Solar water heater 9,000 yen per square meter
    - Solar thermal system 33,000 yen per square meter
  - Installation of " Eco fund project" which assists to implement environmental activities
  - Park and bus ride in Shinjyuku Area, Promotion campaign of public transportation utilization in seaside area.

Solar water heater (Tokyo Gas)



Scheme of Eco fund project

Bus used in park & ride in Shinjyuku area

A1-155

Case of Tokyo Metropolitan Government

- **Mitigation Measures within next 3 years:**
  - Emission reduction crediting scheme for middle-small scale business/industrial facilities
  - Energy saving potential diagnostics for 1800 middle-small scale business/industrial facilities
  - Reduction tax of ½ of cost of metropolitan government designated energy efficiency equipment (limitation: 10 million yen)
  - Solar Power Plant increased to 9000 kilowatt
  - Promotion of bio fuel for vehicles
  - Photovoltaic electricity generation in sewage treatment plants, small scale hydro power plant in water utilities.
  - Promotion of energy saving in existing housing
  - Penetration of 1500 next generation passenger vehicles, installation of 80 battery charging facilities(2013)
  - Subsidiary of ¼ of price difference between next generation car and traditional car for middle-small scale companies.

Photovoltaic electricity generation in sewage treatment plant

Fast battery charging facility (Takaoka Electric MFG. Co.Ltd)

Next generation passenger vehicles (Nissan)

Case of Kyoto City

- **Target: 40% reduction of GHGs by 2030, 60% by 2050** (compared with 1990)
- **Mitigation Measures:**
  "Pedestrian-centered Urban Planning"
  - **Mobility management**
    - Expand the city's policies for "eco-commuting" to 200 local government and public offices and 700 other offices over a certain size (some 190,000 employees).
  - **Transit Mall**
    - Secure space for pedestrians with wider sidewalks and give preference to public transportation with special lanes on roadways.
  - **Restricting vehicle access to narrow streets**
  - **Low-carbon public transportation**
    - Connect the southern region of the city with Kyoto Station by high-frequency, highly reliable buses. Continue to power city buses with biodiesel.
  - **Transitioning the city's fleet to "eco-cars**
    - Transition the entire city fleet to "eco-cars" (fuel-efficient vehicles) an electric vehicles by 2018. Develop the necessary infrastructure to support recharging of vehicle (EV) batteries.

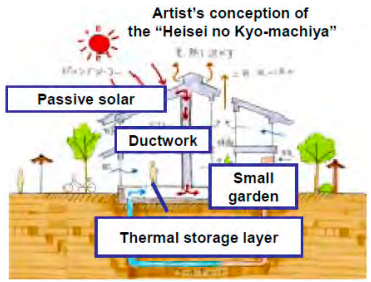
Transit Mall

Case of Kyoto City

"Low-Carbon Building and Use of Local Materials"

– **CASBEE Kyoto-certified Buildings**
  - Promote the construction of low-carbon buildings (energy-saving, long-lasting structures built using locally produced materials that shorten transport routes) that still retain the elegance of old Kyoto through CASBEE Kyoto certification

– **Local lumber, local consumption**
  - Promote local production and local consumption of lumber through Kyo no Yama.



Case of Kyoto City

"Lifestyle Changes"

– **An "eco-fund"**
  - Establish an "eco-fund" to implement environmental policy by promoting activities in the community and at schools and businesses.
  - **Eco-neighborhood Associations**: Use "eco-points" and carbon offsets to promote energy conservation and the collection, conversion, and reuse of waste oil and garbage for waste biomass.
  - **"Eco-schools":** Award points to schools for "eco-friendly" efforts that translate into bonus money for the school budget.
  - **"Eco-business":** Work to increase "eco-commuting" and the use of fuel-efficient company cars. Allow businesses to use reductions they have achieved to offset emissions reported and disclosed in accordance with ordinances.

Learning the concept and method of energy saving in community

Case of Shiga Prefecture

- **Target: 50% reduction of GHGs by 2030** (compared with 1990)
- **Mitigation Measures:**

– **Businesses**
  - Introduction of high efficiency production equipment: improvement of the total efficiency by 22%;
  - Switching of fuel for production: increase in the share of natural gas from 8.6% (2000) to 26.8% (2030);
  - Increase in the ratio of recycled industrial waste: e.g. ratio of recycled waste plastics/rubber from 76% (2004) to 94% (2030);
  - More efficient logistics: reduction of transport volume per production by 30%;
  - Modal shift: substitution of railway transport for freight for 50% of road transport to distant prefectures;
  - Introduction of biomass fuel to freight vehicles: penetration rate of 10%;

Case of Shiga Prefecture

– **Businesses**
  - Use of heat insulating buildings for business: compliance with the heat insulation standard for energy saving buildings in 90% of buildings.
  - Improvement of farming methods: reduction of fertilizer application by all farmers; 100% return of animal waste to farms.
  - Introduction of high efficiency business equipment: improvement of total efficiency by 40%;
  - Use of renewable energy in business buildings: introduction of photovoltaic power generation in 50% of buildings and biomass heating in 10%;

Source: www.pref.shiga.jp

Case of Shiga Prefecture

– **Local governments**
- Maintenance of forests: proper thinning, etc. in all plantation sites (42% of forest area);
- Formation of compact cities: reduction of average distance of intra-city travel by 25%,
  and conversion of unused space to green zone 20%;
- Planting of reeds: increase in the area to 260 ha including existing communities

Source: www.pref.shiga.jp

Case of Shiga Prefecture

– **Citizen**
- Introduction of high efficiency equipment: improvement of total efficiency by 40%;
- Use of heat insulating buildings: compliance with the next-generation heat insulation standard in 90% of buildings;
- Use of renewable energy in houses: introduction of photovoltaic power generation in 20% of houses, solar hot water system in 20%, biomass heating in 10%,
  and passive solar in 10%;
- Penetration of fuel-efficient passenger vehicles: increase in average fuel efficiency
  by 60% (share of hybrid vehicles:90%);
- Introduction of biomass fuel for passenger vehicles: penetration rate of 10%

