JCM Feasibility Study through City to City Collaboration for Low Carbon Society

Waste to Energy by utilizing Waste Heat from MSW incineration at Rayong Integrated MSW Management Center

Entrusted by the Ministry of Environment, Japan in 2016

EX Research Institute Limited

February 28, 2017

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List of Abbreviations

Abbreviation	Description in full
AEDP	Alternative Energy Development Plan
DNA	Designated National Agency
EEDP	Energy Efficiency Development Plan
EPC	Engineering, Procurement, and Construction
ERC	Energy Regulatory Committee
GHG	Greenhouse Gas
IPP	Independent Power Producer
ITD	Italian-Thai development PLC
JCM	Joint Crediting Mechanism
MOEJ	The Ministry of Environment, Japan
MOI	The Ministry of Interior, Thailand
MONRE	The Ministry of Natural Resource and Environment
MRV	Monitoring, Reporting and Verification
NAMAs	National Appropriate Mitigation Actions
NCPO	National Council for Peace & Order
O&M	Operation & Maintenance
ONEP	Office of the Natural Resources & Environment Policy & Planning Office
PAO	Provincial Administrative Organization
PCD	Pollution Control Department
PPP	Public and Private Partnership
PDRC	People's Democratic Reform Committee
SET	The Stock Exchange of Thailand
TE	Thai Eastern Group
TGO	Thai Greenhouse Gas Management Organization
WtE	Waste to Energy

1 Outline of the Project

(1) Objectives

EX implemented the study Research Instituted Limited with purpose of materialization of the "Waste to Energy Project by utilizing waste heat from MSW incineration in Rayong, Thailand" and registration of the project as JCM project, with supports given by the city of Kitakyushu under city to city collaboration between the city of Kitakyushu and Rayong PAO.

(2) Background of the Study

1) Climate Change

The Government of Thailand has ratified both United Nation Framework Convention on Climate Change on December, 1994 and Kyoto Protocol under UNFCCC on August, 2008. The Government of Thailand had assigned Office of the Ministry of Natural Resources and Environment Policy and Planning Office as Designated National Agency (DNA) for UNFCCC since July, 2003, they have set up Thai Greenhouse Gas Management Organization on July 2007 and empowered them as DNA.

As for National Inventory for Greenhouse Gases, The Government of Thailand submitted their first National Communication in 2000 and reported 229.08 million tCO2e as GHG emission in total in Thailand, in which 159.39 million tCO2 from energy sector, 16.39 million tCO2 from Industry、51.88 million tCO2 from Agriculture and 9.32 million tCO2 from Waste Sector.

Beside above, the Government of Thailand published "Power Development Plan formulate in line with the Energy Efficiency for 2011-2030" in 2011 and announced their target of reduction of 7-20 percent of GHG emission in comparison with that of base year, i.e. 2005[1] (medium term goal) and 25 percent reduction per energy unit by 2030[2]. In the National Strategic Plan for Climate Change (2008-2012) published by the Government of Thailand in 2008, The Government of Thailand referred mitigation (GHG emission reduction) together with integrated development of carbon sink as strategy 2 of the plan. The Government of Thailand is under preparation of "Master Plan on Climate Change 2013-2050[3]" and there is a description of "mitigation and strengthen of carbon sink" along with others, such as "adaptation", "development of technologies, database and knowledge can support low carbon development" and "Awareness rising and capacity building for the actual working level in charge of climate change" in the plan. In the description, as for mitigation, the Government of Thailand has prioritized 8 sectors,

[1] 183,287KtonCO2 was emitted in 2005
[2] The Government of Thailand committed 7% of GHG emission reduction at COP20
[3] The Technical Sub Committee have approved the plan has on August, 2014 and planned to be submitted to the Climate Change Committee

including power, transportation, building, industry, waste management, agriculture, forestry, and urban management.

In term of Joint Crediting Mechanism initiated by the Government of Japan, the Government of Thailand agreed to continue to consider the possibility of forming it up as "a concrete measure to realize GHG emission reduction by Japan and countries in Mekong region" under the Action Plan for the Green Mekong Initiative" formulated on October, 2010, then after having many twists and turns, the government of Thailand became one of the countries who participate in Joint crediting Mechanism through process of drafting bilateral agreement by Thai Greenhouse Gas Management Organization, Approved by the cabinet on August 14th, 2015, then signed by both government on November 19th, 2016.

Under the background mentioned above, the Government of Thailand express their intention to strengthen its activities on mitigation and expects much from Joint Crediting Mechanism as one of driving force for mitigation actions. With interest as business, as well as contribution for mitigation in Thailand, expressed by potential investors for the project, EX Research Institute Limited implemented the Study.

2) Waste Management

As the same as that in Japan, the Government of Thailand identified 808 types of waste, which are matched with prescribed conditions as industrial waste and make those separate from waste from others. In addition, the Government of Thailand has classified waste into two categories, i.e., hazardous waste and non-hazardous waste. The waste which the study implementation body focus on is general, non-hazardous solid waste. There are several laws with competent government authorities responsible for General Solid Waste (hereinafter referred as "Municipal Solid Waste or MSW"), such as Enhancement and Conservation of National Environment Quality Act B.E.2535 prescribes the Ministry of Natural Resources and Environment, Public Health Act B.E. 2535 does the Ministry of Health as competent Government Authority. In addition Pollution Control Department is responsible for policy and planning and the Ministry of Interior with Local Administrative Offices under their umbrella are responsible for and in charge of actual operation, including collection, transportation, treatment and disposal

As per the report published by the Ministry of Natural Resources and Environment,

there are 2,450 final disposal sites existing in Thailand and only one-third of them are regard appropriate disposal sites. Some of those sites are still under operation although some located in the center of the cities due to urban area expansion and/or need to immediate close-down, because of no alternatives for those. Including the situation said above, Waste Management became one of the biggest issues, in terms of complains from the resident near the sites, sanitation and environment impact, for the Government of Thailand, and therefore the Government of Thailand started tackling with the issues since the middle of 2000's.

3) Potential Investor

Italian Thai Development Public Company Limited (hereinafter referred as "ITD"), or potential investor for the targeted project, is a one of the largest construction companies listed in The Stock Exchange of Thailand (SET) in Thailand. ITD has a lots of reference sites, including roads, bridges, airports, skyscrapers as well as EPC for power plants. ITD intends to expand its business line to waste management project as investor, as ITD regards waste management project is one of the promising industries in Thailand. Thus, ITD puts highest priority on the project targeted by the study among others in its strategic plan. ITD has strong intention to develop a model project for the appropriate municipal solid waste management in Thailand and realize their intention through implementation of the project targeted by the study. Therefore, ITD is anxious for the project to be materialized with technology for high efficiency and low environmental impact owned by Japanese EPCs and regards supports under Joint Crediting Mechanism as one of the essential factor to minimize different between EPC cost offered by Japanese and that of Chinese.

4) The Study Implementation body

EX Research Institute Limited (EXRI) as the study implementation body, is a think-tank established in 1972, mainly engages in urban planning and environmental consulting works. EXRI has been involved in many projects in the field of bilateral carbon crediting mechanism, such as JCM project development study for the project, Development of Methodology and MRV for "the Project of Introducing High Efficiency Refrigerator to a Food Industry Cold Storage in Indonesia", which is the first project acquired carbon credit in Joint Crediting Mechanism, since 2010. EXRI set up its local offices in both Philippines and Thailand with purpose of enhancement of its activities in the area. EXRI try to establish business model, as a representative for international consortium for JCM with involvement of local offices as management body.

(3) Outline of the Study

The project implementation body conducted the study for commercialization and registration of the targeted project, of which details are as below;

1) General & Basic Information Collection

The project implementation body collected and made data & information as for related laws & regulations, Municipal Solid Waste (MSW), independent power producer IPP), environmental standard etc., Among all, MSW and IPPs become one of hot issues after NCPO coming to the power, thus, Waste to Energy (WtE) projects started moving, then found obstacles in implementation of the projects including legislative system in Thailand. Thus, we have paid special attentions and watched on trend for all related to WtE projects in Thailand

2) Commercialization & JCM project registration

The project implementation body conducted study for commercialization of the project and JCM project registration, including quantification of GHG emission reduction from the project implementation, consideration & discussion on form up of international consortium, adjustment of implementation schedule and supporting MRV activities

The project implementation body set up priority issues as per shown in the Table 1-1 below and conducted the study after having discussion & exchanging idea how to settle the issues.

Table 1-1 Priority Issues in the Study

Items	Prioritized Issues and Resolution
Feasibility	Consideration on Fund raising, stable operation for project period, including O&M, Securement of Profitability, and securement of GHG emission reduction from the project implementation.
	Confirmation on Schedule including approvals
Increase of possibility on receiving order(s)	Consideration on the specification whish the Japanese EPC have advantage
	Optimization of the facilities and equipment and consideration on acceptable EPC cost in Thailand
JCM Registration	Confirmation on conditions for JCM project registration through checking with relevant parties
	Adjustment of Schedule, including commercialization and application for

	JCM subsidy and consideration on alternatives for the case the project implementation body found it difficult to adjust schedule above.
Supporting on MRV Implementation	Supporting for members in expecting international consortium on understanding for JCM, MRV and MRV implementation

(4) Organizational Structure for the Study Implementation

Organizational Structure for the study implementation is as per shown in Figure 1-1, i.e., EXRI, who was entrusted to conduct the study by the Ministry of Environment, Japan (hereinafter referred as "MOEJ"), responsible for total management of the study implementation other than (1) data & information collection for related laws and regulations, climate change, low carbon development, MSW and energy in the host country and (2) feasibility study for the targeted project & JCM project registration. The city of Kitakyushu supported commercialization of the project by utilization of city to city cooperation framework, Nippon Steel & Sumikin Engineering Co., Ltd joined to the study as technical advisor, NTT Data Institute of Management Consulting INC. support for activates in overseas and ex-technical director of Japan Quality Assurance conducted capacity building for better understanding on JCM and MRV implementation.

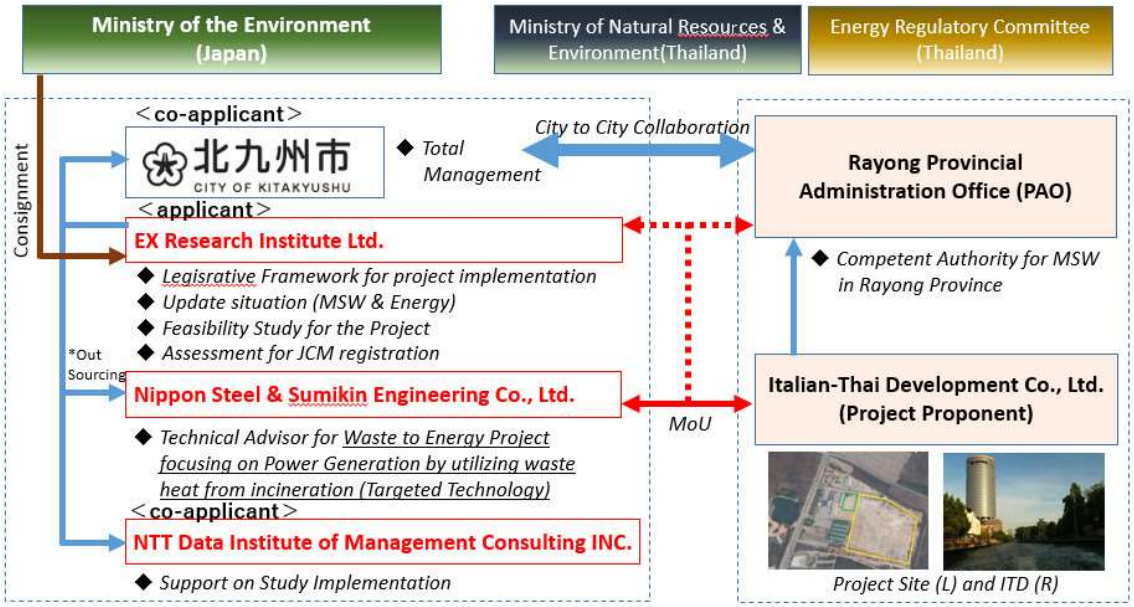


Figure 1-1 Organizational Structure for the study implementation

(5) Implementation Schedule of the Study

The Project implementation body conducted the study as per Table 1-2 (subject basis) and Table 1-3 (Gantt Chart)

Table 1-2　Subject basis Implementation Schedule for the Study

	Subject	Duration
1	Basic & General Data & Information Collection	Project Start – June, 2016
2	Consideration on commercialization	July – September, 2016
3	Consideration on Facilities & Equipment to be employed	October – December, 2016
4	Consideration on JCM project registration	October, 2016 – January, 2017
5	Business Planning & Feasibility Study	October, 2016 – January, 2017
6	Supporting Activities by the city of Kitakyushu	Start – March 10, 2017
7	Site Survey (3 times)	Start – March 10, 2017
8	Debriefing & Workshop	Start – March 10, 2017
9	Report	October, 2016 – March, 2017

Table 1-3 Gantt Chart

No		Description	Completion
1		Collecting Basic & general infor	June
2		Feasibility Study	Sep
	1)	Current Situation & Plan	
	2)	Waste Quality & Quantity	
	3)	Licenses & Approvals	
	4)	Infrastructure	
	5)	Environmental Standard	
	6)	Financial Plan	
3		Facility & Equipment	Dec
	1)	Optimization	
	2)	O&M	
	3)	Cost Reduction	
4		JCM registration	Jan (M)
	1)	Methodology	
	2)	MRV	
	3)	International Consortium	
	4)	Environmental Integrity	
	5)	Schedule Adjustment	
	6)	Financial Scheme	
5		Business evaluation	Jan (M)
6		Support by Kitakyushu	March 10
		Activities in Host country	
		Meetings & Workshops	
		Report	

2016: 5 (1 2 3 4 5), 6 (1 2 3 4 5), 7 (1 2 3 4 5), 8 (1 2 3 4 5), 9 (1 2 3 4 5)

K(TKY) K(THAI) WS(THAI)

No		Description	Completion
1		Collecting Basic & general infor	June
2		Feasibility Study	Sep
	1)	Current Situation & Plan	
	2)	Waste Quality & Quantity	
	3)	Licenses & Approvals	
	4)	Infrastructure	
	5)	Environmental Standard	
	6)	Financial Plan	
3		Facility & Equipment	Dec
	1)	Optimization	
	2)	O&M	
	3)	Cost Reduction	
4		JCM registration	Jan (M)
	1)	Methodology	
	2)	MRV	
	3)	International Consortium	
	4)	Environmental Integrity	
	5)	Schedule Adjustment	
	6)	Financial Scheme	
5		Business evaluation	Jan (M)
6		Support by Kitakyushu	March 10
		Activities in Host country	
		Meetings & Workshops	
		Report	

2016: 10 (1 2 3 4 5), 11 (1 2 3 4 5), 12 (1 2 3 4 5)
2017: 1 (1 2 3 4 5), 2 (1 2 3 4 5)

WS(JPN) WS(JPN) F(2/17)
I(10/28) FD(1/20)

Remarks

K	Kick Off Meeting
C	COP22
I	Intermediate Report
FD	Final Report (Draft)
F	Final Report

2 Findings from the Study

(1) Basic & General Information of the host country

Basic & General information as for the host country, i.e. Thailand where the project implementation body consider to implement the targeted project is as follows;

1) Country & Land

Kingdom of Thailand (hereinafter referred as "Thailand") with its land area of 51.4km2, is located at the area covered by 5-21 north latitude degree (about 1,600km) and 97-106 east longitude (800km), which is in the central part of the Indochina peninsula. It borders on Kingdom of Cambodia in east, the union of Myanmar (hereinafter referred as "Myanmar") in west, The Federation of Malaysia in south and Laos Peoples Democratic Republic and Myanmar. The country can be divided into four regions, i.e., mountain area in north, central plain in the Chaopraya River basin, Although Mekong River flows in the northeastern area of the country, irrigation in the area is not good enough and soil is rather poor with less moisture and fertilizer holding ability, as the most of the area is covered by Korart plateau, the southern part of the country is in Malay peninsula, is between gulf of Siam and Andaman sea.

2) Weather

Thailand is classified tropical monsoon (Am) for the southern part, and Savanna for the other areas in Koppel climate classification. However, the Metrological Agency of Thailand classified the areas in the country into five, i.e., North, Northeast, Central, East and South. There are little differences among the area, however, in general, there is a south-west monsoon blow from Indian ocean bring wet wind and rain and typhoon occurred in East China Sea sometime bring heavy rain together with strong wind. Monsoon start blow at southern part of the country sometime on the month of May, then go up north, there are monsoon in both north and northeastern areas on the month of August, then all the areas including central and south in the country on the month of September and October. There is another monsoon from northeast on and after the month of October, which is from mainland of China and bring cold air to all the area in the country. There are three seasons, i.e. Middle of February – Middle of May as hot season, middle of May to Middle of October as wet season and middle of October to Middle of February as cool-dry season. There are consecutive hot days with more than 40 degrees Celsius in the hot season, while days with lower temperature are recorded in cool-dry season. There are days

with less than 10 degrees Celsius as lowest temperature in the day in highland areas in both north and northeastern areas, while weather in both south and eastern part of the country is rather warmth in comparison with other areas in the country due to the influence of monsoon.

3) People

Majority of Thai is Tai Family. There are Tai Noi Family, which are mixed race between Chinese and Tai in the central part, Tai Yai, Tai Muang and hill tribes in the north, Laotian in northeast and Malay south, however they are assimilating through marriages among different families and races. There are minorities such as Karen, Hmong, and Akha tribes in the mountain area, in addition, Khmer, immigrant from neighboring countries are living in the country.

4) Religion

Majority of Thai is Buddhist. Thai Buddhism is Theravada bossism missed up with Hinduism and Animism, therefore Thai have faith in gods in Hinduism, Aged large trees, strangely shaped rocks other than Buddha. There are many people have faith in Islam living in 3 provinces in southern part of the country, i.e., Naratiwart, Hatyai and Yala.

5) Language

An official language in Thailand is Thai. Thai language was created in reference to Khmer character in thirteen centuries. Thai consist of forty-two consonants and thirty vowels and write in horizontal from left to right. There are lots of vocabularies derived from Sanskrit or Pali and even English, which are used as Thai vocabulary as it is recently.

6) Form of Government

Form of Government in Thailand is constitutional monarchy with the king of Rattanakosin dynasty as the head of the country. His Royal Highness Price Vajiralongkorn ascended to the throne as King X on December 1st, 2016, after death of His Majesty the King Bhumibol Adulyadej on October 13, 2016.

7) Politics

There were drastic changes in politics in Thailand, starting from Antigovernment activities against Taksin Authority, which had been formed since 2001, became

intensified in 2006, and a military coup occurred on September in 2006. Then Peoples Power Party, in line of ex. Premier, kept majority and took power in government administration after general election held on December, 2006. However, the government was collapsed on December, 2008. After the end of People Power Party's rule, The Democratic Party came into office with power until May 2011, then Thai Contribution Party became the ruling party because of another general election held on July, 2011. Administration management done by the Thai contribution party lasted for more than two years, however draft law for amnesty cause political instability again in Thailand. During protest government initiated by Peoples Reform Democratic Committee, last election was held on February, 2014, however as judged by the national supreme court, the result of the election became ineffective and in addition the court dismissed the prime minister on a charge of abuse of office powers. With the background said above, National Council for Peace and Order was set up to hold absolute power over the country and keep on holding its power as of January, 2017.

8) Economy

General Domestic Product (GDP) of Thailand in 2015 reached to 395 billion U.S. Dollar, and US$5,878. - per capita. Economic growth rate is 2.8%. Unemployment ratio in Thailand is 0.8%, which is low level in the world, and agriculture sector, fishery sector and manufacturing sector employ a lot of foreign labors from neighboring countries. Major economic activities in the country is primary industry in terms of number of persons engage in, which covers almost forty percent in total number of person engage in economic activities, while manufacturing industry in terms of GDP, which occupied approximately thirty-four percent, by sector.

Amount of export was 212 billion US dollars and that of import was 177.5 billion dollars. Electric Appliances & Parts, Automotive and parts, machine tools, agricultural products & processed products are the main items for export, while machine tools, crude oil and electric parts are the main items for import. Since ASEAN Economic Community (AEC) was inaugurated by the end of the year 2015, Thai expects to have further economic development due to less limitation on man-power, material, and capital crossing boarders among countries in the community.

Furthermore, Thai is in rich with tourism resources, such as beach resort in southern part and historical places and heritage in the central & northern parts, and

therefore tourism is counted as one of the most important industries in Thailand. There were 26.55 million tourists in 2013, then once reduced to 24.81 million in 2014, number of tourist visited to Thailand increased and reached to 29.88 million, which is almost 30.00 million in 2015. As number of tourist visited to Thailand reached to 9 million for the first three months, which is 15.45 percent increase from figures recorded in previous year), the Government of Thailand prospect to have 32-35 million tourists would visit to Thailand in 2016.

9) Administrative Organization

Administrative Division in Thailand is divided into three categories, i.e., central government, local governments and local administrative offices. The central office consists of cabinet and authorities under different ministries. The local governments are administrative agencies set up at each province as local agencies of the central government headed by the governor dispatched by the Ministry of Interior. Other ministries dispatch their personnel to the local government to support their activities in provincial level. The local administration conducted by local administrative offices mean local administration in their jurisdictional areas and local administrative offices have legislatures with authority to issue notifications and/ or ordinances and executive bodies.

Local administrative by the central government is divided into five levels containing province, district, sub-district, tambol and village. Local government, seventy six provinces in the country as highest in the level responsible for policy, implementation, supervising of the projects to be implemented by the central government, such as any of those in the fields of rural development, employment promotion, improvement of public health and etc., while local administrative offices is divided into Provincial Administrative Office (PAO), Municipality and Sub-district Administrative Office (SAO) together with Bangkok Metropolitan Administrative Office (BMA) and Patthaya as special cities in the country. Figure 2-1 shows correlation among the government agencies related to local administration.

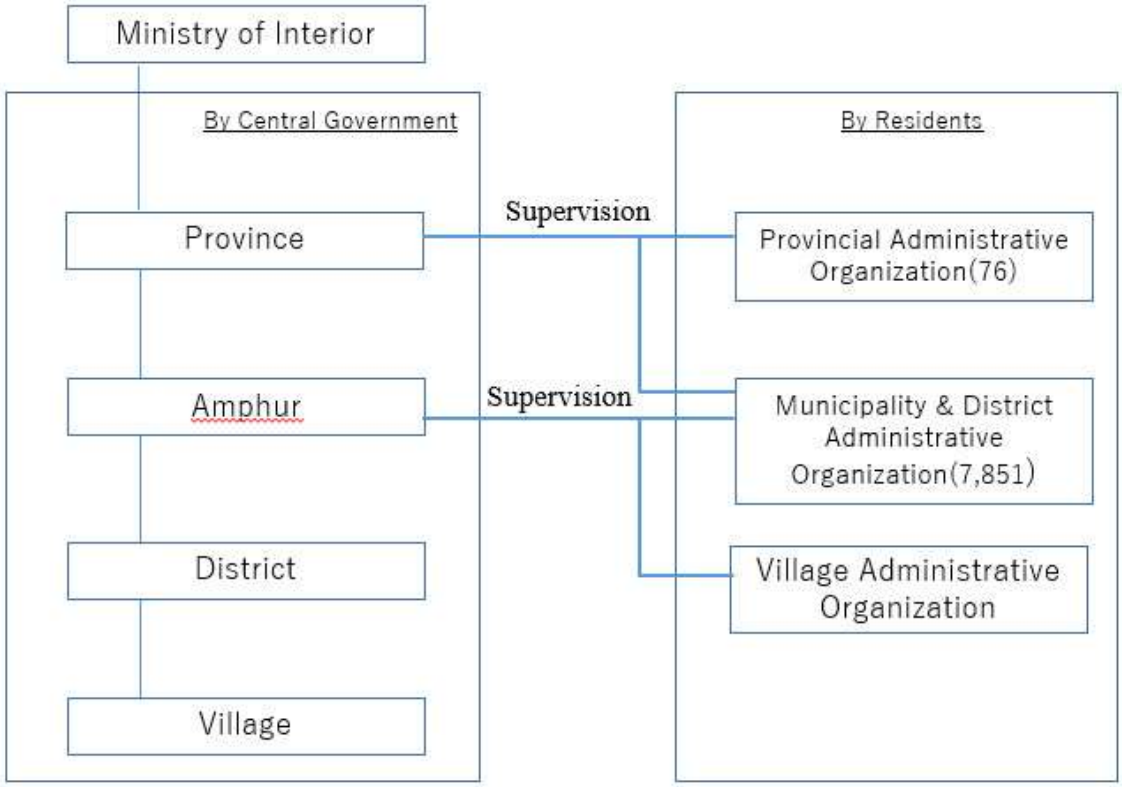


Figure 2-1 Correlation among the Government Agencies related to local administration
Source: EXRI based on information published by the Ministry of Interior

The Ministry of Interior appoints head of local governments, such as governors and head of district offices, while other government agencies dispatch responsible personnel for their competent businesses in each local administrative area. Governors and head of district are empowered maximum authority in local administration in both province and district levels. Local employees work under the governors and/or head of district together with personnel dispatched for their competent businesses from central government. On the other hand, local administrative offices operated by residents in areas consist of legislature with elected councilors and implementation agencies headed by the chief executive officers. Provincial Administrative Organizations responsible for supporting governors, coordination among other local administrative offices, support for local administrative organizations in the same province, and provide services for public facilities, medical services, employment promotion support and so on.
Mayors and heads of Tambols and Villages are selected by direct election by the residents in the area. The deputy mayor as a head of administration together with personnel work for the offices manage local administration in the area. Local assembly are legislature for the local administrative organizations.

(2) Relevant laws & regulations on the targeted project

The targeted project in this study is Waste to Energy project utilized combustible waste contained in municipal solid waste as alternative fuel for power generation. Thus, various laws and regulations will directly or indirectly cover the targeted project. Those are, for example, Approval on Investment, Handling Municipal Solid Waste, Power Generation License, and contract. Italian Thai Development PCL and Thai Eastern Group are potential co-investors for the project, and EX Research Institute Limited considers to participate in the special purpose company (SPC) as representative company from Japan. Therefore, from the point of view of risk management on participation in the SPC, the project implementation body made applicable laws & regulations in order.

1) Municipal Solid Waste related laws & regulations

Waste in Thailand, as the same as in Japan, is categorized by General Waste and Industrial Waste, then Hazardous Waste and Non-Hazardous Waste in both categories. Other than the categories mentioned above, there are Infectious Waste and Radioactive Waste. Applicable laws and regulations are depending on the types of waste, and competent government authorities manage applicable laws & regulations (published as notification and/or ordinance) for such waste. The current government has been working for restructuring waste related laws & regulations since publish of their policy on unification of the relevant laws and regulations in 2013. Although the draft law on cleanliness and order was submitted to the cabinet in 2016, The project implementation body made existing applicable laws & regulations in order as per shown in Table 2-1 below.

Table 2-1 Waste Classification with competent government authorities

Categories		Competent Agencies
General Waste	Municipal Solid Waste	Ministry of Natural Resources and Environment (MONRE), Ministry of Health (MOH), Ministry of Interior (MOI/DLA), Local Governments
	Sludge	
	Hazardous Waste	
	Infectious Waste	
Industrial Waste	Non-Hazardous Industrial Waste	MONRE, Ministry of Industry (MOI)
	Hazardous Industrial Waste	MONRE, MOI, Ministry of

		Transport
	Radioactive Waste	MOH, MONRE

As per shown in Table 2-1, municipal solid waste is managed by the Ministry of Natural Resources & Environment, the Ministry of Interior, the Ministry of Health, and Local Governments in the areas.

The government agencies mentioned above are empowered to manage waste by the laws shown in Table 2-2.

Table 2-2 Municipal Solid Waste Related Laws

Name	Outline (Waste Related only)
Local Government ACT B.E.2496 (1953)	Empowered local governments to manage municipal waste in the areas
Atomic Energy for Peace ACT BE2504	Management on radioactive waste
Enhancement & Preservation of National Environment ACT B.E.2535 (1992)	Formation of National Environmental Committee & Pollution Control Committee, and National Planning on Environment
Public Health ACT B.E.2535(1992)	Prescribed definition and management of general waste and infectious waste of those wastes
Hazardous substance ACT B.E.2535 (1992)	Prescribed definition and management of hazardous waste
Factory ACT B.E.2535(1992)	Prescribed definition and management of industrial waste
Maintain Cleanliness and order of the nation ACT B.E.2535 (1992)	Prescribed duty of the local governments in terms of cleanliness and order in the areas
Provincial Administrative Office ACT B.E.2540(1997)	Prescribed duties of provincial administrative offices on waste management by municipalities and SAOs
Decentralization and local governance ACT B.E.2542(1999)	Prescribed implementation of waste public works, including waste management by local government

All the laws, except for any of those related to infectious waste and radio actives govern municipal solid waste management in Thailand, which is broadly classified into three by objectives, i.e., preservation of national environment, public health & sanitation and orders and instruction for administrative purposes.

Enhancement & Preservation of National Environment ACT B.E.2535 (1992) for environmental conservation & protection, Public Health ACT B.E.2535(1992), Maintain Cleanliness and order of the nation ACT B.E2535 (1992) for public health, and Public Health ACT B.E.2535(1992), Local Administrative Office ACT B.E.2546(2003), Provincial Administrative Office ACT B.E.2540(1997) and Decentralization and local governance ACT B.E.2542(1999) for administrative management are applicable laws for the targeted project.

Outline of Municipal solid waste related prescriptions shown in the major laws are as follows;

Enhancement & Preservation of National Environment ACT B.E.2535 (1992)
Outline ● Environmental Conservation ● Environmental Standard (Public Water, Sea Water, Underground Water, Atmosphere, Noise, Vibration, and others) ● Planning and Implementation of National and Provincial Environmental Plans (National Plan shall be planned by the Minister of Natural Resources & Environment and those for the provinces by the governors for approval given by the committee) ● Funding & Operation of Environmental Committee ● Funding & Operation of Environmental Fund

Enhancement & Preservation of National Environment ACT BE2535, is as indicated by name, was enacted with purpose of enhancement and preservation of national environment in Thailand. In the Act, there is definition of environment, quality of environment & pollutant, identification of government authorities as competent agencies with their authorities and responsibility in its general clause, then prescribes founding & operation of National Environmental Committee in Chapter 1, Funding & operation of Environmental Fund in Chapter 2, Environmental Protection in Chapter 3, and Environmental regulation in Chapter 4. In the Chapter of Environmental Protection, there is provision for environmental standard in Article 32, Setting up

National Environmental Plan in Article 35, Planning Provincial Environmental Plan in Article 38, Environmental Impact Assessment in Article 46 and onward. With regard to Municipal Solid Waste, as the Act defines filth as "waste, hazardous material, infectious material, residue from any of such materials, radioactive, heat, ray, noise, odder, vibration and unpleasant substances, which were disposed or discharged from sources of generation, or existing in nature and may impact on quality of environment or harmful & dangerous to public health or with any of such possibilities, Waste is apparently regard as one of filth and therefore waste management is governed by the Articles in the Act.

Public Health Act B.E. 2535
Outline ● To appointed Minister of Health as competent minister ● To empower the competent minister to enact ministerial orders and issue notification of the ministry and prescribed responsibility of local government ● To fund & operate Public Health Committee ● To manage solid waste & waste water

In the Public Health Act, define solid waste as "paper waste, fiber waste, kitchen waste, waste, plastic waste, container waste, ash, animal manure, dead body of animals, and waste gathered from cleaning at roads, markets, farms and others" in Article 4. Then prescribe local governments as responsible parties for solid waste and waste water in Article 18, authority of local governments to outsource solid and waste water related activities and its condition in Article and empower local governments to issue notification and ordinance for waste collection, transportation, and disposal from the point of views of sanitation and management in Article 20 in Chapter 3.

Decentralization and local governance ACT B.E.2542(1999)
Outline ● Appoint Prime Minister, Minister of Finance, and Minister of Interior as competent ministers for the Act. ● Establish decentralization and local government committee and prescribe authority and duty ● Prescribe demarcation among central government and local governments in public service ● Prescribe authority and duty of local governments

- Prescribe revenue sharing scheme among central government and local governments

Municipalities, Patthaya special city and district offices are authorized to supervise thirty-one type of activities lead to public interest for the people in the area by the Article 16 of the Act. Sanitary management is listed in 17 and solid waste management in listed in 18 together with waste water management. Provincial offices too are authorized to supervise twenty-nine type of activities lead to public interest for the people in the province. Environment & Waste Management, 5 Environmental conservation and preservation and Pollution Control are listed in No. 5. No. 11 and No. 12 accordingly.,

2) Environmental Standard

The Ministry of Natural Resources and Environment has set up Environmental Standard in accordance with Enhancement & Preservation of National Environment ACT B.E.2535 (1992) in Thailand. To say more concretely, the Minister of Natural Resources and Environment is authorized to set up environmental standard upon approval given by National Environmental Committee together with comments received from pollution control committee by the Article 5 of the Act. In addition, the Article prescribes superiority of the environmental standard set up by the competent minister above to other standard set up by other laws, except for the case the value announced in such notification are stricter than the standard said above. The competent minister for the environmental standard is the minister of Natural Resources & Environment as of February, 2017, and as far as our targeted project concern, environmental standard for flue gas and waste water from incinerator and power station set up by the Ministry of Industry shall be applied. Furthermore, labor environment shall be in accordance with the standard noticed by the Ministry of Labor. Environmental standard applied for the project will be explained in latter part.

3) Power Industry related

National Energy Policy Committee Act is the Act prescribes foundation of the Energy Policy Committee as the highest government authority for decision making in energy management in Thailand. The Act has been enacted in B.E.2535(1992) and revised in 2007 and 2008. The Act prescribes foundation of the committee, composition of committee member with prime minister as chairman and authority of the committee.

- Planning of National Energy Policy and Submission to the Cabinet
- Planning of National Energy Management & Development Plan and submission to

the cabinet

- Prescribing price policy in accordance with policy & plan said above.
- Authority & Duty of Government Agencies, States Enterprises, and Private Sector in energy sector on Supervision, coordination, support, and promotion
- Evaluation for implementation of National Energy Policy and National Energy management & Development Plan

In Energy Industry Act B.E.2550 (2007), the Government prescribes to found energy regulatory committee and authority & duty of the committee, along with type of license required for each type of business in energy sector.

4) Feed in Tariff

The Energy Regulatory Committee announced as of January 23, 2015, that "The government recognized the guideline for tariff applicable during transition period from adder to FIT as a result of consultation on power purchasing from renewable energy (not including solar power) at 147th cabinet meeting held on December 15, 2014 and did public notice on January 21st, 2015, of which outline is as follows;

Article 1

This Notification is named "Notification of Energy Regulation on power purchase from renewable energy excluding solar power during transition period from Adder to FIT B.E. 2558

Article 2

This Notification will be made effect on and after the next day of the notification be announced.

Article 3

This Notification will not be applicable for any business operations generating power from renewable energy and selling under the Adder tariff

Article 4

This Notification will be applicable for any business operators to generate power from renewable energy, but not including solar, and plan to sell power under the Adder tariff.

Article 5

In this notification

"Power Authority" means both Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA)

"Project" means project generate power from renewable energy but not including solar and apply for power purchase agreement to either PEA or MEA under the Adder Tariff

Article 6

Any business operators who want to change their power purchase agreement from Adder to FIT in accordance with the Notification shall comply with the terms & conditions below;

(1) Business Operator(s), who has not yet commissioned with grid owned by power authority or has signed up contract within B.E. 2557(2014), or within the period of Scheduled Commercial Operation Date(SCOD) and did not extend SCOD, enable to sell power under FIT after the SCOD stated in PPA application form under Adder Tariff.

(2) Any project(s) applied for PPA, but not yet been approved. Energy Regulatory Committee will receive competitive proposal under FIT

Article 7

Schedule and Procedure shall be as follows;

(1) Application to cancel & re-apply of power purchase agreement to the Energy Regulatory Committee shall be done by 15:30 o'clock on February 2, B.E. 2558 (2015) by form 2 attached to the Notification. No refund for bank guarantee

(2) New Application for power purchase agreement to the Energy Regulatory Committee shall be done by 15:30 o'clock on February 27, B.E. 2558 (2015) by form 3 attached to the Notification

Appendix

1. FIT for VSSP utilize renewable energy
2. Application Form to cancel existing power purchase agreement
3. Application for power purchase agreement for MEA & PEA

Table 2-3 Appendix 1 of Notification of Energy Regulatory Committee

Type of Business and capacity (MW)	FIT (THB/Unit)			Contract (Year)	FIT Premium (THB/UNIT)	
	FiT_F	$FiT_{V.2560}$	FiT (1)		Biomass (8years)	South Premium(2) (during contract)
1.Municipal Solid Waste						
Capacity≤ 1 MW	3.13	3.21	6.34	20	0.70	0.50
Capacity1-3 MW	2.61	3.21	5.82	20	0.70	0.50
Capacity> 3 MW	2.39	2.69	5.08	20	0.70	0.50
2. Landfilled Garbage	5.60	-	5.60	10	-	0.50

3.Biomass *(Direct Combustion)*						
Capacity≤ 1 MW	3.13	2.21	5.34	20	0.50	0.50
Capacity1-3 MW	2.61	2.21	4.82	20	0.40	0.50
Capacity> 3 MW	2.39	1.85	4.24	20	0.30	0.50
4.Biogas (Waste Water / Solid Waste)	3.76	-	3.76	20	0.50	0.50
5.Biogass (from Biomass)	2.79	2.55	5.34	20	0.50	0.50
6.Small Hydro						
Capacity ≤ 200 kW	4.90	-	4.90	20	-	0.50
7.Wind	6.06	-	6.06	20	-	0.50

Remarks:

1) FIT: This rates are applicable for any projects, which will supply power to the national grid from the date of notification published until the end of B.E.2560 (2017) FITv : The rate will be applicable for any project which utilize waste, biomass or biogas as fuel on and after January 1st, B.E. 2561(2018). The rate will be fluctuate depending on core inflation rate against fuel, biomass, and biogas
2) The rate is applicable for any projects to be implemented in YALA province, PATTANI province, NARATHIWAT province and CHANA,TEPA,SABAYOI, NA THAWI districts in SONGKHLA province

Source : The Energy Regulatory Committee (Translated by EX Research Institute)

5) Investment related

There are various laws, such as Commercial Laws for general case, and Investment Promotion Act B.E.2520(1997), Foreign Investment Act B.E.2543(2000) and others, depending on the business form. In this report, we refer outline of Private & Public Partnership Act B.E.2556(2013), as the Act is one of the biggest obstacles in targeted project

The Act was enacted on March 29th, 2013 and announced in governmental gazette no.130 dated on April 3rd, 2013. The definition of "public Project" in the Article 4 of the Act is as follows;

- The Project(s) which government and/or local government(s), solely or multiply responsible for implementation & operation
- The project(s), which utilize natural resources or asset belong to single or multiple

government agency(ies) or local governments

As stated, the Government prescribes that waste in the area shall be collected, transported, processed, and disposed by local government(s) administrate in the area. Thus, waste management is categorized the project, which government, or local government(s) responsible for implementation & operation. In addition, there is another understanding for waste, i.e. waste is asset insisted by the Ministry of Natural Resources and Environment and for the case their understanding would be accepted by the government, waste related business operation would be categorized as the project which utilize natural resources and/or asset belong to the government or local government(s). Articles related to the targeted project are Article 23, which prescribes that the any projects with more than THB1,000 million as investment shall apply for the Act and proceed in accordance with the guidelines in the Notifications issued by the committee for private investment in public project, Article 24, which prescribes procedure for approval to be given by host agency(ies), such as competent government agencies and states enterprises. Once the project proposed by the Host Agency has been approved by the committee in accordance with Article 18 Section 2, go for implementation (selection of party(ies) and contract) in accordance with Articles in Chapter 5. The project will be supervised by the supervising committee nominated by the relevant government authorities as per provision stated in Chapter 6. Except for the case that both the Host Agency(ies) and Evaluation committee agreed, party(ies) would be selected by tender as per provision given in Article 32 and following Articles.

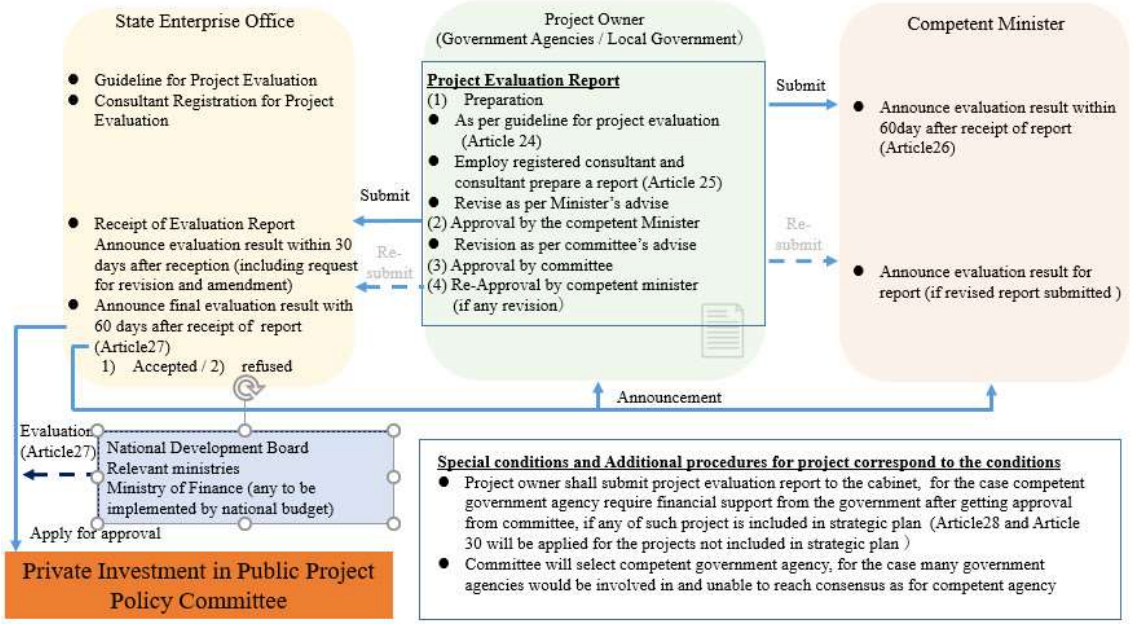


Figure 2-2　Approval Process for Private Investment in Public Project

Source:　Private Investment in Public Project Act (edited by EX Research Institute)

The Act is one of the biggest obstruction in materialization of the waste to energy projects in Thailand together with power purchase agreement. Issues are troublesome procedure for getting approval from the government and it is said that it would take at least two year to get approval after submission of application, except for the case of projects in first truck. Both government and private sector widely recognize the issue, and therefore the Ministry of Interior prepared and proposed revised Maintain Cleanliness and order of the nation ACT to the cabinet for consideration. In the Draft Act, waste related business will be exclusion from Private Investment in Public Project Act, thus the parties involved in expect to speed up materialization of projects in the field.

(3) National Policy & Plan related to the targeting project

1) National Economy & Social Development Plan

The Plan is five-years plan for economic and social development in Thailand. Latest 国 version is 11th plan (2012-2016). In the 11th plan, the Government of Thailand plans to develop the country, which is in fast changing world, with the concept of sustainability and resilience in all sector. The concept is from "Sufficient Economy" which is the basic concept indicated in 9th development plan from the lessons learnt from Asia economic crisis. In the plan, the government listed new regulations governing the world, economic communities, aging society, climate change, food & energy security, state of art technologies, social development, and terrorism as factors to be considered and access the impact on the country. Impact assessment has been done from four aspects, i.e., economic impact, social impact, natural resources & environment, and administration, and concluded that balance between the issues might occur from degrading environmental quality & climate change and economic development shall be considered. Then place "Sufficient Economy" stated above as basic concept, enhancement of the nation & optimization of sustainable development as development policy and enhancement of social capital and natural resources reserve as targets. The government set up strategies covering thirty-eight projects in six sectors, and strategies in environment, waste and energy sectors are as per listed below.