Source: www.pref.shiga.jp

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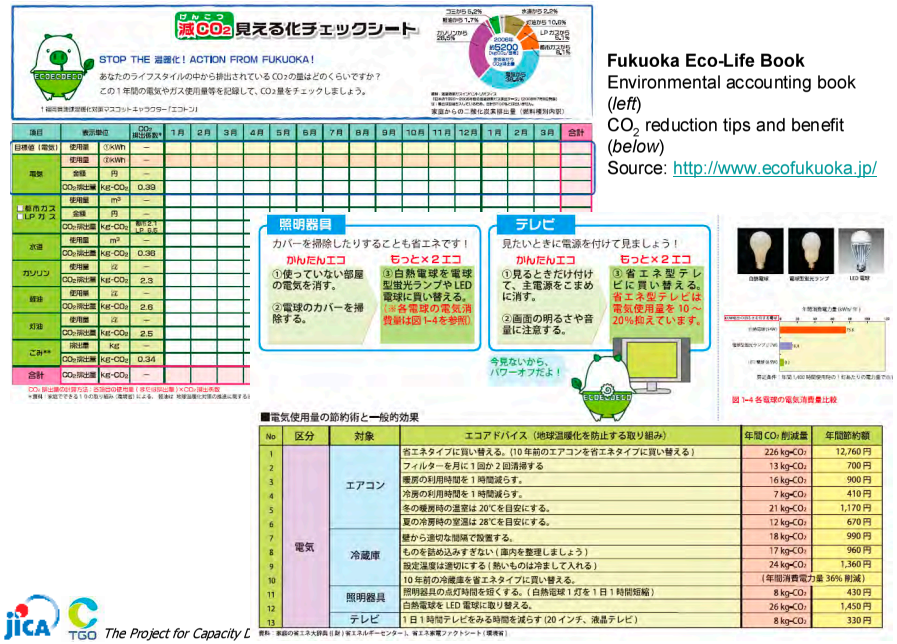
Case of Fukuoka Prefecture

- **Target: 6% reduction by 2012**
  (Approx. 4 million tons reduction)
- **Houses**
  – Target: 10% CO_2 emission reduction at household
  – Preparation/ distribution of a booklet "Fukuoka Eco-Life Book"
    - Tips to reduce GHG emissions at houses
    - Simple environmental accounting book

Fukuoka Eco-Life Book
Source: http://www.ecofukuoka.jp/



Fukuoka Eco-Life Book
Environmental accounting book (*left*)
CO_2 reduction tips and benefit (*below*)
Source: http://www.ecofukuoka.jp/

Case of Fukuoka Prefecture

- **Businesses**
  - Target: 8% CO_2 emission reduction per floor space at buildings
  - Preparation of a tool "Fukuoka Eco-Life Book for Businesses"
    - Tips to reduce GHG emissions at business facilities
    - Simple environmental accounting book for businesses
  - Introduction of domestic carbon credit trading system
    - Fuel switch from oil to biomass waste at boiler

Fukuoka Eco-Life Book for business
Source: http://www.ecofukuoka.jp/

Case of Fukuoka Prefecture

Other measures

- Enhancement of CO_2 absorption by sink
  - Introduction of forest environmental tax in 2004
    - Collection of 1.3 billion yen from citizens and businesses
    - Used for rehabilitation of ruined 29,000 ha forest
- Introduction of new alternative energy
  - Introduction and R&D
  - Hydrogen Strategy

Source: Fukuoka Hydrogen Town
http://www.f-suiso.jp/HyTown/index.html

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Case of Kita-Kyushu City

- **GHG Emissions from the City**
  - 15 million tons CO_{2e} (2005)
  - 66% from industrial sector
  - 16 ton-CO_{2e} per capita (1.5 times larger than national average)
- **Target: 30% by 2030**
  50% by 2050
  (about 8 million tons reduction)
  (compared with 2005 level)
- Selected as one of
  13 "Eco-Model Cities"

Case of Kita-Kyushu City

- **Introduction of new energy**
  - Hydrogen town
  - Solar factories
  - Waste heat recovery
- **Creation of low-carbon communities**
  - Adopt long-lasting energy-efficient houses
  - Introduction of EV and FCV
  - Electric bicycle rental by community
- **Enhancement of citizen participation**
  - Carbon offsetting, Eco point system
  - Integrated low-carbon study system
- **Asia Low-Carbon Emission Center**
  - Transfer low-carbon technology to Asian countries

Source: Kita-Kyushu Eco-model City
www.city.kitakyushu.jp

CDM 6: Validation and Verification including communication with DOE

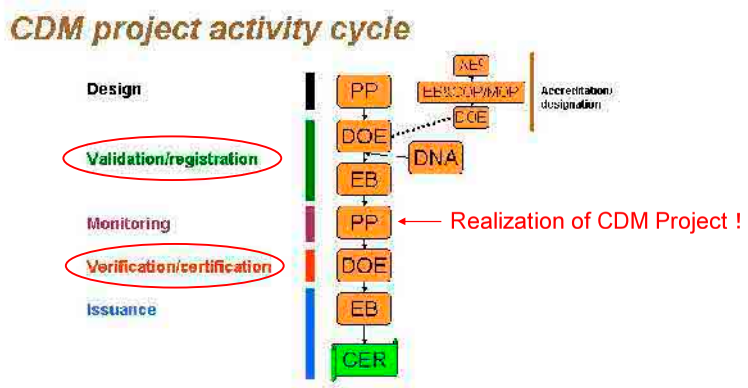
September, 2010

Deputy chief advisor of JICA Expert Team
Kazuhito YAMADA

Today's Agenda

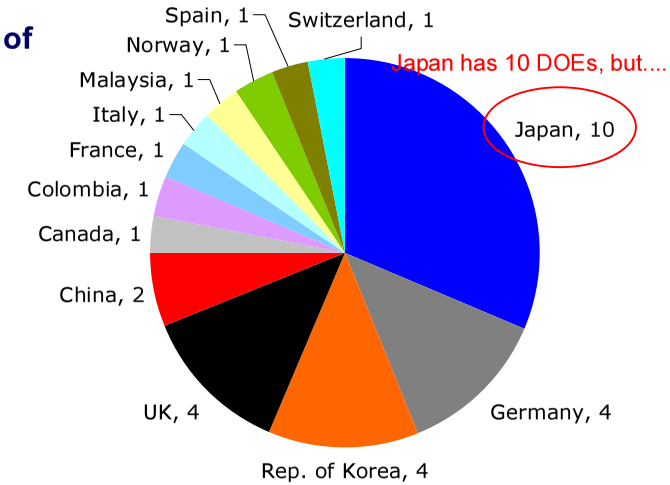
- CDM Project Cycle - confirmation -
- Present status of DOEs
- What is "VALIDATION & VERIFICATION"?
- What is "VVM"?
- Example of current reasons of request for review and rejected
- Contents of VVM
- Important Points of VVM: Validation -Methods of Validation-
- Important Points of VVM: Validation - CAR -
- Important Points of VVM: Validation - CL and FAR -
- Important Points of VVM: Validation - Compatibility with methodologies-
- Important Points of VVM: Validation - Additionality of a project activity-
- Important Points of VVM: Validation - Monitoring plan-
- Important Points of VVM: Verification - Methods of Verification-
- Important Points of VVM: Verification -Compliance of monitoring with the monitoring plan-

CDM Project Cycle - confirmation -



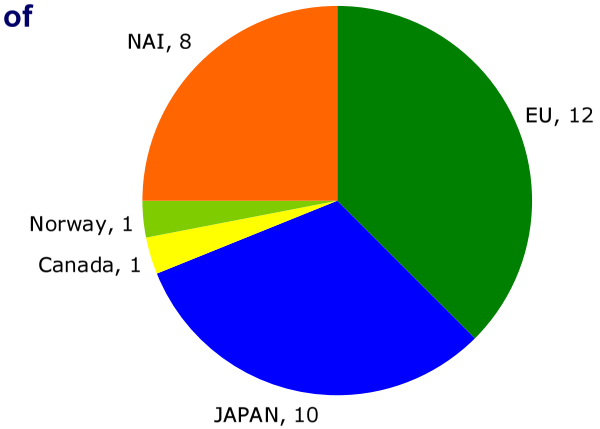
Present status of DOEs (1)

Numbers of DOEs (1)



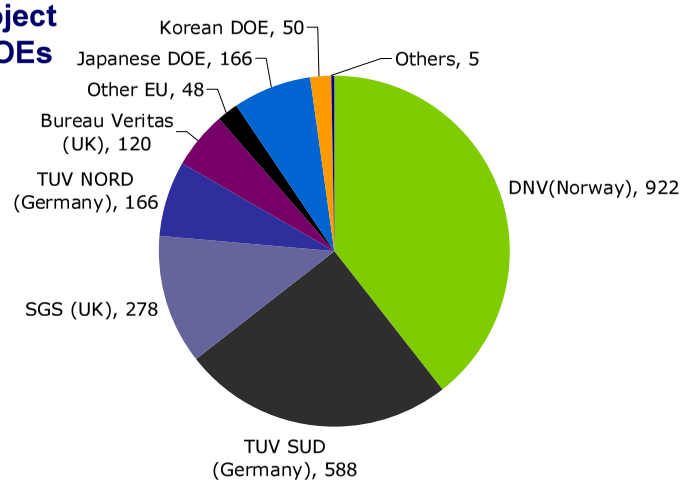
Present status of DOEs (2)

Numbers of DOEs (2)



Present status of DOEs (3)

Registered project numbers by DOEs



What is "VALIDATION & VERIFICATION"?

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

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

What is "VVM"?

VALIDATION AND VERIFICATION MANUAL(VVM)

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

DOEs shall follow this Manual and shall integrate its provisions

Example of current reasons of request for review and rejected

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

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

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

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

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

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

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

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

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

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

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

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

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

Contents of VVM

- I. INTRODUCTION
- II. TERMS FOR VALIDATING AND VERIFYING INFORMATION PROVIDED BY PROJECT PARTICIPANTS
- III. PRINCIPLES FOR VALIDATION AND VERIFICATION
- IV. ADDITIONAL ROLES OF DESIGNATED OPERATIONAL ENTITIES
- V. CDM VALIDATION
- VI. CDM VERIFICATION REQUIREMENTS BASED ON PARAGRAPH 62 OF THE CDM MODALITIES AND PROCEDURES

  - A. Objective of CDM validation
  - B. Validation approach
  - C. Validation methods
  - D. Stakeholder consultation process
  - E. Validation requirements based on paragraph 37 of the CDM modalities and procedures
  - F. Specific validation activities
  - G. Validation report
  - H. Validation opinion

Important Points of VVM: Validation -Methods of Validation-

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

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

Important Points of VVM: Validation - CAR -

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

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

(b) The CDM requirements have not been met;

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

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

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

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

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

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

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

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

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

Important Points of VVM: Validation - CL and FAR -

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

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

Important Points of VVM: Validation -Compatibility with methodologies-

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

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

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

Baseline identification

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

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

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

Algorithms and/or formulae used to determine emission reductions

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

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

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

Prior consideration of the CDM

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

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

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

Investment analysis

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

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

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

Reporting requirements

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

Important Points of VVM: Validation -Monitoring plan-

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

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

Important Points of VVM: Validation -Monitoring plan-

Reporting requirements

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

Important Points of VVM: Verification -Methods of Verification-

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

- Desk review
- On-site assessment

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

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

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

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

Conclusion

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

GHG Mitigation Measures in Waste Sector

23, November, 2010

Deputy chief advisor of JICA Expert Team
Kazuhito YAMADA

A1-168

Today's Agenda

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

What is "GHG mitigation measures"?