5.3	**Enhancement of Agriculture Sector and Food & Energy Security**
5.3.5	Food Reserve at household and community level and development of bio

	energy
5.3.6	Enhancement of Energy Crop (Supervising, Research & etc.)
5.3.7	Promotion on participation in food & energy security
5.6	**Natural Resources and Environment management for realization of sustainable society**
5.6.1	Management of Natural Resources and Environmental Conservation
5.6.2	Realization of Low Carbon Society
5.6.3	Enhancement of resilience in climate change
5.6.4	Enhancement of natural disaster measures
5.6.5	Enhancement of resilience against external factors in environment
5.6.6	Enhancement of Thai' role in the field of environment in international society
5.6.7	Pollution Control
5.6.8	Improvement of the natural resources and environmental management system with fairness and transparency

Any plan under Private investment in public project, as the same as other plan, shall be consistent to the Thai constitution and the National Plan said above (Article 19)

2) National Policy & Plan related to Environment

As prescribed by the Article 13, 35 and 37 in Enhancement & Preservation of National Environment ACT B.E.2535 (1992) stated above, The Minister of Natural Resources and Environment shall prepare National Environment Plan and Governors shall prepare Provincial Environment Plans to be submitted to National Environmental Committee for approval. Beside the Pollution Control Department, by cabinet[4] order in 2013, prepared road map for solid & hazardous waste management and get an approval on it from the cabinet on August, 2014. Based on the road map mentioned above, the Pollution Control Department prepared master plan (B.E.2559-2564(2016-2021)) and was approved by the cabinet on May, 2016. Waste Management in Thailand will be proceeded as per master plan, which consist of five chapters with six appendixes.

[4] NCPO=National Committee for Peace & Order

In the Chapter I of the Master Plan, the Pollution Control Department (PCD) overlooked the current situation of waste management in the country and expressed their concern on impact on environment and health from contamination of underground water by leachate water and odder from inappropriate waste management, such as open dump sites. Then PCD explained that the National Council for Peace & Order (NCPO) put highest priority on municipal solid waste management and as a result, NCPO approved master plan drafted by PCD accordingly. PCD also explained basic concept for waste management in the country is 3Rs, and promote private investment in WtE projects.

In the Chapter II, PCD classified "waste" into 5 types, i.e. general waste from households, general waste from communities, hazardous waste from communities, infectious waste, and industrial hazardous waste in 2.1. As Definition of "Waste from community" is given as "waste generated from activities in communities and to be generated from residences, offices, communities, market, organization and others" it matches with general waste in Japan. In 2.2 and followings, explained situation and issues for municipal solid waste (2.3), hazardous waste (2.4), Infectious waste (2.5) and Industrial Hazardous Waste (2.6) based on statistics for waste published in National Environmental Report 2015. Details of description as for Municipal Solid Waste, which implicated with the target project will be explained in (4)-1) in this report.

The Chapter III is the core of the master plan, in which pollution department explained their policy that the government places resources saving and 3Rs as basic concept and setting Vision, objective(s), goal(s), frameworks, implementation, priority as follows;

[5] Numbers of appendixes are as per Thai Alphabetic order

1. Vision

Solid Waste Management shall be systemized & integrated with participation of all sectors.

2. Objectives

(1) The plan indicates framework and direction to solve the issued in soils and hazardous waste in Thailand

(2) The plan is a guideline for solid and hazardous waste management in Thailand and aims to integrated management by government, private sector, and citizen

(3) Province and Local Governments shall set up waste management plan relevant to actual situation in the areas and implement those.

3. Goals

Target(s) for solid and hazardous waste management set up in this plan are as follows;

- 75% of solid waste in total will be appropriately processed by B.E. 2564(2021)
- 100% of landfilled accumulated waste by B.E.2558(2015) will be cleared by
- 30% of hazardous waste in total will be appropriately processed by B.E.2654
- 100% of infectious waste in total will be appropriately processed by B.E.2563(2020)
- 100% of Industrial Waste in total will be managed by the system by B.E,2563 (2020)
- 50% of local government in total will separate waste at waste generating points by B.E.2564(2021)

Targets set up for each year are as below;

	Target by Year (Achievement Rate=%)					
	2559	2560	2561	2562	2563	2564
Appropriate Process of Solid Waste	50	55	60	65	70	75
Appropriate Process of Landfilled Waste	75	85	95	100	-	-
Appropriate Process of Hazardous Waste	5	10	15	20	25	30
Appropriate Process of Infections Waste	80	85	90	95	100	-
Management of Industrial Waste by system	60	70	80	90	100	-
Waste separation at waste generation points by local governments	5	10	15	20	25	30

4. Framework

(1) 3R

(2) Wide area processing for solid & hazardous waste and utilization as energy

(3) Participation of all the concerning parties and responsibility assignment

(4) Establishment of solid and hazardous waste management method

In the Chapter IV, the Pollution Control Department identify the guidelines and parties concern and make those in order. Outline of the Chapter is as below;

Reduction at generating points

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
Reduction of solid and hazardous waste at generating points	Reduction of amount of solid and hazardous waste & promoting of waste separation for reuse	Prime Minister's Office (PMO), Ministry of Education (MOE) and Ministry of Natural Resources and Environment (MONRE)	Ministry of Interior (MOI (1)), Ministry of Health (MOH) People
	Promotion on utilization of environmentally friendly products and reuse	PMO MOE MONRE	MOI (1) People
	Reduction or prohibition of plastic container & packaging utilization	All government agencies Private Sector	People
	Prohibition of plastic container and packaging by introduction of deposit system for returnable containers at tourist spots	Ministry of Tourism (MOT) MONRE	Private Sector
	Waste Reduction at educational institutes by founding renewable waste bank for students & youth etc.	MOE	MONRE
	Purchasing green products & services by the government agencies	MONRE Ministry of Finance (MOF)	Ministry of Industry (MOI (2))
	Supporting development &	MOI (2)	MONRE

	manufacturing of reusable and durable products & containers		MOF Private Sector
	Waste reduction from manufacturing and promotion of reuse of waste & sub-products from manufacturing	Private Sector	MOI (2) MONRE
	Establishment of efficient use of resource including networking among manufacturers	MOI (2)	Private Sector

Consideration method for potentiality of general & hazardous waste

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
Improvement on collection & transportation of solid and hazardous waste	Evaluation of solid and hazardous waste collection & transportation (including equipment, vehicle & transfer)	Local Governments, Provinces and Patthaya special city (Patthaya)	MOI (1) MONRE
	Waste separation and setting of date & time for different type of waste by local governments		
	Waste separation and collecting system for the municipal solid waste to be generated at tourist spots, especially in the high season.		
	Preparation of Transfer Station		
	Enhancement of hazardous waste management	MOI (2)	MOI (1) and Local Governments
	Optimization of documentation for Infectious	MOH and MOI (1)	MONRE

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
	waste management		
	Issuance of ordinance as for waste separation and service charge for waste collection by local governments	Local Governments	MOI (1), MOH & MONRE
	Promotion of waste separation system with communities and recycling companies	MOI (1)	MOH, MOI (2), MONRE & Private Sector
	Collection of used products under the EPR and appropriate waste processing from the point of view of environmental consideration		
Waste utilization in More efficient way	Preliminary study & evaluation for closure and renovation of landfills (waste quality & landfill sites)	Local Governments, Provincial Office, Patthaya & private sector	MOI (1) & MONRE
	Closure or renovation of existing landfills and transport new waste to renovated landfills or utilization as fuel		
	Upgrading from OPEN DUMP to SANITARY LANDFILL		
	Supervising & monitoring of leachate from landfills and waste water nearby		
Establishment of model project for solid waste processing	Establishment of Waste Center	Local Government, Provincial Offices, Patthaya and	MOI (1), MONRE, Ministry of Energy (MOE (2)), MOT,
	Integrated solid waste processing and utilization as energy		

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
	Solid waste separation and utilization as energy	Bangkok Metropolitan Administrative Office (BMA)	Ministry of Defense, Private Sector & Special Economic Zone (SEZ)
	Areal Prioritization and financial support		
	Preparation of guideline for waste management for the zone, such as tourist spots and special economic zones (SEZs)		
Hazardous waste management	Preparation of storage for hazardous waste and transportation for processing and disposal	Local governments, provinces, BMA and Patthaya	MOI (1), MONRE& Private sector
	Preparation of industrial waste processing facilities covering all the area in the country	MOI (2)	
	Promotion on E-WASTE separation and recycling	MOI (2)	
Separate Management of Infectious Waste	Preparation of Processing facilities and waste separation at waste generating points, such as hospitals and clinics	Local governments, provinces, BMA and Patthaya	MOH, MOI (1), MONRE & Private Sector
Laws & Regulations	Implementation laws & regulations for specific type of waste such as E-WASTE	MONRE	MOH, MOI (1), MOI (2), MOT & MOE (2)
	Revision of Public Health Act (Collection, Processing Fee & traceability of Infectious waste, and Establishment of monitoring system)	MOH	MOI (1), MONRE, & MOI
	Revision of Hazardous Substance Act B.E.2535 and	MOI (2)	MONRE

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
	reinforce penalty & revoking of operation license		
	Preparation of laws & regulations to support alliance of local governments and development & operation of all landfills	MONRE, MOI (1) & MOH	Local Governments & Province
	Fixation waste disposal points and time & date for waste collection	Local governments, provinces, BMA and Patthaya	MONRE & MOH
	Preparation of a guideline for private sector who consider investment in waste related business	MOI (1), MOT (2), MOI (2) & MOE	MONRE & MOH
	Preparation of guidelines for both general & hazardous waste management (sites selection, structure, construction, operation, infectious waste, operation of incinerators for hazardous waste)	MONRE & MOH	MOI (1) & Ministry of Science & Technology (MOST)
	Compensation for residence near landfills	MONRE, MOH& MOI (1)	Local Governments & Province
	Proclamation of laws & regulations as for waste management at tourist spots		
	Revision of laws & regulations as for private sectors' involvement in waste related business		
	Supervision & monitoring of hazardous waste generators		

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
	by monitoring system		
	Monitoring on Illegal dumping and legal actions against violators		
	Environmental monitoring on neighborhood area of landfills and compliance to environmental standard by landfills operators		

Supporting methods for general & hazardous waste management

Category	Guideline	Implementation body(ies)	Supporting Party(ies)
Supporting on general & hazardous waste management	Awareness raising for promoting people's participation in waste management	MOH, PMO, MONRE & MOI (1)	People & Private Sector
	Awareness raising for waste separation at tourist spots		
	Introduction of waste management education related curriculum by educational institutions		
	Development of evaluation system for Products Life and promotion of purchasing and utilization of products made from recycled material with high durability		
	Consideration on management method and technic in relevant to actual situation in areas and Development of method		

The government of Thailand has announced a cabinet decision on August 19, 2014, in which the government authorized the Ministry of Interior to develop pilot model through implementation of the project in Ayutthaya, and announced again on June 12th, 2015 that the government authorized the Ministry of Interior to responsible for the case of Ayutthaya and general waste in Thailand. In response to the cabinet decisions mentioned above, the Ministry of Interior has published "guideline for general waste management in Thailand" on June, 2015、which made it clear that the Ministry of Interior would take initiative in waste management in Thailand, except for policy making and technical evaluation. In the guideline, the Ministry of Interior referred clustering, cost for appropriate processing & disposal and laws & regulations as three major issues in waste management in Thailand. Outline of the guideline is as follows;

Clustering

Clustering in waste management mean optimization including wide area processing by grouping of provinces and local governments. Clusters indicated in the guideline are as follows;

Table 2-4 Definition of cluster by size

Classification	
Large Scale (L)	Amount of general solid waste to be collected & transported will be more than 500tons/day
Medium Scale (M)	Not less than 300ton but not more than 500tons/day
Small Scale (S)	Less than 300tons/day

The Ministry of Interior explained necessity of consideration of cost effectiveness in wide area processing, residents' agreement on construction of wide area processing facilities and recognition of basic principal of "waste generators' responsibility for waste" Situation by clusters is as follows;

Table 2-5　Potentiality of each cluster

Classification	Potentiality
Large Scale (L)	Enable to have 44 wide area processing groups in 27 provinces by clustering of 1,347 local governments, where operators would be able to select processing methods among incineration, WtE, RDF manufacturing and composting.

Medium Scale (M)	Enable to have 60 wide area processing groups in 50 provinces by clustering of 3,092 local governments, where operators would be able to select processing methods among incineration, WtE, RDF manufacturing and composting.
Small Scale (S)	Enable to have 47 wide area processing groups in 47 provinces by clustering 2,165 local governments, where operators would be able to select processing methods among landfill, composting, small scale incineration and composting.

The Ministry of Interior did not include Bangkok Metropolitan into the cluster above and explained that there are 890 million tons per year or 9,914 tons per day of waste generated and transported to three transfer stations, then processed at transfer stations or final disposal sites by landfilling, composting and/or incineration (established with power generating unit)

Processing and/or disposal methods applicable for each cluster is shown in table 2-5 and clusters in all provinces in Thailand is shown in table 2-6

Table 2-6 Processing & Disposal method applicable for each cluster

Cluster	Landfill	Compost	Incinerator (S)	RDF	Incinerator (L)	WtE
L	O	O	O	O	O	O
M	O	O	O	O	O	
S	O	O	O	O		

Table 2-7 Clusters in each province in Thailand

No	Province (as per Thai Alphabetic order)	Amount of Waste (Tons / Day)	Amphur	Cluster			
				L	M	S	Total
1	Krabi	652.19	8	0	1	1	2
2	Kanchanaburi	490.23	13	0	1	0	1
3	Kalasin	381.24	18	0	1	0	1
4	Kamphaeng Phet	380.48	11	0	1	0	1
5	Khon Kaen	2,159.45	26	2	1	1	4
6	Chanthaburi	492.37	10	0	1	0	1

No	Province (as per Thai Alphabetic order)	Amount of Waste (Tons / Day)	Amphur	Cluster			
				L	M	S	Total
7	Chachoengsao	1,994.78	11	1	1	1	3
8	Chonburi	4,045.17	11	4	0	1	5
9	Chainat	309.97	8	0	1	0	1
10	Chaiyaphum	791.07	16	1	0	1	2
11	Chumphon	304.78	8	0	1	0	1
12	Chiang Mai	1,225.88	18	1	1	1	3
13	Chiang Rai	1,801.81	24	2	0	2	4
14	Trang	505.15	10	1	0	0	1
15	Trat	900.39	9	0	2	0	2
16	Tak	253.33	7	0	0	1	1
17	Nakhon Nayok	840.93	4	1	0	1	2
18	Nakhon Pathom	1,810.20	7	1	3	0	4
19	Nakhon Phanom	428.42	12	0	1	0	1
20	Nakhon Ratchasima	1,217.59	32	1	1	1	3
21	Nakhon Si Thammarat	1,216.90	23	1	1	1	3
22	Nakhon Sawan	929.76	15	1	0	1	2
23	Nonthaburi	2,357.83	6	2	2	0	4
24	Narathiwat	266.22	13	0	0	1	1
25	Nan	410.79	15	0	1	0	1
26	Bueng Kan	2,653.50	23	4	1	0	5
27	Buriram	637.60	8	1	0	1	2
28	Pathum Thani	2,296.09	7	3	0	0	3
29	Prachuap Khiri Khan	913.37	8	0	2	0	2
30	Prachinburi	413.45	7	0	1	0	1
31	Pattani	517.87	12	0	1	1	2
32	Phra Nakhon Si Ayutthaya	1,640.90	16	2	0	2	4
33	Phang Nga	285.51	9	0	0	1	1
34	Phatthalung	413.64	8	0	1	0	1
35	Phichit	548.08	11	0	1	1	2
36	Phitsanulok	450.62	12	0	1	0	1
37	Phetchaburi	666.95	9	1	0	1	2
38	Phetchabun	688.22	8	0	1	1	2

No	Province (as per Thai Alphabetic order)	Amount of Waste (Tons / Day)	Amphur	Cluster			
				L	M	S	Total
39	Phrae	674.20	11	0	1	2	3
40	Phayao	495.58	8	0	1	0	1
41	Phuket	1,104.82	3	1	1	0	2
42	Maha Sarakham	1,098.76	13	0	2	1	3
43	Mukdahan	394.12	7	0	1	1	2
44	Mae Hong Son	178.47	7	0	0	1	1
45	Yala	89.62	9	0	0	1	1
46	Yasothon	484.62	8	0	1	0	1
47	Roi Et	410.65	20	0	1	0	1
48	Ranong	256.71	5	0	0	1	1
49	Rayong	1,545.81	8	2	1	0	3
50	Ratchaburi	781.93	10	0	2	1	3
51	Lopburi	1,035.83	11	1	0	2	3
52	Lampang	821.53	13	1	0	1	2
53	Lamphun	360.33	8	0	1	0	1
54	Loei	730.83	14	0	2	0	2
55	Sisaket	184.13	22	0	0	1	1
56	Sakon Nakhon	435.45	18	0	1	0	1
57	Songkhla	1,546.40	16	2	0	1	3
58	Satun	318.48	7	0	1	0	1
59	Samut Prakan	3,074.76	6	4	0	0	4
60	Samut Sangkhram	330.43	3	0	1	0	1
61	Samut Sakhon	1,494.62	3	1	1	1	3
62	Sa Kaeo	894.07	13	0	2	1	3
63	Saraburi	256.26	9	0	0	1	1
64	Sing Buri	209.02	6	0	0	1	1
65	Sukhothai	359.84	9	0	1	0	1
66	Suphan Buri	654.13	10	0	1	1	2
67	Surat Thani	1,490.87	19	1	1	1	3
68	Surin	252.07	17	0	0	1	1
69	Nong Khai	509.68	9	0	1	1	2
70	Nong Bua Lamphu	184.49	6	0	0	1	1

No	Province (as per Thai Alphabetic order)	Amount of Waste (Tons / Day)	Amphur	Cluster			
				L	M	S	Total
71	Ang Thong	217.78	7	0	1	0	1
72	Udon Thani	336.21	7	0	1	0	1
73	Uthai Thani	687.53	20	0	1	1	2
74	Uttaradit	400.91	9	0	1	0	1
75	Ubon Ratchathani	177.45	8	0	0	1	1
76	Songkhla	2,030.18	25	1	2	1	4
Total		64,801.28	877	44	60	47	151

Source: The Ministry of Interior, Thailand

Processing Cost

The Ministry of Interior set up standard cost for collection & transport and processing from consideration among Department of Local Administration Promotion, Suranari University, Provincial Electricity Authority, and Civil & Construction Department

Distance	Within 30km (unprofitable if distance is more than 30km)			
Transportation Cost	THB850.-/ton (average) THB42.5/ton/km			
Processing Cost	Method	Processing Cost		
	Landfill	THB314.-/t		
	Integrated Processing	THB500.-/t		
	Incineration and/or RDF manufacturing (THB/ton)			
	Amount of waste (t/day)	Incineration	Gasification	RDF
	>50		880	330
	50-100	1,500	743	240
	100-200	1,300	635	197
	200-500	1,027	430	54
	>500	869	-	32
	>1,000	762	-	

Legal Consistency

The Ministry of Interior explained legal consistency for empowerment of the Ministry as follows;

- Although Article 23 of the District & Sub-District Administrative Act B.E.2537 as well as Article 50, 53 & 56 of Municipality Administrative Act B.E.2496 prescribed responsibility of local government on waste management in the area, no provision as for authority & functions of the Ministry of Interior was given.
- It is necessary to empower the Ministry of Interior, to progress waste management in Thailand more smooth, by granting authority to decide standard & tariff for waste collection & transportation.
- The Ministry of Interior is under processing for revision of National Cleansing and Order Act, as the Act was enacted in 1992 and does not matched with actual situation at present.
- Transferring provisions for waste management from Public Health Act & provision for authority for budget inclusion from Conservation of National Environment Act to National Cleansing & Order Maintenance Act.

Renewable Energy

Power Development Plan (2015-2036)

The Energy Policy Committee has approved Power Development Plan (2015-2036), which is twenty-one years' energy development plan during 2015-2036 as of May 14, 2015, the plan was finalized after holding 6 times public hearings, with consideration on downward revision of GDP caused by economic recession, energy saving plan and development of alternative energy, and consist of three criteria, i.e. National Energy Security, Ecology, and Economy.

Regarding promotion of renewable energy utilization, there are relevant descriptions in both national energy security and ecology and set up its target doubled from previous plan approved in 2010 (ratio of power supply has been increased from 8% in 2030 to 16% in 2016). Outline of the plan is as follows;

(1) Fuel Diversity
- Lower dependability on natural gas
- Increase fuel mix ratio for clean coal technology
- Increase amount of power to be imported from neighboring countries
- Increase ratio of renewable energy utilization in grid mix
- Preparation of nuclear power plant by the end of Power Development Plan 2015

(2) Optimization of safety rate for power supply
- Secure more than 15% of safety rate during peak

(3) Preparation of power system & infrastructure
- Investment on Transmission Lines to support integration between ACE & GMS

- Development of smart grid for optimization of integrated utilization of renewable energy

(4) Grid Mix (1)Technological structure

		Description	Capacity(MW)	
1		Power Generation Capacity (2014)		37,617
2		Power Generation Capacity of New Power plants to be constructed (2015-2036)		57,459
		Breakdown		
	1)	Clean Coal Technology(9 projects)	7,390	
	2)	Natural Gas (15 projects)	17,478	
	3)	Nuclear (2 projects)	2,000	
	4)	Gas Turbine (5 projects)	1,250	
	5)	Co-generation	4,119	
	6)	Renewable Energy	12,105	
	7)	Pump up storage	2,101	
	8)	Import	11,016	
3		Power Generation Capacity of plant to be closed		-24,736
		Total		70,335

(5) Power supply Target by source

Target set up by power source	2014	2026	2036
	%	%	%
Renewable Energy	7	16	18
Hydro	3	2	2
Hydro (Import)	6	9	15
Natural Gas	64	51	37
Coal (Import)	9	15	17
Lignite (Domestic)	10	7	6
Nuclear	0	0	5
Total	100	100	100

(6) Energy Efficiency Development Plan(EEDP) and Alternative Energy Development Plan (AEDP) shall be combined

(7) Energy Saving & GHG emission reduction

- 36% of GHG Reduction by 2036 through utilization of Renewable Energy and

energy saving at industry, commercial building, domestic and public sector
- 89,672GWh of power from expecting power demand in 2036 will be saved

(8) Selling price of electricity will be THB4.87/kWh in average for twenty years.

3) Climate Change

Activities in the field of climate change in Thailand are as described in 1. Outline of the Project, (2) background 1) climate change above. The Government of Thailand, about National Energy Saving Plan for 20years (2011-2030) and Thailand NAMAs toward 2020, set up its intermediate target of 7-20 percent GHG emission reduction by 2020 in comparison with amount of GHG emitted in 2005, and 25% of GHG emission reduction from energy per GDP. The Government of Thailand announced again in Intended National Determined Contribution (INDC) submitted on October 1, 2015 that The Government of Thailand will reduce 20 percent of GHG emission in comparison with that of 2015 (up to 25% depending on support for appropriate technologies, financial support, and capacity building to be provided based on balanced and ambitious agreement under UNFCCC)

Appendix to INDC

Baseline	An amount of GHG emission in 2030 estimated based on that in 2005 (in the absence of major mitigation actions) (Estimated amount of GHG emission in 2030 (BaU) = 555MtCO2e)
Duration	2021-2030
Targeted Sectors	Economy Wide (Including land use, but will judge for land use change and forestry)
Targeted GHG	Carbon Dioxide (CO2), Methane(CH4), Nitrogen-Oxide(N2O)), HFCs, PFCs and SF6
Premise & Methodology	IPCC 4th Assessment Report National Statistics including sector-wise activities and socio-economic prospection
Progress in Planning	- Conducting Public Hearings for INDC - Interest among stakeholders is under adjustment at both cross-agencies type work-group and stirring committee consist of representatives from representative agencies from each sector, academic sector, and private sector - Organized three times of national investigative commissions in assessment phase

	- Drafted in accordance with National plans listed bellows; National Economic Development Plan Master Plan for Climate Change (2015-2050) Power Development Plan (2015-2036) Master Plan for Development of Smart Grid in Thailand (2015-2036) Energy Efficiency Development Plan (2015-2036) Alternative Energy Development Plan (2015-2036) Plan for environmentally sustainable transportation system (2013-2031) National Industry Development Plan (2012-2031) Road Map for Solid & Hazardous Waste Management
International Market Mechanism	The Government of Thailand recognizes importance of market mechanism in enhancement of cost-effective mitigation actions. And therefore, the Government of Thailand looks for measures, such as source of finance, capacity development and technology development & transfer, which will support realization of sustainable & resilient low carbon society together with possibility of utilization of bilateral, regional, and international market mechanism.
Review & Adjustment	The Government of Thailand reserve the right to review and adjust its INDC in accordance with new agreement under UNFCCC.

Statement in relevant to mitigating in the INDC is as follows;

- Amount of GHG emission was 5.63tCO2e/person and 409.54TCO2e/GDP in 2012 in Thailand
- The Government of Thailand has already achieved 4% of emission reduction at the time COP20 was help in Lima, Peru, and continue to make effort to achieve its target of 7 percent emission reduction by 2020
- The Government of Thailand has promoted fuel conversion from coal to natural gas since the beginning of 1980s and 72 percent of power generated in total in Thailand was generated by natural gas in 2005. Consequently, it would cost much to reduce more GHG emission in energy sector.
- The Ministry of Energy placed energy security and economy & ecology as base principal, prepared power development plan (2015-2036), Energy Efficiency Plan (2015-2036)、Alternative Energy Development Plan (2015-2036) in which the Ministry set up its targets of 20 percent for ratio of renewable energy utilization in capacity basis and 30 percent in consumption basis by

2036

- In the Plan for Environmentally Sustainable Transportation System (2013-2031). The Government expect further GHG emission from improvement of bus transportation system, double lines for railway and expansion of train-service areas in Bangkok Metropolitan and introduction of new motor way tax system based on amount of CO2 emission.
-

(4) Current Situation

1) Waste

Fresh Municipal solid waste

Generation, processing, and disposal of municipal solid waste in 2014 published by the Pollution Control Department (PCD) in 2015 is as per Figure 2-3, below.

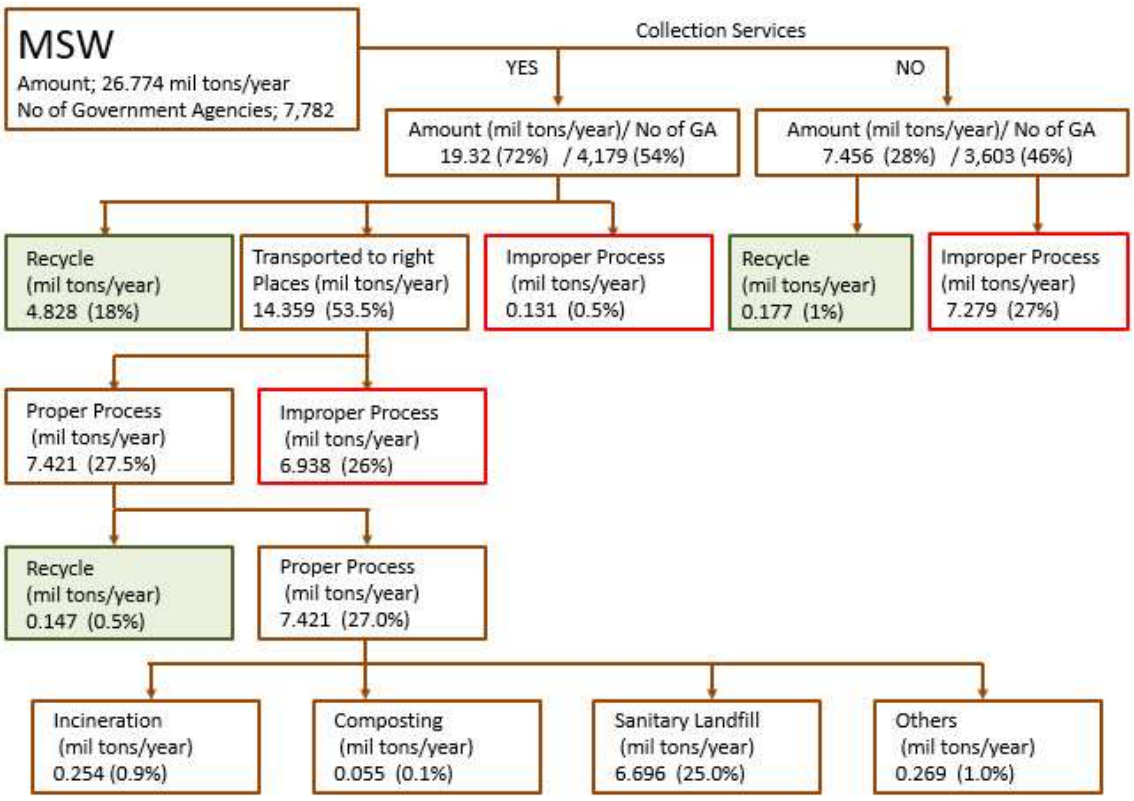


Figure 2-3 Generation, Processing & Disposal of Municipal solid waste in Thailand (2014)

There was 26.19million tons / year or 72 thousand tons / day of municipal solid waste generated in 2014. There are 7,777 government agencies who manage municipal solid waste in Thailand and 4,422 correspond to 57 percent of government agencies among all provide collection & transportation services for municipal solid waste. Amount of

waste collected by 4,422 government agencies was reached to 19.99 million tons or 75% in total, 6.93 million tons of municipal solid waste equivalent to 46.8% of the collected by government agencies (or 20.46% in total) was inappropriately disposed. The Pollution Control Department stated that "inappropriate disposal means disposal at open dump and/or open burning, which government agencies in small size in rural area still continue to process and/or dispose municipal solid waste remain unchanged from old style, and, the Pollution Control Department try to improve by taking various actions, such as clustering such small government agencies with others.

When it comes to classification by processing & disposal, there are 7.85 million tons by appropriate processing & disposal, 13.49 by inappropriate processing & disposal, 4.82 million tons by recycling. Among the waste appropriately processed and/or disposed, 0.39 million tons was incinerated, 0.06 million tons was composted and 7.05 million tons was landfilled. Among the waste. Among the waste reused and/or recycled, 3.63 million tons was used for material recycle, 1.07 million tons for composting and/or anaerobic digestion for methane gas collection and 0.01 million tons for alternative fuel use.

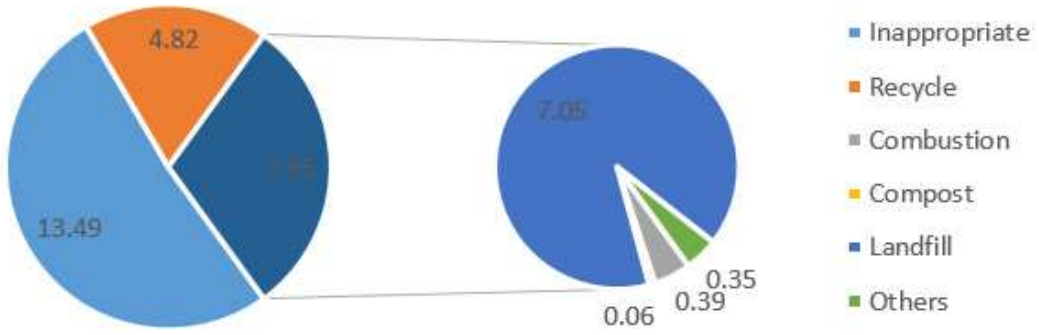


Figure 2-4 Distribution of Waste Processing & Disposal

There are 2,450 processing and/or disposal sites in Thailand, and among them 480 sites are regard as appropriate processing and/or disposal sites, of which details are as follows;

Table 2-8 Details of Appropriate processing &/or Disposal Site in Thailand

Facility type	Number

	Public	Private
Sanitary & Engineered Landfill	73	5
Controlled Dump (Disposal less than 50t/day)	356	25
Incinerator with flue gas treatment facilities	1	2
Incinerator with flue gas treatment facilities (Processing less than 10t/day)	2	0
Integrated System	12	0
Mechanical Bio Treatment	1	1
Waste to Energy	0	2
Total	445	35

The Government of Thailand announced that the government would promote wide are processing of municipal solid waste, private investment, and utilization of municipal solid waste as energy based on the Road Map approved by the cabinet on August 14, 2014 and Master Plan and described 3Rs activities in National Annual Environmental Report in 2014. Transition of amount of waste generated and processing & disposal during 2008-2014 is shown in table 2-8, while comparison among key index between 2013 and 2014 in table 2-9.

Table 2-9 Transition of amount of MSW generated, processed & disposed by type

Year	Amount		Amount & Ratio (unit for amount: million ton)					
	Total (Million ton)	Per person (kg)	Processing & Disposal				Reuse & Recycle	
			Appropriate		Inappropriate			
			Amount	%	Amount	%	Amount	%
2008	23.93	1.03	5.69	23.8	14.79	61.8	3.45	14.4
2009	24.41	1.04	5.97	24.8	14.28	59.2	3.86	16.0
2010	24.22	1.04	5.77	23.8	14.55	60.1	3.90	16.1
2011	25.35	1.08	5.64	22.2	15.61	61.6	4.10	16.2
2012	24.73	1.05	5.83	23.6	13.62	55.1	5.28	21.4
2013	26.77	1.15	7.42	27.7	14.20	53.0	5.15	19.2
2014	26.19	1.11	7.88	30.1	13.49	51.4	4.82	18.4

Table 2-10 Comparison among key index of MSW management in Thailand

Description	Unit	Year		Ratio (%)
		2013	2014	

Amount of MSW generated / year	Mil t	26.77	26.19	-2.17
Number of Local Agencies provided services in the area (%)[6]	-	4,179(53.7)	4,422(56.9)	3.2
Amount of MSW collected and transported / year (%)	Mil t	19.32(72.2)	19.66(75.1)	2.9
Amount of MSW transported to the disposal sites (%)	Mil t	14.36(53.64)	14.81(56.55)	2.9
Amount of MSW appropriately processed and/or disposed (%)	Mil t	7.42(27.7)	7.88(30.1)	2.4
- Incineration	Mil t	0.25	0.39	53.5
- Compost	Mil t	0.06	0.06	0.0
- Landfill	Mil t	6.70	7.05	5.3
- Others	Mil t	0.27	0.35	30.1

Amount of municipal solid waste generated in 2014 was decreased by 2.17 percent in comparison with that of 2013, but increased 9.4 percent from that in 2008. Although amount of MSW appropriately process & disposed was increased, Inappropriate processing and disposal was the highest and occupied more than 50 percent of MSW processed & disposed in total in 2014. From decrease of number of government agencies, increase of ratio of both collection and transportation to disposal sites, understood that Appropriate processing & disposal ratio was improved. Further, it is generally recognized that decrease of amount of MSW generated in the year was due to partly contribution of 3Rs promotion by the government, but mainly economic recession.

Landfilled Municipal Solid Waste

There was 28.0 million tons of inappropriately processed and/or disposed MSW in Thailand in 2013. The government of Thailand has been transferring such inappropriately disposed MSW to appropriate disposal sites and already transferred 13.2 million tons of MSW

Incidents & Accidents

There are 56 environment related incidents and accidents, including a fire at final disposal site at Preksa Mai in Samut Prakarn (as of March 16, 2014,) and an illegal

[6] Number of government agency has decreased from 7.782 in 2013 to 7,777 in 2014 due to municipalities integration. Increase or decrease ratio in the table is calculated based on number of government agency in total as denominator

dumping at Ban Ramun District in Chonburi Province (as of November 18, 2014,) in waste sector, reported to the concerning government agencies in 2014.

Budget for Waste Management

Thai national budget for the fiscal year 2014 was 2,525,000 million Thai Baht. The Government appropriate 87,550 million Thai Baht for Environmental Management. The budget mentioned above was appropriated for projects classified by six categories and used for pollution control and environmental management. 10,990 million Thai Baht was allocated for local government for municipal waste (solid, waste water and sludge) management and operation in accordance with Enhancement of National Environmental Conservation B.E.2535 (1992), Decentralization Plan Implementation Act B.E.2542 (1999) and Action Plan for Rural Environment Management 2014, including 21 of solid waste management projects, worth 920 million Thai baht and 5 of waste water treatment projects worth 179 million Thai Baht.

Besides, the Government granted 660 million Thai Bath in total from Environmental Found, which was founded based on provision given by Enhancement of National Environment Conservation Act to six projects listed in table 2-10 below;

Table 2-11 Projects granted by Environmental Found in 2014

	Project name	Amount (THB Million)
1	Project of Carbon Release at Map Ta Phut stockpiling terminal	125.00
2	Project of installation of ground flare in Map Ta Phut by Olefins Co., Ltd.	300.00
3	Project of upgrading waste water treatment and vacuum cleaning system by Marblex Co., Ltd.	3.52
4	Project of upgrading waste water facility by Thai Eastern Industry Co., Ltd.	5.00
5	Project of Water Treatment & Biogas generation by Kanchanadit Palm Oil Co., Ltd.	77.00
6	Project of installation of dust filter by M Metal (Thailand) Co., Ltd	150.00
	Total 6 projects	660.52

Others

The Government of Thailand identified responsibilities for parties' concern in MSW management.

2) Private Investment in Public Project

As the Private investment in public project stated above is one of the biggest obstacles in implementation of the targeted project, EX Research Institute as representative for the international consortium examined describes steps for getting approval for the project in details and points of discussion about the Act in Thailand.

First of all, it is said that there are many steps starting from planning to implementation for commercialization and it would take about 2 years except for any of those in fast truck. Application process for commercialization is as per prescribed in Article 24 – 27 as well as indicated in Figure 2-2 below.

In addition, the Ministry of Interior, with background of growing concern in Waste to Energy Project, issued notification of the ministry as for private investment in waste related project on December 21, 2015[7]. According to the Notification, there are 14 procedures in 5 stages at both the Ministry and local governments before submitting application to the Department of State Enterprise.

Table 2-12 Procedure for commercialization stated in the Notification of the Ministry of Interior

	Stage	Work in details
1	Preparation of Application for approval	Sign up MoU among local governments
2		Getting approval from councils in the area
3		Report to Director General of Dept. of Local Administration (DLA)
4		Collecting data & information by DLA
5		Review of application by provincial office
6	Document Examination(DLA/MOI)	Preparation of examination report by DLA, the Ministry of Interior
7		Getting approval from the Minister of Interior

[7] 内務省通達・通達番号 MT0891.4/W7578

	Stage	Work in details
8	Preparation of application for commercialization	Notice of result to local government(s)
9		Selection of private parties and legal check for draft contract by local government(s)
10		Submission of application for commercialization (including owner of the project and draft contract with the owner)
11	Approval (DLA/ MOI)	Finalization of application for commercialization
12		Getting approval from the Minister of Interior
13	Procedures for commercialization	Acquisition of licenses and conclusion of contracts (EIA(as prescribed by COP)、approval for construction, factory license, power purchase agreement and etc.)
14	Submission	Submit application to State Enterprise Policy Office (SEPO)

3) Other target business related movements

Waste Management

The Government of Thailand approved an Action Plan prepared based on Road Map the Government of Thailand approved an Action Plan prepared based on Road Map and Mater Plan on September 20th, 2016. The Action Plan, titled "Thailand Zero Waste", was proposed by the Ministry of Natural Resources and Environment and covering a year of 2016. There are three stages in Action Plan, and setting its target of realization of solid waste reduction & waste separation in first stage, realization of efficient waste collection in second stage and realization of appropriate waste processing with technical basis. The Action Plan approved by the cabinet covers first & second stages and with basic concept of 3Rs, enhance waste separation for recyclable waste and hazardous waste at waste generating points in first stage and establishment of efficient waste collecting & transport system for giving more value on separated wastes in the first stage. The targets placed in the Action Plan are as per indicated in the Master Plan.

Movement of WtE in Thailand

It was reported that 26 companies submitted their applications for 50MW of quota, given by Energy Regulatory Committee (ERC), to industrial waste based WtE project on September 22, 2916, although receiving time for application was from September 22 to

26, 2016. (No applicants on next day and onward, because of an announcement “FIRST COME FIRST SERVE POLICY”) According to the report, the companies submitted application were as per listed in Table 2-12

Table 2-13 List of Applicants who submit their application for power purchase agreement for industrial waste based WtE project

	Project Name	Applicants
1	Genco Renewable Power Plant	GENCO Renewable Co., Ltd.
2	Industrial Waste Power Plant, Pichit Industrial Estate	Energy Republic Co., Ltd.
3	Baan Wah Industrial Waste Power Plant	Chai Wattana Green Power 1 Co., Ltd.
4	PG and C Power Plant (Saharattana Nakorn)	PG and C 5714 Com., Ltd.
5	V Group Industrial Waste Power Plant (4 MW)	V Group Development Co., Ltd.
6	Electrical power production project, Saharattana Nakorn Industrial Estate	Sirilapha power Co., Ltd.
7	Chonburi Clean Energy	Chonburi Clean Energy Co., Ltd.
8	Waste to Energy Power Plant, Pichit 2	Sbang Yang Yuen Pichit Co., Ltd.
9	Progress Waste to Energy	Progress Interchem (Thailand) Co., Ltd.
10	N15 Amata Nakorn power Plant	N15 Technology Co., Ltd.
11	Genco clean Energy Power Plant	Genco Clean Energy Co., Ltd.
12	Progress Industrial Waste to Energy	Progress Polychem (Thailand) Co., Ltd.
13	Prime Road Renewable Co., Ltd.	Prime Road Renewable Co., Ltd.
14	Glow Hemraj Wind	Glow Hemraj Wind Co., Ltd.
15	Electrical power project, Pichit Industrial Estate	Ava Grand Energy Co., Ltd.
16	Pyrolysis oil Power Plant 4.5 MW.	Thai Powertech Engineering Co., Ltd.
17	Electricity Production Project, Saharattana Nakorn Industrial Estate	Recovery House Co., Ltd.
18	Industrial waste to Electricity Project	Siam Cement Energy Conservation
19	Industrial waste Power Plant, Amata City Industrial Estate	Super Earth Energy 5 Co., Ltd.
20	PG & C Power Plant (Hemraj)	PG & C 5714 Co., Ltd.
21	Thai Eastern Bio Power Co., Ltd.	Thai Eastern Bio Power Co., Ltd.
22	Industrial waste Power Plant, Saharattana Nakorn Industrial Estate	Prachu Thara Co., Ltd.
23	Rayong Clean Engineering	Rayong Clean Engineering Co., Ltd.
24	Industrial Waste Power Plant, Saharattana Nakorn Indusrital Estater	Solar EPCF Co., Ltd.

25	Industrial Waste Power Plant, Hi-tech Industrial Estate (Baan Wah)	Solar EPCF Co., Ltd.
26	Industrial waste Power Plant, Laem Chabang Industrial Estate	Super Earth Engineering 1 Co., Ltd.

Order in the Table 2-10 indicates priority ranking as a result of drawing. ERC will start negotiation with the parties with priority rankings and continue to do it to 50MW. Result of evaluation was announced on October 28, 2016. A company under GENCO with highest ranking in priority failed, while an ESCO under Siam Cement with 18th rank in priority succeed to acquire the power purchase agreement. In this public offering, ERC released 41.83MW of quota for 7 companies including the ESCO under Siam Cement. According to the announcement made by ERC, the successful parties shall submit other licenses to ERC within 120 days after the selection done by ERC, then contract with Electricity Generation Authority of Thailand by February 25th, 2017. Expected commercial operation date (ECOD) shall be before the end of 2019.

Regarding the municipal solid waste incineration based WtE project, which is target for the project, preliminary announcement for public offer for 100MW was made by ERC on August, 2016, the official public offering was announced on December, 2016. I It is said that ERC received requests from local governments whose area were not selected as prioritized areas in public offering and ERC and the Ministry of Interior did not reach an agreement are the reasons for delay in announcement of public offering. There is another information said that the Ministry of Interior did investigated progress in 14 procedures for each potential project and shared all information with relevant government agencies, and therefore the government needed some time to finalize it.

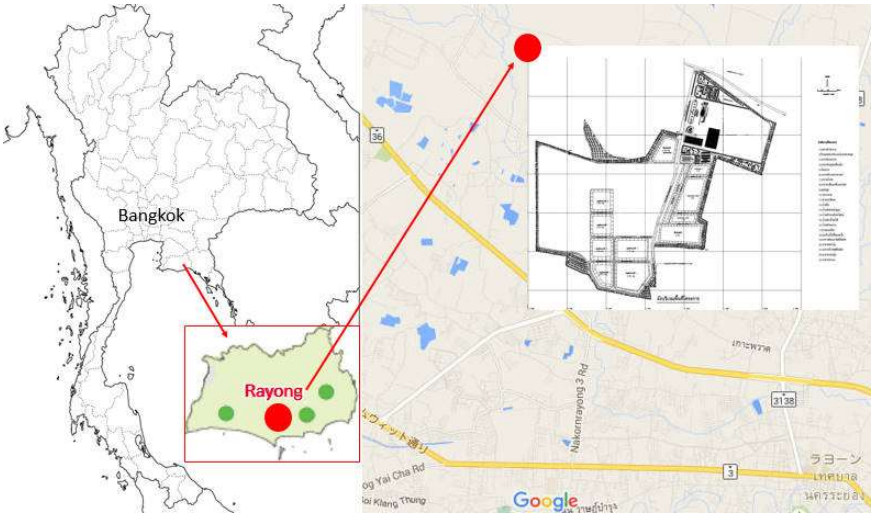
3 Outline of the targeted project

(1) Outline of the project

The project targeted in this study is WtE project to be established at Rayong Integrated waste management center by Italian -Thai Development PCL, one of the largest general contractor in Thailand, and utilized waste heat from appropriate process of municipal solid waste, which is generated in Rayong Province. Outline of the project is as per Table 3-1 below.

Table 3-1 Outline of the Project (Summary)

Project Name	Waste to Energy Project utilize waste heat from incineration of municipal solid waste at Rayong integrated waste management center (2nd Phase)

Project Site	Administrative Location (Thampa, Muang Rayong, Rayong Province, Thailand) GPS North Latitude 12”74’83 East Longitude 100”23’90 Location Map  Land Owner Rayong Municipality (Long-term Lease to Rayong PAO for free)
Project Owner	International Consortium to be formed up Italian Thai Development PCL, Thai Eastern Group and EX Research Institute Limited[8]
Business line	Operation of a 500tons/day scale MSW Incinerator and power generation (capacity 8.5MW) by utilizing waste heat from waste incineration
Facilities & Equipment to be installed	MSW Incinerator (Stalker Type), Waste Heat Recovery Boiler, Turbine, Alternator, Flue Gas & Waste Water Treatment facilities, Pre-Treatment facility, Ash & burnt residue handling unit, Piping, Electric Cabling, Control unit & transmission unit

As there is 1st phase on-going antecedent to the targeted project, explain correlation between 1st phase and the targeted project in Figure 3-1 below. As shown in the Table, there is more than 1,000tons of MSW generated in Rayong province and among all, 400tons/day of MSW was transported to Rayong integrated waste management center as of May, 2016, then increased to 500tons/day after closing of landfill, located at Pak Nam district in Rayong city, and owned by Rayong municipality by the October 2016.

[8] EX Research Institute will participate in the project only for the case the project would be registered as JCM project

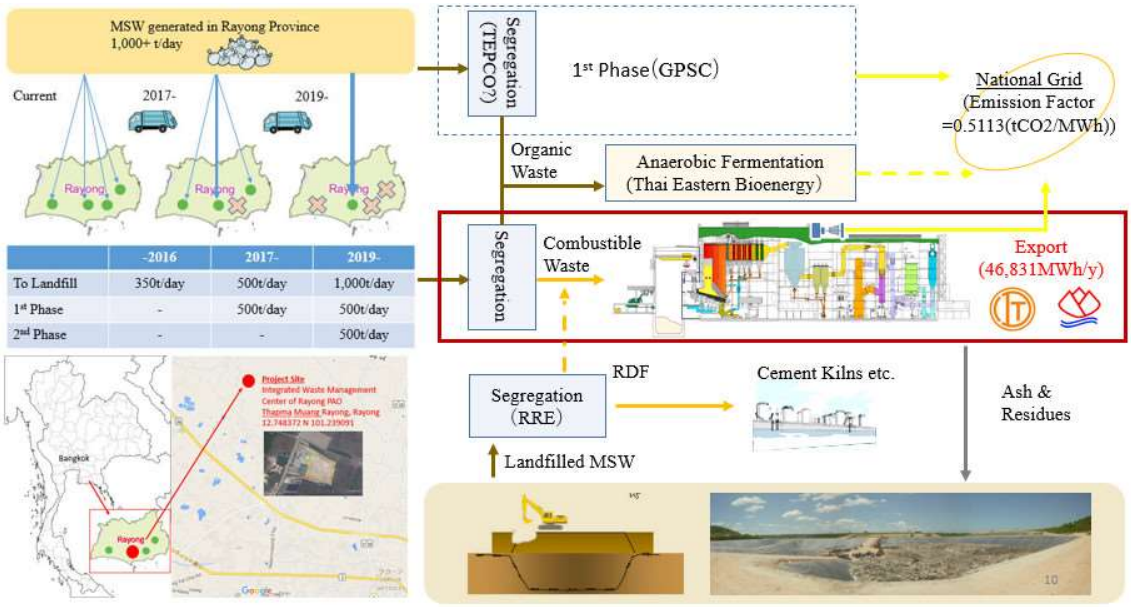


Figure 3-1 Correlation between 1st & 2nd phases of the project

(2) General Information as for project site (Rayong Province)

Summary of general information of Rayong province, where the project site is located, published in Rayong Development Plan is as follows;

Geographic features

Rayong province is in the eastern part of Thailand and neighboring with Na Yai Arm District and Kaenghandmaeo District of Chantaburi Province in east, Sattahip district and Banglamung district in Chonburi province in west, Nong Yai district, Bothong district, and Siracha district in north and face to Siam Bay in south. There is plain made from debris spreading along the coast and hill zones in inland area. Rayong river flow in the central part, while Bang Pakong river flows in the western part of the province.

Administrative District

Rayong province has 3,552 Km2 of land area and land area belong to each district in the province is as per shown in Table 3-1 below. Administrative district in Thailand can be divided into Province, District, Municipality, Town, and Village. Administrative offices to manage those administrative districts are municipality (tesabaan nakhorn in Thai language), Town Office (Tesabaan muang in Thai language) Small town office (Tesabaan Tambol) and sub-district office (tambol in Thai language) depending on population in area. There is one special city, 2 municipalities, 27 town offices, 54 tambol administrative office and 439 villages in Rayong province.

Table 3-2 Land area and administrative district in Rayong province

District	Land Area (km2)	Administrative Office					
		Special city	municipality [9]	Town Office[10]	SAO	Tambol	Village
Total	**3,551.997**	**1**	**2**	**27**	**37**	**54**	**439**
Muang Rayong	514.547	1	1	6	7	11	84
Ban Chang	238.372	-	1	3	1	3	20
Klang	788.463	-	-	8	9	15	147
Wan Chang	395.249	-	-	1	4	4	29
Ban Khai	489.075	-	-	3	5	7	66
Pluak Daeng	618.341	-	-	2	6	6	34
Kao Chamao	269.950	-	-	1	3	4	29
Nikom Pattana	238.000	-	-	3	2	4	30

Municipal Solid Waste Management

MSW generated in Rayong province is managed by xx local governments in the province under supervision of provincial office, provincial administrative office, and local administrative offices. As model area in eastern part of Thailand, the government of Thailand promote wide area waste processing and constructed Rayong integrated waste management center as wide area waste processing center for the province. Rayong Provincial Administrative Office (PAO) manage and operate the center. Organizational structure and section in charge of waste management is as per shown in Figure 3-2 below.

[9] Tambol Muang in Thai, defined an administrative district with population of more than 10 thousand but less than 50 thousand

[10] Tesabaan Tambol in Thai, define an administrative district with population of more than 5 thousand but less than 10 thousand

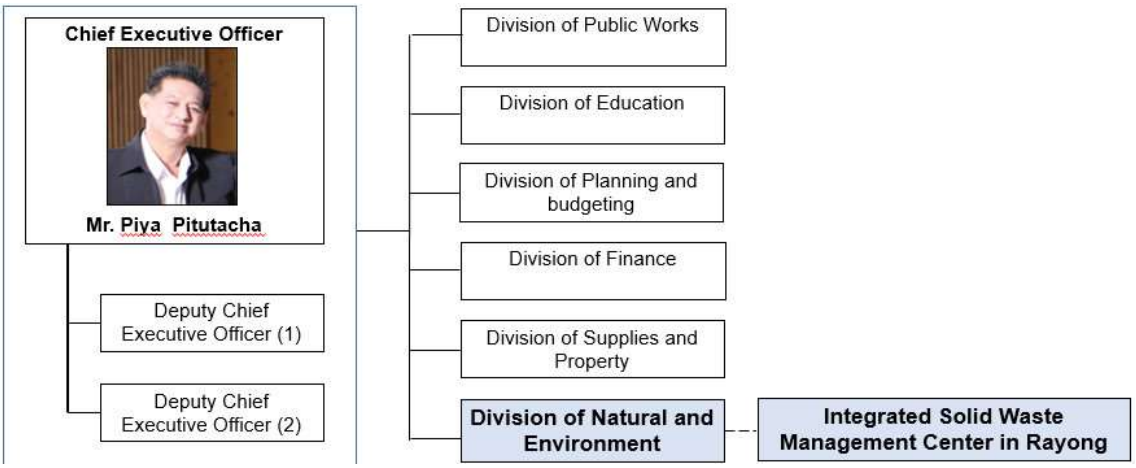


Figure 3-2 Organization Chart of Rayong PAO

Source: Rayong Provincial Administrative Office (PAO)

Population

Population and transition of population in Rayong province is as per shown in Table 3-2. Population in 2015 was 674 thousand and increase 1.8-2.0 percent during 2012-2015. Rayong District, which is prefectural capital and industrial & commercial agglomeration area, has the biggest or 40 percent of total population in the province

Table 3-3 Population by District in Rayong province

District	Population (Increase or Decrease Rate)								Density
	2012		2013		2014		2015		
Total	637,736	1.79	649,275	1.79	661,220	1.82	674,393	1.97	189.9
Muang Rayong	250,084	1.68	254,998	1.95	260,490	2.13	265,869	2.04	516.7
Ban Chang	62,432	3.49	63,802	2.17	65,045	1.93	67,374	3.52	282.6
Klang	128,204	0.48	128,940	0.57	129,594	0.51	129,773	0.14	164.6
Wan Chang	25,562	0.94	25,763	0.78	25,813	0.19	25,810	0.01	65.3
Ban Khai	62,466	1.07	63,212	1.19	63,915	1.11	64,549	0.99	132.0
Pluak Daeng	47,335	4.70	49,192	3.85	51,452	4.49	54,664	6.06	88.4
Kao Chamao	23,344	0.09	23,496	0.65	23,775	1.18	23,816	0.17	88.2
Nikom Pattana	38,309	3.50	39,872	4.00	41,136	3.12	42,538	3.35	178.7

Population above does not include labors from neighboring countries living in the province and

employees in industrial estates, such as Map Ta Phut Industrial Complex and IRPC which is an industrial estate with agglomerated petrochemical industry, commuting from outside of the province. Population in Rayong province might be over 1 million if include labors and commuters mentioned above.

Socio-Economy

GDP in Rayong province was 90,750 million Thai Baht (about 270 billion Japanese Yen) and GDP per capita was 1.06 million Thai baht in 2013. Among industrial groups, GDP of mining industry was 22,000 million Thai Baht (38%) and that of manufacturing was 346,000 million Thai Baht (38%) compare to that of primary industry, i.e., 22,000 million Thai Baht (2%). (Table 3-4)

Table 3-4 GDP by Industrial Groups in Rayong province (unit: THB million)

Industrial Group	2009	2010	2011	2012	2013
Primary Industry					
Agriculture, Forestry &	**22,376**	**27,363**	**33,705**	**27,025**	**22,660**
Hunting	18,973	23,942	29,691	22,523	18,873
Fishery	3,403	3,421	4,014	4,502	3,787
2nd & 3rd Industries	**570,366**	**688,762**	**730,853**	**827,199**	**883,004**
Mining	217,612	241,906	274,982	344,687	353,116
Manufacturing	231,420	311,187	286,181	303,293	346,477
Public Utilities	38,984	40,634	57,254	51,518	48,809
Construction	5,384	6,294	5,440	4,641	6,707
Commercial	41,657	50,067	52,231	52,582	56,467
Service (general)	1,544	1,747	1,974	2,148	2,430
Hotel & Restaurant	11,770	15,261	16,156	16,125	15,312
Transport, Warehouse &	4,921	4,682	5,417	6,568	7,475
Communication	5,514	5,550	19,093	32,611	33,256
Finance	6,197	5,736	6,068	6,370	6,400
Real Estate	2,974	3,222	3,271	3,404	3,541
Administration (inc.	1,646	1,692	1,758	2,050	1,827
military & police)	593	640	827	967	1,004
Education	148	146	202	235	183
Social Welfare					

Self-Employee					
Total	592,742	716,125	764,558	854,225	905,664
GDP per capita	752,979	873,241	918,774	1,011,901	1,058,293
Estimated Population (Thousands)	787	820	832	844	856

Number of visitors to the province, which give impact on amount of waste generated in the area was as per Table 3-5. Number of visitors to the province was 5.9 million in 2014, which was increased 4.85% from last year and days of stay in average was 2.54 days.

Table 3-5 Number of Visitors stayed overnight in Rayong province

	2012	2013		2014	
			Y-Y rate		Y-Y rate
Total	5,347,954	5,643,533	5.53	5,917,210	4.85
Thai	4,877,889	5,163,919	5.86	5,444,316	5.43
Foreigner	470.065	473,614	0.76	472,894	-0.15

Meteorological Data

- Meteorological date for the project site for 2015 and 2016 were obtained and attached to this report as appendix 5-1 and appendix 5-2.

- Others

According to the annual report published by Department of Meteorology of Thailand, there were 258 typhoons came to Thailand. 21 typhoons Among all came to eastern part of Thailand, where the project site is located, once in May, once in June, once in July, three times in September, thirteen times in October and twice in November.

(3) Outline of supposed Project Owner

1) Italian-Thai Development Public Company Limited

Supposed owner of the project is Italian-Thai Development Public Company Limited (ITD), which is one of the largest general contractor and listed in Security Exchange Market of Thailand (SET). Data & information as for the company published at their website is as follows;

Table 3-6　Company Profile & Business Lines

Company Name	Italian Thai Development Public Company Limited
Business Line	Civil & Infrastructure Work and Development
Head Office	Bangkok, Thailand
Registered Capital	THB6,335,808,993(about 210,000 million Japanese Yen)
Net Asset (consolidate in 2015)	THB78,095,140,000(about 2,57,400 million Japanese Yen)
Sales(ditto)	THB51,297,495,000(about1,69,300 million Japanese Yen)
Profit & Loss (ditto)	-THB486,567,000(about-1,600 million Japanese Yen)
Number of Employee	7,000
Annual Report (2014)	http://www.itd.co.th/annual_report/AR_ENG/AR-ITD-2014E.pdf

ITD has decided to enter waste-related business other than their main activity of civil & construction works and approached to several potential projects in Thailand. As some of potential projects owner, whom ITD approached, have permit for waste related business operation in area, but are weak in financial base, ITD considers to participate in such projects as both investor and being involved in business operation as well as contractor for civil, construction and EPC.

2) Thai Eastern Group (TEG)

Thai Eastern Group consists of 11 companies including their first business of Chonburi Crocodile Zoo & Resort(CCZR) in Chonburi province. CCZR was established in 1991, then expanded their business to Palm Mill in 1992, Latex manufacturing business in 1994 年, Rubber Block manufacturing business in 2000, then unified all business to establish Thai Eastern Group. In 2006, TEG kicked off rubber & palm plantation. As far as energy-related business concern, TGE established THAI EASTERN BIOPOWER in 2011 and collect methane gas from waste water at their own factory for energy use.

Table 3-7 Company Profile of Thai Eastern Group

Company Name	Thai Eastern Group
Business Line	Oil Palm & Rubber plantation, manufacturing of oil palm & rubber related products and energy
Head Office	Chonburi Province, Thailand
Registered Capital	THB485 million (about 14,550 million Japanese Yen)
Net Asset (consolidate in 2015)	THB900 million (27,000million Japanese Yen) (4 core companies only)
Sales(ditto)	Not open to the public
Profit & Loss (ditto)	Not open to the public
Number of Employee	425 (4 core companies only)
Annual Report (2014)	http://www.thaieasterngroup.com/PDF/Brochure%202013%20rev.13-11-13.pdf

As TEG owns and operates methane collation from waste water at their own factory for energy use and have good relationship with locally influential parties in both Chonburi and Rayong province, TEG expressed their keen interest in the project and approached to responsible authorities for negotiation. TEG aims to be involved into anaerobic fermentation operation for organic waste from 1st phase and expand their operation into WtE project in 2nd phase.

(4) Japanese Representative for the project

EX Research Institute Limited (EXRI), which is implementation body for the study, will participate in the project as Japanese representative and apply for JCM subsidy, register the project in JCM & responsible for communication with Japanese parties. EXRI has been established as a company engage in urban planning & environmental consultation in 1971, having its principal place of business at Toshima-word, Tokyo, Japan and has 5 branches in Japan and 2 branches in overseas. Company Profile is as per shown in Table 3-9 below.

Table 3-8 Company Profile of Japanese Representative for International Consortium

Company Name	EX Research Institute Limited
Head Office	17-22 Takata 2 choume, Toshima-ku, Tokyo, Japan
Homepage	www.exri.co.jp
Establishment	1971
Business Line	Urban Planning Environmental Consulting Service
Registered Capital	30 million Japanese Yen
Number of Employee	100
Annual Turn Over	Approximately 2,500 million Japanese Yen
Branches	Osaka Branch, Tohoku Branch, Chuubu Office, Kyushu Office, Muroran Office, EXRI PH(Philippines)、EXRI ASIA(Thailand)

(5) License, Approval, and Contract

License, Approval, and Contract required for commercialization of the target project are as follows;

License	Detail	Status
Approval on Land	Business Operator shall obtain approval from local government, which administrate area	The government allows business operator to construct

Utilization	where the project site is located based on consistency with Land Utilization Plan published by the Ministry of Interior	WtE power plant at site, where is not located in the industrial zone, as special measure in accordance with Article 44 of Thai Constitution
Factory License	To be given by Department of Industrial Works	Application shall be made after contract power purchase agreement
Power Generation Permission	To be given by Energy Regulatory Committee (ERC)	Ditto
Power Purchase Agreement	Contract with Electricity Authority based on an approval granted by ERC	ERC is said to allocate 200MW of quota for MSW incineration based WtE projects. 1st quota for 100MW is under public offering to be closed by March 2nd, 2017
MSW procurement agreement	One of the conditions given by financing companies for project finance. Local Government is the competent agency for waste procurement	Continue to have close contact with Rayong PAO (supposed to be selected through tender)
Approval on Private Investment in Public Project		Not applicable for the project, since revised National Cleanliness & Order Act has been enacted

Supposed International Consortium shall obtain all the licenses and approvals mentioned above for commercialization of the targeted project. Among all, to have waste procurement agreement with Rayong PAO, who has full authority in waste management in Rayong province, is the most important. Targeted project can be commercialized, from the point of view of licensed and approvals, once the project has power purchase agreement with Provincial Electricity Authority (PEA) based on quota granted by ERC, complete Initial Environmental Examination and reach to consensus residents in the area, as other licenses and approvals are not so critical to be granted.

(6) Financial Plan

Even though Italian Thai Development Public Company Limited (ITD) has a choice that ITD would commercialize the targeted project fully financed by themselves, ITD is looking for financial support in a form of project finance from commercial banks with premises of preparation of 30-40% of capital in total by themselves. ITD started negotiation with banking corporation for possibility of project finance for WtE projects, as ITD considers to be involved into a few similar projects (WtE) at the same time. One of the leading banking corporation in Thailand gave comments under the condition of further negotiation needed to ITD that They rather positive for Corporate Finance than Project Finance. If ITD desire Project Finance, then it would be better for ITD to consider (i) to take majority of shares in formation of special purpose company and engage in civil & construction works for the project, (ii) to submit all data & information including reference of similar project of EPC company, although they judge less risk on employment of Japanese EPC and (iii) to submit all evidence as for licenses, permissions, approvals & contract for business operation. Since ITD is listed in Security Exchange Market of Thailand and has credit as leading general contractor among the banking corporation in Thailand, ITD seems have high possibility to get financial support, including corporate finance from the market.

(7) MSW procurement plan

1) MSW management plan in Provincial Development Plan for Rayong province

Rayong province, as the same as other province did, has prepared and published "Provincial Development Plan" and latest version of the plan as of 2016 is "Provincial Development Plan for Rayong province BE2557-2560 (Revised in 2560). The plan consists of 4 chapters with 100 pages and explained as for waste in 10 lines in (4) of section 5 "natural resources and environment" in chapter 3 "current situation and assessment". Description in the plan is as follows;

Amount of MSW generated in Rayong Province is 1,000 tons/day and become one of the biggest issues in the province. The Government of Thailand recognize importance of issue and various government agencies are under consideration on countermeasures for, to say concretely,

- Promotion of wide area processing of MSW
- Establishment of procedure for new comers to waste related business (e.g. WtE)
- Establishment of management method for general & hazardous waste
- Awareness raising for sustainable management

Rayong province entered agreement on WtE project with private company in 2014, in which the private company will manufacture RDF for energy use.

In next part, explain details of waste related budget allocated and attached to the plan

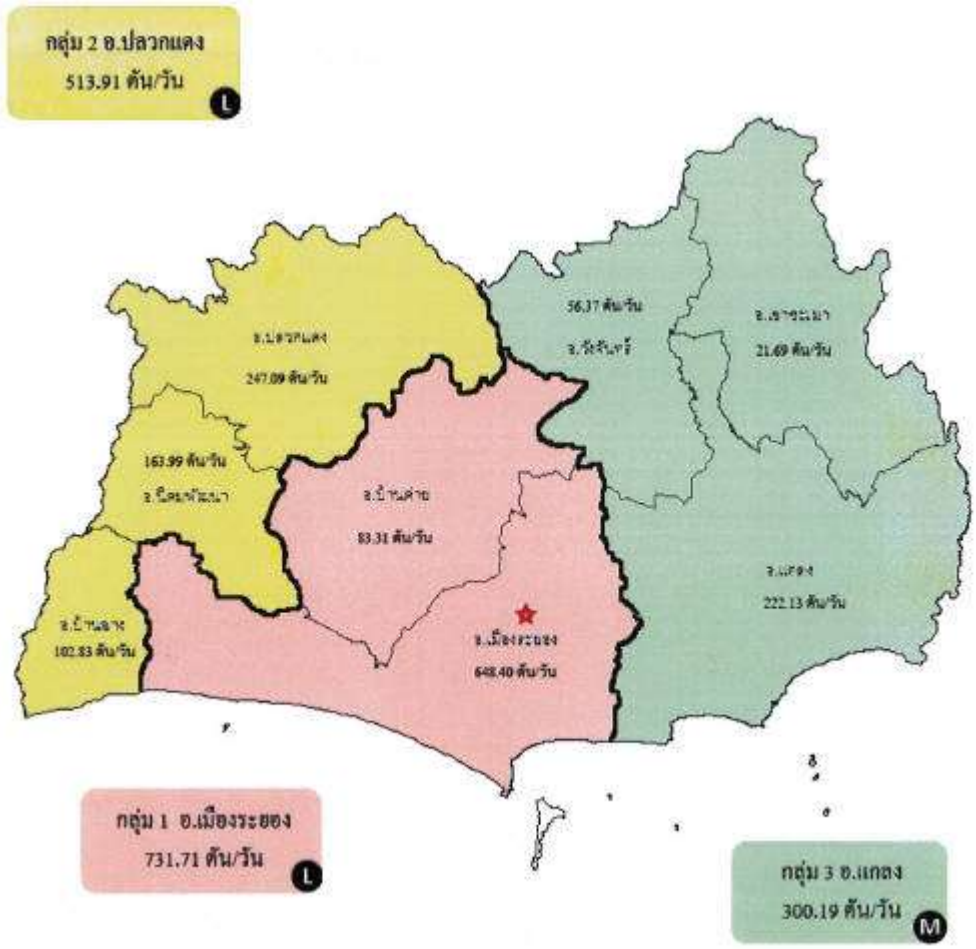
Plan					Budget	Implement
Project		Strategy	Finance	Output	2017	
Strategy 3						
13	Preparation of guideline for sustainable waste management	3.2 Management of Hazardous substance emission from sludge from industrial activities and protection against accidents and disasters	2. Ministry's Budget	1. Economic Development	100,000,000	Department of Local Administration (DLA) / Map Ta Phut municipality
14	Hazardous waste management			3. Natural Resource & Environmental Management	13,000,000	
21	Composting or Anaerobic fermentation for wet waste from offices		3. DLS's budget	1. Economic Development	800,000	PTT GLOBAL CHEMICAL PUBLIC COMPANY LIMITED
Strategy 4						
11	Waste separation for recycling	4.4 Support on solid & hazardous waste management at waste generating points	1. Provincial Budget	3. Natural Resource & Environmental Management	2,500,000	Ministry of Natural Resources and Environment, Rayong Branch
13	Promotion of WtE				1,500,000	
24	Support for waste separation for WtE				30,000,000	Ministry of Energy Rayong Branch
143	Training center for solid waste processing in Rayong		3. DLS's budget		10,000,000	Rayong PAO
145	Project to construct Incinerator in Samet island				190,000,000	
146	Project on optimization of waste management				70,000,000	

Plan					Budget	Implement
Project		Strategy	Finance	Output	2017	
	in Samet island in Rayong District					
147	Project on construction of anaerobic fermentation facility at Rayong IWMC				253,000,000	
148	Project on construction of incinerator for infectious waste in Rayong	4.4 Support on solid & hazardous waste management at waste generating points	3. DLS's budget	3. Natutal Resource & Environmental Management	250,000,000	Rayong PAO
149	Rebirth of landfills in Rayong & Map Ta Phut municipalities				30,000,000	
150	Improvement & optimization of waste processing at Rayong & Klang municipalities				50,128,000	
151	Construction of Transfer Station at Klang municipality				120,000,000	
152	Construction of sludge treatment facility at final disposal points				20,000,000	
153	Increase of amount of waste to be collected at contaminated areas				30,000,000	
1	Reduce amount of				30,000,000	

Plan					Budget	Implement
Project		Strategy	Finance	Output	2017	
54	solid waste					
155	Construction of composting center at Rayong IWMC				9,840,000	
	Odder monitoring system at Rayong IWMC	4.4 Support on solid & hazardous waste management at waste generating points	3. DLS's budget	3. Natural Resource & Environmental Management	9,345,000	Rayong PAO
157	Campaign ford solid waste reduction				30,000,000	Rayong PAO
161	Designing of Waste processing & recycling plant and waste water management in Map Ta Phut municipality				50,000,000	Map Ta Phut municipality
162	Structural improvement of reservoirs near landfills				4,850,000	Klang municipality
166	Campaign for appropriate waste management for tourist and tourism industry by media		4. Private Sector's budget	1. Economic Development	5,000,000	PTT GLOBAL CHEMICAL PUBLIC COMPANY LIMITED
167	Promotion on Appropriate process for landfilled waste				5,000,000	
168	Promotion of waste collection in form of public – private				2,000,000	

Plan					Budget	Implement
Project		Strategy	Finance	Output	2017	
	partnership and business development in the area					
169	Designing of domestic waste separation facility	4.4 Support on solid & hazardous waste management at waste generating points	4. Private Sectors' and/or Communities' budget		2,000,000	PTT GLOBAL CHEMICAL PUBLIC COMPANY LIMITED
170	Composting & anaerobic fermentation of WET waste				800,000	
Total					**1,319,763,000**	

2) Clusters in Rayong province planned by the Ministry of Interior



Remarks

1. Pink	Group 1	Rayong District	731.71t/day (L)
2. Yellow	Group 2	Pruak Daeng District	513.91t/day (L)
3. Blue	Group 3	Klang District	300.19t/day (M)

Figure 3-3 Clusters in Rayong province

Source: The Ministry of Interior "Guideline for Waste Management in Thailand

(8) Quality of Municipal Solid Waste

EX Research Institute Limited (EXRI) conducted waste analysis for municipal solid waste generated and transported to Rayong Integrated Waste Management Center (IWMC) in 2015. EXRI visited Rayong IWMC and checked quality of MSW and interviewed with members of staff work for Rayong IWMC and Rayong Renewable Energy Co., Ltd., and confirmed quality of MSW is not too much different from those of last year. Therefore, EXRI concluded that the quality of waste is almost as the same as those of last year and make data & information obtained from the research conducted

last year in order, for evaluation.

1) Outline of the Research conducted in 2015

Location	Rayong Integrated Waste Management Center 1) Segregation Center (Mon—Fri) and 2) 3rd Landfill (daily)
Duration (1) Date	1) October 5-11, 2015(7 days for wet season) 2) November 9-15, 2015 (7 days for dry season)
Duration (2) Time	5 am – 12 am
Sampling Method	Sampling waste from all waste transported to both Segregation Center and Landfill, then quartering until getting an amount of waste necessary for analysis.
Conductor	EX Research Institute and Local sub-contractor
Items analyzed	1) Three Elements 2) Composition Analysis 3) Ultimate Analysis 4) Net Calorific Value
Analysis Method	As per ASTM applicable for each item

2) Result from Research

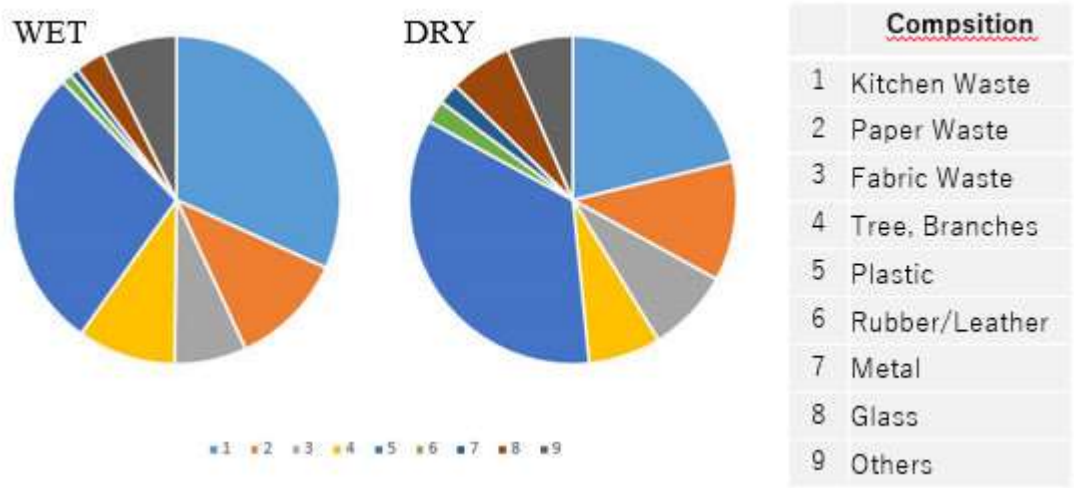
Collected a sample per day at both segregation center and landfill (5 samples / season x 2times at segregation center + 7 samples / season x 2 times at landfill = 24 samples in total), and conducted 3 elements analysis, composition analysis for both wet and dry basis, and get an result as follows;

3 elements

Element		Minimum	Max	Average
Combustible	WET	32.24	42.83	39.46
	DRY	71.04	87.66	81.21
Ash	WET	5.92	13.38	9.06
	DRY	12.34	28.96	18.79
Moisture	WET	47.29	55.80	51.48
	DRY	-	-	-

- Composition Analysis

Composition (% of total in weight)	WET			DRY		
	Min	Max	Average	Min	Max	Average
Kitchen Waste	24.51	37.11	30.29	14.19	28.29	21.22
Paper Waste	7.26	14.31	10.79	7.79	18.27	11.79
Fabric Waste	1.37	11.82	6.77	3.08	14.50	8.25
Wood & Grass	2.29	14.99	9.26	4.22	10.96	7.15
Plastic Waste	23.12	29.43	26.63	31.91	39.49	34.55
Rubber & Leather	0.08	2.87	0.96	0.52	5.52	2.23
Metal	0.46	1.37	0.81	1.30	3.32	2.09
Bottle & Glass	1.50	4.59	2.81	3.98	9.40	6.20
Others	4.52	10.77	7.04	4.55	9.79	6.52



As EXRI supposed to remove combustible waste from MSW and processed by incinerator in 2015, EXRI conducted ultimate analysis and measure for net calorific value for combustible waste after segregation. There are 3 units of trommels with different size of separation holes with labors for initial separation and spinner for secondary separation, thus composition of combustible waste after separation is mainly plastic with less moisture.

Segregation Line at Rayong IWMC (Combustible Waste is piled in the left)

Result of Ultimate Analysis (5 samples)

Chemical Element	WET			DRY		
	Average	Min	Max	Average	Min	Max
Carbon	46.05	38.30	51.56	67.90	64.49	70.59
Hydrogen	8.41	6.96	9.51	12.39	11.48	13.02
Nitrogen	0.35	0.30	0.39	0.52	0.49	0.55
Oxygen	6.74	5.31	9.16	10.02	7.26	13.20
Chlorine	1.29	0.72	2.99	1.88	1.04	4.20
Sulfur	0.05	0.04	0.06	0.07	0.06	0.08

Result of NCV measurement (5samples)

Sampling Date	2015/11/9	2015/11/10	2015/11/11	2015/11/12	2015/11/13
NCV(kcal/kg)	7,998	7,568	7,861	7,646	6,721

From the table above, Net Calorific Value of the combustible waste after waste segregation ranges 6,721kcal/kg as minimum and 7,998kcal/kg as maximum with 7,553kcal/kg as average. Result of 3 element analysis of combustible waste after waste segregation is as per indicated in table below;

Element		Average	Min	Max
Combustible	WET	62.74	67.90	52.71
	DRY	92.79	94.08	90.83
Ash	WET	4.93	6.36	3.57
	DRY	7.21	5.92	9.17
Moisture	WET	32.21	26.96	43.72

	DRY	-	-	-

39,910-40,480kj/kg for form tray, 43,404-45,939kj/kg for waste bag, and 35,012kj/kcal for packaging for retort food are Net Calorific Values introduced in report in Japan and values obtained from research above are almost matched with those in Japan.

Since Rayong PAO consider to develop anaerobic fermentation of organic waste and methane gas collection for energy use. For the case Rayong PAO would implement anaerobic fermentation, organic waste as material for anaerobic fermentation shall be separated more strictly.

Supposed options for waste processing by incineration including the case above are as follows;

	Pre-Treatment (Segregation)	Process	Remarks
1	No	Mass-Burn (incinerate all MSW transported to incinerator)	Ash and burnt residue shall be landfilled (5-10% of amount of waste incinerated)
2	Yes	Incinerate only RPF/RDF (waste with high NCV) separated from segregation process and landfill remaining waste	About 40% of MSW will be landfilled, depending on availability of other process
3	Yes	Incinerate combustible waste after separation of organic waste for further process & incombustible waste	5-10% of MSW incinerated in total and residue from fermentation (10-20% of MSW processed in total for the case of anaerobic process or 0-100% for the case of aerobic process)

EXRI estimated NCV for fresh MSW based on the data obtained from research conducted in 2015 by methodology introduced by notification no 95 of the Ministry of Social Welfare, Japan, As EXRI conducted waste analysis based on case 2 in the table above in 2015. Estimated NCV for fresh MSW both in wet & dry basis are as follows;

Net Calorific Value	Max	Min	Average
WET	1,605.90	1,302.00	1,487.90
DRY	3,781.35	3,377.25	3,661.96

(9) Quantity of Municipal Solid Waste

67 Municipalities and Sub-District Administrative Organization (SAO) in total in Rayong province are authorized to manage municipal solid waste generated in their administrative areas. There are 67 municipalities & SAOs in Rayong province and 県内 Amount of MSW in the province was published by a few government authorizes and the figures shown in each report are not matched. Amount of MSW generated in the province, published by Rayong PAO is as below;

Rayong District (8 municipalities & 8 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Rayong PAO	1.5	1.54
Map Ta Phut Municipality	108.0	84.39
Banphe Municipality	26.0	18.26
Noen Phra Municipality	20.0	20.42
Thap Ma Municipality	25.0	24.31
Nam Khok Municipality	6.0	4.64
Choeng Noen Municipality	40.0	31.92
Taphong SAO	13.5	15.49
Nata Khwan SAO	5.0	2,84
Ban Laeng SAO	5.0	3.17
Kleang SAO	4.0	4.26
Rayong Municipality	105.0	57.45
Kachet SAO	0.5	
Samnak Thong SAO	2.0	
Phae SAO	6.0	
Klaeng Kachet Municipality	5.0	
Total	372.5	268.69

Nikhom Pattana Distrcit (3 municipalities & 1 SAO)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Mapkha Patthana SAO	10.0	9.39
Nikhom Patthana SAO	12.0	8.36
Nikhom Patthana municipality	15.0	-
Makahm Khu municipality	44.0	-
Total	81.0	17.75

Ban Khai District (8 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Non Ta Phan SAO	3.0	2.13
Ban Khai SAO	4.0	3.59
Bang But SAO	4.0	3.08
Ta Khan SAO	6.0	4.55
Ban Khai Patthana SAO	4.0	3.03
Nong Bua SAO	8.0	5.53
Nong Lalok SAO	18.0	8.42
Chak Bok SAO	2.0	2.35
Total	49.0	32.68

Ban Chang District (4 municipalities & 1 SAO)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Ban Chang municipality	30.0	31.14
Samnak Thon municipality	11.0	-
Samnak Thon SAO	3.5	-
Phala municipality	6.0	-
Bang Chang municipality	10.0	-
Total	60.5	31.34

Pluak Daeng District (2 municipalities & 6 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Maenam Khu SAO	7.5	7.97

Nikhom Patthana SAO	12.0	8.36
Pluank Daeng municipality	15.0	-
Jomphonjalphay municipality	10.0	-
Map Yang Phon SAO	50.0	-
Pluank Daeng SAO	30.0	-
Ta Sit SAO	10.0	-
Nong Rai SAO	2.0	-
Total	136.5	16.33

Kleang District (6 municipalities & 9 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Huai Yang SAO	2.0	2.74
Nikhom Patthana SAO	12.0	-
Pak Nam Kasae municipality	4.0	-
Ban Na municipality	4.5	-
Khlong Pun SAO	4.0	-
Phang Rat SAO	2.5	-
Kondin municipality	5.0	-
Kondin SAO	10.0	-
Noen Kho municipality	1.0	-
Krasae Bon SAO	16.0	-
Thang Kwian SAO	4.0	-
Wang Wa SAO	20.0	-
Chak Don SAO	4.5	-
Song Salueng municipality	4.0	-
Sonthongpu municipality	10.0	-
Total	130.5	2.74

Nikhom Patthana District (2 municipalities & 2 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Mapkha Patthana SAO	10.0	9.39
Nikhom Patthana SAO	12.0	8.36
Nikhom Patthana municipality	15.0	-

Makahm Khu municipality	44.0	-
Total	81.0	17.75

Khao Chamao District (1 municipality & 3 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Cham Kho municipality	3.5	-
Khao Chamao SAO	2.0	-
Nam Pen SAO	4.0	-
Khao Noi SAO	3.0	-
Total	12.5	-

Wang Chan District (1 municipality & 4 SAOs)

Local Government	Generation (t/day) (2014)	Transported to IWMC (t/day) (2016)
Chum Saeng municipality	10.0	-
Pa Yap Nai SAO	6.0	-
Chum Saeng SAO	7.0	-
Phlong Ta Lam SAO	5.0	-
Wang Chan SAO	8.0	-
Total	36.0	-

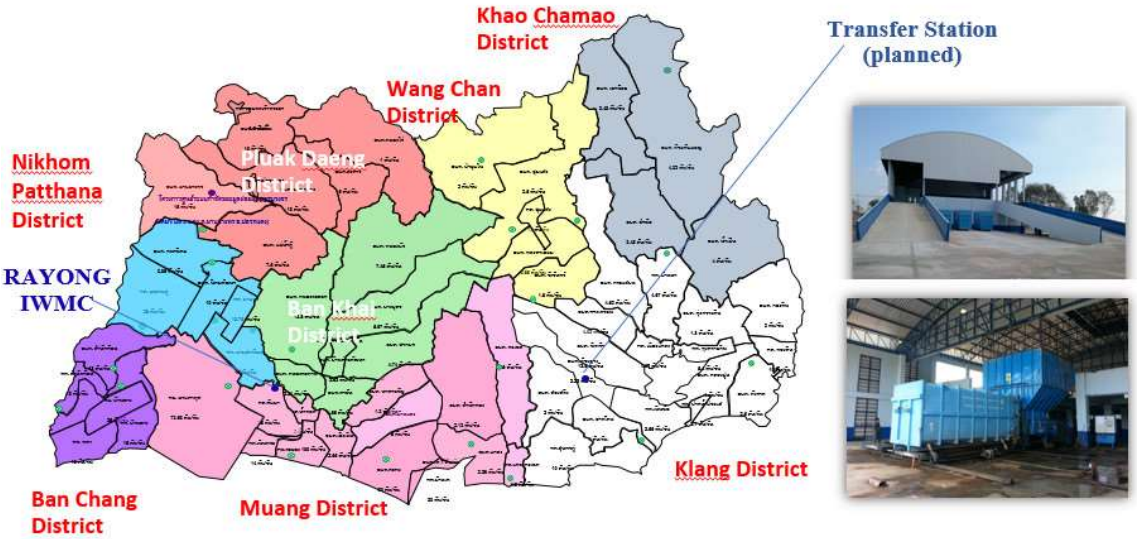


Figure 3-4 Districts & Wadte related facilities in Rayong Province

Rayong PAO has prepared wide area processing & efficient improvement on collection & transportation plan for municipal solid waste and has a plan to close 21 open dump sites in the province & construct new transfer station near Klang municipality. Rayong PAO expects to have more amount of MSW, as there would be no open dump sites available for SAOs & cost reduction from utilization of new transfer station. As transportation cost from new transfer station to Rayong Integrated Waste Management Center would be bared by Rayong PAO, Rayong PAO expect much more amount of MSW from covering areas, i.e., Khao Chamao district, Wan Chang district & Klang district

(10) Operation & Maintenance Plan

Staff Assignment

Local Governments form up management team for the facility and supervise sub-contracted operators, who are a part of EPC contractor or their affiliated companies and engage in operation & maintenance of the facility in Japan. Sub-contractor will dispatch a factory manager, an assistant manager & an administrative assistant other than teams consist of 4-6 members including a chief, a sub-chief and engineers for facilities, electricity for facility operation. In addition to the sub-contract mentioned above, local government have another sub-contractor to dispatch operator for pit crane, ash handling, and traffic control and others. In the targeted project, the project owners supposed to receive 500tons/day of MSW, incinerate 150tons of combustible waste after segregation and generate power for 24 hours a day, therefore considered to have 12hours / shift x 2 shift and to be managed by one each of factory manager, assistant factory manager and administrative assistant with 4 teams consist of 4 members. Time to receive MSW at the facility is planned to be day time (6 am to 3 pm)

表 3-1 Staff Assignment

	Day Shift	Team 1	Team 2	Team 3	Team 4	Remarks
Factory Manager	1					
Assistant Factory Manager (Chief Engineer)	1					
Main Operator		3	3	3	3	
Crane		1	1	1	1	
Weighting House	1					
Platform	2					
Inspection & Maintenance	3					

Measurement & Analysis	1					
Material Control	1					
Waste Wheel Loader	2					
Ash Handling	3					
Administrative Assistant	1					
Sub-Total	16	4	4	4	4	
Total	32					

Source: Nippon Steel & Sumikin Engineering Co., Ltd.