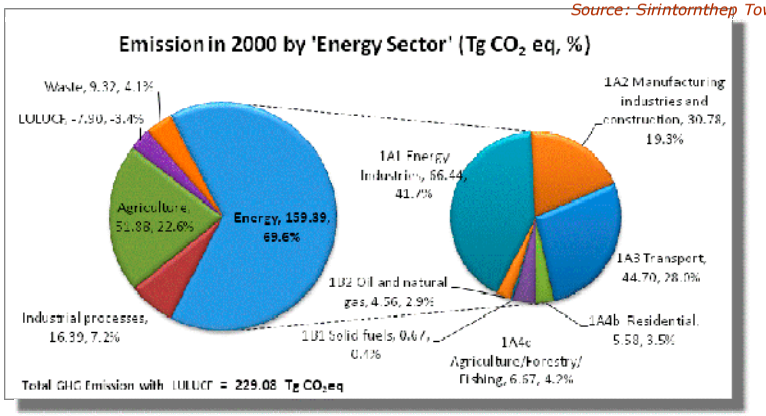
- Climate change **mitigation** is action to **decrease the intensity of radiative forcing** in order to reduce the potential effects of global warming;
- Mitigation may be achieved through the **reduction of GHG emissions** or through the **enhancement of sinks** that absorb GHGs, e.g., forests.

Source: Climate Change, Wikipedia

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

Anthropogenic GHG emissions in Thailand

Source: Sirintornthep Towprayoon et al



- All sectors are related to anthropogenic GHG emissions.

How to mitigate GHG emissions in the sector?

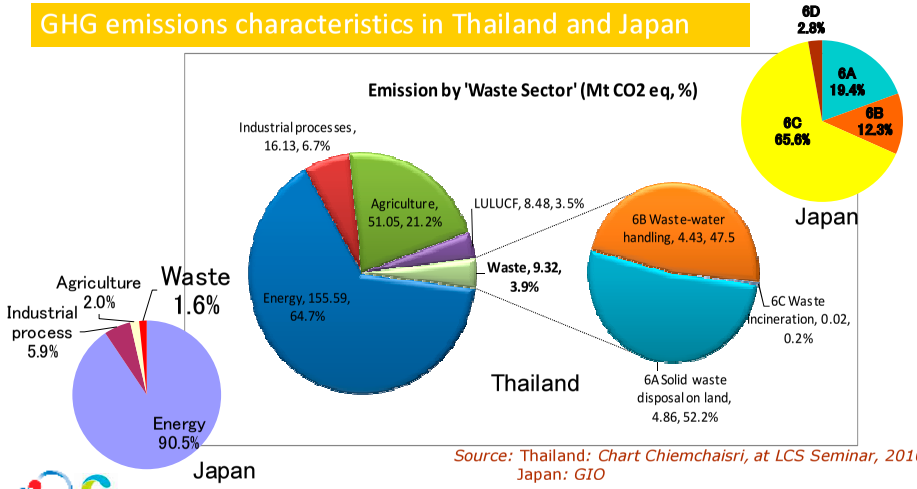
- Identify **main GHG emission sources** in the sector;

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

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

GHG mitigation measures in Waste Sector

GHG emissions characteristics in Thailand and Japan



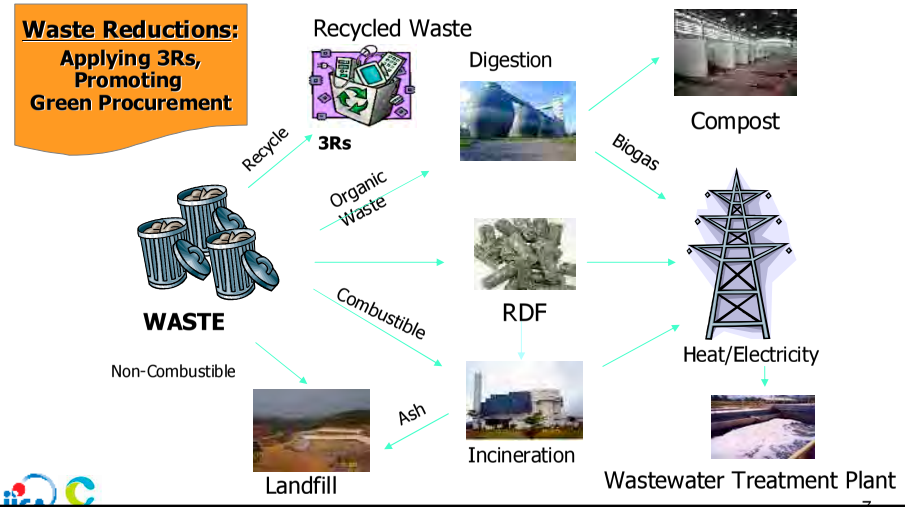
Source: Thailand: Chart Chiemchaisri, at LCS Seminar, 2010
Japan: GIO