The project owners will recruit members of staff in Rayong province, except for any whom the project owner might not be able to find in the province, or even such staff, put highest priority on any who come from the province, with purpose of contribution for the province, where the project site is located.

Operation & Maintenance

The project owner will do basic operation and periodical maintenance by themselves through Special Purpose Company to be established for business management. However, the project owner will out-sourcing repairing works and maintenance in large scale to EPC contractor. The project owner will request EPC contractor to provide any of such services at lowest cost, for example, by utilization of its local affiliate existing in Thailand.

4 Feasibility

(1) Feasibility of the targeted project

EX Research Institute (EXRI) exanimated feasibility of the targeted project by evaluating data & information obtained through study implementation this year in addition to those of last year. The 1st phase of the project. Project owner (GPSC) is going to sign up a power purchase agreement with PEA by the end of July, 2017. Rayong PAO started construction of segregation center, which will be leased to the project owner from the beginning of 2016, and completed construction at the beginning of 2017. The project owner divided original project into two projects, i.e. waste segregation & RDF power generation, and select construction site for power plant outside of Rayong IWMC, to avoid having approval for power generation business under PPP Act. As total investment for segregation center will be less than 1,000 million bath, the project owner expected more simple procedures to obtain an approval for the project under PPP Act, but finally such approval was waived by the revised National Cleanliness & Order Maintain Act on January 17, 2017.

Segregation Center under construction (L) & Composting Facility

Waste segregation facility, which the project owner intended to employ is full automation type, means all the process will be mechanically done, and this is different from others where employ labors for manual waste separation The RDF manufacturing factory will collect THB100.-/ton of tipping fee from Rayong PAO. And therefore, in order for RDF manufacturing factory to maintain their operation, they have to have other income, such as from sales of recyclable material and RDF, while supposed monthly cost for operation will be labor cost, utility expenses, building rental fee payable to Rayong PAO, depreciation etc. Parameters to assess profitability of the business are as follows;

		Parameter	Q'ntity	Unit
1		Amount of MSW to be received	500	Tons/day
2		Yield of RDF/RPF	25	%
	2)	Amount of RDF to be manufactured	125	Tons/day
3	1)	Income (1) Tipping Fee	100	THB/ton
	2)	Income (2) RDF sales[11]	150-400	THB/ton
	3)	Income (3) Recyclable material sales[12]	250,000	THB/day
4		Initial Cost (Facility only)[13]	150,000	THB1K
5		Labor Cost	2,400	THB1K/Y
6		Maintenance & Repairing (including overhaul & demolition)	45,000	THB1K/Y
7		Land & building rental fee	6,000	THB1K/Y
8		Utility cost	1,200	THB1K/Y
9		Depreciation (fixed depreciation for 20 years)	75,000	THB1K/Y

[11] Buying price of RDF/RPF on a delivered at site was THB0.2/Mcal/kg (Feb 2017)
[12] THB8.00 – 11.60/kg for plastic bottle & THB35.36/kg for aluminum can etc
[13] Estimation based on market price offered by local suppliers

RDF/RPF manufactured at waste segregation factory can be sold to power station and cement factories in Thailand. Among them cement factories are, although RDF/RPF to be sold to the cement factory shall be met with condition given by them, the biggest buyer of RDF/RPF in Thailand. The largest cement company answered to our inquiry and informed that specification of RDF/RPF acceptable to buy for them is: NCV shall not be less than 4,000kcal/kg and foreign materials contaminated ratio shall be less than 20%, and their buying price of RDF/RPF is about half of their procurement cost of coal in NCV basis. International market price for coal was increased in recent months, but suppose US$60.-/ton on an FOB basis and NCV for coal is 6,600kcal/kg, their buying price for RDF/RPF might be in a range of US$30-35.-/ton on a delivered at their gate basis. Their buying price shall include transportation cost, for the case of Rayong IWMC, from Rayong to Saraburi, i.e. THB700-800.-/ton, thus value for RDF/RPF at manufacturing facility might be THB400.-/ton. The value mentioned above is matched with the information which EXRI obtained from SEPCO, who operate existing waste segregation center in Rayong IWMC. Waste segregation center to be established in 1st phase might sell their manufactured RDF/RPF to power plant at the price of THB150-400/ton.

From the fact that there is no waste segregation center could make up long-term contract with local governments, waste segregation center for long-term operation basis can be established only with concept of "integrated waste management" and from this point of view, and as the project owner for the 2nd phase can establish business without separation due to revision of PPP Act, assessment done above is for reference only.

EXRI confirmed that the project owner for the 1st phase will employ closed loop waste cooling system for their condensate type steam turbine and started civil work for reservoir (20rai[14] with capacity of 300 thousand M3) as water supply source. Figure below shows location of waste segregation center and reservoir, in which circled by yellow line correspond to segregation center and that of blue correspond to reservoir. Power plan will be constructed next to the segregation center. Location of project site and related infrastructure are shown in Figure 4-1.

[14] 1 rai = 1,600m2

Figure 4-1　Location map of Rayong IWMC and related infrastructure in the area
Source: Prepared by EXRI based on Google Map

Regarding connection with national grid, possible connecting points and high voltage transmission lines in the area are as per shown in Figure 4-2 below.

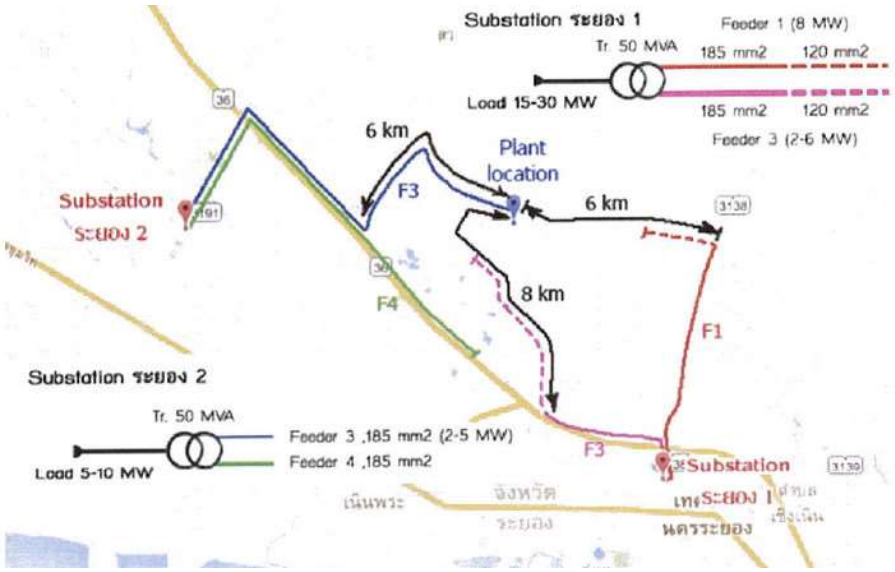


Figure 4-2 High voltage transmission lines & possible connecting points
Source: Provincial Electricity Authority

The Project Owners for the targeted project have contracts with Nippon Steel & Sumikin Engineering Co., Ltd. (NSENGI) which the project owners consider to employ as EPC contractor since NSENGI acquired Suteinmuller Bubcock. Initial & operation cost for

the project, which NSENGI proposed as of January, 2017 is as follows;

Construction Cost		
	Process	Cost (JPY)
1	Civil & Construction	693,00,000
2	Plant Construction	4,328,000,000
3	Temporary Works & Management	479,000,000
	Total	5,500,000,000

Condition for Estimation

Fuel : Mixed combustible Waste after segregation
(NCV: 4,000kcal/kg)
Capacity & Number of Furnace : 150t/day x 1 unit
Capacity of power generation : 8,500kw
Component : Water tube Boiler, Condensate Type Turbine, Dry type flue gas treatment & SNCR

Operation Cost		
	Item	Cost (JPY)
1	Utility Cost & Consumable Expenses	113,211,000
2	Inspection, Maintenance & Repairing Fee	93,000,000
3	Labor Cost	64,000,000
	Total	270,211.000

NSENGI informed that they well recognized necessity of cost down to secure profitability in the project, thus, they would try their best to do so.

(2) Consideration on advantage of Japanese EPCs

Not only Japanese EPC, but also Local & Third countries' EPC positively act in the field, which targeted in the study. Cost & expenses offered by Japanese EPCs are generally high but enjoy good reputation for their products and services, including aspect of low environmental impact, offered, while it is desirable for Japanese EPCs to prove advantage or high efficiency in energy conversion & further reduction of GHG emission by introduction of high efficient facilities & equipment. It will be depending on the sites, but some, in the same manner of Japan, there is difficulty in finding site for waste processing in Thailand, require to achieve better than environmental standard

prescribed by laws & regulation. Japanese can achieve such target except for the special cases, but it might cause to cost increase and performance degradation.

Consideration on realization of high efficient WtE plant

Generating efficiency is calculated by equation below

$$Generation\ \ Efficiency \quad = \quad \frac{Power\ \ Output \quad \times 100 \quad (\%)}{Energy\ \ Input(Waste + Fuel)}$$

Generation efficiency is calculated under the given condition below and the Government of Japan provides more than 20% as generation efficiency for the WtE plant with capacity of 400-600 tons/day, which is the same scale as the plant in target project, as condition given for granting facility development in Japan.

Table 4-1 Condition for generation efficiency estimation for facility development subsidy

Net Calorific Value of MSW	8,800kcal
Air Ratio	1.4-1.5
Steam Condition	400℃、4MP
Condensate Turbine Type	Air-Cooling
Flue Gas Treatment	Dry type
Flue gas re-heating catalyzer	n/a (low temperature catalyst (185℃)
White smoke protection	n/a

Measures to achieve high efficient power generation are stable incineration with low-air ratio, increase temperature & pressure of boiler, improve boiler efficiency, improve turbine efficiency, improve heat utilization by better steam utilization and so on. Technical elements & operation and impact on efficiency are as per shown in the table below;

Technical elements &/or operation	Impact	Condition for comparison
Low temperature economizer	1.0%	Temperature at flue gas outlet of boiler 250℃→190℃
Low air ratio incineration	0.5%	300t/day Air ratio 1.8→1.4
Low temperature catalyzer	1.0-1.5%	Temperature at flue gas inlet to

		catalyzer 210℃→185℃(no re-heating)
High efficient dry type flue gas treatment	3.0%	Wet type flue gas treatment → dry type high efficient treatment
No white smoke protection	0.4%	No white smoke condition 5℃ 60%→0%
No closed system for waste water	1.0%	Temperature at flue gas outlet of boiler 250℃→190℃
High Temperature & High pressure Boiler	1.5-2.0%	Steam Condition 3MP 300℃→4MP 400℃
Condensate Turbine	0.5%	Steam to be used at deaerator Main Steam→Extract from Turbine
Water-cooling	2.5%	Exhaust Pressure of Turbine -76KPaG → -94KPaG

Source: Manual for development of high efficient waste based power plant / MOEJ

As stated above, the project owners intend to employ Nippon Steel & Sumikin Engineering (NSENGI) as EPC for the project. Facility offered by the NSENGI realized 25-28% of generating efficiency by introduction of high temperature & high pressure boiler, improvement of material to be used for super heater, low air ratio incineration, lower flue gas temperature, low temperature economizer, lower turbine output steam pressure and no-catalyst denitrification facility. However comprehensive decision will be required, as there might be risks, such as corrosion of heater and water tube by low air ratio incineration, abrasion by low pressure steam output from turbine, and cost increase in both initial investment & operation caused by utilization of SIC laminated SC for high temperature & high pressure boiler.

Sensitive Analysis by generation efficiency for the targeted project estimated based on parameters set up by the study is as per Table 4-2 below. It's shows 0.29MWh/h of power increase or decrease for every 1% of fluctuation, and increase or decrease THB 13.2 million/ year for 1-8 year and THB11.8 million /year for 9th year and onward.

Table 4-2 Expected profit from business operation by generating efficiency

	Unit	Project Scenario					
Generating Efficiency	%	25	26	27	28	29	30

Power Generation		MWh	7.27	7.56	7.85	8.14	8.43	8.72
Profit from power sales	Y1-8	THB(Mil) /year	330.6	343.8	357.1	370.4	383.7	397.0
	Y9-20		290.5	302.2	313.9	325.5	337.2	348.8
	Total		6.130.8	6,377.0	6,623.2	6,869.5	7,115.7	7,361.9

Source: by EXRI based on FIT published by ERC

No subsidy for WtE plant is available at present & no such plan in future in Thailand Consequently, MSW incineration based WtE business operator shall secure profitability from expected profit from business operation, after deducting all the cost & expenses, including project development cost, plant construction cost, operation & maintenance cost, repairing cost and demolition cost. FIT for renewable energy is as per shown in Table 2-3 above, and tipping fee is approximately THB400.-/ton except for Bangkok & Chiang Mai[15]. Therefore, it is essential for the project owner to squeeze initial cost and operation & maintenance cost and become big barrier to employ Japanese EPC contract to with high efficiency, Low environmental impact but high cost

Japanese EPCs will be requested to work as below, for having more chance to receive orders

- Let Thai central & local governments understand importance of selecting reliable entity & technology through approached done & to be done by the Government of Japan & Japanese local governments.
- Let Thai central & local governments understand appropriate process and proper cost for appropriate process
- Cost reduction through establishment of local & third countries procurement network by Japanese EPC

<u>Effort of cost reduction tried by Japanese EPC</u>

Difference between cost of Japanese EPC and that of third countries is one of the critical factor in selecting EPC. EX Research Institute Limited (EXRI) obtained answers from Nippon Steel & Sumikin Engineering (NSENGI), to whom EXRI contacts for the targeted project, that NSENGI would reduce cost by taking actions below;

- Engineering cost& Implementation cost will be reduced for the second project and after by optimization of operation of 1st project in Thailand (assume the targeted

[15] THB400.-/ton for landfill operator and THB100.-/ton as market price for processors

project is 2nd project or after)

- Procurement cost will be reduced by establishment of offshore procurement network, such as from India
- Civil & Construction cost will be reduced by form up consortium with reliable local contractors

Japanese EPC informed that they consider to support business operator in terms of operation & maintenance as follows;

- To receive trainee(s) at their project site(s) in Japan for their better understanding of operation technic
- To dispatch Supervisor(s) to provide On the Job Training at the site.
- To utilize know-how and experience of local affiliate companies (NSES & SBE) in operation, maintenance & repairing

Implementation of comprehensive support

Basic concept for waste management in Thailand provided by competent government agencies, such as the Ministry of Natural Resources, the Ministry of Interior, the Ministry of Health is "Integrated Waste Management", which means starting from 3Rs promotion and realize waste reduction, reuse & recycle by promoting 3Rs activities, optimize waste collection & transportation and as a result, minimize amount of waste to be processed or landfilled in cost effective way and at the last end, processed or landfilled by appropriate method. And this is the scenario drawn by the Thai Government.

Thai faces problems in construction of waste-related facilities and therefore the Government of Thailand recognize importance of residents' consensus and employment of reliable technologies, which might be accepted by the resident. The Government of Thailand regard Japan as one of the successful countries in waste management, as Japan could succeed in waste reduction as a result of 3Rs promotion, construct and operate waste processing &/or disposal facilities after having residents' consensus, and therefore the Government of Thailand desires to have knowledge sharing and technical transfer from Japan. There are Japanese local governments, such as city of Kitakyushu, who willing to support local governments in overseas in the field of waste management. To approach to the central & local governments as a part of Japanese local governments' support for integrated waste management might be one of the effective way to materialize the project.

Since EX Research Institute Limited (EXRI), as the implementation body of the study as well as possible Japanese representative for the targeted project, intend to employ Japanese EPC, EXRI would like to have continued support, such as invitation of stakeholders from overseas to participate in seminars and sites visit by JCM project, as

such activities are sure to assist Japanese EPC's business in overseas.

5 Consideration on JCM registration

(1) Consideration on Quantification of GHG emission reduction

The project under planning by international consortium formed up by Italian-Thai Development PCL and Thai Eastern Group, is to install power generation facility with waste incinerator, which planed by Rayong PAO and generate electricity to be exported to the national grid. GHG emission reduction will be achieved by substitution of grid electricity by electricity generated by waste heat utilization.

1) Methodology for Quantification

Emission Sources and Type of GHG

Emission Sources and Type of GHG for the project are as follows;

Category	Activity	GHG	Remarks
Reference Emission	Power Generation	CO_2	GHG, which will be emitted from Grid connected power stations, without the project activities.
Project Emission	Fossil Fuel to be consumed on site	CO_2	GHG will be emitted from consumption of fossil fuel as auxiliary on site
	Electricity to be consumed on site	CO_2	GHG will be emitted from consumption of electricity, which imported from grid, and consumed on site
	Fossil Fuel to be consumed on site	CO_2	GHG will be emitted from consumption of fossil fuel for pre-treatment
	Electricity to be consumed on site	CO_2	GHG will be emitted from consumption of electricity, which imported from grid and consumed for pre-treatment
	RDF deprived from old waste	CO_2	GHG will be emitted from combustion of RDF deprived from old waste

Reference Emission

$$RE = EG_p \times EF_{grid} \qquad \text{Equation (1)}$$

where

RE_p = Reference emission for period "p"(t CO_2)

EGp = Amount of electricity generated and exported to the national grid for period "p"(MWh)

EF_{grid} = Grid Emission Factor (t CO_2/MWh)

Project Emission

Project Emission shall be quantified by the equation below.

$$PE_p = PE_{elec,plant,p} + PE_{FF,plant,p} + PE_{elec,pre-t,p} + PE_{FF,pre-t,p} + PFalt,p$$

where

PE_p = Project Emission for the period "p"(t CO_2)

$PE_{elec,plant,p}$ = GHG emission from electricity consumption on site for period"p" (t CO_2)

$PE_{FF,plant,p}$ = GHG emission from consumption of fossil fuel on site for period "p" (t CO_2)

$PE_{elec,pre-t,p}$ = GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PE_{FF,pre-t,p}$ = GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PEFalt,p$ = GHG emission from fossil fuel consumption for pre-treatment for period "p" (tCO2)

$$PE_{elec,,plant,p} = EL_{plant,p} \times EF_{grid}$$

where

$EL_{plant,p}$ = Amount of electricity imported from the national grid and consumed by the project for period "p" (MWh)

EF_{grid} = Grid Emission Factor(tCO2/MWh)

$$PE_{FF,plant,p} = FF_{plant,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{plant,p}$ = Amount of Fossil Fuel consumed as auxiliary on site for period “p”(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type”i”(Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type ”i”(tCO2/ton)

$$PE_{elec„pre-t,p} = EL_{pre-t,p} \times EF_{grid}$$

where

$EL_{pre-t,p}$ = Amount of electricity imported from national grid and consumed for pre-treatment for period”p” (MWh)

EF_{grid} = Grid Emission Factor (tCO2/MWh)

$$PE_{FF,pre-t,p} = FF_{pre-t,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{pre-t,p}$ = Amount of Fossil Fuel consumed for pre-treatment for period “p”(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type ”i” (Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type “i”(tCO2/ton)

$$PE_{Falt,p} = F_{alt,dry,p} \times TC_{pla} \times FCF_{pla}$$

where

$F_{alt,dry,p,}$ = Amount of Electricity imported from the national grid and consumed on site for period “p”(MWh)

TC_{pla} = Fraction of carbon for plastic in dry matter (%)

FCF_{pla} = Fraction of fossil carbon in total (%)

Emission Reduction

Amount of GHG emission reduction is quantified by following equation, i.e. Reference Emission minus Project Emission

$$ER_p = RE_p - PE_p \qquad \text{Equation (3)}$$

where

ER_p = Emission Reduction for period "p"(t CO_2)

Precondition for Estimation

Amount of MSW to be received ; 500t/day
Amount of Combustible Waste in MSW ; 150t/day
Capacity of Incinerator : 150t/day
Net Calorific Value for MSW (after segregation) ; 16,710kj/kg[16]
Working days ; 330 days / year
Power Generation efficiency of the facility ; 28%
Amount of electricity consumed on site ; 0.89MWh/h

Reference Emission

Reference emission, i.e., an amount of GHG emission from power generation by power stations, which connected to grid, generate and export power to the grid, is quantified by equation (1) above and values to be applied are set up as per the table below.

Parameter	Unit	Value	Remarks
EG_p	MWh	By Monitoring	
EF_{grid}	tCO2/MWh	Default Value	Default Value published by the Host Country (=0.5113 tCO2/MWh)

Amount of electricity to be generated by the project is estimated as 64,488MWh/year, and amount of electricity to be consumed on site is estimated as 388MWh/year from the precondition set up above, As a result, an amount of electricity to be generated and exported to the grid will be 64,100MWh/year. Consequently, amount of GHG emission reduction is calculated as 32,774tCO2/year.

Project Emission

[16] NCV for Fresh combustible waste after segregation

As the project under consideration is to establish power generation unit attached to MSW incinerator, GHG emission from MSW incineration is not regard as project emission for the project. Therefore, project emission for the project is from consumption of fossil fuel as auxiliary on site, consumption of electricity on site, consumption of fossil fuel for pre-treatment and consumption of electricity for pre-treatment. Project emission is calculated by the equation (2) above with values for each parameter shown in the table below, while values to be applied for quantification are as per shown in the table below

Parameter	Unit	Value	Remarks
$EC_{plant,p}$	MWh	Monitoring	
$EC_{pre-t,p}$	MWh	Monitoring	
EF_{grid}	tCO2/MWh	Default	Default Value published by the host country (=0.5113tCO2/MWh)
$FF_{aux,i,p}$	L	Monitoring	
$FF_{pre-t,,i,p}$	L	Monitoring	
NCV_{FFi}	GJ/t	Default	i=diesel (43.3) IPPC Default Value
EF_{FFi}	tCO2/GJ	Default	i=diesel (0.0748) IPPC default value (max)
TC_{pla}	%	Default	IPCC Default Value (85)
FCF_{pla}	%	Default	IPCC Default Value (100)

In this project, electricity to be consumed on site and pre-treatment is planned to be procured by power plant in the project, except for the period of off-operation of power plant, while an amount of electricity to be imported from the grid and consumed on site and pre-treatment during off-operation period. Fossil fuel might be consumed at emergency generator for the case of power outage in off-operation period, if any. Actual amount of both electricity and fossil fuel to be consumed will be monitored through the project operation, while it is estimated approximately 338,000kWh/year covering amount of electricity to be consumed for maintenance and at office buildings during off-operation period.

Emission Reduction

GHG emission reduction by the project is estimated as 32,774tCO2/year from the reference emission and project emission estimated above.

(2) Consideration on MRV Methodology & Monitoring

1) Methodology

The project targeted in the study, basically plans to generate power by utilizing combustible waste separated from municipal solid waste to be collected and transported by Rayong PAO. However, there might be some possibility to process combustible waste from landfills in the Rayong Integrated Waste Management Center in near future, as space for landfill will not be not enough. Situation at Rayong IWMC is considered as common in Thailand, so the implementation body of the study worked for methodology by taking the situation above into consideration.

Consideration on Eligibility

	Eligibility Criterion	Reason
1	Project shall generate power by utilization of waste heat deprived from incinerator, which is designed, constructed, and operated for combustion of MSW	Thermal energy deprive from MSW incineration includes that from plastic waste. As emission factor for incineration of plastic waste is high, project might emit more GHG than reference scenario, if incineration would be included into the project
2	For the case the project utilize existing old waste buried at landfills as alternative fuel (including RDF & RPF), then 1) The project participants shall establish organization and system to conduct appropriate monitoring operation for RDF deprived from old waste. 2) The Project participants shall not utilize RDF in excess of the upper limitation set up by the PDD 3) The project shall adopt default values for GHG emission from combustion of plastic waste as follow (as per default value set up by IPCC2006) CF=0.85 FCF=1.00	RDF deprived from old waste is used as alternative fuel for power generation, and this is not categorized as waste heat (from MSW combustion)

3	The project shall contain the incinerator with capacity of not less than 300tons/day and not less than 25% of total energy conversion efficiency in electricity form.	Thermal conversion efficiency & safety on operation of facility is the key factor for the methodology.
4	For the case MSW incinerator will be constructed under the project, the project shall be proved either power generation is an addition to MSW incineration project or MSW to be combusted at the incinerator is combusted without waste heat recovery including power generation, without the project activity.	Project is to achieve GHG emission reduction by utilization of waste heat. Thus, the project shall prove there is or will be waste heat available to use for power generation

Consideration on Quantification of GHG emission

Please refer to 4-2-2 above

Consideration on securing conservativeness

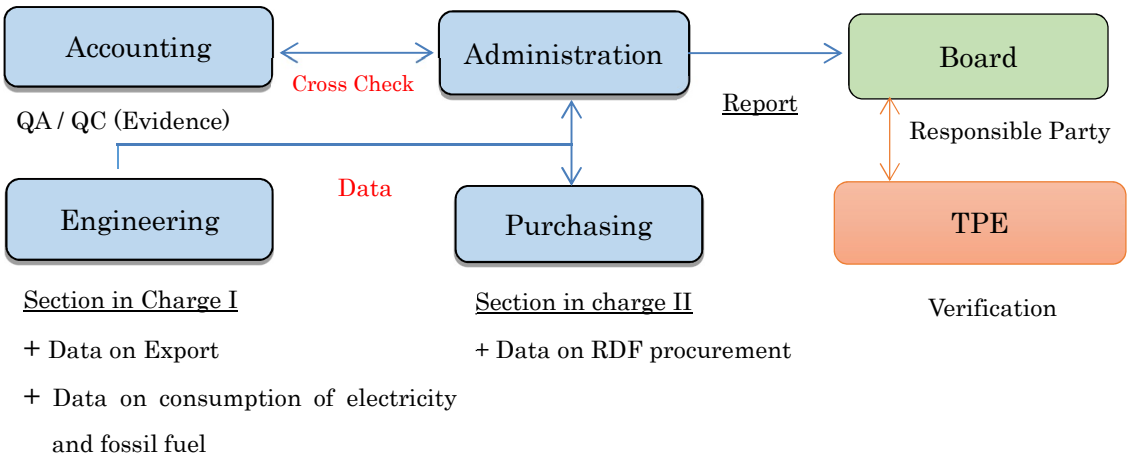
Clearly explained by the Power Development Plan, the Government of Thailand provides their policy of promotion of carbon neutral energy, such as renewable energy, hydropower, and even nuclear power, and assumed it make grid emission factor lower than that published by Thai Designated National Agency. From the point of view of securing conservativeness, consider to adopt emission factor applicable for each monitoring period on ex-post basis.

2) MRV

Monitoring is expected to be done by the project operator as a part of routine work of business operation, and monitoring report prepared by the business operator is expected to have internal audit, then to be submitted to the Third Party Entity for verification after final approval given by the board of directors.

Organizational Structure for MRV Implementation

Organizational structure planned to be formed in the project is as below;



Monitoring Methodology

Layout of facilities & equipment to be installed under the project under planning is as per Figure 5-1. Monitoring points as per methodology explained above are also shown in the Figure 5-1 below.

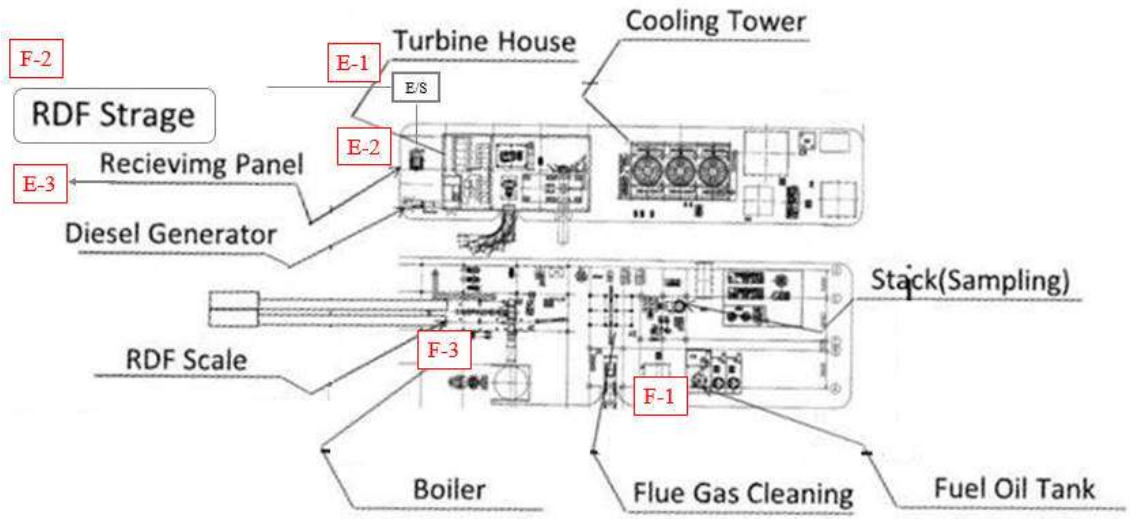


Figure 5-1 Monitoring Points

Details of monitoring point shown in Figure 5-1 with monitoring method are as follows;

Point	Parameter		Unit	Frequency	Instrument
E-1	EG_p	Amount of electricity generated and exported to national grid	MWh	Daily	Accumulated Electricity Meter
E-2	$EC_{plant,p}$	Amount of electricity imported from national grid and consumed at	MWh	Once/day when used	Accumulated Electricity

		plant			Meter
E-3	$EC_{pre-t,p}$	Amount of electricity imported from national grid and consumed at pre-treatment facility	MWh	Once/day when used	Accumulated Electricity Meter
F-1	$FF_{aux,i,p}$	Amount of fossil fuel consumed at plant	L	Once/day when used	Accumulated Flow Meter
F-2	$FF_{pre-t,,i,p}$	Amount of fossil fuel consumed at pre-treatment facility	L	Once/day when used	Accumulated Flow Meter
F-3	$AF_{aux,i,p}$	Amount of RDF manufactured from old MSW	Mt	Once/day when used	Weighing Machine

Assumed flow from monitoring activities to verification to be conducted by the third-party entity is as follows;

- Appointed person in charge from The Engineering Section, which is responsible for operation of the plant, will monitor and record values of 1) amount of electricity exported to the grid, 2) amount of RDF, which is processed from old waste, consumed, 3) fossil fuel consumed as auxiliary and electricity imported from the grid & consumed both on site and for pre-treatment.
- The format shall be checked by the chief of the section and filed in pre-fixed files on daily basis, then send to Administrative Section periodically.
- Administration Section shall cross check values in the report submitted by accounting section, purchasing section and engineering section, then convert into electric format for filing.
- Values for each parameter monitored and filed, will be transcribed to monitoring report including spread sheets of Project Design Document and submitted to the Board of Directors for approval
- Board of Director will submit monitoring report to Third Party Entity for verification, then submitted verified monitoring report to JCM joint committee for credit issuance.

A summary of roles of each section in terms of monitoring, filing and QA/QC in operation flow is as per description in the table below.

Table 5-1 Assumed QA/QC for each parameter to be monitored

Parameter	Measurement & Record	QA/QC
Amount of electricity to be exported to the national grid	● **Engineering Section** will monitor the parameters and record actual values in the pre-fixed format ● **Administration Section** will convert data into electric form and file ↓ **Administration Section** will prepare monitoring report to be sent to board for approval, then send to TPE for verification	cross check with invoices issued to electricity buyer(s)
Amount of RDF consumed		cross check with both with delivery notes and invoice to be issued by RDF supplier(s)
Amount of electricity imported from the national grid and consumed on site & pre-treatment		Cross check values in the report submitted by the engineering division with invoice issued by electricity buyer(s)
Amount of fossil fuel consumed on site & for pre-treatment		Cross check with values in the report submitted by the purchasing division and engineering division with invoice issued by supplier(s)

Measurement Instrument for Monitoring Activities

The project participants will install measurement instrument with uncertainties of less than 5%, as prescribed by the JCM and calibrate periodically for less errors in monitored values.

(3) Environmental Integrity

The project under planning is power generation project utilize waste heat from MSW incineration. To operate incinerator as source of heat supply is essential for the project, EXRI researched flue gas emission standard in other than environmental standard for effluent, noise, vibration as follows;

1) Emission standard for flue gas

Pollutant	Emission Source(Fuel)	Combustion
Total Suspended Particulate (TSP)(mg/m3)	Incinerator & Boiler (Biomass and other fuel)	≦320
Sulfur Dioxide (SO_x)(ppm)		≦60

Oxides of Nitrogen (NO_x) (ppm)		≦200
CO(ppm)	Applicable for all	≦690
Sulfuric Acid(ppm)		≦80
HCl(mg/m3)		≦160
Antimony(mg/m3)		≦16
Arsenicum(mg/m3)		≦16
Copper(mg/m3)		≦24
Lead(mg/m3)		≦24
Chlorine(mg/m3)		≦24
Mercury(mg/m3)		≦2.4

Reference Condition :25℃ at 1 atm or 760mm Hg & dry basis

2) Effluent Standard

Effluent standard is different depending on discharging points, i..e, river or irrigation 排 cannel. Table 5-2 indicate effluent standard for both river and irrigation cannel.

Table 5-2 Effluent Standard

Parameter	Discharge point	
	River	Irrigation cannel
Ph	5.5-9.0	6.5-8.5
TDS	<3,000mg/l	1,300mg/l
SS	<50mg/l	30mg/l
Temperature	<40℃	<40℃
Color & muddiness	Acceptable	Acceptable
Sulphide (H_2S)	<1.0mg/l	<1.0mg/l
Cyanide (HCN)	<0.2mg/l	<0.2mg/l
Fat, Oil & Grease	<5.0mg/l	<5.0mg/l
Formaldehyde	<1.0mg/l	<1.0mg/l
Phenols [17]	<1.0mg/l	<1.0mg/l
Free Chlorine	<1.0mg/l	<1.0mg/l
Pesticides	Not detected	Not detected
Biochemical Oxygen Demand (BOD)	<20.0mg/l	<20.0mg/l

[17] Methyl phenol is added into parameter for discharge to irrigation cannel

Total Kjeldahl Nitrogen (TKN)	<100.0mg/l	-
Chemical Oxygen Demand (COD)	<120.0mg/l	-
Zinc (Zn)	<5.0mg/l	<5.0mg/l
Hexavalent Chromium	<0.25mg/l	<0.3mg/l
Trivalent Chromium	<0.75mg/l	-
Arsenicum (As)	<0.25mg/l	<0.25mg/l
Copper (Cu)	<2.0mg/l	<1.0mg/l
Mercury (Hg)	<0.005mg/l	<0.005mg/l
Cadmium (Cd)	<0.03mg/l	<0.03mg/l
Selenium (Se)	<0.02mg/l	<0.02mg/l
Barium (Ba)	<1.0mg/l	<1.0mg/l
Lead (Pb)	<0.2mg/l	<0.1mg/l
Nickel (Ni)	<1.0mg/l	<0.2mg/l
Magnesium (Mn)	<5.0mg/l	<0.5mg/l
Radioactive substance	-	Not detected
Tar	-	Not detected

3) Noise Standard (Factory)

Maximum Noise <115dB

Maximum noise per operation hour(s) per day is as follows;

Operation Hours	Max Noise(dB)	Operation Hours	Max Noise(dB)
>12	87	<2	100
<8	90	<1 1/2	102
<6	92	<1	105
<4	95	<1/2	110
<3	97	<1/4	115

Environmental standards prescribed in Thailand are as above, while some of the project owner agreed with resident to work for more strict emission standard and/or effluent standard. Since the lower environmental impact is one of the strong point for Japanese EPC, the implementation body of the study will promote such low environmental impact technologies

(4) Contribution for Host country's sustainable development

1) Realization of appropriate MSW processing & disposal with low National Burdon

As stated, amount of municipal solid waste has been increasing due to economic development and changing of nation's life style. Along with constrain of landfill

capacity and growing of national awareness, waste management in Thailand is in transition period. Waste Management in unprofitable operation and therefore, the Government is requested to improve balance of payment for sustainable operation. The targeted project will contribute to host country's sustainable development through business operation by (i) De-toxify and reduction of waste which is currently landfilled and (ii) reduction of operation cost by getting income from selling power generated from waste heat from MSW incineration

2) Technical Transfer

There are only four MSW incineration based WtE plants, which EXRI targeted in the study, in Thailand as of October 2016, and technical transfer for operation & maintenance is required for popularizing of the technology. Nippon Steel & Sumikin Engineering (NSENGI) together with Suteinmuller Babcock, their affiliated company, have comprehensive knowledge starting from support on documentation for the administrative offices to operation & maintenance, as they have more than 500 reference sites in the world, where they had installed their stalker type incinerators with power generation facilities and support for operation & maintenance. City of Kitakyushu, the other implementation body for the study administrate waste management, i.e., 3R promotion, optimization of waste collection & transportation and preparation & implementation of waste management plan, as local government. As strongly requested by the local stakeholders, the project owner will transfer technology & knowledge from both NSENGI & City of Kitakyushu to local parties through implementation of the project.

3) Job creation and vitalization of local economy

In the targeted project, the project owners intend to procure various facilities, equipment, and machines, except for any of those for higher efficiency and low environmental impact, from local parties and contract local parties for civil & construction works. Thus, the targeted project would create job opportunities and expect economic effect in the area. Other than construction period, the targeted project would create another job opportunity by employment of management and many members of staff, including operators, maintenance staff, security guard for business operation. The target project and concerning parties would contribute for local economy by paying various taxes as well.

(5) Workshop for better understanding of MRV for JCM project

City of Kitakyushu & EX Research Institute Limited (EXRI) organized workshop for better understanding of MRV for JCM project as a part of the study in Thailand on both September 26th & 27th, 2016

Outline

	1st Workshop	2nd Workshop
Date	September 26, 2016	September 27, 2016
Venue	Meeting Room at Italian Thai Development PCL	Meeting Room at Bangkok Representative Office, Nippon Steel & Sumikin Engineering Co., Ltd.
Lecturer	Mr. Shigenari Yamamoto, Asia Engineering Consultant Co., Ltd. (AEC)	
Organizer	City of Kitakyushu & EX Research Institute Limited	
Participants	15 person in total, including members of staff from ITD and assistant professor from Chiang Mai University (environmental engineering)	8 person in total, including members of staff from NSENGI and potential project owners, other than the targeted project
Program	As per below	
Distribution	A set of presentation document (as per appendix 1)	

Program

Time	Program
09:30-09:40	Opening of the Workshop[18]
09:40-09:50	Keynote Address Mr. Junichi Sono, Director, City of Kitakyushu
09:50-10:00	Outline of the Project & purpose of organizing workshop Mr. Satoshi Takagi, EX Research Institute Limited
10:00-12:00	Background of Joint Crediting Mechanism (Climate Change / UNFCCC / Kyoto Protocol / CDM & JI / NAMAs / New Mechanisms / BOCM & JCM) Mr. Shigenari Yamamoto / AEC
12:00-13:00	Lunch
13:00-16:00	● Outline of JCM (Basic Concept / Scheme / Framework / Project Cycle / Carbon Credit / JCM subsidy) ● Introduction of JCM projects & JCM project development studies ● MRV (Applicable methodologies for targeted project and planning

[18] Mr. Jedsada, Project Director from ITD for the 1st Workshop and Mr. Takeshi Nimura, Senior Manager for 2nd workshop made opening speeches.

Time	Program
	& implementation of MRV) Mr. Shigenari Yamamoto / AEC
16:00 -	Closing of the Meeting[17]

Mr. Yamamoto, invited as lecturer to the workshop, is used to be Deputy General Manager for Global Environment Division as well as Counselor for Japan Quality Assurance and engaged in climate change (mitigation) related projects, including validation & verification of CDM projects as Designated Operational Entity (DOE) and supported on development of CDM projects. He is the person who engaged in the studies for BOCM/JCM project development after 2010, when the Government of Japan started studying new mechanism, and participated in the study for the development of large scale JCM projects conducted by the Ministry of Economy, Industry & Trade in recent year. Participants to the workshop such as members of staff from ITD commented that "the workshop was very interesting & useful, as they had a chance to learn project cycle, especially validation, monitoring and verification from the point of view of Third Party Entity (TPE), accuracy on monitoring, uncertainty of measurement instrument and other studies conducted under the study for JCM project development from the TPE".

At Workshop 1st workshop (L) and 2nd workshop (R)

6 Future

The Government of Thailand announced that they would receive application for PPA for MSW incineration based WtE project during March 1-2 and conclude evaluation by the end of March. The 1st phase of Rayong Project is listed one among 8 most well prepared projects and assured to obtain quota for PPA. Once 1st phase of Rayong project succeed, it will become a model project in Thailand and it make 2nd phase of the project accelerates to be implemented. EX Research Institute Limited established its affiliated company in 2016 and, took over shares of local waste-pretreatment

manufacturer on January 2017. EXRI will continue to work for the targeted projects and even other projects in the same field by utilizing affiliated companies in Thailand.

7 Challenges

Possibility to spread WtE project in Thailand is increasing, as the Government of Thailand settled issued on Private Investment in Public Project as well as Power Purchase Agreement in some extent. The project owner will carefully watch the movement of selection for 1st quota from general view, and make best effort to have waste procurement contract with Rayong PAO, as the project owners expect to face higher competition on it.

8 Conclusion

EXRI, as a Japanese representative for the project had an opportunity to study both specific for the targeted project as well as general issues as for WtE projects by completion of study, including commercialization of WtE project and JCM registration. EXRI will continue to work for commercialization of WtE and other waste-related business in Thailand and neighboring countries. It would be our great pleasure if our report can help for those who have intention to develop similar project in the Thailand.

Appendix:

1. Implementation Schedule for the Study(Gantt Chart)
2. Report on Activates in host country(including Presentations)

(1) Presentation used at meetings

(2) Introduction of city of Kitakyushu

(3) Text distributed at the workshops

3. Meteorological Date of the project site

Description			Completion	2016																						
No		Item		5					6					7					8					9				
				1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1		Collecting Basic & general inform	June																									
2		Feasibility Study	Sep																									
	1)	Current Situation & Plan																										
	2)	Waste Quality & Quantity																										
	3)	Licenses & Approvals																										
	4)	Infrastructure																										
	5)	Environmental Standard																										
	6)	Financial Plan																										
3		Facility & Equipment	Dec																									
	1)	Optimization																										
	2)	O&M																										
	3)	Cost Reduction																										
4		JCM registration	Jan (M)																									
	1)	Methodology																										
	2)	MRV																										
	3)	International Consortium																										
	4)	Environmental Integrity																										
	5)	Schedule Adjustment																										
	6)	Financial Scheme																										
5		Business evaluation	Jan (M)																									
6		Support by Kitakyushu	March 10																									
		Activites in Host country																										
		Meetings & Workshops				K(TKY)		K(THAI)																		WS(THAI)		
		Report																										

Description			Completion	2016															2017									
No		Item		10					11					12					1					2				
				1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1		Collecting Basic & general inform	June																									
2		Feasibility Study	Sep																									
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5		Business evaluation	Jan (M)																									
6		Support by Kitakyushu	March 10																									
		Activites in Host country																										
		Meetings & Workshops					WS(JPN)																WS(JPN)					
		Report						I(10/28)															FD(1/20)				F(2/17)	

Remarks

K	Kick Off Meeting
C	COP22
I	Intermediate Report
FD	Final Report (Draft)
F	Final Report

Entrusted by
The Ministry of Environment, Japan
2016

Feasibility Study on JCM project development for realization of low carbon society under inter-city cooperation

Power Generation from Waste Heat from MSW incineration in Rayong, Thailand

北九州市 CITY OF KITAKYUSHU

株式会社 エックス都市研究所 EX Research Institute Ltd. Environmental and Regional Planning, Research and Consulting

NTT DATA Global IT Innovator

CONTENT

1. Outline of the Study …Summary for the study

Goal

- Realization of Low Carbon Society / Growth in Asia (Reduction of GHG emission in Asia)

Objectives

- Completion of General & Basic Study for Waste Power Plant Project in Rayong Province (Phase II)
- Completion of preparation for JCM registration, including application for subsidy (max.50%)

Activities

1. To update General Situation in Thailand (Governing Laws & Regulation, National Policy, Action Plan, Current Situation, Environmental Standard and so on)
2. To study license & permission for business establishment & operation
3. To prepare an initial EPC concept design for the project
4. To study the possibility of project applicability for JCM
5. To study the possible MRV implementation under JCM
6. To study the possibility for the Japanese private sector(s) being involved into the project
7. To prepare draft initial business plan for the project

Subject to final confirmation given by the concerning parties

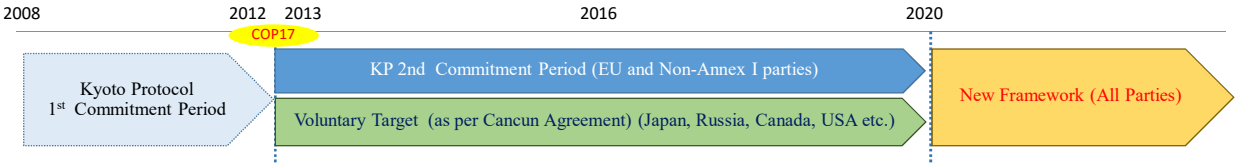
3

2. Background of the Study (1) … New Mechanism in Mitigation under Climate Change

NAMAs & New Mechanisms

Year	Details of Conference	Decision
2007	COP13 (Bali, Indonesia)	Decided to form Add-Hock Working Group for Long Term Cooperative Action
2009	COP15 (Copenhagen, Sweden)	Decided to take note of "New Mechanism"
2011	COP16 (Cancun, Mexico)	Decided to consider the establishment of one or more market-based mechanisms at COP17
2012	COP17 (Durban, South Africa)	Decided to request AWG-LCA to define and elaborate modalities and procedure for the mechanisms
2013	COP18 (Doha, Qatar)	Decided to adopt decision note for recognition of implementation of various approaches by parties to the conference and enable to report estimated amount of GHG reduction in Biennial Report to be submitted to UNFCCC (as a part of Section II Quantified Economic-Wide Emission Reduction Target)

Road Map set up by UNFCCC at COP17



✓ Parties, who did not submit their legal binding target for 2nd commitment period, set up their voluntary target in accordance with Copenhagen Accord (for the case of Japan, 3.8% of emission reduction by 2020 based on the amount of GHG emission in 2005

✓ International Society consider to increase emission reduction quantity by accepting IPCC's recommendation

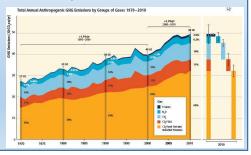
Japan has Established a New Mechanism named "JCM" and launched since 2013

4

2. Background of the Study (2) … COP21

Current Situation (from IPCC Fifth Assessment Report)

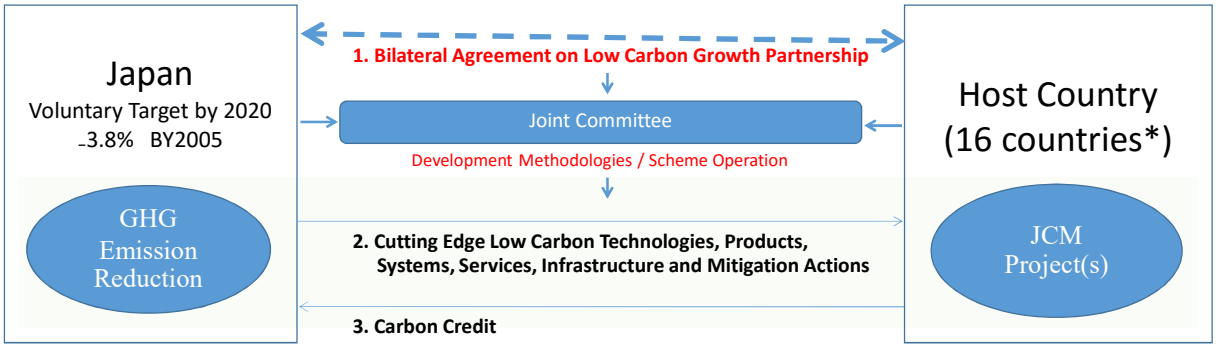
- Mitigation scenarios reaching about 450-500ppm CO2-eq by 2100 show reduced cost for achieving air quality and energy security objectives, with significant co-benefit for human health, eco-system impact and sufficiency of resources and resilience of energy system.
- GHG emission in the past 10 years was drastically increased
  (without additional effort to reduce GHG emissions beyond those in place today…
  surface temperature increases in 2100 from 3.7 – 4.8c compare to pre industrial level)



Policy & Direction

- International Community adopted "Paris Agreement" at 21st session of Conference of Parties (COP21) to UNFCCC
  1) "hold the increase in the global average temperature to below 2c above pre-industrial level by reducing emission to 40 giga-tons or to 1,5c above pre-industrial levels" (Section 17)
  2) "A mechanism to contribute the mitigation of greenhouse gas emissions and support sustainable development is hereby established under the authority & guidance of the Conference of the Parties (Article 6)
- The Government of Japan initiate and promote Joint Crediting Mechanism as a mechanism and 16 countries including Thai have participated in JCM as of January 2016

1. Background of the Study (3) … Joint Crediting Mechanism



1. Objectives

- ✓ To contribute ultimate objective of UNFCCC (reduce or remove GHG emission)
- ✓ To appropriately evaluate mitigation actions which contribute to GHG emission reduction
- ✓ To facilitate diffusion low carbon technologies, products, systems, services & infrastructure, mitigation actions and sustainable development.

2. Basic Concept

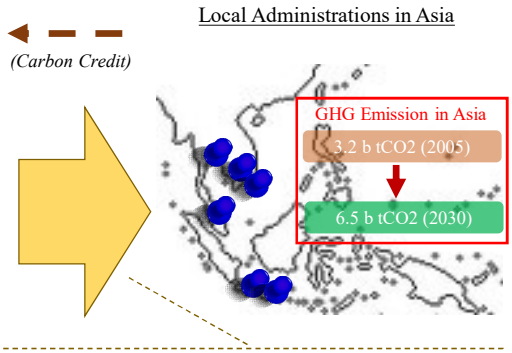
- ✓ To ensure Environmental Integrity
- ✓ To make scheme Simple, Transparent & Practical
- ✓ To secure reliability of Carbon Credit to be generated from JCM(BOCM)

*** *please refer to Appendix 1. countries joined to JCM*

2. Background of the Study (4) … Realization of Low Carbon Society in Asia

環境省 Ministry of the Environment

JCM Project Planning Study on Realization of Low Carbon Society in Asia



Goal

To Realize 'Low Carbon Society & Growth in Asia"

Activities under the Study

1. Introduction & Transfer of Technologies, Systems & Know-How to Local Administrations in Asia
2. Mulit-Project(s) development in Local Administration Level under the concept of "Realization of Low Carbon Society & Growth in Asia" through implementation of JCM

**** 9 projects have been selected to be implemented on entrustment basis for the fiscal year of 2015 (as of April 13, 2015)*

2. Background of the Study (5) … Kitakyushu City & it's Activities in Thailand

北九州市 CITY OF KITAKYUSHU

Asia Center for Low Carbon Society

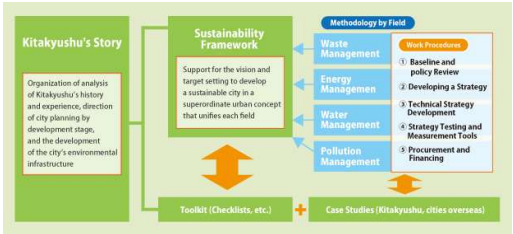
- Established in 2010
- Providing services for
  1) Technology Transfer (total package as integrated solution for realization of low carbon society in Asia)
  2) Human Resource Development (for Specialist)
  3) Research & Feasibility Study
- Website: http://asiangreencamp.net/eng/index.php

Green Asia International Strategic Comprehensive Special Zone

Environmental Model City / Future City

- Selected by the Government of Japan
- Set up voluntary target of GHG emission reduction of
  - -50% in Kitakyushu city by 2050
  - -150% in Asia by 2050 *base year=2005

Kitakyushu Model



Parties from Thailand

Department of Industrial Work

Date	Memorandum of Understandings
Dec 2014	for Cooperation on Creating of Eco Industrial Complex Development at IRPC

Industrial Estates Authority of Thailand

Date	Memorandum of Understandings
Aug 2014	for Cooperation on Development of Map Ta Phut Eco Industrial Town

2. Background of the Study (6) … Municipal Solid Waste in Thailand

Current Situation

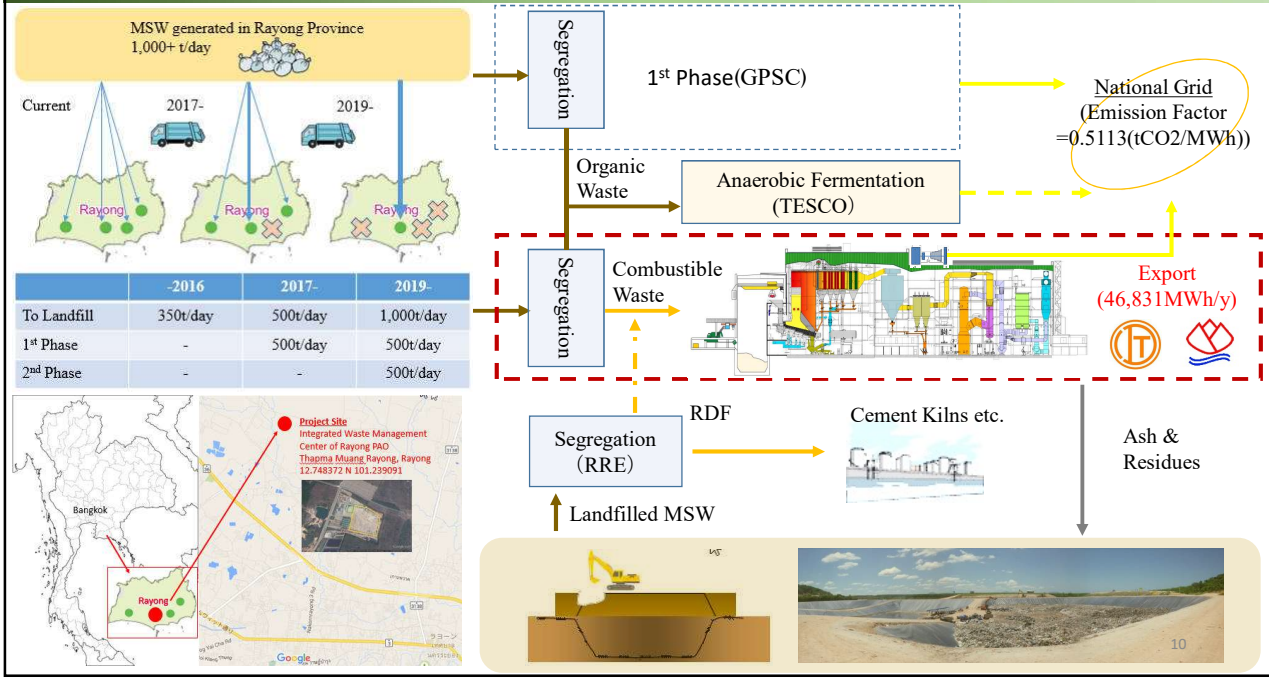
- Proper MSW management is one of the issues with highest priority in the country
- 26.1 million tons / year of MSW was generated in 2014
- Limited numbers of appropriate disposal sites in the country
  (446 sites from 2,490 sites in total are regarded as appropriate disposal sites)
- Physical Restriction on Development of new sites
- Financial barrier on establishment of new intermediate facilities
  (Ceiling Service Fee set up by the Government is extremely low)

Policy & Direction

- The Cabinet requested Ministry of Natural Resources & Environment to draft Road Map & Master Plan for Solid Waste Management (Road Map was approved by the cabinet on August, 2014 and Master Plan is under evaluation)
- Four directions in the road map, i.e.
  1) appropriate management for fresh municipal solid waste
  2) restoration of old & existing inappropriate disposal sites with utilization of old waste existing in the landfill
  3) enhancement of laws & regulation on MSW management & standardization
  4) enact laws & regulation for sustainable management & environmental education
- Others remarkable policies in the road map
  1) Promotion on investment from private sector to the waste management field in Thailand
  2) Make use of both fresh & old waste as resource

9

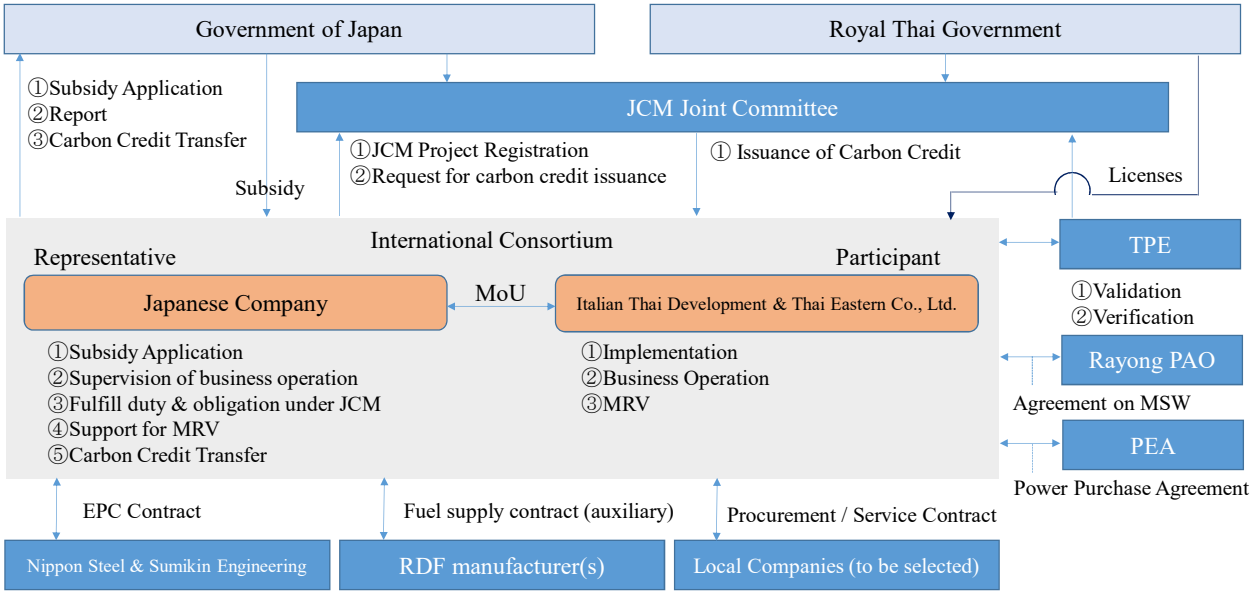
3. Targeted Project…Power Generation from Waste heat recovered from MSW incineration in Rayong



	-2016	2017-	2019-
To Landfill	350t/day	500t/day	1,000t/day
1st Phase	-	500t/day	500t/day
2nd Phase	-	-	500t/day

10

4. Correlation among the parties involved in the Project and JCM project implementation



5. Activities under the Feasibility Study (for JCM registration)

- The Government of Japan evaluate or conduct simple due-diligence in order to secure feasibility of the project
- Japanese firm who will participate as representative from international consortium need to secure feasibility of the project, as the Japanese firm shall take responsibility for subsidy granted by the Government of Japan.
- In order for all the parties involved in to avoid wasting time, it is better to assess whether or not the project has possibility to apply and acquire subsidy under JCM step by stem through project implementation.

Will study the feasibility of the project & see possibility for JCM subsidy and prepare JCM subsidy application for the project, if necessary

1. To update General Situation in Thailand (Governing Laws & Regulation, National Policy, Action Plan, Current Situation, Environmental Standard and so on)
2. To study license & permission for business establishment & operation
3. To prepare an initial EPC concept design for the project
4. To study the possibility of project applicability for JCM
5. To study the possible MRV implementation under JCM
6. To study the possibility for the Japanese private sector(s) being involved into the project
7. To prepare draft initial business plan for the project

6. Schedule for the Study

2016: May, June, Jul, Aug, Sep, Oct, Nov, Dec
2017: Jan, Feb

- May 17 Kick off Meeting held at the Ministry of Environment, Japan (Tokyo)
- May 25-Kick off & first meeting in Thailand
  - May 25 Kick off Meeting with Italian-Thai Development & Thai Eastern (Ba
  - June 3 Kick off Meeting with Rayong Provincial Administrative Office (Ray

Data & Information Collection

- Sep Workshop on JCM (Scheme & MRV) (Bangkok)
- UNFCCC COP22 (Presentation of the Project at side event organized by the Government of Japan)
- Dec Meeting among the parties might form up International Consortium for the Project Implementation

Reporting & Assessment

- JCM high level meeting (Presentation of the Project) (Bangkok)

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Appendix 1. Terms & Condition for JCM subsidy application (1)

1. Governing Laws & Regulations

1) Law on Appropriateness of Budget Execution for Grant (1955)
2) Guideline for Grant for Carbon Dioxide Emission Reduction countermeasures (2014)
3) Guideline for Grant for realization of Leap-Frog development model (2014)

2. Recipient of Grant

International Consortium formed among Japanese & Foreign parties with purpose of operate project efficiently

3. Applicant of Grant

Application shall be Joint Application by parties in the International Consortium. Subsidy shall be granted to the representative of Joint Applicants and it shall be any Japanese party.

4. Responsibility of the Representative of the International Consortium

1) Procurement & Installation of Facility & Equipment
2) Test Run
3) Accounting for Grant
4) MRV
5) Submission of Annual Report (Emission Reduction) to the Japanese Government (for statutory useful years)

5. Amount to be Subsidized

Not exceeding ½ of the Project Cost

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Appendix 1. Terms & Condition for JCM subsidy application (2)

5. Terms & Conditions for Grant

1) Cost Optimization (Article 8)

2) Progress Report (Article 11)
Progress Report shall be submitted to the Japanese Government either within 30 days on and after the project completion or before March 10 of the same fiscal year when the project completed by Form No. 14). Annual Progress Report shall be submitted to the Japanese Government by April 30 for the case the project period would extend to next year.

3) Annual Business Report (Article 16)
Annual Business Report for the fiscal year shall be in accordance with Form No. 18 an submitted to the Japanese Government by April 30 during statutory useful year of the Project.

4) Project Registration (Article 18-1)
Subsidized project shall be registered as JCM project at Joint Committee set up or to be set up in host country

5) MRV (Article 18-2)
1st MRV in accordance with JCM rules, shall be conducted within a year on and after the completion of the project. Any carbon credit might generated by 2020 shall be verified in 2021.

6) Carbon Credit (Article 18-2)
not less than ½ of carbon credit verified by TPE shall be transferred to the Japanese Government

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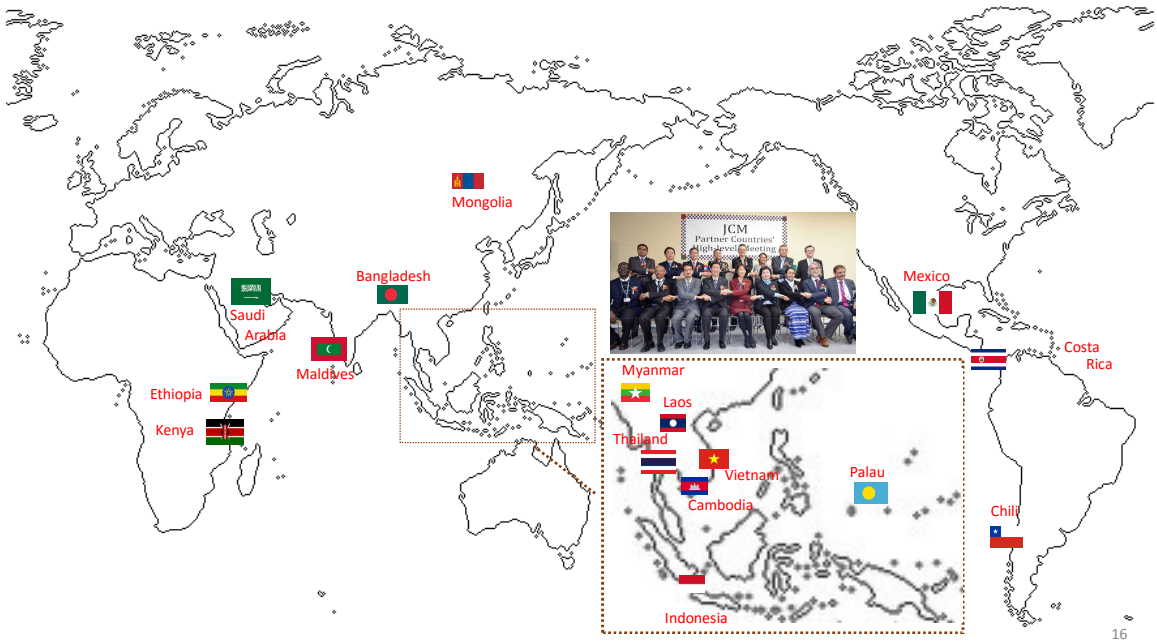
Appendix 2. Countries joined into Joint Crediting Mechanism



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Appendix 3. JCM Projects registered at Joint Committee as of May 25, 2016 (1)

JCM registered : 15 projects in total (Indonesia 6, Mongolia 2, Palau 3 and Vietnam 4)

Country	Project Code	Project Name
Indonesia	ID006	Installation of Inverter-type Air Conditioning System, LED Lighting and Separate Type Fridge Freezer Showcase to Grocery Stores in Republic of Indonesia
	ID005	Energy Saving for Air-Conditioning at Textile Factory by Introducing High-efficiency Centrifugal Chiller in Batang, Central Java (Phase 2)
	ID004	Energy Saving for Air-Conditioning at Textile Factory by Introducing High-efficiency Centrifugal Chiller in Karawang West Java
	ID003	Project of Introducing High Efficiency Refrigerator to a Frozen Food Processing Plant in Indonesia
	ID002	Project of Introducing High Efficiency Refrigerator to a Food Industry Cold Storage in Indonesia
	ID001	Energy Saving for Air-Conditioning and Process Cooling by Introducing High-efficiency Centrifugal Chille
Mongolia	MN002	Centralization of heat supply system by installation of high-efficiency Heat Only Boilers in Bornuur soum Project
	MN001	Installation of high-efficiency Heat Only Boilers in 118th School of Ulaanbaatar City Project
Palau	PW003	Small Scale Solar Power Plants for Commercial Facilities in Island States II
	PW002	Small Scale Solar Power Plants for Schools in Island States
	PW001	Small scale solar power plants for commercial facilities in island states

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Appendix 3. JCM Projects registered at Joint Committee as of May 25, 2016 (1)

Country	Project Code	Project Name
Vietnam	VN004	Introduction of amorphous high efficiency transformers in power distribution systems in the southern part of Viet Nam
	VN003	Low carbon hotel project in Vietnam: Improving the energy efficiency of commercial buildings by utilization of high efficiency equipment
	VN002	Promotion of green hospitals by improving efficiency / environment in national hospitals in Vietnam
	VN001	Eco-Driving by Utilizing Digital Tachograph System

JCM subsidy granted: 58 projects including 15 projects registered as JCM project mentioned above (7 projects in Thailand)

2016	Energy Saving for air-conditioning at Tire manufacturing plant by introducing high efficiency chiller in Thailand
2016	Energy Saving for air-conditioning at semiconductor manufacturing plant by introducing high efficiency chiller in Thailand
2015	Co-generation system for automobile manufacturing plant in Thailand (by Nippon Steel & Sumikin Engineering Co., Ltd.)
2015	Energy Saving for air-conditioning at semiconductor manufacturing plant by introducing high efficiency compressor
2015	Energy Saving for at textile manufacturing plant by introducing high efficiency manufacturing unit in Thailand
2015	Solar Power plant by utilizing factory roof top
2015	Energy Saving for frozen showcase at convenience stores

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Appendix 3. Introduction of a Joint Implementation Body (1)… City of Kitakyushu

By another presentation by the city of Kitakyushu

Appendix 2. Introduction of a Joint Implementation Body (2)… EX Research Institute Limited

Outlook of the Company	
Head Office	Tokyo, Japan
Business Line	Think-Tank & Planning Office
Field of Business	Urban & Rural Community Environment
Establishment Year	1971
Employee	96
Branches	Osaka, Nagoya, Sendai & Muroran
Main Clients	Government of Japan, JICA, NEDO, Administrative Offices in Japan

References projects (Waste Management & Waste to Energy)

Philippines
H26 Feasibility Study on Waste to Energy Project in Davao city, Philippines
Vietnam(MOE)
H25 Asia Low Carbon Society F/S on Large Scale Project Development under JCM in Da Nang City
Laos(MOE)
H24 Aerobics Transaction of General Waste and Methane Destruction at Sanitary Landfill
Cuba (JICA)
H20 Improvement of the capacity on urban solid waste management in Havana city, Cuba
Dominic(JICA)
H20 Project for Institutional Capacity Development on Nation Wide Solid Waste

Thailand
H27 Feasibility Study on RDF Power Plant in Samut Prakarn, Thailand
H26 Feasibility Study on RDF Power Plant in Nakhon Patom, Thailand
H25 Feasibility Study on Hazardous Industrial Waste Treatment in Thailand (MOEJ)
H25 Research on possibility for Mercury transaction method (MOEJ)
H24 Development of Basic Scheme for PRTR - system in Thailand (JICA)
H24 ECO TOWN (METI)

環境省 Ministry of the Environment

Entrusted by
The Ministry of Environment, Japan
2016

Feasibility Study on JCM project development for realization of low carbon society under inter-city cooperation

Power Generation from Waste Heat from MSW incineration in Rayong, Thailand

北九州市 CITY OF KITAKYUSHU

株式会社 エックス都市研究所 EX Research Institute Ltd. Environmental and Regional Planning, Research and Consulting

NTT DATA Global IT Innovator

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CONTENT AGENDA

1. Progress of the Feasibility Study
2. Implementation Schedule from August and onward
3. Agenda
1) Possible Support can be provided by the City of Kitakyushu
2) How to materialize the project and JCM registration

2

1. Progress the Study

2016: May, June, Jul, Aug, Sep, Oct, Nov, Dec
2017: Jan, Feb

- May 17 Kick off Meeting held at the Ministry of Environment, Japan (Tokyo)
- May 25-Kick off & first meeting in Thailand
  - May 25 Kick off Meeting with Italian-Thai Development & Thai Eastern (Bangkok)
  - June 3 Kick off Meeting with Rayong Provincial Administrative Office (Rayong)

Data & Information Collection

- General Information
- Project Development related data & information



3

2. Implementation Schedule for the Study (July 26 and onward)

2016: May, June, Jul, Aug, Sep, Oct, Nov, Dec
2017: Jan, Feb

- July 26 2nd Meeting in Thailand with Italian-Thai Development & Thai Eastern (Bangkok)
- July 28 2nd Meeting with Rayong Provincial Administrative Office (Rayong)
- Aug 09 2nd Meeting with the Ministry of Environment, Japan (Tokyo)

Data & Information Collection

- Sep 26-27 Workshop on JCM (Scheme & MRV) (Bangkok)
- UNFCCC COP22 (Presentation of the Project at side event organized by the Government of Japan)
- Dec Meeting among the parties might form up International Consortium for the Project Implementation
- JCM high level meeting (Presentation of the Project) (Bangkok)

Reporting & Assessment

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3. 1 Possible Support can be offered by the city of Kitakyushu

1) Basic Concept for the WtE Project Development (presented by Mr. Jadesada, Choochat, Italian Thai Development)

Finance

Technology

Local Partner

Technical Support for Integrated Waste Management

PROJECT

北九州市 CITY OF KITAKYUSHU

The City of Kitakyushu can provide you various kinds of technical support as a part of International Corporation (Nippon Steel & Sumikin for this project), support corporates in the city !!!

3. 2 CCAC, one of the supporting activities ongoing in Thailand, implemented by the city of Kitakyushu

1. Climate Pollutants & CCAC

CLIMATE & CLEAN AIR COALITION TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

Short Lived Climate Pollutants (SLCPs)
- Black Carbon
- Methane (CH_4)
- Hydrofluoro-Carbons (HFCs)
- Tropospheric Ozone (O_3)

Long Lived Climate Pollutants (SLCPs)
- Carbon Dioxide (CO_2)

CCAC is
- a COALITION encourage parties to mitigate SLCPs
- Conducting projects covering 8 sectors (Agriculture, Bricks, Cook stoves & Heat stoves, Heavy Duty Diesel Vehicle & Engine, HFC, Oil & Gas and Waste) with 3 cross sectors

The City of Kitakyushu is
- registered as mentor city to both Rayong municipality & Map Ta Phut municipality in Waste Initiative under CCAC, and
- Implemented CCAC project in both municipalities in 2015 as 1st year
- Plan to continue CCAC project in both municipality in 2016 as 2nd year

3. 2 CCAC, one of the supporting activities ongoing in Thailand, implemented by the city of Kitakyushu

2. Outline of the CCAC Project

1st Year	Rapid City Assessment (Collect Data & Information as Baseline)
2nd Year	Development of Project with Implementation Plan
3rd Year	Project Implementation

北九州市
CITY OF KITAKYUSHU

- ◆ Establishment of reliable relationship
- ◆ Technical Support (Expert Dispatch, Workshop)
- ◆ Co-Work on Project Development, Planning & Project Implementation
- ◆ Basic Data & Information as for City, Municipal Solid Waste Management
- ◆ Technical Tour to Kitakyushu (option)

เทศบาลเมืองมาบตาพุด
MAP TA PHUT MUNICIPALITY

4. Issues to be discussed in the meeting

1. Support from the City of Kitakyushu

1) Expansion of area of activities to other areas in Rayong Province, such as Klang city ???
2) Expansiion of area of activities to other province, such as Chiang Mai ???

2. Commercialization of the Project

1) Update current situation based on the concept & target explained in the 1st Meeting
2) Assessment / Analysis of the approach
   - Issues & Barriers
3) Concept, Direction and Strategy to ensure commercialization of the targeted project
   - budget (Initial & O&M)
   - technology
   - local coordination
   - Others, if any
4) Source of Finance for the project (Rayong & Others, if any)
   (own finance or project or corporate finance ? Any negotiation with any specific banking corporation ? If so how is their responses ???)

3. Workshop on JCM focusing on MRV implementation

1) Date (September 26 and/or 27)
2) Venue (A Meeting Room at Italian Thai, if possible)
3) Participants (Approx. 5-8 person)

環境省 Ministry of the Environment

Entrusted by
The Ministry of Environment, Japan
2016

Feasibility Study on JCM project development for realization of low carbon society under inter-city cooperation

Power Generation from Waste Heat from MSW incineration in Rayong, Thailand

3rd Meeting in Thailand on September 26, 2016

北九州市 CITY OF KITAKYUSHU

株式会社 エックス都市研究所 EX Research Institute Ltd. Environmental and Regional Planning, Research and Consulting

NTT DATA Global IT Innovator

CONTENT AGENDA

1. Progress of the Feasibility Study
2. Implementation Schedule from September and onward
3. Agenda

1) Briefing on Workshop for "MRV in JCM…advices from point of view of Third Party Entities

1. Outline of the Study …Summary for the study

Goal

- Realization of Low Carbon Society / Growth in Asia (Reduction of GHG emission in Asia)

Objectives

- Completion of General & Basic Study for Waste Power Plant Project in Rayong Province (Phase II)
- Completion of preparation for JCM registration, including application for subsidy (max.50%)

Activities

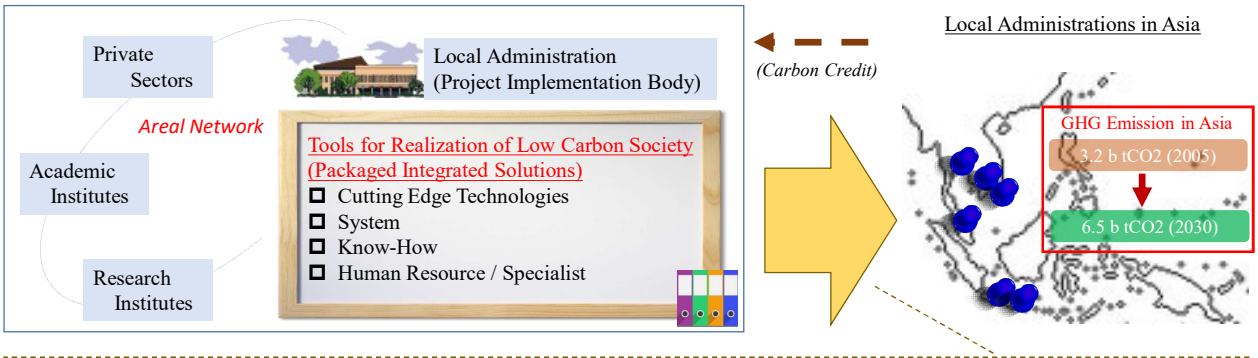
1. To update General Situation in Thailand (Governing Laws & Regulation, National Policy, Action Plan, Current Situation, Environmental Standard and so on)
2. To study license & permission for business establishment & operation
3. To prepare an initial EPC concept design for the project
4. To study the possibility of project applicability for JCM
5. To study the possible MRV implementation under JCM
6. To study the possibility for the Japanese private sector(s) being involved into the project
7. To prepare draft initial business plan for the project

Subject to final confirmation given by the concerning parties

2. Background of the Study (4) … Realization of Low Carbon Society in Asia

環境省 Ministry of the Environment

JCM Project Planning Study on Realization of Low Carbon Society in Asia



Goal

To Realize 'Low Carbon Society & Growth in Asia"

Activities under the Study

1. Introduction & Transfer of Technologies, Systems & Know-How to Local Administrations in Asia
2. Mulit-Project(s) development in Local Administration Level under the concept of "Realization of Low Carbon Society & Growth in Asia" through implementation of JCM

**** 9 projects have been selected to be implemented on entrustment basis for the fiscal year of 2015 (as of April 13, 2015)*

2. Background of the Study (5) … Kitakyushu City & it's Activities in Thailand

北九州市 CITY OF KITAKYUSHU

Asia Center for Low Carbon Society

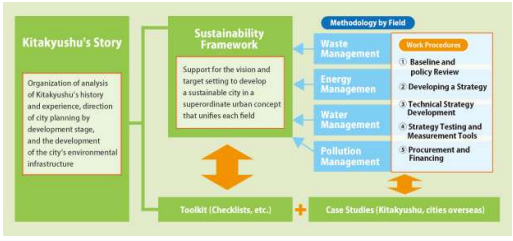
- Established in 2010
- Providing services for
  1) Technology Transfer (total package as integrated solution for realization of low carbon society in Asia)
  2) Human Resource Development (for Specialist)
  3) Research & Feasibility Study
- Website: http://asiangreencamp.net/eng/index.php

Green Asia International Strategic Comprehensive Special Zone

Environmental Model City / Future City

- Selected by the Government of Japan
- Set up voluntary target of GHG emission reduction of
  - -50% in Kitakyushu city by 2050
  - -150% in Asia by 2050 *base year=2005

Kitakyushu Model



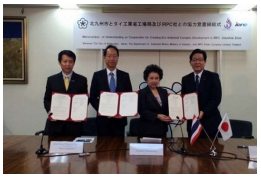
Parties from Thailand

Department of Industrial Work

Date	Memorandum of Understandings
Dec 2014	for Cooperation on Creating of Eco Industrial Complex Development at IRPC

Industrial Estates Authority of Thailand

Date	Memorandum of Understandings
Aug 2014	for Cooperation on Development of Map Ta Phut Eco Industrial Town



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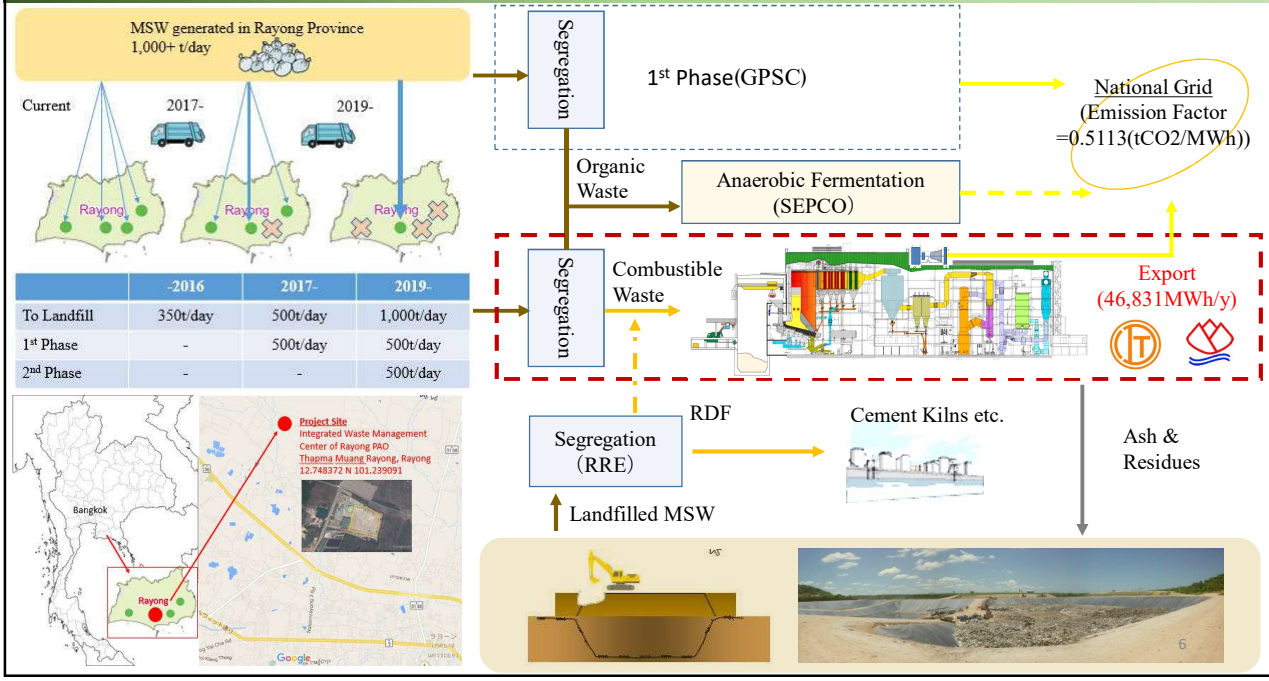
3. Targeted Project…Power Generation from Waste heat recovered from MSW incineration in Rayong



	-2016	2017-	2019-
To Landfill	350t/day	500t/day	1,000t/day
1st Phase	-	500t/day	500t/day
2nd Phase	-	-	500t/day

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1. Progress the Study

2016: May, June, Jul, Aug, Sep, Oct, Nov, Dec
2017: Jan, Feb

- May 17 Kick off Meeting held at the Ministry of Environment, Japan (Tokyo)
- May 25-Kick off & first meeting in Thailand
  - May 25 Kick off Meeting with Italian-Thai Development & Thai Eastern (Bangkok)
  - June 3 Kick off Meeting with Rayong Provincial Administrative Office (Rayong)
- July 26- 2nd Field Survey in Thailand
  - July 26 2nd Meeting with potential project owner (Bangkok)
  - July 28- Meetings with Rayong Provincial Administrative Office (Rayong)
- Aug 09 2nd Meeting held at the Ministry of Environment, Japan (Tokyo)

Data & Information Collection

- General Information
- Project Development related data & information



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2. Implementation Schedule for the Study (September 26 and onward)

2016: May, June, Jul, Aug, Sep, Oct, Nov, Dec
2017: Jan, Feb

- Sep 26-27 3rd Meeting & Workshop on JCM (Scheme & MRV) (Bangkok)
- Oct 20-21 1st JCM Domestic Workshop in city of Kitakyushu
- UNFCCC COP22 (Presentation of the Project at side event organized by the Government of Japan)
- Dec Meeting among the parties might form up International Consortium for the Project Implementation
- Oct 20-21 1st JCM Domestic Workshop in city of Kitakyushu
- JCM high level meeting (Presentation of the Project) (Bangkok)

*** Consideration on business materialization

- How to materialize the project
- Technical & Financial Assessment for the targeted project

Reporting & Assessment

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3. Agenda for 3rd Meeting

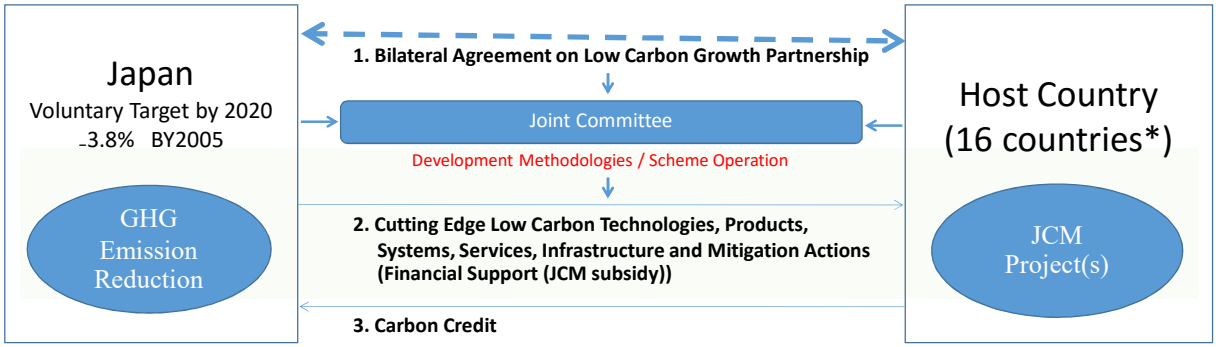
(1) Workshop for MRV in JCM…advices from the points of view of Third Party Entities

1) General Information

Lecturer	Mr. Shigenari Yamamoto EX. Technical Counsellor, Japan Quality Assurance (JQA)
Venue	Meeting Room at Italian Thai Development Head Office Bangkok, Thailand
Time & Date	09:30 – 16:00 on September 26 &27
Program	
	Joint Crediting Mechanism - Background & History (Climate Change / UNFCCC / Kyoto Protocol / CDM & JI / NAMAs / New Mechanism / BOCM & JCM) - Outline of JCM (Basic Concept / Outline of Scheme / Framework / Project Cycle / Carbon Credit / JCM subsidy) - Introduction of JCM project development studies
	MRV - MRV initiated by project proponent(s) - - Consideration on possible methodology for the targeted project - Consideration on possible MRV for the targeted project

3. Agenda for 3rd Meeting

2) JCM at a glance



1. Objectives

- ✓ To contribute ultimate objective of UNFCCC (reduce or remove GHG emission)
- ✓ To appropriately evaluate mitigation actions which contribute to GHG emission reduction
- ✓ To facilitate diffusion low carbon technologies, products, systems, services & infrastructure, mitigation actions and sustainable development.

2. Basic Concept

- ✓ To ensure Environmental Integrity
- ✓ To make scheme Simple, Transparent & Practical
- ✓ To secure reliability of Carbon Credit to be generated from JCM(BOCM)

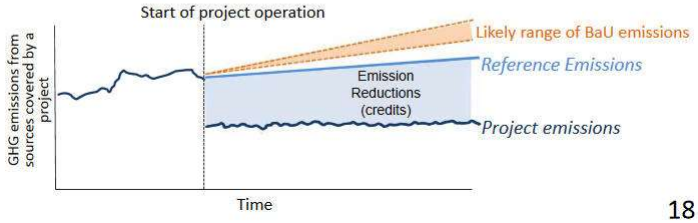
3. Agenda for 3rd Meeting

3) Methodology under consideration for the targeted Project

Basic Concept for Crediting under the JCM

(Subject to further consideration and discussion with host countries)

- In the JCM, emission reductions to be credited are defined as the difference between "reference emissions" and project emissions.
- The reference emissions are calculated below business-as-usual (BaU) emissions which represent plausible emissions in providing the same outputs or service level of the proposed JCM project in the host country.
- This approach will ensure a net decrease and/or avoidance of GHG emissions.