A1-169

for your reference

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

WTE Strategic Approaches



Integrated Waste Management System Specifically for Generating Renewable Energy

for your reference

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

Criteria to Develop Cluster Size

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

for your reference

Appropriate Technologies

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

Pollution Control Department

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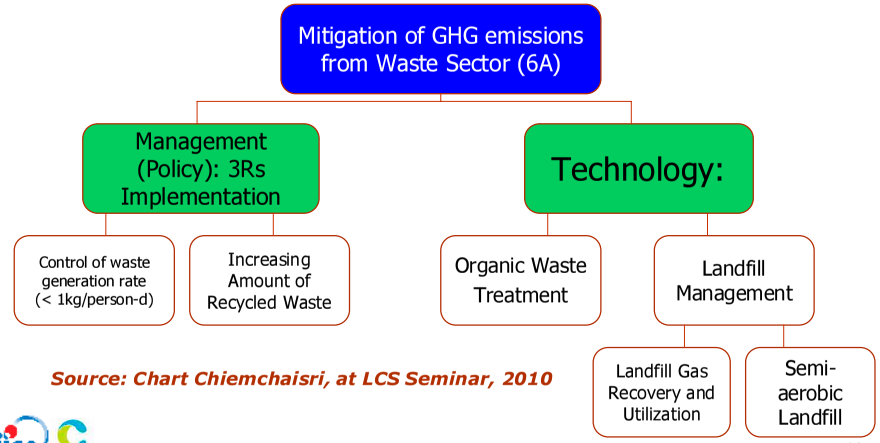
GHG mitigation measures in Waste Sector

Mitigation of GHG Emission from Waste Sector (6A)



Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

Potentials and Limitations of GHG Mitigation Technology Options

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

Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

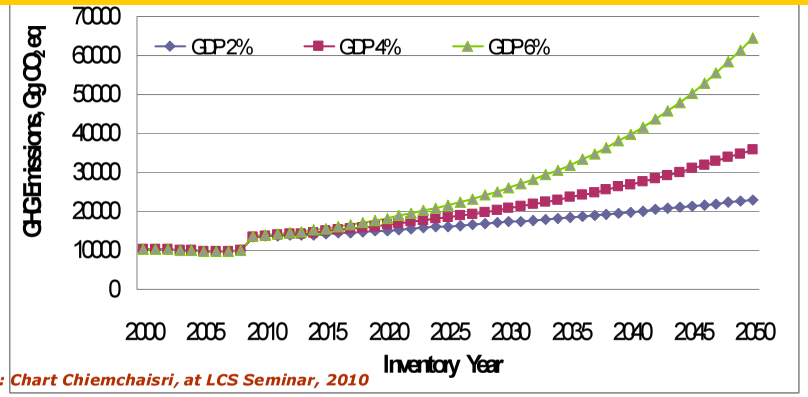
Assumption for Evaluation of GHG Emissions Reduction from Mitigation Measures

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

Source: Chart Chiemchaisri, at LCS Seminar, 2010

GHG mitigation measures in Waste Sector

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

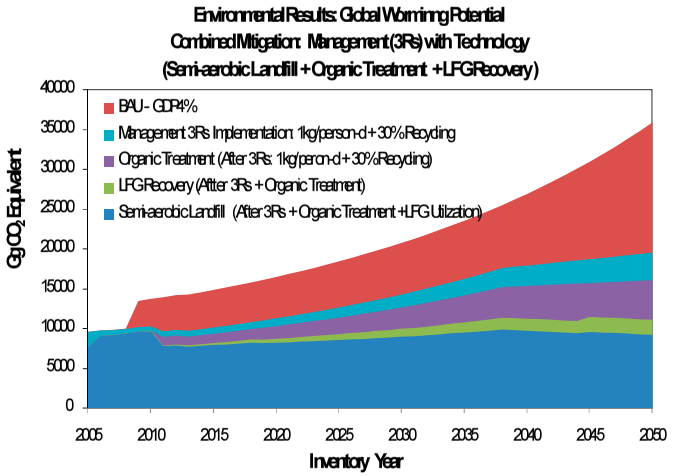


Source: Chart Chiemchaisri, at LCS Seminar, 2010

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

GHG mitigation measures in Waste Sector

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



Source: Chart Chiemchaisri, at LCS Seminar, 2010

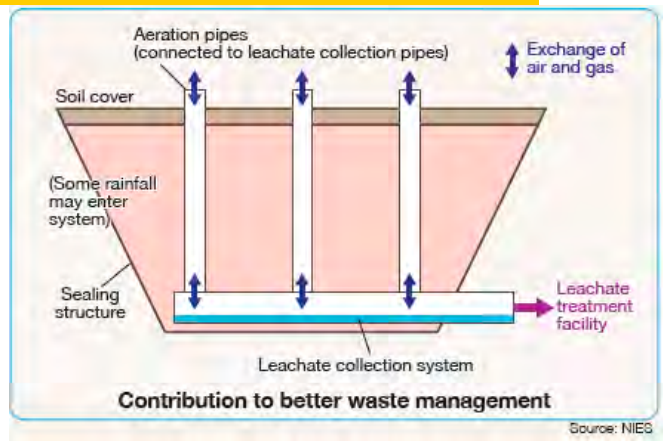
GHG mitigation measures in Waste Sector

Semi-aerobic landfill system

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

GHG mitigation measures in Waste Sector

Semi-aerobic landfill system



GHG mitigation measures in Waste Sector

Semi-aerobic landfill system

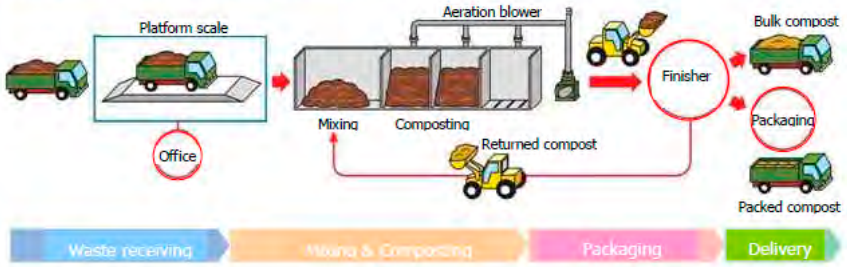
GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes

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

GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes



GHG mitigation measures in Waste Sector

Ultrahigh-temperature aerobic fermentation composting process by YM Aerobes

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

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

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

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

GHG mitigation measures in Waste Sector

MRV: Measurement

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

GHG mitigation measures in Waste Sector

MRV: Measurement

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

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

You need to measure only this item.