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Source: The Government of Japan / Recent Development of Joint Crediting Mechanism

Basic Concept
- Simplification
- Conservative manner in quantification of GHG emission reduction

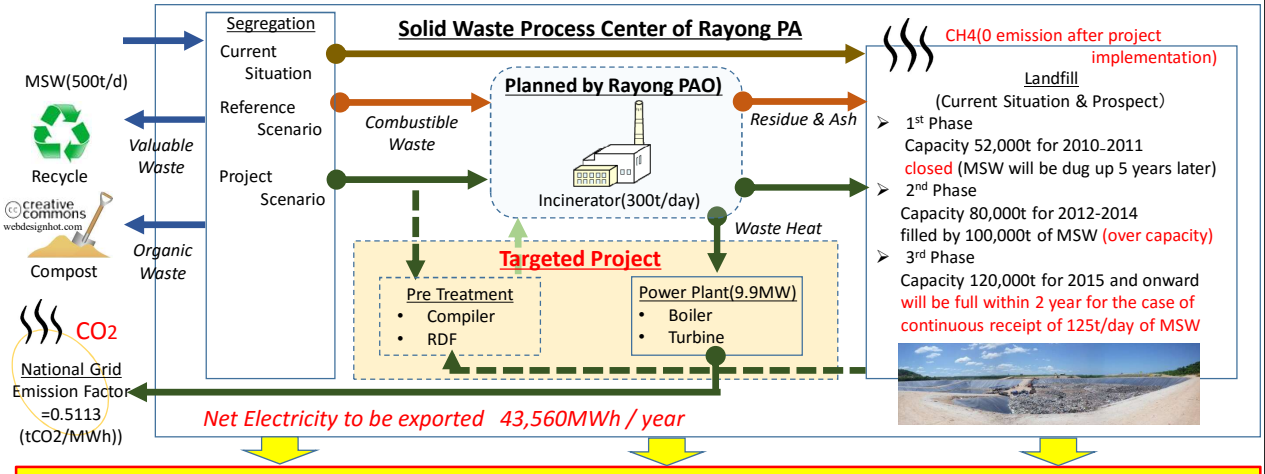
Quantification of GHG
- Type of GHG
- Reference Scenario & Emission
- Project Scenario & Emission
- Emission Reduction
- Monitoring
- Quality Control & Quality Assurance

- "M"onitoring ...approved by & registered at J/C
- "R"eporting
- "V"erification...verified by Third Party Entty

Issuance of Carbon Credit under JCM

Appendix. Supporting Material for the Workshop on JCM/MRV

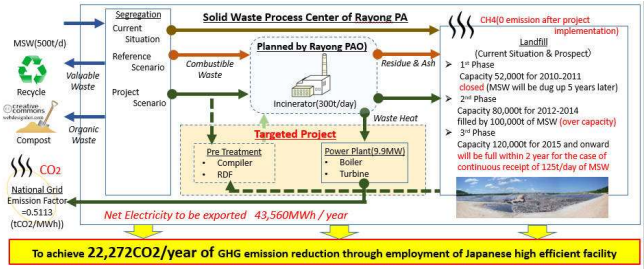
1. Outline of the Targeted Project



To achieve 23,913CO2/year of GHG emission reduction through employment of Japanese high efficient facility

Appendix. Supporting Material for the Workshop on JCM/MRV

2. Requirement for the project registered under JCM



Methodology
- Reference Scenario & Emission
- Project Scenario & Emission
- Emission Reduction
- Monitoring Plan
  - Parameters to be monitored
  - Monitoring Points
  - Organizational Structure
  - QA/QC

Validation

Monitoring

Reporting

Verification

Others *(Credit Transfer and Management of Special Account for Subsidy & Reporting to MOEJ, if necessary)*

Appendix. Supporting Material for the Workshop on JCM/MRV

3. Possible Reference Scenario & Reference Emission (1)

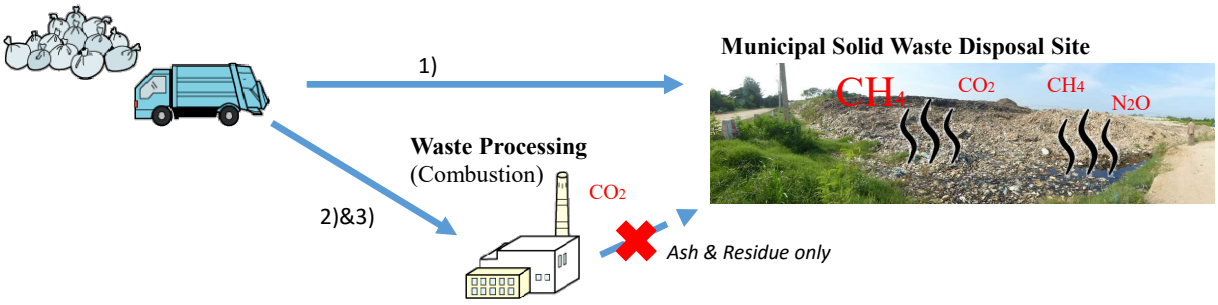
In the absence of the Project, municipal solid waste which will be process in the project will be
1) Landfilled
2) Combusted without heat recovery
3) Combusted with heat recovery with conventional technology

GHG emission (reference emission) for each case mentioned above contains

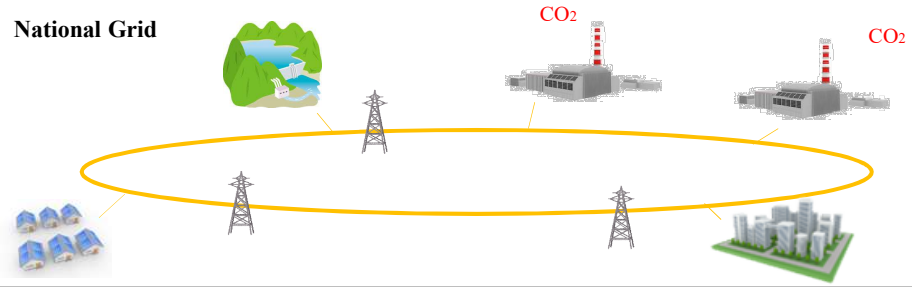
Activity	GHG	Remarks	1)	2)	3)
Power Generation	CO_2	Carbon Dioxide, which will be emitted from Grid connected power stations (for generating the same amount of electricity to be replaced by the project), in the absence of the project activities.	✓	✓	✓
Waste Processing (Combustion)	CO_2	Carbon Dioxide, which will be emitted from combustion of municipal solid waste at newly established incinerator		✓	✓
Disposal	CH4	Methane gas, which will be emitted from degradation of organic waste dumped under specific circumstances at waste disposal point(s)	✓		
Disposal	N2O	Nitrous oxide, which will be emitted from leachate from waste disposal points(s)	✓		
Disposal	CO_2	Carbon Dioxide which will be emitted from degradation of organic at waste disposal point(s), including those from leachate	-	-	-

Appendix. Supporting Material for the Workshop on JCM/MRV

3. Possible Reference Scenario & Reference Emission (2)



1), 2)&3)
Amount of Electricity to be generated by the project & exported to national grid would be generated by existing power plants connected to the grid with GHG emission factor of 0.5113tCO2/MWh



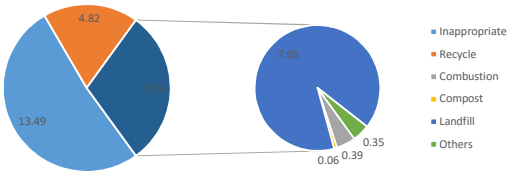
Appendix. Supporting Material for the Workshop on JCM/MRV

3. Possible Reference Scenario & Reference Emission (3)

Which scenario can be "Reference Scenario" for the project ???

FACT SHEET

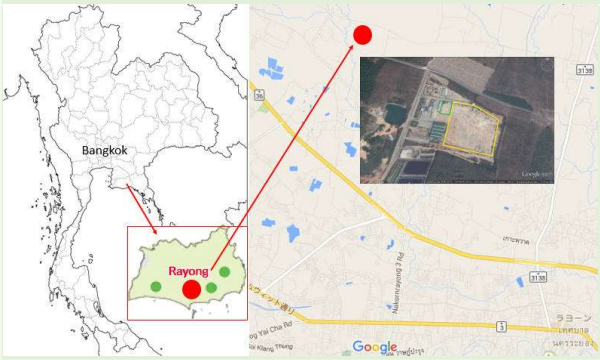
- There was 26.19million tons of municipal solid waste in total generated in Thailand in 2014
- Among 26.19milliong tons of municipal solid waste generated in Thailand, almost half is inappropriately disposed and only 0.39 million tons was combusted.



- The Government of Thailand published "Road Map" & "Master Plan" to indicate guidance for proper waste management depending on the amount of waste generated and processed

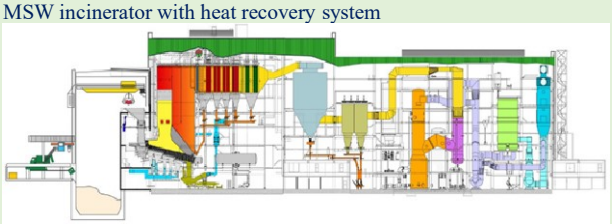
Appendix. Supporting Material for the Workshop on JCM/MRV

4. Project Scenario & Project Emission
1) Key Indicators (1)

Project Name	Power Generation by waste heat from MSW combustion in Rayong Province, Thailand (2nd Phase)
Project Site	Integrated Waste Management Center of Rayong PAO, Thapma, Muang Rayong, Rayong Province, Thailand
GPS coordinates	N 12. 74. 8372 / E 101.23.9091
Location Map	
Ownership of the Land Area	Rayong Provincial Administrative Organization (Rayong PAO)

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Project Scenario & Project Emission
1) Key Indicators (2)

Outline of the operation	1) Receive municipal solid waste (MSW), 2) Combust as waste processing, 3) Utilize waste heat from MSW combustion, 4) Generate electricity for self consumption and export to national grid
Facilities & Equipment to be employed by the project	1) Incinerator 2) Water Tube Boiler 3) Turbine 4) Alternator 5) Condenser 6) Super Heater 7) Economizer 8) Flue Gas treatment unit 9) Ash Handling unit 10) Water treatment unit 11) Control Unit with Panel 12) Transformation Unit etc. MSW incinerator with heat recovery system  Source : Nippon Steel & Sumikin Engineering Co., Ltd.
Amount of Waste to be received & processed	500 tons/day
Number of operating days	365 days for office & 330 days for facilities (incinerator and boiler & power generation islands with flue gas & water treatment systems)

Appendix. Supporting Material for the Workshop on JCM/MRV

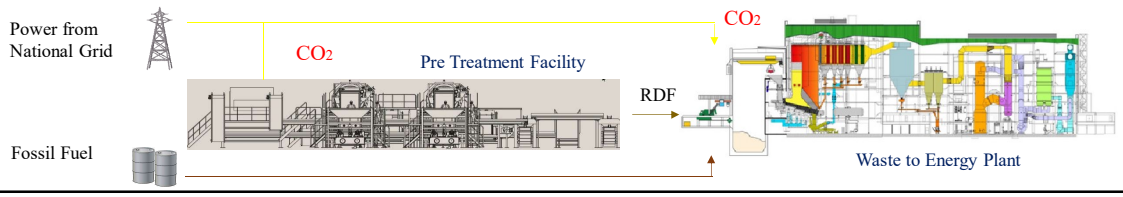
4. Project Scenario & Project Emission
1) Key Indicators (3)

Net Calorific Value (NCV)	4,000kcal/kg (after 1st segregation = yield 25%)
Energy Conversion Efficiency	28%
Electricity to be generated / year	53,721MWh
Electricity to be consumed at site	6,886.7MWh / year (330 days)
Electricity to be consumed at pre treatment facility	
Electricity to be imported from national grid and consumed at site (during shut down for annual maintenance)	75.4MWh / year (for 35 days including amount of electricity to be consumed at office area)
Fossil Fuel to be consumed at site	Not available
Fossil Fuel to be consumed at pre treatment facility	Not available
RDF made from old waste to be consumed as auxiliary fuel	Actual, if any

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Project Scenario & Project Emission

Activity	GHG	Description
Fossil Fuel to be consumed on site	CO_2	Carbon Dioxide, which will be emitted from consumption of fossil fuel as auxiliary on site
Electricity to be consumed on site	CO_2	Carbon Dioxide, which will be emitted from consumption of electricity to be consumed on site (1) Power supplied by the project (2) Power supplied by national grid
Fossil Fuel to be consumed at pre treatment facility	CO_2	Carbon Dioxide, which will be emitted from consumption of fossil fuel for pre-treatment
Electricity to be consumed at pre treatment facility	CO_2	Carbon Dioxide, which will be emitted from consumption of electricity, to consumed for pre-treatment (1) Power supplied by the project (2) Power sullied by national grid
RDF deprived from old waste, to be consumed by the project	CO_2	Carbon Dioxide, which will be emitted from combustion of RDF deprived from old waste



Appendix. Supporting Material for the Workshop on JCM/MRV

4. Methodology for Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

1) Reference Emission

$$RE = EGp \times EFgrid \quad \ldots\ldots 1$$

Where

RE_p **= Reference emission for period "p"(t CO_2)**

EGp=Amount of electricity generated and exported to the national grid for period "p"(MWh)

EF_{grid}=Grid Emission Factor (t CO_2/MWh)

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Methodology for Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

2) Project Emission (1)

$$PE_{"p"} = PE_{elec,plant,"p"} + PE_{FF,plant,"p"} + PE_{elec,pre\text{-}t,"p"} + PE_{FF,pre\text{-}t,"p"} + PF_{Falt,"p"} \quad \ldots\ldots 2$$

Where

$\boldsymbol{PE_p}$ **=Project Emission for the period "p"(t CO_2)**

$PE_{elec,plant,"p"}$=GHG emission from electricity consumption on site for period"p" (t CO_2)

$PE_{FF,plant,"p"}$=GHG emission from consumption of fossil fuel on site for period "p" (t CO_2)

$PE_{elec,pre\ \ "p"}$=GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PE_{FF,pre\ \ "p"}$=GHG emission from fossil fuel consumption for pre-treatment for period "p" (t CO_2)

$PE^{F}_{alt,"p"}$=GHG emission from alternative fuel (RDF deprived from old waste) consumption on site for period "p" (tCO2)

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Methodology for Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

2) Project Emission (2)

$$PE_{elec,plant,p} = EL_{plant,p} \times EF_{grid}$$

Where
$EL_{plant,p}$=Amount of electricity imported from the national grid and consumed by the project for period "p" (MWh)
EF_{grid}=Grid Emission Factor(tCO2/MWh)

$$PE_{FF,plant,p} = FF_{plant,p} \times NCV_{FFi} \times EF_{FF,i}$$

Where
$FF_{plant,p}$=Amount of Fossil Fuel consumed as auxiliary on site for period "p"(ton)
$NCV_{FF,i}$=Net Calorific Value for Fossil Fuel type"i"(Gj/ton)
$EF_{FF,i}$=Emission Factor for Fossil Fuel type "i"(tCO2/ton)

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Methodology for Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

2) Project Emission (3)

$$PE_{elec,pre-t,p} = EL_{pre-t,p} \times EF_{grid}$$

where
$EL_{pre-t,p}$=Amount of electricity imported from national grid and consumed for pre-treatment for period"p" (MWh)
EF_{grid}=Grid Emission Factor (tCO2/MWh)

$$PE_{FF,pre-t,p} = FF_{pre-t,p} \times NCV_{FF"i"} \times EF_{FF,i}$$

where
$FF_{pre-t,p}$=Amount of Fossil Fuel consumed for pre-treatment for period "p"(ton)
$NCV_{FF,i}$=Net Calorific Value for Fossil Fuel type "i" (Gj/ton)
$EF_{FF,i}$=Emission Factor for Fossil Fuel type "i"(tCO2/ton)

$$PEFalt,p = Falt,dry,p \times TCpla \times FCFpla \times 44/12$$

Where
$F_{alt,dry,p,}$=Amount of RDF deprived from old waste consumed as alternative fuel on site for period "p"tons)
TC_{pla}=Fraction of carbon for plastic in dry matter (%)
FCF_{pla}=Fraction of fossil carbon in total (%)

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Methodology for Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

3) Emission Reduction

$ER''p''=RE''p''-PE''p''$ ……3

Where

$ER_{''p''}$=**Emission Reduction for Period "p"(t CO_2)**

Appendix. Supporting Material for the Workshop on JCM/MRV

4. Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

1) Reference Emission estimated

RE=*EG"p"*× *EFgrid*……1

Parameter	Unit	Value		Remarks
		Estimation	Actual	
EG"p"	MWh	53,721MWh	Monitoring	
EFgrid	tCO2/MWh	Default Value (1)	Default Value (2)	Default Value published by the Host Country ((1) ex ante =0.5113, (2) ex post = latest figure published by DOA shall be applied (tCO2/MWh)

Estimated Amount of Reference Emission = 27,467tCO2/year

Appendix. Supporting Material for the Workshop on JCM/MRV

5. Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

2) Project Emission estimated

$PE"p"=PEelec, plant,p + PE_{FF,plant,p} + PE_{elec,pre\text{-}t,p} + PE_{FF,pre\text{-}t,p} + PF_{Falt,p}$.....2

Parameter	Unit	Value		Remarks
		Estimation	Actual	
$EC_{plant,p}$	MWh	6,959.1MWh	Monitoring	
$EC_{pre-t,p}$	MWh		Monitoring	
EF_{grid}	tCO2/MWh	Default (1)	Default (2)	Default Value published by the Host Country ((1) ex ante =0.5113, (2) ex post = latest figure published by DOA shall be applied (tCO2/MWh)
$FF_{plant,i,p}$	L	0	Monitoring	
$FF_{pre-\ ,i,p}$	L	0	Monitoring	
NCV_{FFi}	GJ/ton	Default ("I"(diesel)= 43.3)		IPPC Default Value
EF_{FFi}	tCO2/GJ	Default ("I"(diesel)=0.0748)		IPPC default value (max)
$PF_{Falt,p}$	tons	0	Monitoring	TC_{pla}(Fraction of carbon for plastic in dry matter =0.85) FCF_{pla}(Fraction of fossil carbon in total =1.00)

Estimated Amount of Project Emission = 3,559tCO2/year

Appendix. Supporting Material for the Workshop on JCM/MRV

5. Quantification of GHG (Reference Emission, Project Emission & Emission Reduction)

3) Project Emission estimated

$ER"p"=RE"p"-PE"p"$ 3

Estimated Amount of Emission Reduction = 23,908tCO2/year

Appendix. Supporting Material for the Workshop on JCM/MRV

6. Monitoring Plan

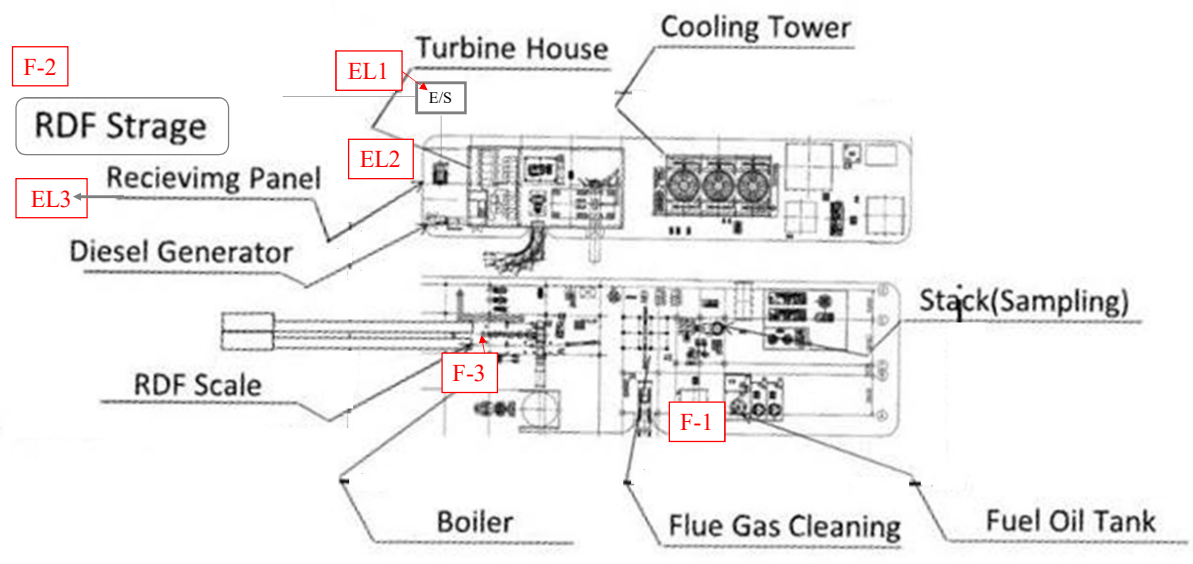
1) Parameters to be monitored & monitoring method

Parameter	Description	Unit	Monitoring		
			Point	Instrument	Frequency
$EG_{,p}$	Amount of electricity generated and exported to the national grid for period "p"	MWh	EL1	WATHOUR meter	Once/day
$EC_{plant,p}$	Amount of electricity imported from the national grid and consumed on site for period "p" (MWh)	MWh	EL2	WATHOUR meter	Once/day
$EC_{pre-\ ,p}$	Amount of electricity imported from the national grid and consumed for pre treatment for period "p" (MWh)	MWh	EL3	WATHOUR meter	Once/day
$FF_{plant,i,p}$	Amount of Fossil Fuel consumed as auxiliary on site for period "p"	Litter	FF1	Flow Meter	Once/day
$FF_{pre-t,,i,p}$	Amount of Fossil Fuel consumed as auxiliary for pre treatment for period "p"(ton)	Litter	FF2	Flow Meter	Once/day
$PFF_{alt,p}$	Amount of RDF deprived from old waste consumed as alternative fuel on site for period "p"	Ton	FF3	Weigh Measure	Every lot

Appendix. Supporting Material for the Workshop on JCM/MRV

6. Monitoring Plan

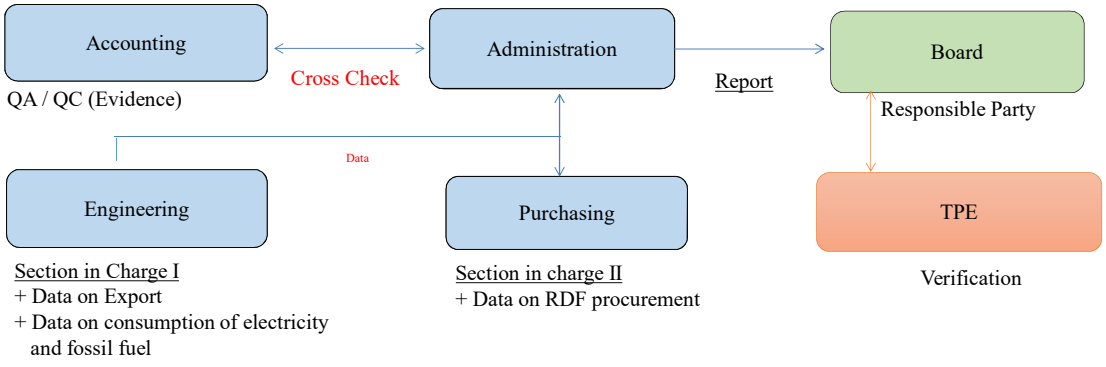
2) Monitoring Points



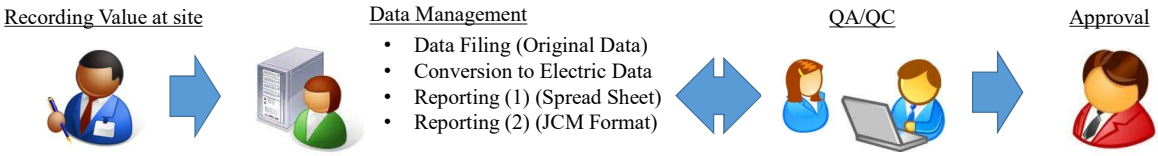
Appendix. Supporting Material for the Workshop on JCM/MRV

6. Monitoring Plan

2) Organizational Structure for Monitoring Work

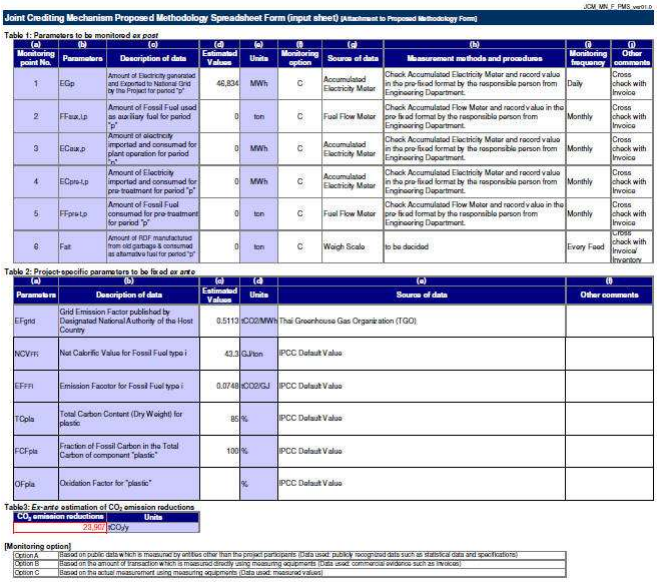


3) Work Flow (Internal Process)



Appendix. Supporting Material for the Workshop on JCM/MRV

7. Reporting



JCM_MN_F_PMS_ver01.0

Joint Crediting Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
1	EGp	Amount of Electricity generated and Exported to National Grid by the Project for period "p"	46,834	MWh	C	Accumulated Electricity Meter	Check Accumulated Electricity Meter and record value in the pre-fixed format by the responsible person from Engineering Department.	Daily	Cross check with Invoice
2	FFaux,p	Amount of Fossil Fuel used as auxiliary fuel for period "p"	0	ton	C	Fuel Flow Meter	Check Accumulated Flow Meter and record value in the pre-fixed format by the responsible person from Engineering Department.	Monthly	Cross check with Invoice
3	ECaux,p	Amount of electricity imported and consumed for plant operation for period "p"	0	MWh	C	Accumulated Electricity Meter	Check Accumulated Electricity Meter and record value in the pre-fixed format by the responsible person from Engineering Department.	Monthly	Cross check with Invoice
4	ECpre-t,p	Amount of Electricity imported and consumed for pre-treatment for period "p"	0	MWh	C	Accumulated Electricity Meter	Check Accumulated Electricity Meter and record value in the pre-fixed format by the responsible person from Engineering Department.	Monthly	Cross check with Invoice
5	FFpre-t,p	Amount of Fossil Fuel consumed for pre-treatment for period "p"	0	ton	C	Fuel Flow Meter	Check Accumulated Flow Meter and record value in the pre-fixed format by the responsible person from Engineering Department.	Monthly	Cross check with Invoice
6	Falt	Amount of RDF manufactured from old garbage & consumed as alternative fuel for period "p"	0	ton	C	Weigh Scale	to be decided	Every Feed	Cross check with Invoice/ Inventory

Table 2: Project-specific parameters to be fixed *ex ante*

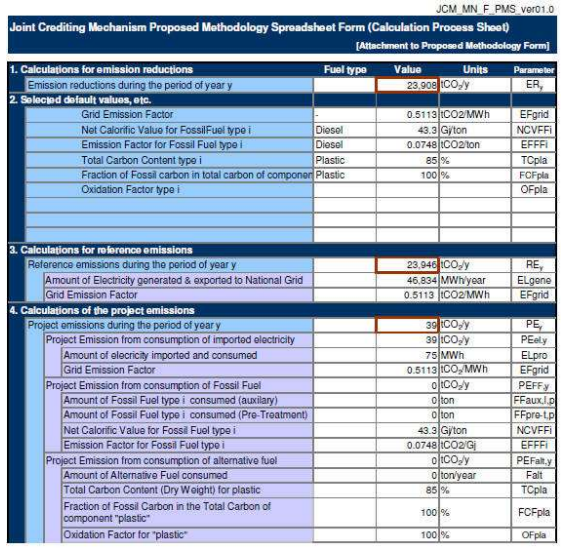
(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
EFgrid	Grid Emission Factor published by Designated National Authority of the Host Country	0.5113	tCO2/MWh	Thai Greenhouse Gas Organization (TGO)	
NCVFFi	Net Calorific Value for Fossil Fuel type i	43.3	GJ/ton	IPCC Default Value	
EFFFi	Emission Facotor for Fossil Fuel type i	0.0748	tCO2/GJ	IPCC Default Value	
TCpla	Total Carbon Content (Dry Weight) for plastic	85	%	IPCC Default Value	
FCFpla	Fraction of Fossil Carbon in the Total Carbon of component "plastic"	100	%	IPCC Default Value	
OFpla	Oxidation Factor for "plastic"		%	IPCC Default Value	

Table3: *Ex-ante* estimation of CO_2 emission reductions

(a) CO_2 emission reductions	Units
23,908	tCO2/y

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)



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Joint Crediting Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

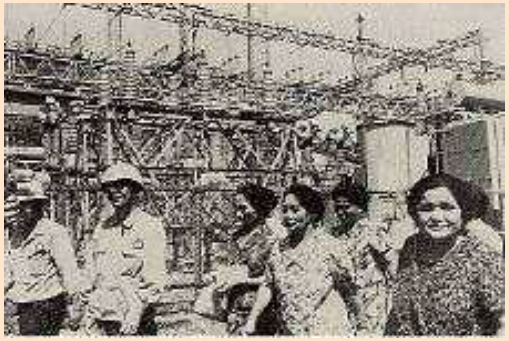
	Fuel type	Value	Units	Parameter
1. Calculations for emission reductions				
Emission reductions during the period of year y		23,908	tCO_2/y	ER_y
2. Selected default values, etc.				
Grid Emission Factor	-	0.5113	tCO2/MWh	EFgrid
Net Calorific Value for FossilFuel type i	Diesel	43.3	Gj/ton	NCVFFi
Emission Factor for Fossil Fuel type i	Diesel	0.0748	tCO2/ton	EFFFi
Total Carbon Content type i	Plastic	85	%	TCpla
Fraction of Fossil carbon in total carbon of componer	Plastic	100	%	FCFpla
Oxidation Factor type i				OFpla
3. Calculations for reference emissions				
Reference emissions during the period of year y		23,946	tCO_2/y	RE_y
Amount of Electricity generated & exported to National Grid		46,834	MWh/year	ELgene
Grid Emission Factor		0.5113	tCO2/MWh	EFgrid
4. Calculations of the project emissions				
Project emissions during the period of year y		39	tCO_2/y	PE_y
Project Emission from consumption of imported electricity		39	tCO_2/y	PEelt,y
Amount of elecricity imported and consumed		75	MWh	ELpro
Grid Emission Factor		0.5113	tCO_2/MWh	EFgrid
Project Emission from consumption of Fossil Fuel		0	tCO_2/y	PEFF,y
Amount of Fossil Fuel type i consumed (auxilary)		0	ton	FFaux,l,p
Amount of Fossil Fuel type i consumed (Pre-Treatment)		0	ton	FFpre-t,p
Net Calorific Value for Fossil Fuel type i		43.3	Gj/ton	NCVFFi
Emission Factor for Fossil Fuel type i		0.0748	tCO2/Gj	EFFFi
Project Emission from consumption of alternative fuel		0	tCO_2/y	PEFalt,y
Amount of Alternative Fuel consumed		0	ton/year	Falt
Total Carbon Content (Dry Weight) for plastic		85	%	TCpla
Fraction of Fossil Carbon in the Total Carbon of component "plastic"		100	%	FCFpla
Oxidation Factor for "plastic"		100	%	OFpla

Environment Cooperation between Kitakyushu City and Thailand Cities Under the CCAC-MSWI

Kitakyushu Asian Center for Low Carbon Society

Environment Bureau, City of Kitakyushu

Regional resources
Experience with overcoming pollution problems



Company visit by citizens

Citizens

Partnership

Government

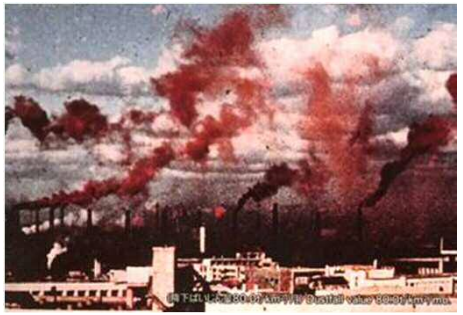
Companies

Reinforcement of restrictions and supervision

Agreement to prevent pollution

Kitakyushu City with recovered environments

1960s



Present

Solution of pollution problems is a starting point for international cooperation on environmental issues.

Transferring the experience of overcoming pollution problems so that developing nations need not repeat the same mistake

OECD Green Cities Programme

Paris, France

Chicago, U.S.A.

Stockholm, Sweden

Kitakyushu, Japan

“Green Growth in Kitakyushu, Japan “ issued by OECD in 2013

Once a polluted industrial zone, Kitakyushu is now a modern industrial city pursuing green growth.

OECD Green Cities Programme Commemorative Meeting on the Publication of Kitakyushu Report, 18 October, 2013

Mayor Kitahashi received the report from Director of Public Governance and Territorial Development, OECD.

Development of international cooperation on environmental issues since 1980

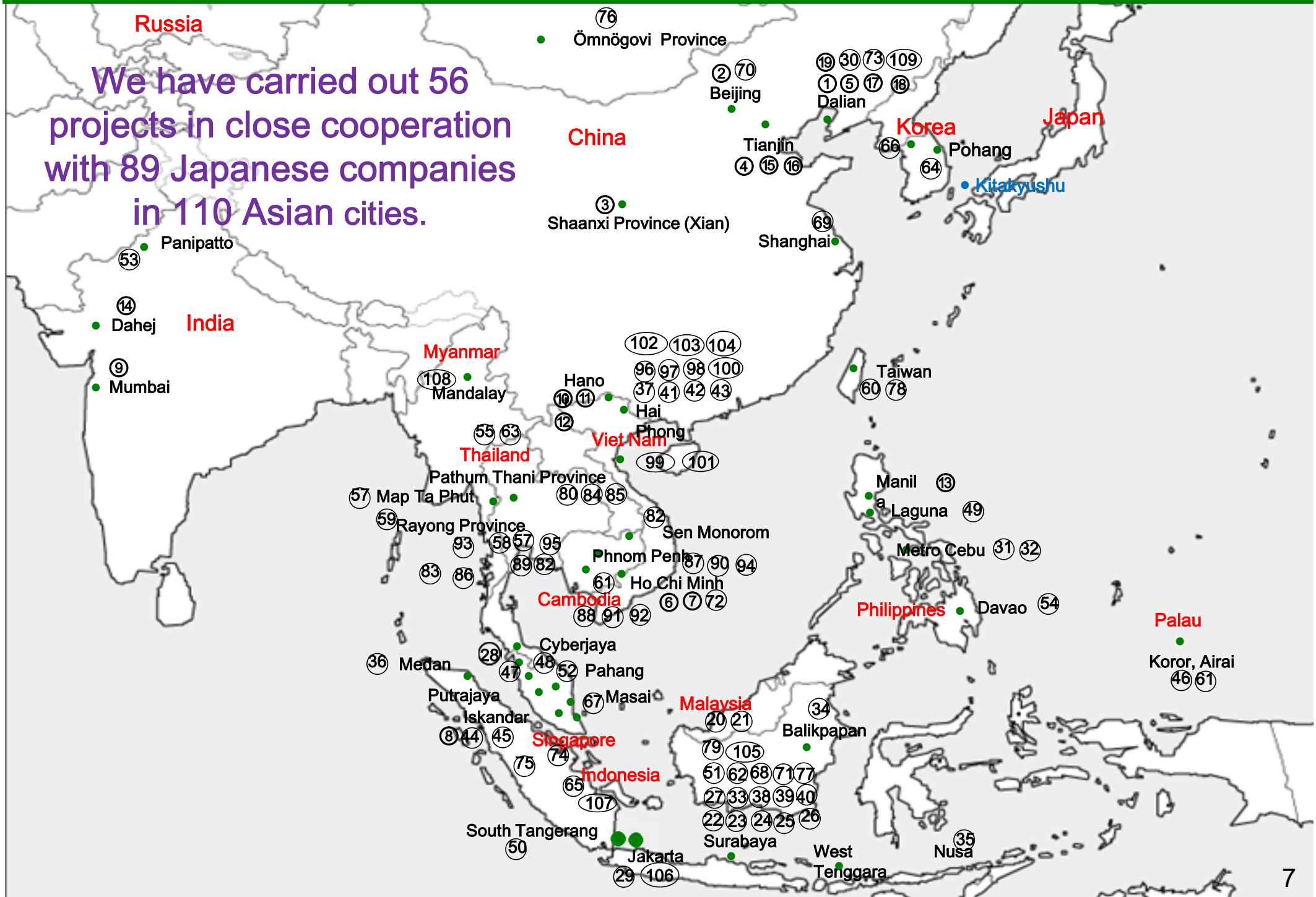
Accepted trainees: 7,453 persons from 150 nations; Dispatched specialists: 175 persons to 25 nations
Promotion of cooperation networking between Asian cities and environmental improvement projects

Contribution to environmental improvements in Dalian, China
(Dalian City received the Global 500 Award in 2001.)

Water supply project with Phnom Penh City, Cambodia

waste composting project with Surabaya City, Indonesia
(Adopted by over 20,000 households)

Diverse Project Development Map



Key Person in NESDB from Thailand Visiting Kitakyushu

Kitakyushu's actions attract attention from international society

Arkhom Termpittayapaisith, Secretary General of the National Economic and Social Development Board (NESDB) visit to Kitakyushu on Oct.19, 2013. Presented by NNA

B6 | BUSINESS NATIONAL

Bangkok Post

Rayong eco-town to copy Japan lead

Factories to co-exist with communities

Bangkok Post (Oct.25,2013)

Bangkok Post (Oct. 25, 2013) reported that

"The Kitakyushu eco-town is a good example of communities and factories living together in harmony, while Rayong is home to many industrial factories along the Eastern Seaboard"

" Kitakyushu has become a clear example of development by shifting from heavy to environmental industries."

Support for the Thailand Eco-Industrial Town Concept

Based on the Green Industry Concept, the Eco-Industrial Town Concept aims to create an eco-friendly industrial complex in cooperation with industrial estates, local communities, DIW, and IEAT .

Thailand

National Social and Economic Development Board (NESDB)

MOI

MNRE

Inter-governmental (G-to-G)

Japan

METI, MOEJ

Support

Support

Department Industrial Works (DIW)

IRPC Eco Industrial Zone (DIW)

This is the largest petrochemical complex in Southeast Asia. It is owned by IRPC Public Company Limited, a oil refining and petrochemical company, under the umbrella of PTT, the largest energy company in Thailand.

Signing of MoU between DIW, IRPC and City of Kitakyushu

Support

Industrial Estate Authority of Thailand (IEAT)

Map Ta Phut Industrial Estate (IEAT)

An industrial estate established in 1988 with a focus on the heavy and chemical industries, Map Ta Phut IE received a large amount of yen-based loans from the Overseas Economic Cooperation Fund (OECF) of Japan. The estate is well-located near the Port of Map Ta Phut and U Tapao International Airport.

Signing of MoU between IEAT and City of Kitakyushu

Support

Support

Rayong PAO, Rayong City, Map Ta Phut City

Municipal Waste Management

Collaboration with industrial park and community

Energy utilization

Mutual consent between NESDB and City of Kitakyushu

City of Kitakyushu (Asian Center for Low Carbon Society)

Kitakyushu Model

Support tool that has systematically arranged the know-how, experience, and technologies acquired in Kitakyushu's quest to overcome pollution and become an environmentally-advanced city.

Kitakyushu Eco-Town

Japan's largest, leading resource recycling and circulation base. About 30 recycling businesses are being developed or are in operation in Eco-Town.

Kitakyushu Smart Community

Focusing on plant cogeneration, the Smart Community aims to achieve the local supply and local consumption of energy to connect factories and residences.