GHG mitigation measures in Waste Sector

Exercise:

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

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

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

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

18 January, 2011

Eiko Watatsu, Tetsuya Yoshida
JICA Expert Team

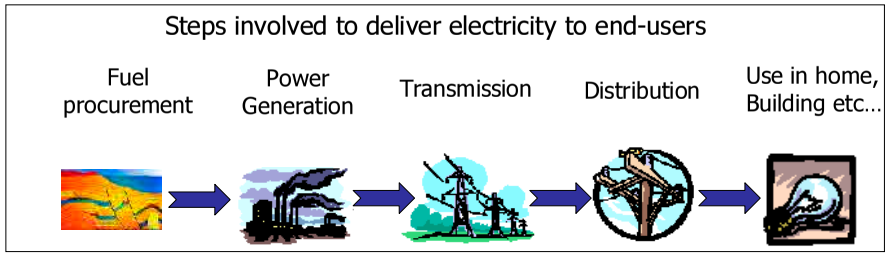
Energy Sector

Contents

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

Introduction

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



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

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

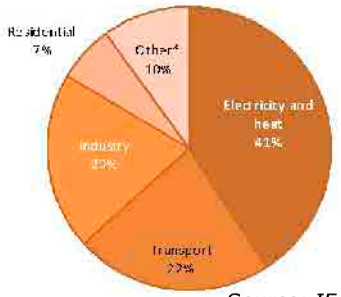
Status of sector (1)

-Energy-related GHG emission-

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

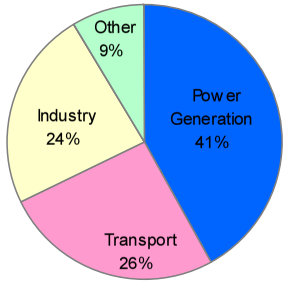
CO2 emissions by sector in 2008

- World -



Source: IEA

- Thailand -



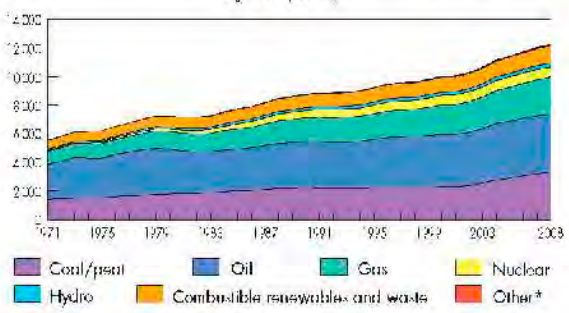
Source:EPPO

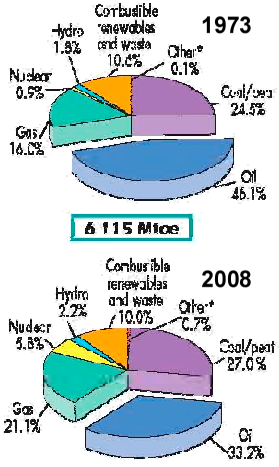
Status of sector (2)

- World Energy Supply -

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

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





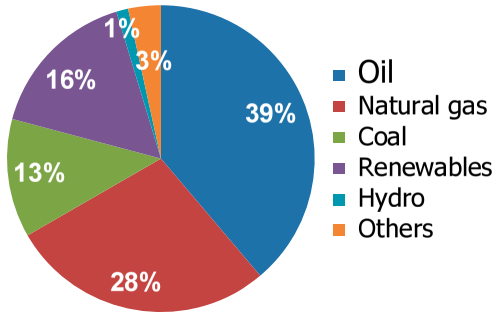
Source: IEA

Status of sector (3)

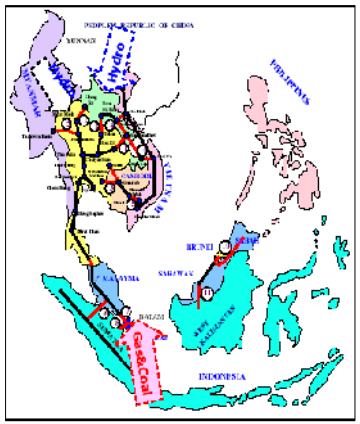
- Energy supply in Thailand -

- Natural gas use are promoted to use in Thailand.

Primary Energy Supply in 2008 (119,346 ktoe)



Source: LCS seminar



Comparison of value of by-product in fossil fuel combustion

Coal = 100

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

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

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

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

Which options are suitable for Thailand?

Key Energy and Climate Security Challenges in Thailand

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

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

Source: LCS seminar

Option 1 Improving fuel type and efficiency in power generation

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

Thailand Power Development Plan (PDP2010)

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

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

Source: PDP 2010

Grid emission factors of Asian-Pacific countries

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

CCGT; Combined Cycle, Gas Turbine

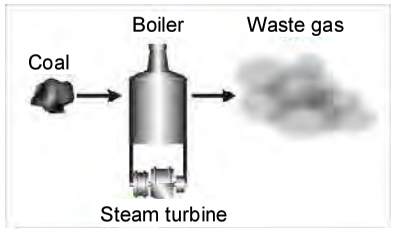
- CCGT plants produce less CO2 per unit energy output than coal or oil technologies .