Establish Model in Rayong and Promote to all over Thailand

Optimization of energy use, waste management, water management, etc. Symbiosis with local community
Eco-friendly industrial park and surround area through realization of safe and secure environment

Eco Industrial Town Project

"Symbiosis between Factories and Communities"

Promote 3R, Environment Education and Awareness

Support for Implementation

IEAT(Map Ta Phut Industrial Estate)

DIW・IRPC (IRPC Industrial Zone)

Rayong

City of Kitakyushu

- Concept of Eco Center
- Concept of Energy Management
- Concept of Waste Management
- Concept of Water Management
- ・・・・

Provide Accumulated Know-hows

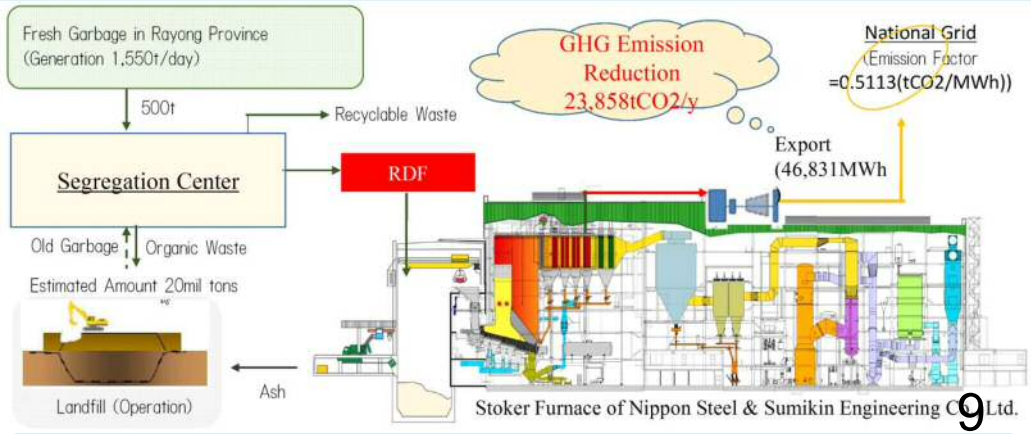
Activities in Energy and Waste Sector

Energy Sector

Activities	Description	
Activity 1: Low-carbon facility as a symbol	Introduction of solar panel and high-efficiency chiller for eco center	
Activity 2: Low-carbon inside the industrial park	Introduction of cogeneration system for facility which has power and heat demand.	
Activity 3: Low-carbon outside the industrial park	Introduction of waste heat recovery power generation system for cement plant	

Waste Sector

Municipal Solid Waste management and Waste to Energy



Establishment of SWM Model in Rayong and Promote to all over Thailand

Project Partners

Financial and technical support

Implementation at local and national levels

Project Implementation Process

Oct 2015

Kick-off meeting with city officials

Preliminary survey and visualize the current waste management system

Feb 2016

Detailed survey and identify the gaps

Introduction of good practices of Kitakyushu City in waste management

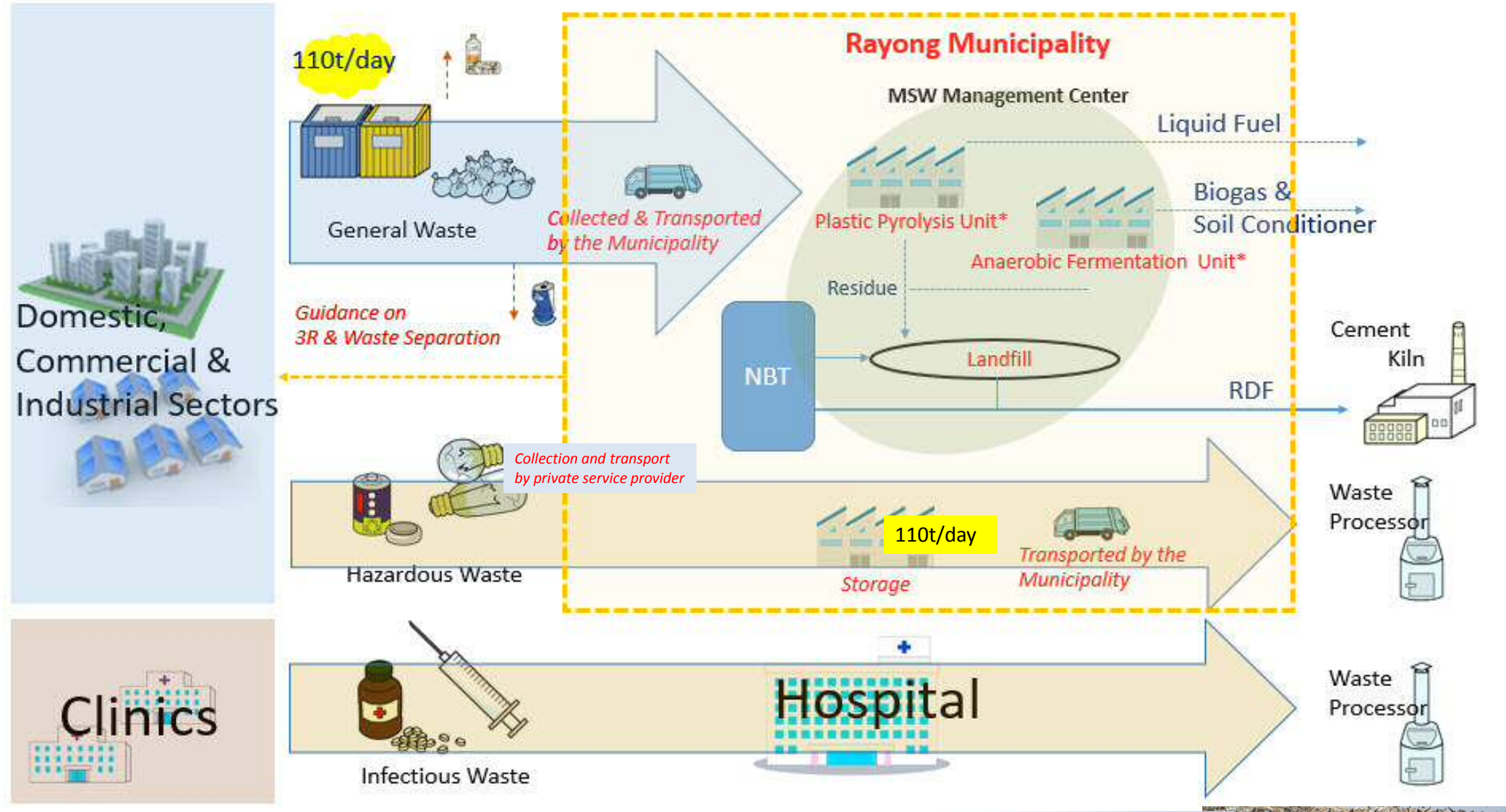
Mar 2016

Workshop to develop an action plan to improve the waste management

Identify the key actions for work plan stage of CCAC

Training of community leaders/volunteers on 3R (reduce, ruse, recycle)

Study the Existing MSWM System in Rayong







Visualization and Identification of Gaps

Rayong Municipality

Municipal waste generation

- Total 110 tons/day
- 1.7kg per person/day

Waste composition

- Organic (25.55)
- Paper (12.12)
- Textile (8.49)
- Grass/wood (16.36)
- Plastic (30.91)
- Metal (0.61)
- Glass (2.42)
- Others (3.54)

10Baht/month/household
110 tons/day
(Mixed collection)

Contracted to Pak Nam Muang Sa-Ard Co., Ltd (14 compact trucks)

5. Collection fees are cheap

4. There are no trucks for sorted collection/ The number of waste collection personnel is insufficient

Illegal Dumping

3. Although there are laws, they are not enforced and there is much illegal dumping

2. The recycling rate is low/ no data of informal recycling

1. No waste separation/ Residents don't have much of an awareness of recycling

6. While there is a waste to energy plan, it is not progressing.

Plastic liquidation equipment
Operations suspended due to RDF insufficiency

Bio-gas power generation equipment
Due to gas holder damage in 2010, operations are suspended

TambolPak Nam
No1" Excess land
Beside No1 2013 start

No1 Closed
Rayong Landfill

No2 Closed
Rayong Landfill
3.5ha 2001 start

7. Shortage of plastic raw materials/ Shortage of labor

Manufacturer: Poland
Start of operations: 2010
Capabilities: 6 tons/day plastic →4,500ℓ crude oil
Start of operations: 24-hour continuous operations
Construction costs: 0.21 billion yen Ministry of Energy budget
Fuel: LPG
Crude oil selling price: purchased by IRPC at 60 yen/ℓ

8. Gas holder damage/ Machinery corrosion/ Aging facilities/ Long decomposition period for organic materials

Manufacturer: made in Australia and Finland
Start of operations: 2004
Waste processing capacity: sorted garbage 40 tons/day + crushed garbage 20 tons/day
Construction costs: 0.45 billion yen Ministry of Energy budget

9. There is no fence surrounding the disposal site/The access road to the disposal site is unpaved/The lighting within the disposal site is dark/ There are not enough workers

Area 2.7ha Acceptance commenced in 1995
When they have finished digging up the No2 disposal site, there are plans to commence digging up of the No1 disposal site

Area 3.5ha Acceptance commenced in 2001
RDF digging up commenced from 2014

Digging up RDF

Cement plant

10. The budget allocation for MSWM is insufficient/ The purposes for which the budget can be used are limited

Development of Action Plans with key stakeholders

Action plan for improving MSWM

Residual Waste

Integrated waste management facility Of Rayong PAO
- **Final treatment (recycling, composting RDF and incineration)**
- **Final disposal (sanitary landfill)**

Activity 1: Environmental Education on 3R

Activity 2: Promotion of waste banks and composting

Activity 3: Improvement of collection and intermediate facility

Activity 4: Closure of open landfill and convert into urban greening

Cooperation for Environment Education and Public Awareness

[ภาพถ่ายด้านนอกอาคาร]

■ประชาชน ประมาณ 70 คนมาช่วยเป็นอาสาสมัคร

■บริการ เผยแพร่ข้อมูลด้านสิ่งแวดล้อม โดยแบ่งเป็นโซนประวัติการแก้ไขปัญหามลพิษ ปัญหาสิ่งแวดล้อมโลกและอื่นๆรวม 8 โซน

■อุปกรณ์ ใช้อุปกรณ์อนุรักษ์สิ่งแวดล้อมที่มีเทคโนโลยีด้านสิ่งแวดล้อมที่ทันสมัย

■เปิดเมื่อ เมษายน ค.ศ.2002

Supporting Know-how to Eco Center

Eco Center to be built in 2017 in Rayong Province

Environment Supporter (Volunteer)

Supporting Capacity Building for Environment Education and Public Awareness

Primary school in Rayong Province

Various Activities of City of Kitakyushu in Environment Field (3R Concept, Education System, Public Awareness and so on) Attract Elementary School in Thailand

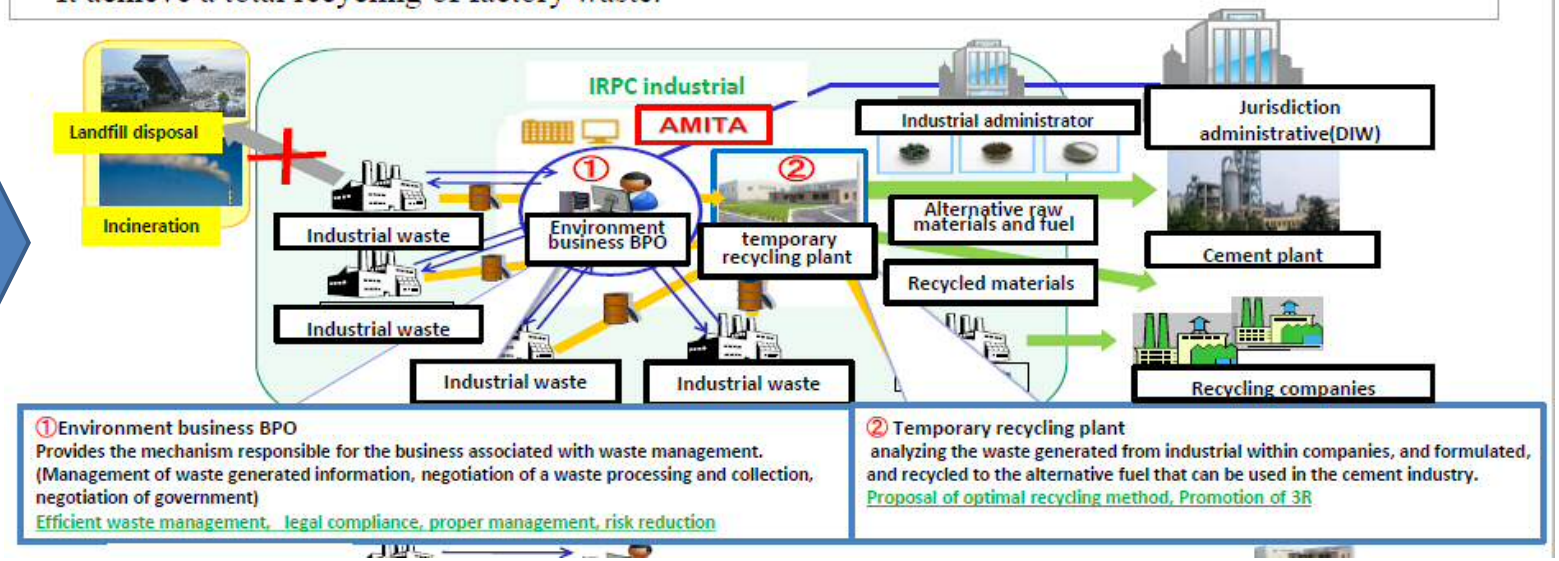
“Srinakharinwirot University Prasanmit Demonstration School (Elementary) visited Kitakyushu on January 17, 2016

Date	Activities
Jan. 17(Sun.)	Suvarnabhumi International Airport to Fukuoka Airport
Jan. 18(Mon.)	Kitakyushu Eco Town Next Generation Energy Park Hibiki Biotope
Jan. 19(Tue.)	Waste to Energy Facility TOTO Museum Environment Museum
Jan. 20(Wed.) ～21(Thurs.)	Co-activities with Sone-Higashi Elementary School ①
Jan. 22(Fri.)	Co-activities with Sone-Higashi Elementary School ②
Jan. 25(Mon.)	Nissan Motors Co., Ltd. Kyushu Electric Power Co., Inc. Co- activities with Takami Elementary School
Jan. 26(Tue.)	Yasukawa Electric Coperation Honjyo Can&Bottle Recycling Center Courtesy Call to SG of Environment Bureau, City of Kitakyushu
Jan. 27(Wed.)	Fukuoka Airport to Suvarnabhumi International Airport

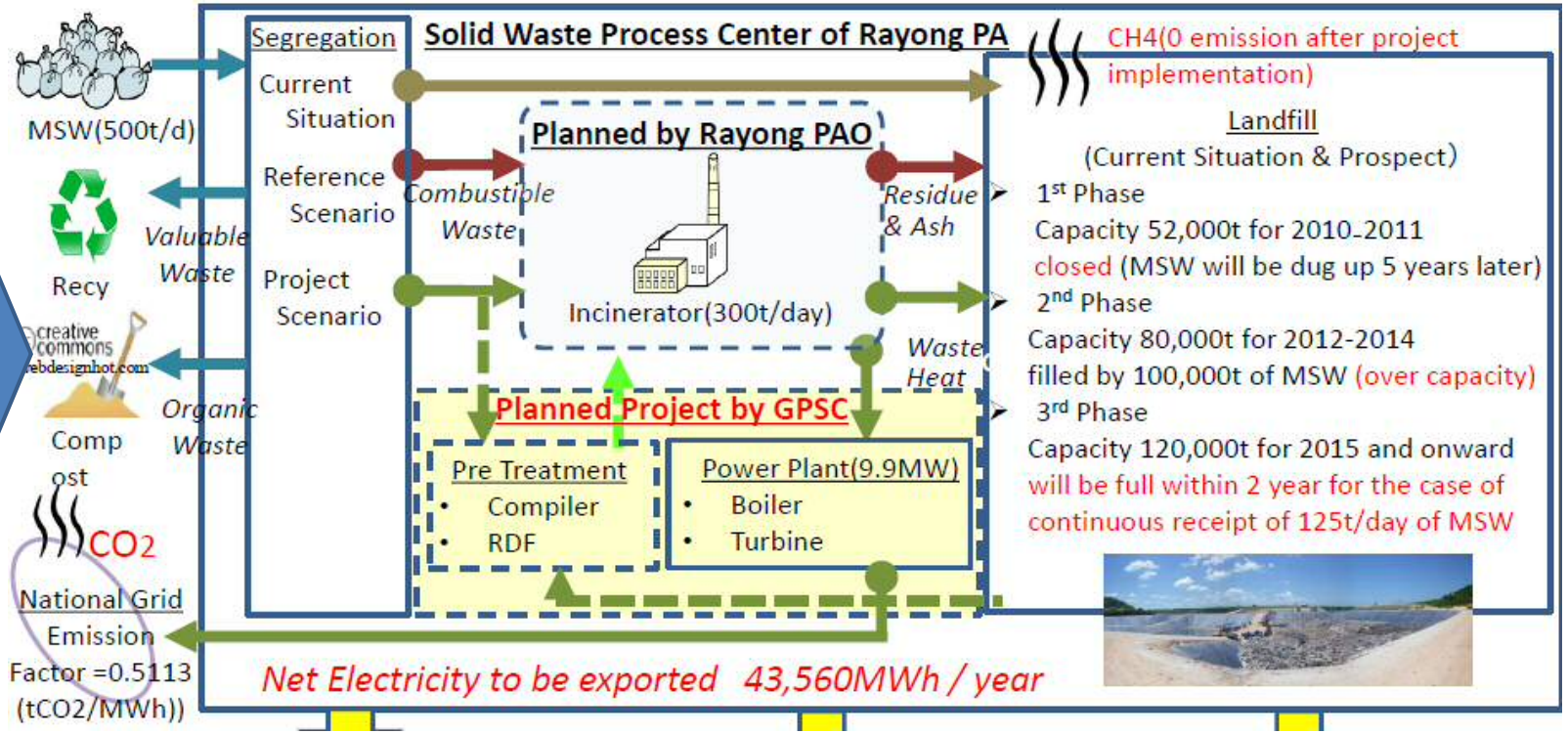
Link to the Larger Recycling and Incineration Projects with business sector under JCM

Recycling industrial wastes with low carbon emission project

Aiming to establish advanced models for both reduction of waste disposal cost and reduction of CO2 emissions. By using the software, promote the optimal matching and usage of waste generated raw fuel. It achieve a total recycling of factory waste.



Waste to Energy from Solid Municipal Waste



Advantages for local government and businesses in Japan and Thailand through City-to-City Cooperation

Japanese local governments

- Experience and know-how of Japanese cities can be provided for issues in partner cities.
- Comprehensive projects can be identified as a result of involvement from the earliest stages of action planning and work planning
- The successful business opportunities for Japanese companies can be identified and lead to the stimulation of the local/regional economy.

Japanese businesses

- Japanese businesses can understand the real needs of partner cities
- Barriers to entry into overseas markets can be lowered because there is a relationship of mutual trust between municipalities.
- Practical proposals can be developed in line with action plans as a result of involvement from the earliest stages of planning.

Win-Win

Thailand local governments

- New experience, know-how, and technology can be achieved at lower administrative costs
- Long-term follow-up support can be received through mutual trust.
- The successful business opportunities for Thailand companies can be identified and lead to the stimulation of the local/regional economy.
- Reduction of CO_2 emissions can lead to the simultaneous mitigation of pollution and improvement in lifestyle quality.

Thailand businesses

- Easy access to potential Japanese technologies
- There is a sense of security when technology is introduced as a result of mutual understanding and support between cities.
- Japan's low-carbon technologies can be introduced where there are reservations about costs through the application of the JCM.

Thank You

Junichi Sono, Director, Kitakyushu City
D.G.J.Premakumara, Senior Researcher, IGES

Ⅵ. Validation/Verification Process of the JCM

Stage1 : Validation

Independent evaluation of a proposed JCM project by a Third Party Entity(TPE) in order :

1) to be registered as a JCM project;
2) to determine whether actual monitoring systems and procedures comply with the monitoring plan;
3) to check if the monitoring arrangements are ready to start monitoring activity, ensuring the emission reductions achieved by the project activity can be reported and verified.

Stage1 : Validation

Validation process shall be conducted based on **Objective Evidences**.

- **Objective evidences**

  Objective evidence is independent information from PP that shows or proves that something exists or is true.

  Objective evidence can be collected by performing observations, measurements, tests, or by using any other suitable method.

Stage1 : Validation

Step1 PP: Preparation of **draft PDD** (Including **Monitoring Plan**) and **MoC**(Modalities of Communication) ;

↓

Step2 PP→ JC&TPE: Submission of **draft PDD**（Including **Monitoring plan**) **with MoC;**

↓

Step3 JC : Making **draft PDD**（Including **Monitoring plan**) publicly available and collect Public Inputs;

↓

Step4 TPE: Validation of **draft PDD** (Including **Monitoring Plan**) based on objective evidence;

↓

Step5 PP: Completion of **PDD**(Including **Monitoring Plan**);

Stage1 : Validation

Step6 TPE : Preparation of **Validation Report;**

↓

Step7 TPE→ PP : Submission of **Validation Report;**

↓

Step8 PP→ JC : ・Request for Registration as a JCM project;

・Submission of **PDD**（including **Monitoring Plan**),

MoC(Modalities of Communication)

and **Validation Report;**

↓

Step9 JC : ・Registration of the proposed project as a JCM Project;

・Approval of the **Monitoring Plan in the registered PDD;**

Stage2：Implementation of Monitoring Activities and Preparation of draft Monitoring Report

Step10 PP: Implementing Monitoring Activities in accordance with **the approved Monitoring Plan;**

↓

Step11 PP: Collecting, Recording , Archiving, Summarizing and Reporting **the Monitored Data**;

↓

Step12 PP: Preparation of **draft Monitoring Report** during the Monitoring Period;

↓

Stage3 : Verification

Periodic independent review and *ex post* determination by TPE of the monitored/reported GHG emission reductions as a result of the registered JCM project during the Monitoring Period:

1) to determine whether the project activity has been implemented and operated as per the registered PDD and the approved monitoring plan;

Stage3 : Verification

2) to determine whether actual monitoring systems and procedures comply with the approved monitoring plan;

Stage3 : Verification

3) to assess whether the data is measured/recorded/archived/collected/reported as per the approved monitoring plan and GHG emission reductions achieved by the project activity is correctly calculated.

* Verification process shall be conducted based on **Objective Evidences**.

Stage3 : Verification

Step13 PP→ TPE: Submission of

draft Monitoring Report;

↓

Step14 TPE: Verification of

draft Monitoring Report;

↓

Step15 PP: Completion of **Monitoring Report;**

Stage4 : Request for Issuance and Issuance of Credits

Step16 TPE : Preparation of **Verification Report;**

↓

Step17 TPE→ PP : Submission of **Verification Report;**

↓

Step18 PP→ JC : ▪ Request for Issuance;

▪ Submission of **Monitoring Report** with Verification Report;

↓

Step19 JC: Determination on amount of credits to be issued;

Government: Issuance of Credits.

Ⅶ. International Equivalence of Measurements & Calibration

International equivalence of measurements: the CIPM MRA

- The CIPM(International Committee for Weights and Measures) MRA(Mutual Recognition Arrangement) is the framework through which National Metrology Institutes demonstrate the international equivalence of their measurement standards and the calibration and measurement certificates they issue.

JCGM (Joint Committee for Guides in Metrology) 200:2012 2.39 “Calibration”

operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

JCGM 200:2012
2.39 Calibration

NOTE 1 A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

NOTE 2 **Calibration should not be confused with adjustment of a measuring system, often mistakenly called "self-calibration", nor with verification of calibration**

JCGM 200:2012
2.39 (6.11) Calibration

NOTE 3 Often, the first step alone in the above definition is perceived as being calibration.

Calibrating of Measuring Instruments

- One important requirement of the quality assurance system is the **traceability** of a measuring instrument **to national standards**. This demand is generally based on ISO 9000 requirements. The traceability is given, if a measuring instrument or measuring system was calibrated in an uninterrupted chain using a reference, which in turn is traceable to national standard.

How long is the calibration valid?

- The **determination of when to perform a calibration** is solely the **responsibility of the user.**
- The application, which means the conditions of the workplace, the type of usage of the measuring unit, frequency of use and safety requirements of the product to be assembled, decisively influence the required number of calibration intervals.

How long is the calibration valid?

- If measuring systems are integrated into the moving assembly process, then it will certainly be more meaningful to select shorter calibration intervals compared to measuring systems used in a laboratory environment. Calibration intervals can be significant anywhere from 3 months to approximately 2 years.

Ⅷ. Calculation of Reference Emissions & Emission Reductions for Power Generation from Waste Heat from MSW incineration in Rayong, Thailand

Determination & Calculation of Reference Emissions

- RE_y : Reference CO_2 emissions during the period of year y [tCO_2/y]

$$RE_y = PEG_y \times EF_{CO2,grid}$$

RE_y	: Reference emission [tCO2/y]
PEG_y	: Project net quantity of electricity generation and supply to the grid in the project in year y [MWh/y]
$EF_{CO2,grid}$	: Emission factor for grid electricity in year y[tCO2/MWh]

Reference emissions are calculated by multiplying the grid emission factor by the amount of monitored net electricity generated and supplied to the national grid by the project.

Calculation of Project Emissions: $PE_y[tCO_2]/yr$

- **Project emissions are the total of the following emissions:**
  - **Emissions associated with the electricity consumption**
  - **Emissions associated with the fossil fuel consumption**
  - **Emissions associated with the RDF consumption**

$$PE_y = PE_{elec,y} + PE_{ff,y} + PE_{RDF,y}$$

PE_y	Project Emission in year y [tCO2/y]
$PE_{elec,y}$	Project Emissions associated with the electricity consumption =Consumption of Import Electricity from the Grid （MWh/y） ×Grid Emission Factor （CO2-t/MWh）
$PE_{ff,y}$	Project Emissions associated with the fossil fuel consumption =Consumption of Fossil Fuels （ton/y） ×NCV （GJ/ton） × Emission Factor(ton-CO2/GJ)
$PE_{RDF,y}$	Project Emissions associated with the fossil fuel usage =Weight C(ton/y) of Waste Plastic Fuel × C% comes from fossil fuel ×44/12

Calculation of Emission Reductions

- Emission reductions are calculated as the difference between the reference emissions and project emissions.
- $ER_y = RE_y - PE_y$

  ER_y : GHG emission reductions in year *y* [t-CO_2e]

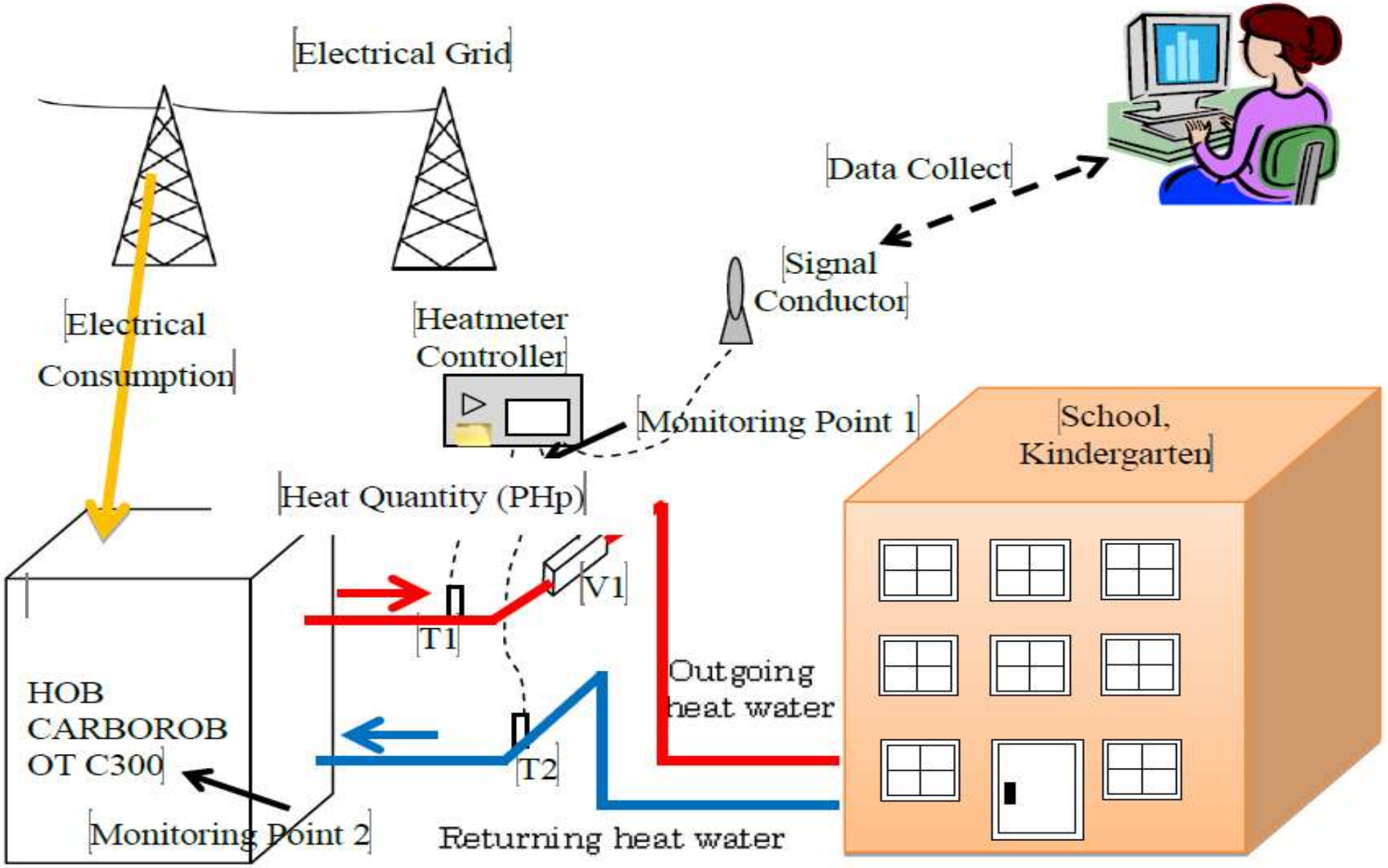
  RE_y : Reference emissions in year *y* [t-CO_2e/y]

  PE_y : Project emissions in year *y* [t-CO_2e/y]

Ⅸ. MRV Experiences in another JCM Project

1. Heat Only Boiler (HOB) Project in Mongolia

1.1 Figure of all emission sources and monitoring points relevant to the JCM project



1.2 MRV (Measurement, Reporting and Verification) under the JCM

Robust, transparent, consistent and accurate monitoring and reporting of greenhouse gas emissions are essential for the effective operation of the JCM in Mongolia.

MRV is the key process for ensuring reliability of reporting greenhouse gas emissions in a simple way.
MRV Process is as follows.

- **M-1: Draw input and output flow-diagram, such as Fuel, Heat and Electricity in HOB.**
  M-2: Describe monitoring points and monitoring instruments while operating the HOB relating to the emission sources in the flow-diagram. : Figure 1.
  M-3: Examine the accuracy of monitoring instruments.

- **R-4: Calculate and Report the amount of emission reductions using daily and monthly reporting data in the HOB.**
- **V-5: Verify the calculated and reported emission reductions with trail of evidences, such as daily and monthly reporting data in the HOB.**

1.3 MRV activities in the HOB

∗ Project Participants implemented the MRV process and have to be responded to the verification activities with evidence trails.

∗ Reference emission sources (Monitoring points)

- PH_p : Net heat quantity supplied by the project HOB
  →Heat meter Controller

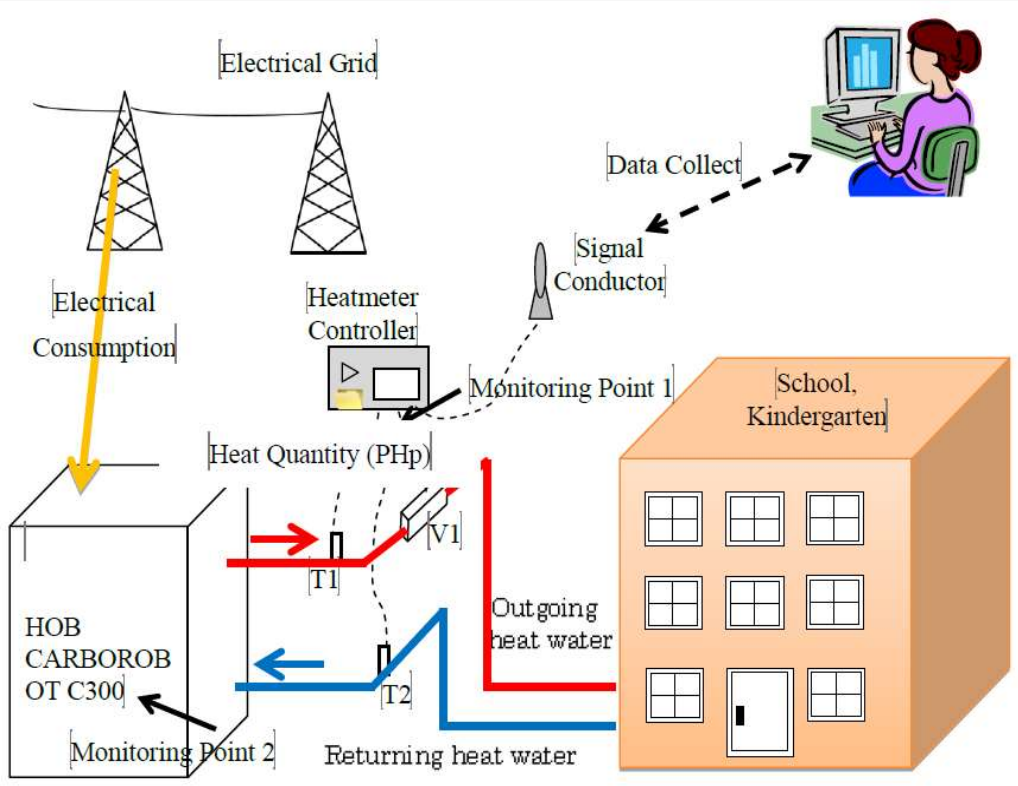


Figure 1. Flow-diagram

∗ Project emission sources (Monitoring points)

- PH_p : Net heat quantity supplied by the project HOB
  →Heat meter Controller
- EC_p :Electricity imported from the grid
  →Total hours of the project HOB operation

1.4 Calculation of Reference Emissions

- **Reference emissions are calculated by "the reference coal consumption".**
- $RE_p = PH_p / \eta_{RE, HOB} \times EF_{CO2,coal}$

RE_p : **Reference CO_2 emissions** during the period p [t-CO_2/p]

PH_p : **Net heat quantity supplied by the project HOB** during the period *p* [GJ/p]

→**To be monitored *ex post*. (Monitored values)**

$EF_{CO2,coal}$: **CO_2 emission factor of coal** [t-CO_2/GJ]

→ **Determined in the AM002_ver01.0**

1.5 Calculation of Project Emissions

- **Project emissions are calculated by "the project coal consumption" and "the electricity consumption of the project HOB"**
- $PE_p = PH_p \div \eta_{PJ,\,HOB} \times EF_{CO2,coal} + EC_p \times EF_{CO2,grid}$

PE_p : Project emissions during the period *p* [t-CO_2/p]

EC_p : Electricity consumption of the project HOB during the period *p* [MWh/p]

$EF_{CO2,grid}$: CO_2 emission factor of coal [t-CO_2/MWh]

→ **Determined in the AM002_ver01.0**

- $EC_p = RPC_{PJ,HOB} \div 1{,}000 \times HMP_p$

HMP_p : Total hours of the project HOB operation during the monitoring period *p* [h/p]

→**To be monitored *ex post*. (Monitored values)**

1.6 Data and parameters determined in the Approved Methodologies（AM002_ver01.0）

Parameter	Description of data	Default value
$\eta_{RE,\ HOB}$	Boiler efficiency of the reference HOB	53.3%
$\eta_{PJ,HOB}$	Boiler efficiency of the project HOB	61.0%
$EF_{CO2,coal}$	CO_2 emission factor of coal	0.0909 t-CO2/GJ
$EF_{CO2,grid}$	CO_2 emission factor of the grid electricity	1.1030t-CO2/MWh

1.7 Calculation of Emission Reductions

- $ER_p = RE_p - PE_p$

ER_p : Emission reductions during the period p [t-CO_2/p]
RE_p : Reference emissions during the period p [t-CO_2/p]
PE_p : Project emissions during the period p [t-CO_2/p]

1.8 Project-specific parameters to be fixed *ex-ante*

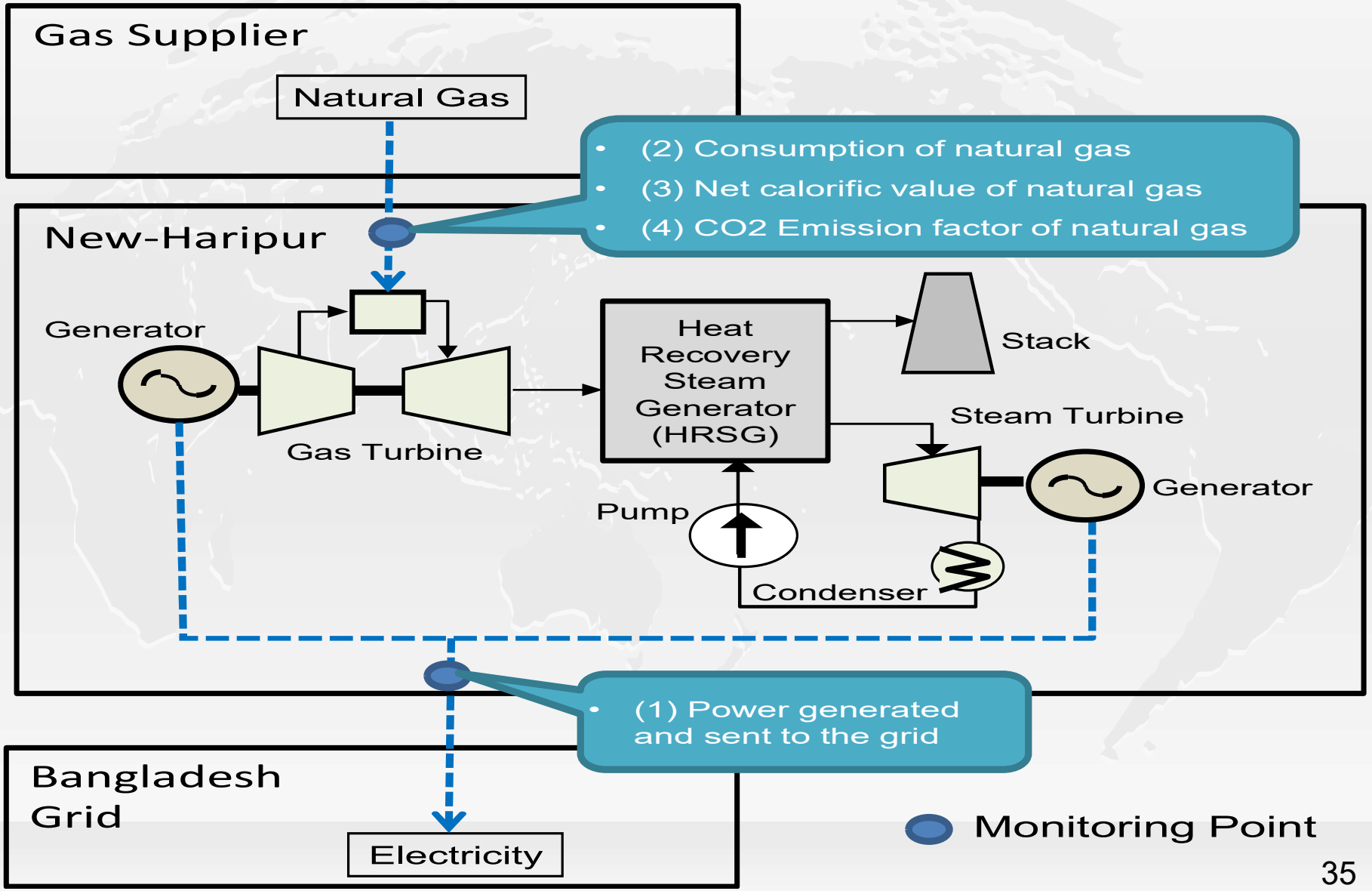
Parameter	Description of data	Value
$RPC_{PJ,HOB}$	**Rated power consumption of the project HOB**	**1.2 kW** Catalog value provided by the manufacturer of the project HOB

1.9 Parameters to be monitored *ex-post*

Parameter	Units	Monitoring Method	Measurement method and procedures
PH_p	GJ/p	**Actual measurement using measuring equipments**	・**Meet the Mongolian National Standard (MNS).** "MNS 6241:2011" ("Heat meters. General requirements for the installation, commissioning, operational monitoring and maintenance"). ・Accepted uncertainty is ±5% according to "MNS 4549:2005" ("Calculator of heat meter. The method and means of verification"). ・**the Heat meter with the verification →Official approval** ・**The verification validity ：4 years**
HMP_p	h/p	**Actual measurement using measuring**	**Total time from the start time of monitoring to the end time of monitoring**

2. MRV Research Study for Natural Gas Combined Cycle Power Plant

2.1 Figure of all emission sources and monitoring points relevant to the BOCM project



2.2 Determination of Reference Emissions

Reference emissions are calculated by multiplying the amount of **electricity sent to the grid by the proposed project** by the **Reference emission factor** provided in the approved methodology.

2.3 Calculation of Reference Emissions

- $RE_y = EG_{PJ,y} * EF_{RF}$

RE_y : **Reference CO_2 emissions** during the period of year y [tCO_2/y]

$EG_{PJ,y}$: Power generated and sent to the grid in year *y* [MWh/y] → **To be monitored *ex post*.**

EF_{RF} : Reference emission factor provided in the approved methodology [tCO_2/MWh] → **Fixed *ex ante***

Ⅸ.1 References

- **Information on JCM Partner Countries: Thailand**

https://www.jcm.go.jp/th-jp/about

- **Recent Development of the Joint Crediting Mechanism (JCM) August 2016 Government of Japan**

http://www.mmechanisms.org/document/20160822_JCM_goj_eng.pdf

- **PARIS AGREEMENT**

http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

- **Thailand INDC**

http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Thailand/1/Thailand_INDC.pdf

- **Japan INDC**

http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Japan/1/20150717_Japan's%20INDC.pdf

IX.2 References

- **International vocabulary of metrology — Basic and general concepts and associated terms (VIM) JCGM 200:2012**

http://www.bipm.org/utils/common/documents/jcgm/JCGM_200_2012.pdf

- **Calibrating of Measuring Instruments, DEPRAG.**

http://www.deprag.com/en/screwdriving-technology/technical-information/calibrating-of-measuring-instruments.html

THANK YOU!

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s-yamamoto@aec-inc.jp

添付資料1. タイ国ワークショップ講演資料(1/2)

“For Self-Implementation of the JCM MRV (Measurement(Monitoring), Reporting and Verification) Activities by Thailand People”

September 2016

Shigenari YAMAMOTO, AEC

Contents

Contents

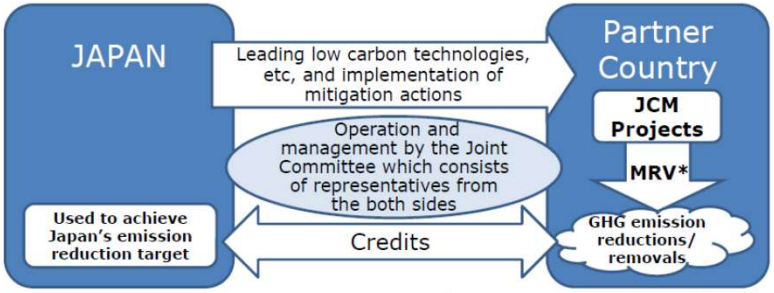
Abbreviation

- JCM : Joint Crediting Mechanism
- PDD : Project Design Document
- JC : Joint Committee
- PP : Project Participant
- TPE : Third Party Entity

Ⅰ. Scheme of the JCM

Basic Concept of the JCM

- Facilitating diffusion of leading low carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries.
- Appropriately evaluating contributions from Japan to GHG emission reductions or removals in a quantitative manner and use them to achieve Japan's emission reduction target.
- Contributing to the ultimate objective of the UNFCCC by facilitating global actions for GHG emission reductions or removals.



*measurement, reporting and verification

Features of the JCM

(1) The JCM starts its operation as a non-tradable credit type mechanism.

(2) Both Governments continue consultation for the transition to a tradable credit type mechanism and reach a conclusion at the earliest possible timing, taking account of implementation of the JCM.

(3) The JCM aims for concrete contributions to assisting adaptation efforts of developing countries after the JCM is converted to the tradable credit type mechanism.

(4) The JCM covers the period until a possible coming into effect of a new international framework under the UNFCCC. 5

JCM Partner Countries

- Japan has held consultations for the JCM with developing countries since 2011 and has established the JCM with Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Lao PDR, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar and Thailand.

Mongolia
Jan. 8, 2013
（Ulaanbaatar）

Bangladesh
Mar. 19, 2013
(Dhaka)

Ethiopia
May 27, 2013
(Addis Ababa)

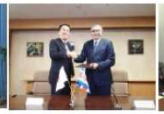
Kenya
Jun. 12,2013
(Nairobi)

Maldives
Jun. 29, 2013
(Okinawa)

Viet Nam
Jul. 2, 2013
(Hanoi)

Lao PDR
Aug. 7, 2013
(Vientiane)

Indonesia
Aug. 26, 2013
(Jakarta)



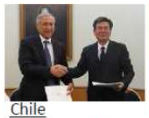
Costa Rica
Dec. 9, 2013
(Tokyo)

Palau
Jan. 13, 2014
(Ngerulmud)

Cambodia
Apr. 11, 2014
(Phnom Penh)

Mexico
Jul. 25, 2014
(Mexico City)

Saudi Arabia
May 13, 2015



Chile
May 26, 2015
(Santiago)

Myanmar
Sep. 16, 2015
(Nay Pyi Taw)

Thailand
Nov. 19, 2015
(Tokyo)

- In addition, the Philippines and Japan signed an aide memoire with intent to establish the JCM.

Ⅱ. COP21 Paris

Statement by Prime Minister Shinzo Abe at the COP21 (Excerpt)

PARIS2015
CONFÉRENCE DES NATIONS UNIES SUR LES CHANGEMENTS CLIMATIQUES
COP21·CMP11

The second component of Japan's new set of contribution is innovation. The key to acting against climate change without sacrificing economic growth is the development of innovative technologies. To illustrate, there are technologies to produce, store and transport hydrogen towards realizing CO2–free societies, and a next-generation battery to enable an electric car to run 5 times longer than the current level. By next spring Japan will formulate the "Energy and Environment Innovation Strategy." Prospective focused areas will be identified and research and development on them will be strengthened. (snip)

In addition, many of the advanced low-carbon technologies do not generally promise investment-return to developing countries. Japan will, while lowering burdens of those countries, promote diffusion of advanced low carbon technologies particularly through implementation of the JCM.