Registered CDM projects of AM0029

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

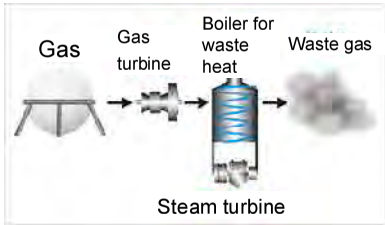
AM0029 :Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas

IGCC: Integrated coal Gasification Combined Cycle

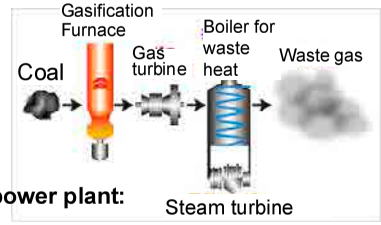


Conventional coal power plant:35%

Ultra supercritical coal power plant: 42%



Combined Cycle power plant: 48%



IGCC power plant: 50-%

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

Option 2

Increasing Renewable Energy

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

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

Potential of RE in Thailand

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

Source: LCS seminar

Alternative Energy Development Plan (2008 – 2022)

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

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

Issue and challenge for RE use

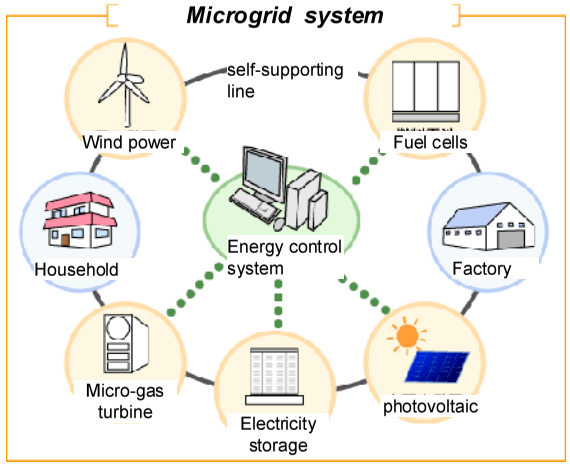
- Issue
  - Typical construction costs for new renewable energy power plants are high.
  - Many renewable energy sources are variable over hourly, daily and/or seasonal time frames.
- Challenge
  - Choice the best sites, low operation, maintenance and fuel costs
  - Energy-storage technologies
  - Use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

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

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

Concept of micro-grid system

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



Conclusion

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

Industry Sector

Contents

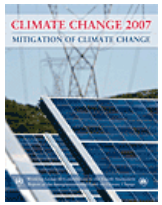
- Characteristics of World's GHG emissions from industrial sector
- Overview of Thailand GHG emissions from industrial sector
- Industrial Mitigation Measures
  - Sector-wide Measures
  - Sector-specific Measures
- Issues and future outlook

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

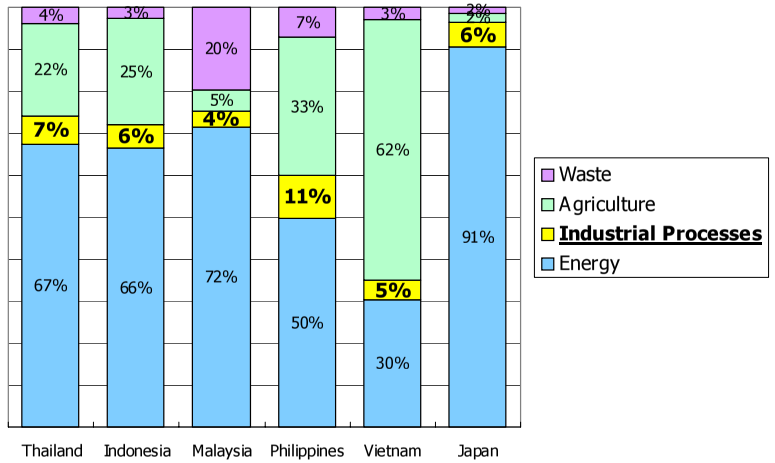
- Approximately 85% of the industrial sector's energy use in 2004 was in the energy-intensive industries:
  - iron and steel, nonferrous metals, chemicals and fertilizers, petroleum refining, minerals (cement, lime, glass and ceramics) and pulp and paper
- Many older, inefficient facilities remain in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

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

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

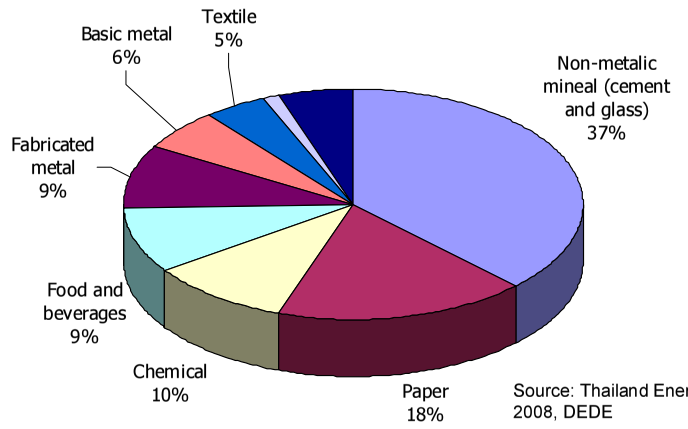


GHG emissions in Thailand and Asia



Source: UNFCCC, ONEP and JGSEE, 2010

Energy Consumption by Industry Sector in Thailand



Source: Thailand Energy Situation 2008, DEDE

Renewable energy is excluded

Based on ktoe, data from 2008

Industrial Mitigation Measures

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

Source: IPCC

Sector-wide Mitigation Measures -1-

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

Source: ECCJ

Sector-wide Mitigation Measures -2-

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

Sector-wide Mitigation Measures -3-

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

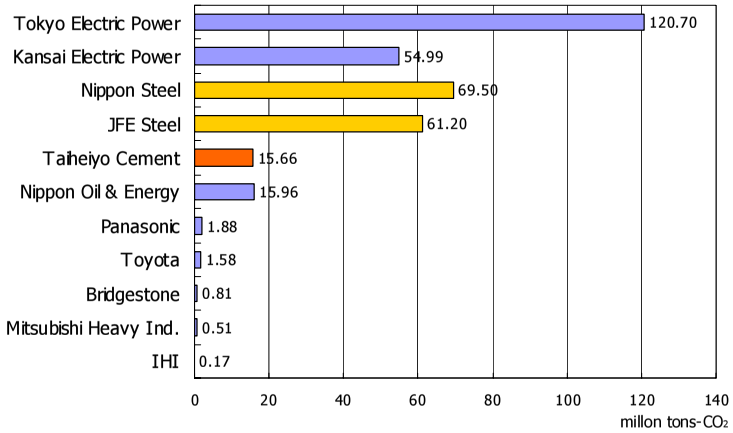
Source: UNFCCC

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

Source: IPCC

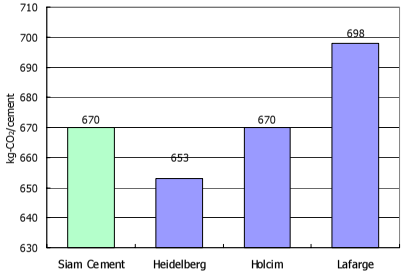
Sector-specific Mitigation Measures -Background-

CO_2 emissions from some of the major Japanese companies



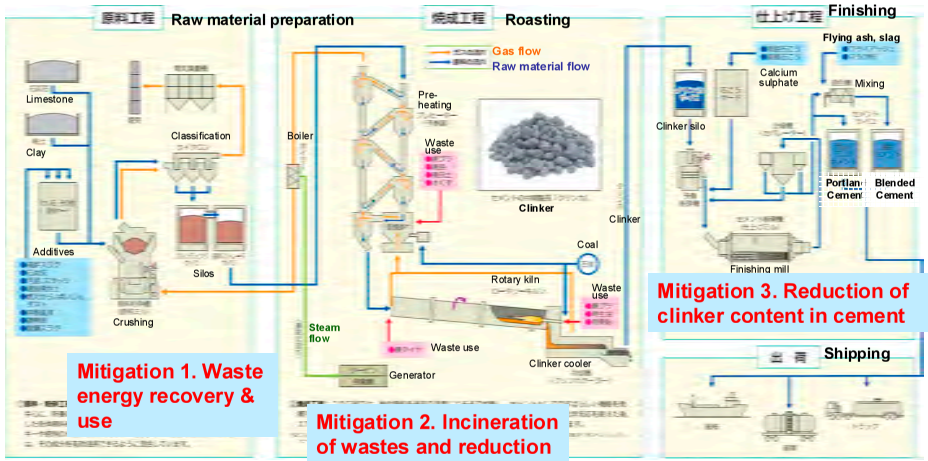
Sector-specific Mitigation Measures -Cement Industry-

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



Source: WBCSD

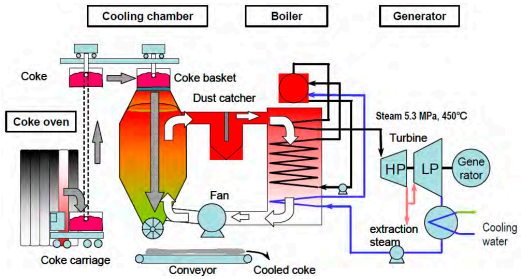
Sector-specific Mitigation Measures -Cement Industry-



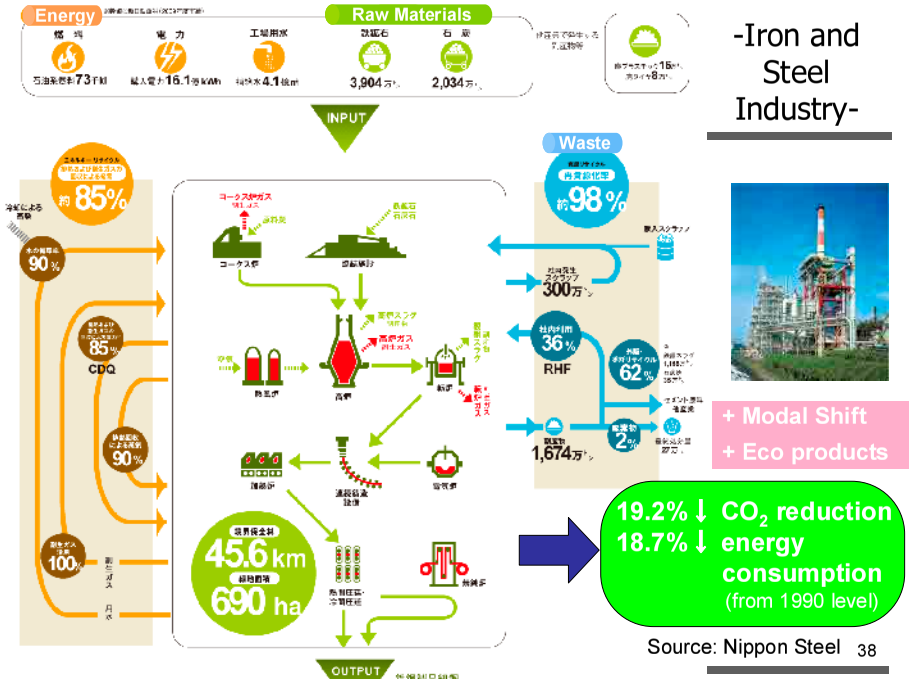
Source: Japan Cement Association

Sector-specific Mitigation Measures -Iron and Steel Industry-

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



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



-Iron and Steel Industry-

+ Modal Shift
+ Eco products

Source: Nippon Steel

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Issues and futures

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

Source: IPCC analysis

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

GHG mitigation measures in Energy and Industry Sector

Exercise:

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

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