8

Japan's INDC (Excerpt)

Japan's INDC

○ Japan's INDC towards post-2020 GHG emission reductions is at the level of a reduction of 26.0% by fiscal year (FY) 2030 compared to FY 2013 (25.4% reduction compared to FY 2005) (approximately 1.042 billion t-CO_2eq. as 2030 emissions), ensuring consistency with its energy mix, set as a feasible reduction target by bottom-up calculation with concrete policies, measures and individual technologies taking into adequate consideration, *inter alia*, technological and cost constraints, and set based on the amount of domestic emission reductions and removals assumed to be obtained. .

Information to facilitate clarity, transparency and understanding

○ The JCM is not included as a basis of the bottom-up calculation of Japan's emission reduction target, but the amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan's reduction.

Reference information
GHG emissions and removals
JCM and other international contributions

○ Japan establishes and implements the JCM in order both to appropriately evaluate contributions from Japan to GHG emission reductions or removals in a quantitative manner achieved through the diffusion of low carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions in developing countries, and to use them to achieve Japan's emission reduction target.

○ Apart from contributions achieved through private-sector based projects, accumulated emission reductions or removals by FY 2030 through governmental JCM programs to be undertaken within the government's annual budget are estimated to be ranging from 50 to 100 million t-CO_2

Thailand
Intended Nationally Determined Contribution (INDC: Excerpt)

- Thailand intends to reduce its greenhouse gas emissions by 20 percent from the projected business-as-usual (BAU) level by 2030.
- The level of contribution could increase up to 25 percent, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support through a balanced and ambitious global agreement under the United Nations Framework Convention on Climate Change (UNFCCC).

PARIS AGREEMENT Article 2

(a) Holding the increase in the global average temperature to well below 2 ° C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 ° C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

PARIS AGREEMENT Article 4

2. **Each Party shall prepare**, **communicate and maintain successive nationally determined contributions** that it intends to achieve. **Parties shall pursue domestic mitigation measures**, with the aim of achieving the objectives of such contributions.

12. Nationally determined contributions communicated by Parties **shall be recorded in a public registry** maintained by the secretariat.

PARIS AGREEMENT Article 4

9. **Each Party shall communicate a nationally determined contribution every five years** in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement and be informed by **the outcomes of the global stocktake** referred to in Article 14.

10. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement **shall consider** common time frames for nationally determined contributions at its first session.

PARIS AGREEMENT Article 4

3. **Each Party's successive nationally determined contribution** will **represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition**, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

The JCM related Articles in the Paris Agreement

Article 6 of the Agreement

2. Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.
3. The use of internationally transferred mitigation outcomes to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties.

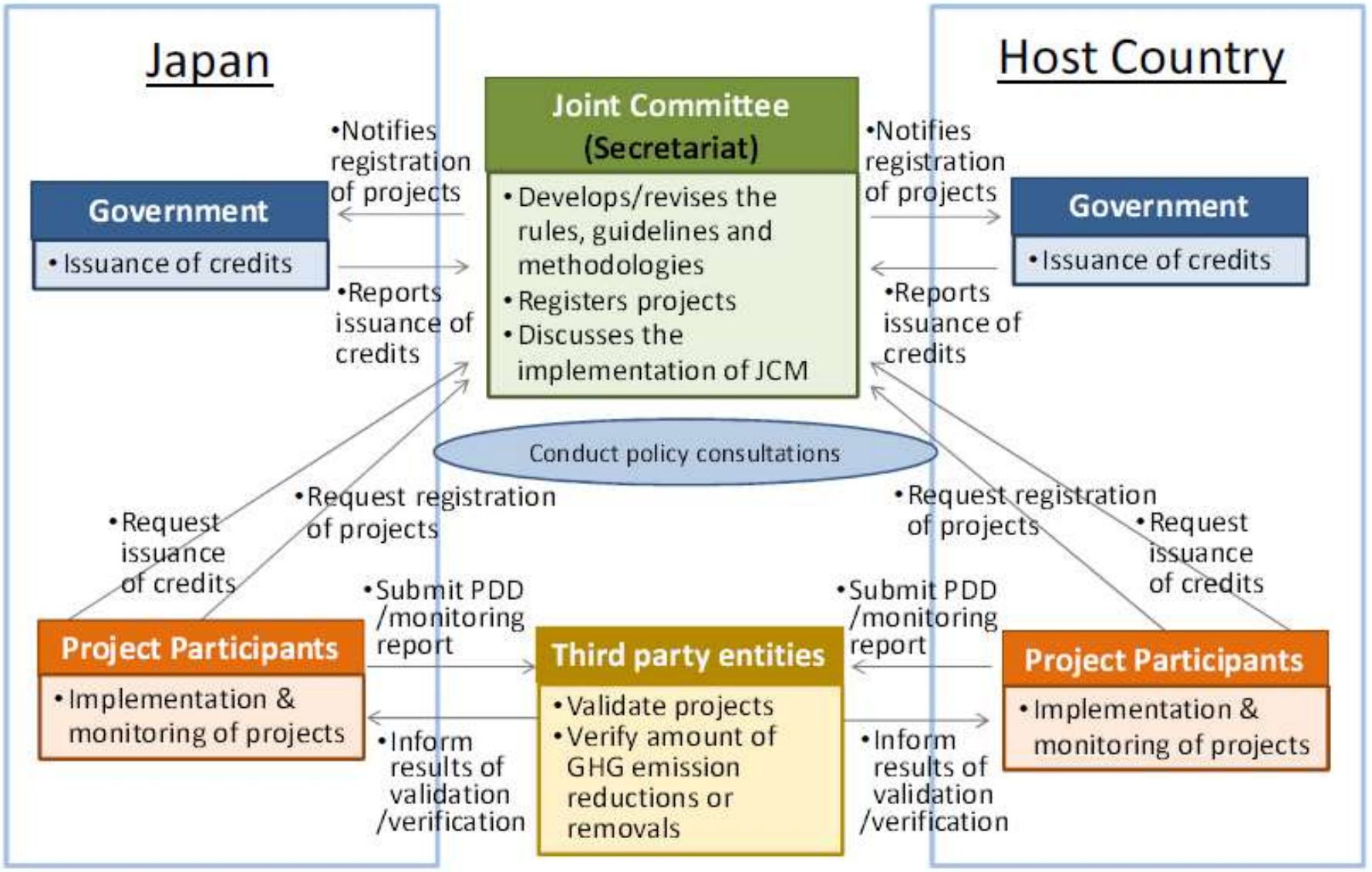
- Use of market mechanisms, including the JCM, is articulated under Article 6 which prescribes for the use of emission reductions realized oversees towards national emission reduction targets.
- The amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan's reduction in accordance with the Paris Agreement.
- Japan is going to contribute to the development of the guidance for robust accounting including for avoidance of double counting to be adopted by the CMA*.

*the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement

10

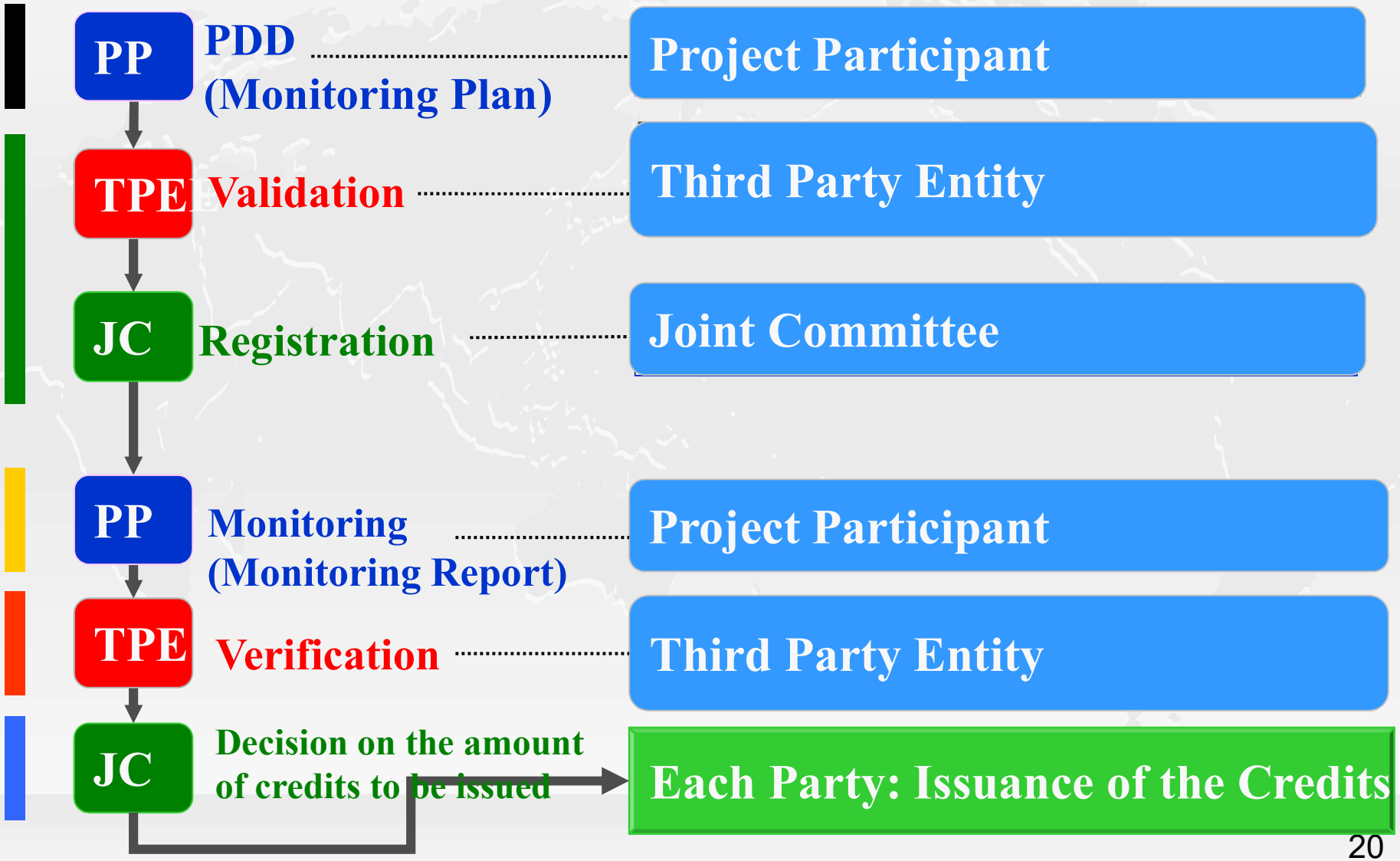
Ⅲ. Structure of the JCM

Structure of the JCM



Ⅳ. The JCM Project Activities

The JCM Project Activities



Progress of the JCM in each partner country as of June 10th 2016

Partner countries	Start from	No. of JC	No. of registered projects	No. of approved methodologies	Pipeline (JCM Model & demonstration projects in FY13-15)
Mongolia	Jan 2013	3	2	2	4
Bangladesh	Mar 2013	3		1	5
Ethiopia	May 2013	2		1	1
Kenya	Jun 2013	2		1	3
Maldives	Jun 2013	2		1	2
Viet Nam	Jul 2013	4	4	5	14
Lao PDR	Aug 2013	1			2
Indonesia	Aug 2013	5	6	10	22
Costa Rica	Dec 2013	1			
Palau	Apr 2014	3	1	1	3
Cambodia	Apr 2014	2		1	2
Mexico	Jul 2014	1			
Saudi Arabia	May 2015	1			1
Chile	May 2015	1			
Myanmar	Sep 2015	1			1
Thailand	Nov 2015	1			7
Total	16	33	13	23	67

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Necessary documents for the JCM

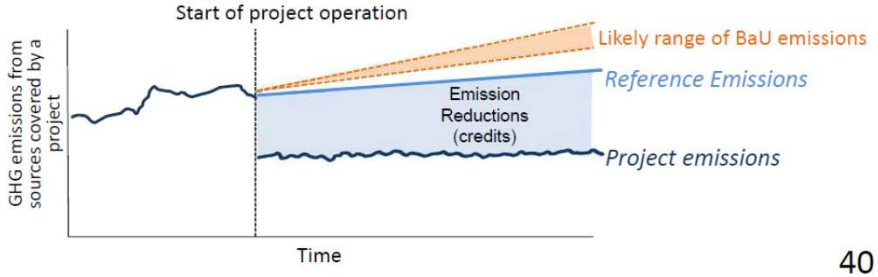
(Subject to further consideration and discussion with host countries)

		Rules and Guidelines
Overall		✓ Rules of Implementation ✓ Project Cycle Procedure ✓ Glossary of Terms ✓ Guidelines for Designation as a Third-Party Entity (TPE guidelines)
Joint Committee		✓ Rules of Procedures for the Joint Committee (JC rules)
Methodology		✓ Guidelines for Developing Proposed Methodology (methodology guidelines)
Project Procedures	**Developing a PDD**	✓ Guidelines for Developing Project Design Document and Monitoring Report (PDD and monitoring guidelines)
	Monitoring	
	Validation	✓ Guidelines for Validation and Verification (VV guidelines)
	Verification	

Basic Concept for Crediting under the JCM

(Subject to further consideration and discussion with partner countries)

- In the JCM, emission reductions to be credited are defined as the difference between "reference emissions" and project emissions.
- The reference emissions are calculated below business-as-usual (BaU) emissions which represent plausible emissions in providing the same outputs or service level of the proposed JCM project in the partner country.
- This approach will ensure a net decrease and/or avoidance of GHG emissions.

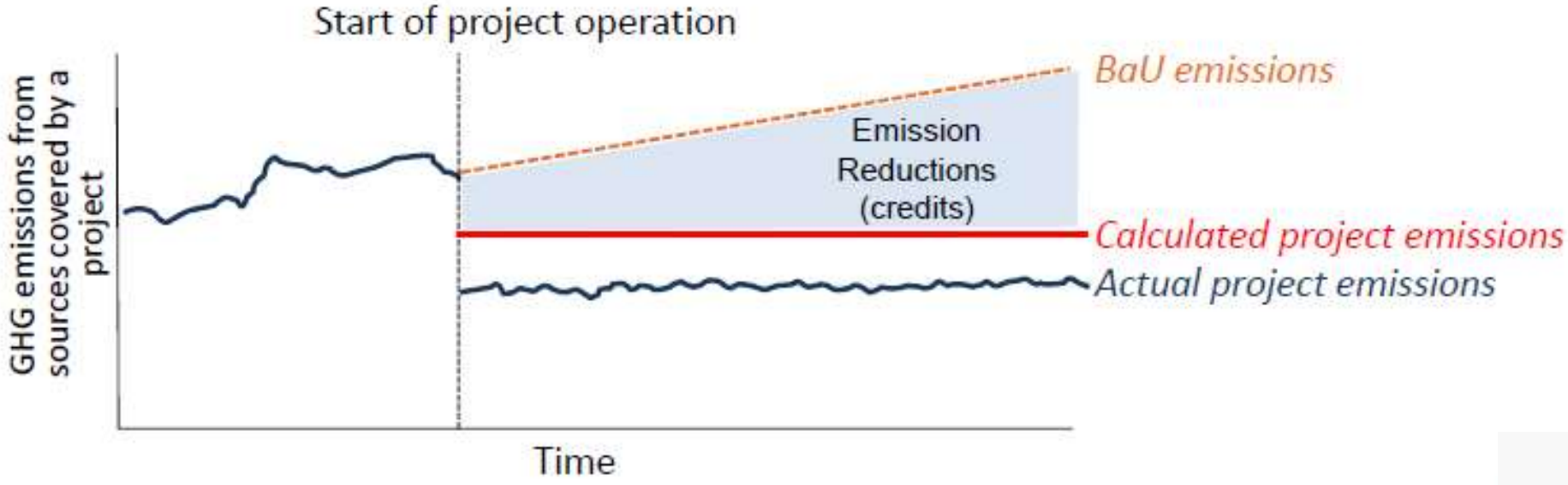


40

Addendum: ways to realize net reduction

(Subject to further consideration and discussion with host countries)

- A net decrease and/or avoidance of GHG emissions can be realized in alternative way, instead of calculating the reference emissions below BaU emissions.
- Using conservative default values in parameters to calculate project emissions instead of measuring actual values will lead calculated project emissions larger than actual project emissions.
- This approach will also ensure a net decrease and/or avoidance of GHG emissions, as well as reduce burdens of monitoring.



Basic concept of Eligibility criteria in JCM methodology

(Subject to further consideration and discussion with partner countries

Eligibility criteria in JCM methodologies contain the following:

- ✓ The requirements for the project to be registered as a JCM project. *<Basis for the assessment of validation and registration of a proposed project>*
- ✓ The requirements for the project to be able to apply the JCM methodology. *<same as "applicability condition of the methodology" under the CDM>*

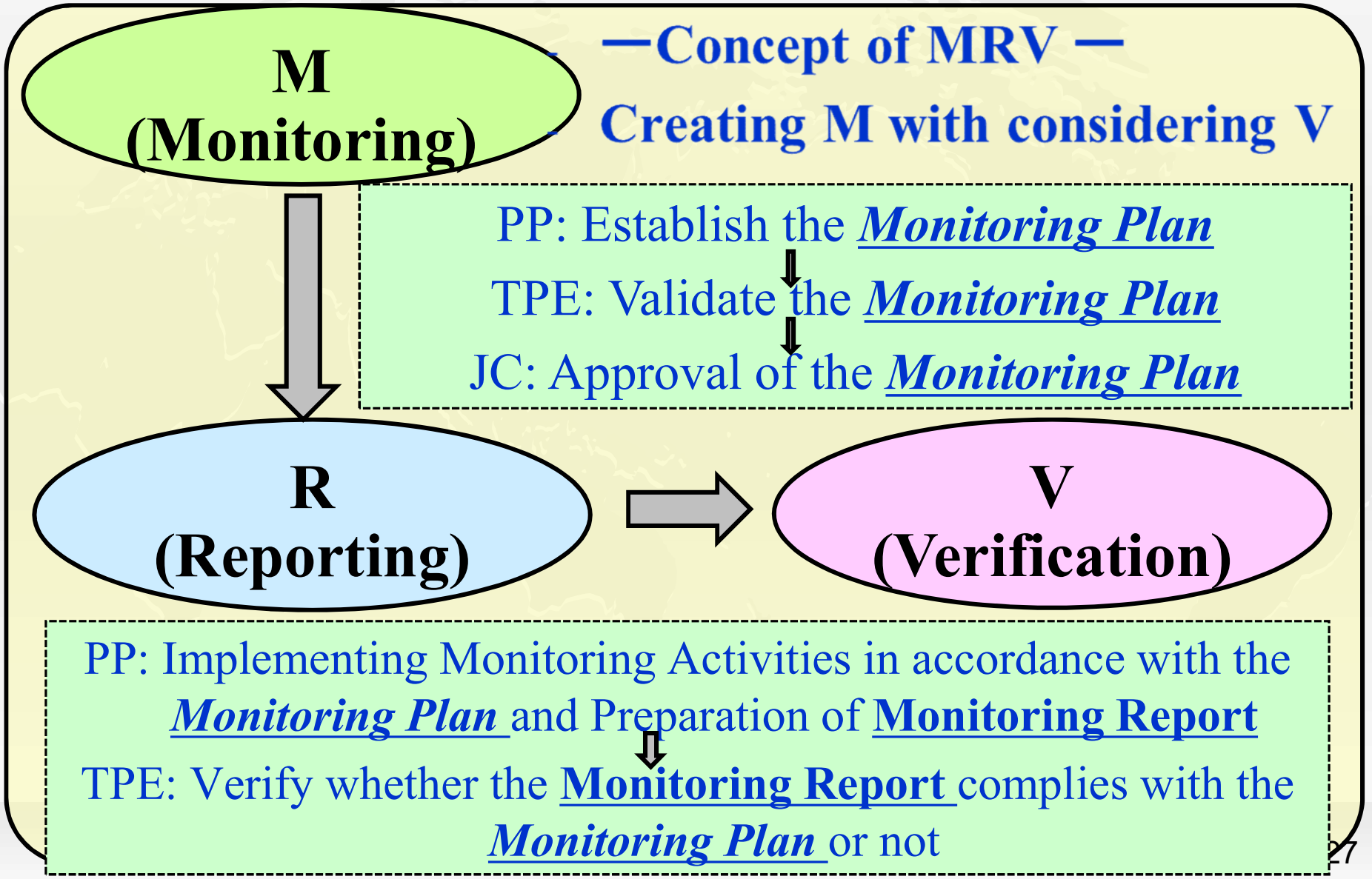
1. Both Governments determine what technologies, products, etc should be included in the eligibility criteria through the approval process of the JCM methodologies by the Joint Committee.
2. Project participants can use the list of approved JCM methodologies when applying for the JCM project registration.

Examples of eligibility criteria 1.
- Introduction of *xx* (products/technologies) whose design efficiency is above *xx* (e.g. output/kWh) *<Benchmark Approach>*
- Introduction of *xx* (specific high efficient products/technologies, such as air conditioner with inverter, electric vehicles, or PV combined with battery) *<Positive List Approach>*

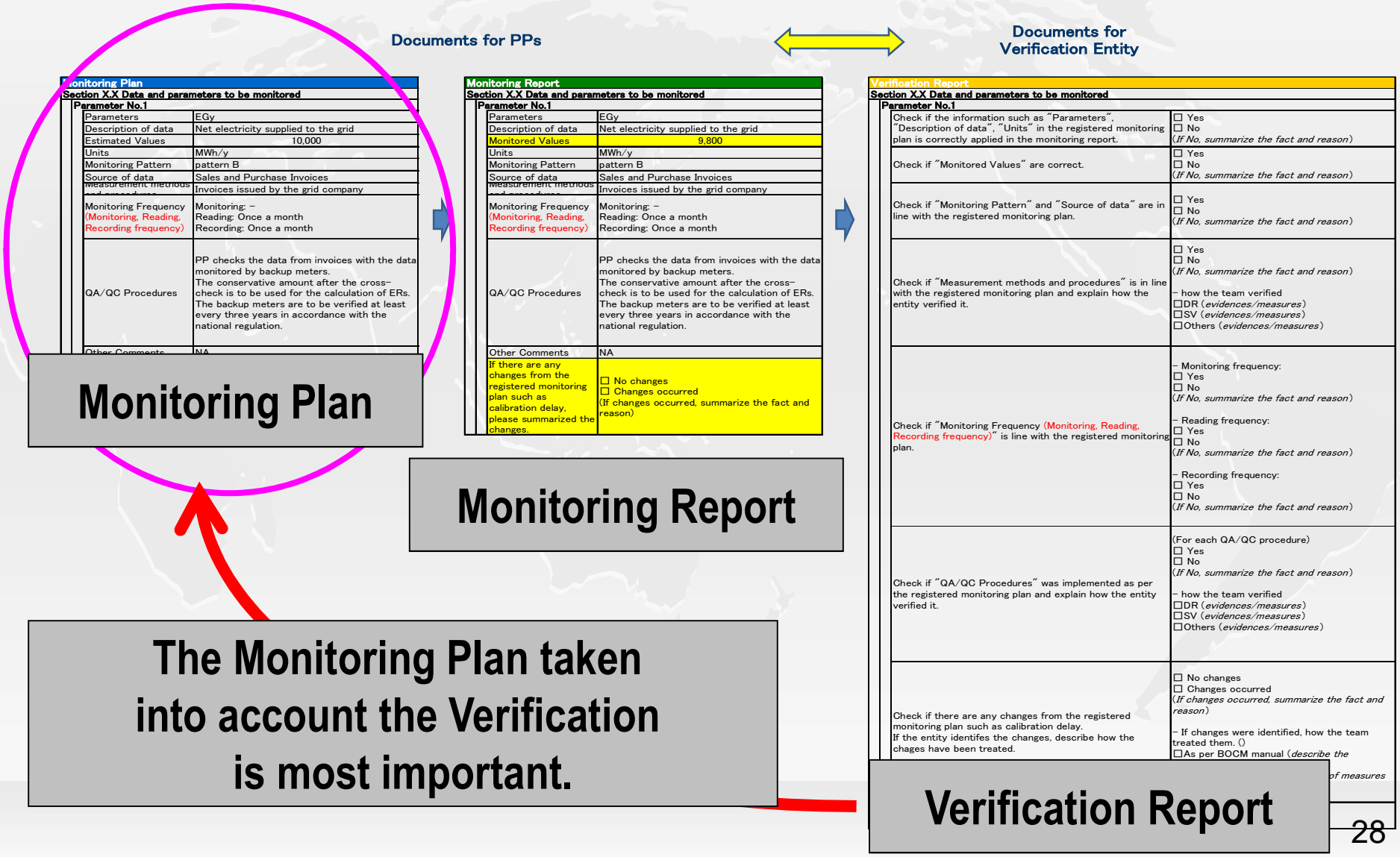
Examples of eligibility criteria 2.
- Existence of historical data for *x* year(s)
- Electricity generation by *xx* (e.g. PV, wind turbine) connected to the grid
- Retrofit of the existing boiler

Ⅴ. Concept of MRV & Structure of MRV

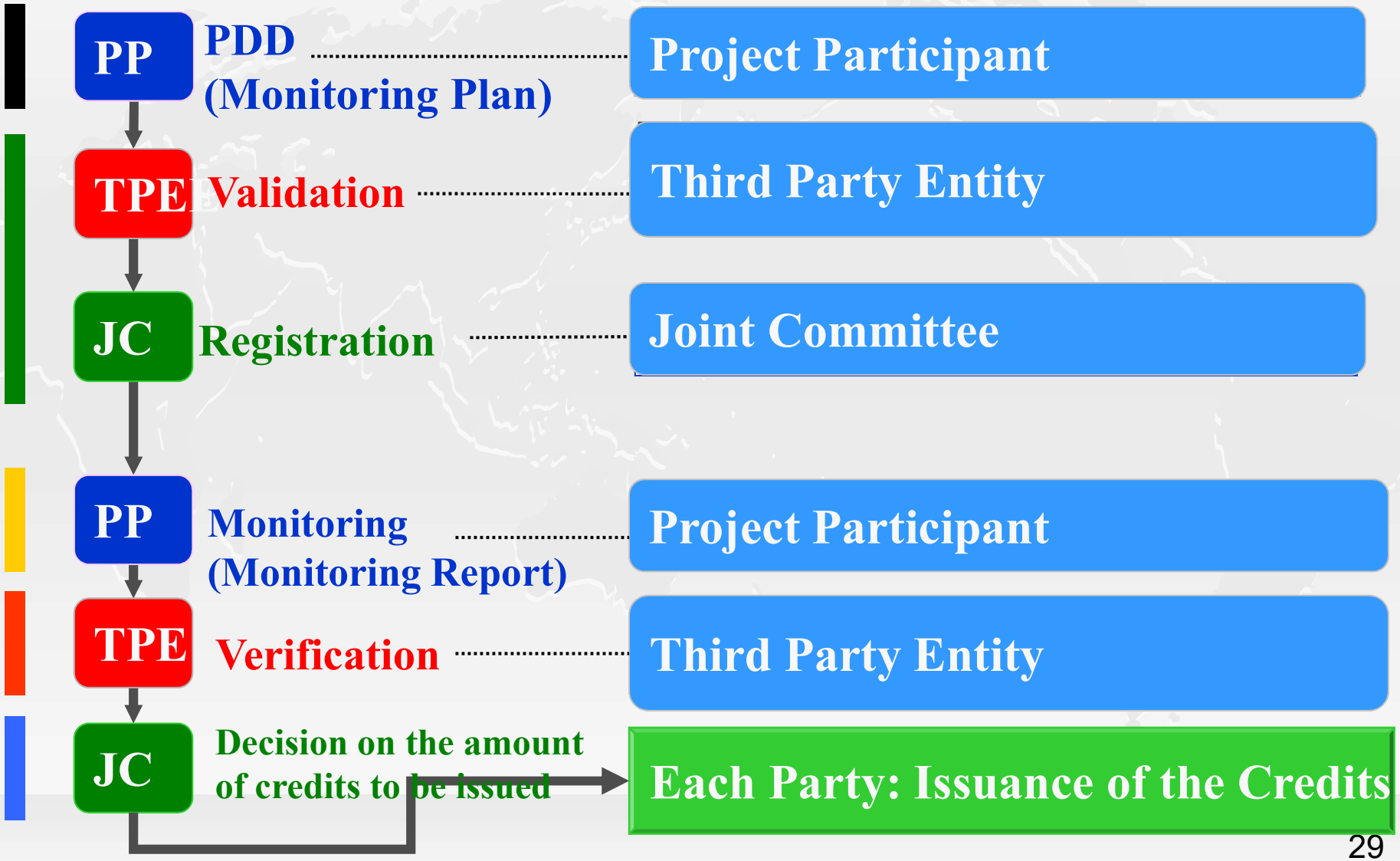
1. Concept of MRV & Structure of MRV



2. Developing a Monitoring Plan taken into account the Verification is the most important



3. Project Cycle of the JCM/BOCM



4. Main Player and Supporter

- **Main player of the scheme: PP** (responsible for the GHG emission reductions/removal)
- **Others: Supporter** (Scheme owner, Consultant, NGO, Experts, Verifier)

Key to success: Management and Operation of project activities（including monitoring activities） **by PP (Main player) independently**

5. Monitoring and Quantifying emissions/ removals

(1) **Activity data**

- Value representing the amount of PP's activity during the monitoring period

-**PP's responsibility**: Monitoring of activity data

(Ex. Amount of consumed coal : sales/purchase invoices, etc.)

(2) **Emission/Removal factor**

- **Joint Committee: Determination of default values**

→Approved Methodologies

6. The data which needs to be monitored in order to quantify emission reductions credibly

- **CO2Emissions（ton)＝**

  Amount of Activity(ton、kl、kNm_3、GJ、MWh）

  ×Emission factor（ ton-CO_2 /GJ、 ton-CO_2 /MWh）

・ Accurate and precise monitoring of activity data

⇒ To ensure credible quantification of the emission reductions

・Activity data：amount of fuel, raw materials, heat, and electricity consumption

（**measured by using verified or calibrated measurement instruments**）

7. Monitoring and Quantifying emissions / removals

Use of default values (conservative)

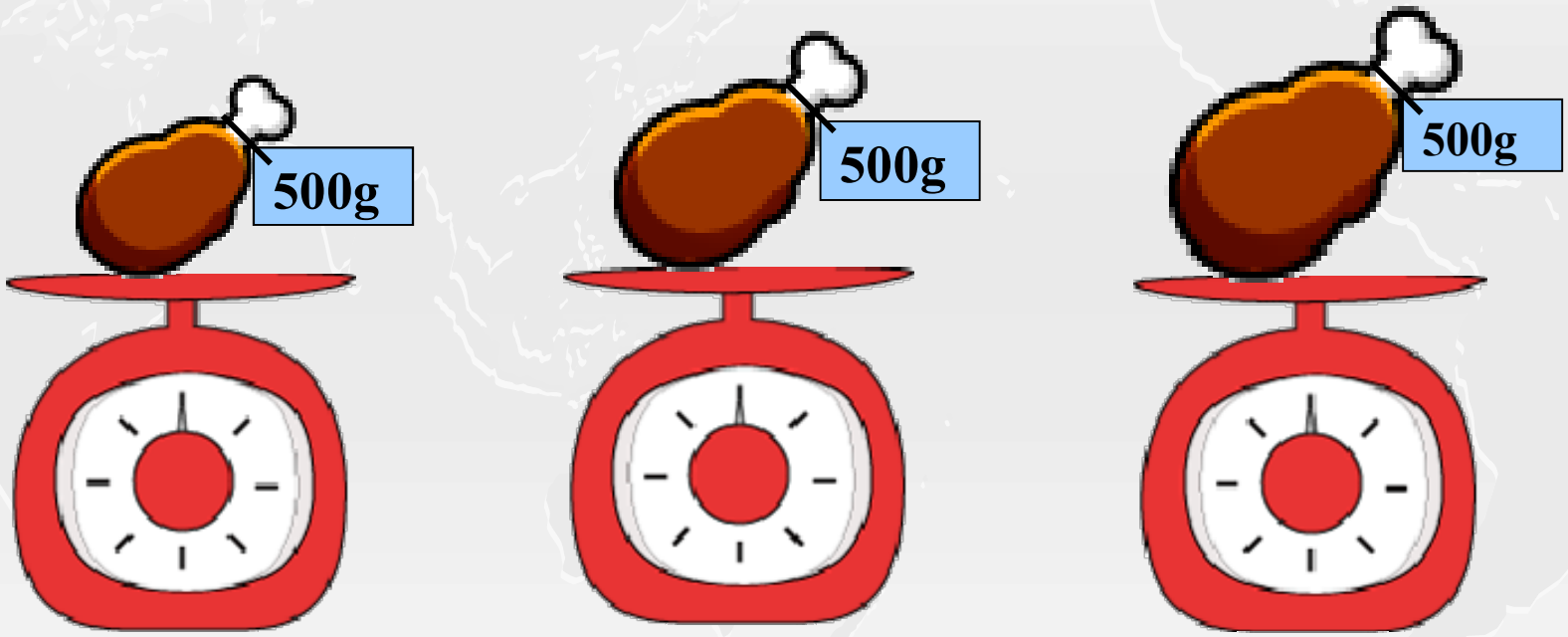
Condition for the application of default values
- Boiler efficiency : η
- Electricity consumption : kWh

Simplify the monitoring activity

Parameters to be monitored

⇒ **only the Activity Data**

8.1 Accuracy & Precision
500g correct or not?



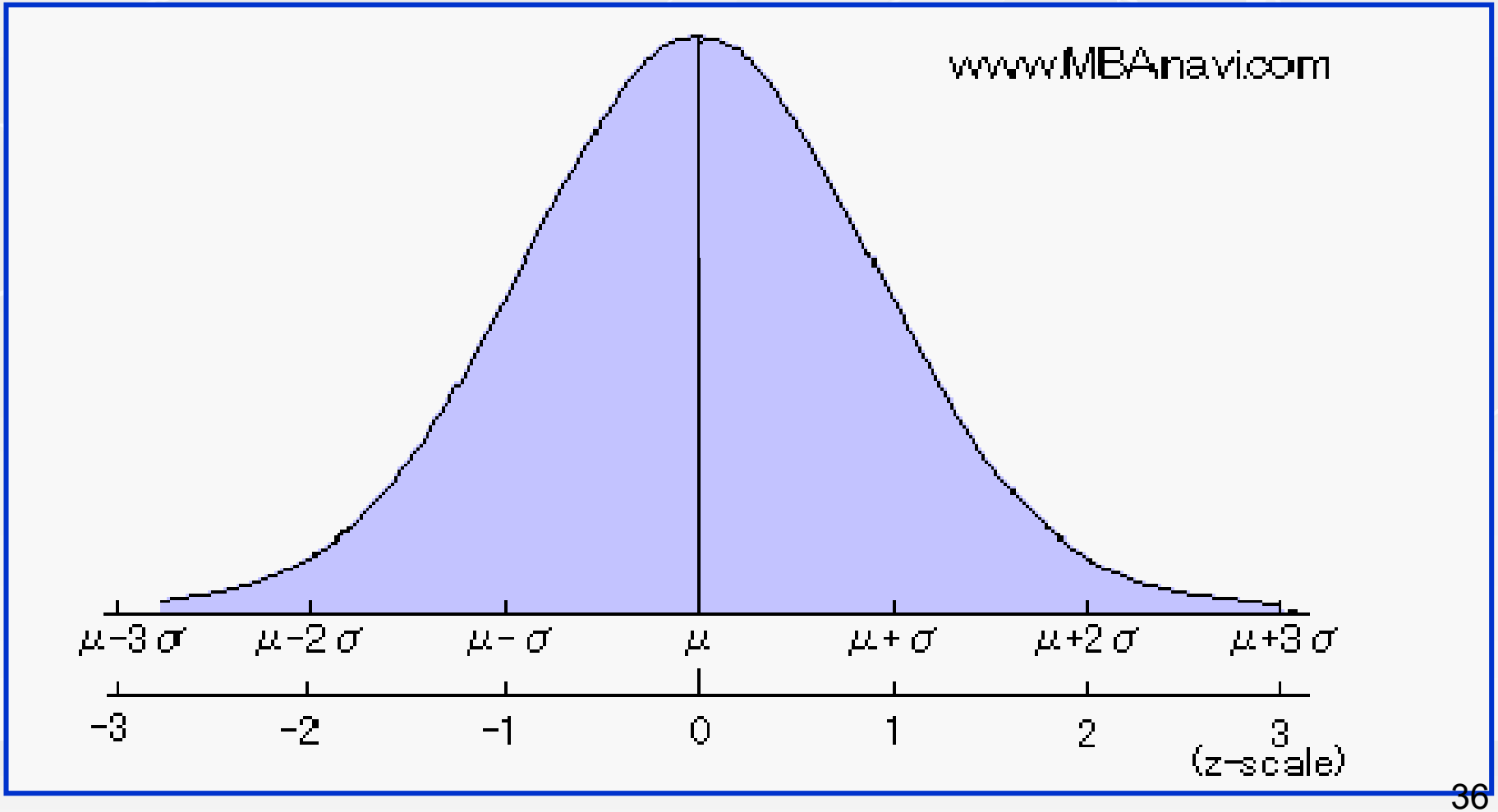
Which is correct 500g?

8.2 Accuracy & Precision

High Accuracy
Low Precision

High Precision
Low Accuracy

8.3 Permissible Uncertainty
95 percent confidence interval :2σ



CLIMATOLOGICAL DATA FOR THE PERIOD 2015-2015

Station	RAYONG	Elevation of station above MSL	2.6	Meters
Index Station	48478	Height of barometer above MSL	4.54	Meters
Latitude	12° 37' 56.0" N	Height of Thermometer above ground	1.2	Meters
Longitude	101° 20' 37.0" E	Height of wind vane above ground	15	Meters
		Height of rainguage	0.94	Meters

Elements		N-Years	JAN	FEB
Pressure(hPa)	Mean	1	1013.2	1012.6
	Mean Daily Range	1	4	4.2
	Ext.Max.	1	1018.9	1017.93
	Ext.Min.	1	1008.3	1008.39
Temperature(Celsius)	Mean Max.	1	30.1	30.6
	Ext.Max.	1	31.5	32.3
	Mean Min.	1	20.9	23.9
	Ext.Min.	1	16.4	19.5
	Mean	1	25.3	26.9
Dew Point Temp.(Celsius)	Mean	1	19.9	22.1
Relative Humidity(%)	Mean	1	74	76
	Mean Max.	1	89	87
	Mean Min.	1	58	62
	Ext.Min.	1	36	38
Visibility(Km.)	Mean	1	7.3	7.2
	07.00LST	1	6.5	6.5
Cloud Amount(1-10)	Mean	1	4	4
Wind (Knots)	Prev.Wind	1	S	S
	Mean	1	1.4	3.3
	Max.	1	15	20
Pan Evaporation(mm.)	Total	1	114.6	124.3
Rainfall(mm)	Total	1	1.4	38.8
	Num. of Days	1	2	3
	Daily Max.	1	1.3	16.6
Sunshine Duration(hr.)	Mean	1	270.1	244.8
Phenomena(Days)	Fog	1	0	0
	Haze	1	19	10
	Hail	1	0	0
	ThunderStorm	1	0	1
	Squall	1	0	0

MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
1011.9	1010.2	1008.6	1007.9	1007.9	1008.3	1008.9	1011.2	1010.7	1012.7	1010.34
4.1	4.1	3.6	3.1	3	3.3	4.2	4.2	4	4	3.82
1016.47	1014.91	1013.64	1013.64	1013.04	1012.77	1014.27	1015.05	1014.99	1018.45	1018.9
1007.79	1004.6	1005.51	1004.44	1002.12	1002.57	1000.53	1006.44	1006.26	1008.21	1000.53
31.2	32.3	32.4	31.8	31.5	31.6	31.2	31.7	33	32.3	31.6
32	33.5	34	33.7	32.3	35.2	34	34.2	34.5	33.5	35.2
26.8	27	28.9	27.5	28	27.1	26.1	25.1	24.9	23.8	25.8
23.5	23.5	26	23	23	23.6	23.2	23	24	20	16.4
28.7	29.3	30.3	29.6	29.5	29.2	28.5	27.9	28.3	27.6	28.4
24.4	24.4	25.7	25.3	25.5	24.7	25	24.8	24.6	22.7	24.1
78	76	77	78	79	77	82	84	81	76	78.2
86	85	84	86	86	85	92	95	95	91	88.2
70	65	70	71	74	69	71	70	64	60	66.9
60	40	53	62	61	44	62	54	51	43	36
7.7	7.8	9.6	9.7	9.6	10	9.3	8.4	9.2	8.6	8.7
7.1	7.8	9.7	9.9	9.5	9.6	8.8	7.9	8.6	7.7	8.3
5	5	6	7	7	8	7	7	5	5	5.8
S	S	S	S	S	SW	S	S	S	S	-
3.3	3	4.3	4.1	6	5.6	3.7	1.6	1.6	1.8	3.3
17	15	31	25	20	20	20	18	18	22	31
150.6	142.6	161.3	140.5	156.1	137.7	110.8	108.8	120.1	125.9	1593.3
28.9	25.4	175.6	233.3	52.5	107.9	407.3	228.5	108.5	41.6	1449.7
5	4	12	18	12	10	17	18	9	3	113
12.5	16.3	84	53.5	12.6	54.7	103.1	54	40.3	40.2	103.1
229.4	236.3	201.6	181.5	174.6	180	149.3	188.9	248.1	259.6	2564.2
0	0	0	0	0	0	0	0	0	0	0
3	9	2	0	0	0	0	3	2	9	57
0	0	0	0	0	0	0	0	0	0	0
4	5	10	7	2	9	12	17	11	5	83
0	0	0	0	0	0	0	0	0	0	0

CLIMATOLOGICAL DATA FOR THE PERIOD 2016-2016

Station	RAYONG	Elevation of station above MSL	2.6	Meters
Index Station	48478	Height of barometer above MSL	4.54	Meters
Latitude	12° 37' 56.0" N	Height of Thermometer above ground	1.2	Meters
Longitude	101° 20' 37.0" E	Height of wind vane above ground	15	Meters
		Height of rainguage	0.94	Meters

Elements		N-Years	JAN	FEB
Pressure(hPa)	Mean	1	1012.8	1013.4
	Mean Daily Range	1	4.1	4.3
	Ext.Max.	1	1019.44	1018.16
	Ext.Min.	1	1007.12	1007.85
Temperature(Celsius)	Mean Max.	1	31.1	31.4
	Ext.Max.	1	33.6	34
	Mean Min.	1	23.8	23.5
	Ext.Min.	1	16.5	16.3
	Mean	1	27.2	27.1
Dew Point Temp.(Celsius)	Mean	1	22.7	21.2
Relative Humidity(%)	Mean	1	77	72
	Mean Max.	1	89	87
	Mean Min.	1	65	57
	Ext.Min.	1	34	30
Visibility(Km.)	Mean	1	8	6.9
	07.00LST	1	6.5	5.7
Cloud Amount(1-10)	Mean	1	5	5
Wind (Knots)	Prev.Wind	1	S	S
	Mean	1	2.7	2.9
	Max.	1	15	21
Pan Evaporation(mm.)	Total	1	115.8	132.9
Rainfall(mm)	Total	1	108.4	5.3
	Num. of Days	1	9	1
	Daily Max.	1	33.8	5.3
Sunshine Duration(hr.)	Mean	1	-	-
Phenomena(Days)	Fog	1	0	0
	Haze	1	5	14
	Hail	1	0	0
	ThunderStorm	1	0	1
	Squall	1	0	0

MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
1011.7	1009.2	1007.9	1008.2	1007.8	1006.3	1007.6	1008	1009.9	1010.7	1009.46
4	4.2	3.9	3.3	3.2	3.4	3.8	4	3.9	3.9	3.83
1017.13	1014.27	1012.67	1011.57	1011.7	1012.77	1011.88	1013.9	1015.75	1015.5	1019.44
1007.37	1004.31	1003.93	1004.16	1004.24	1001.8	1003.79	1003.88	1005.5	1006.34	1001.8
31.8	33.3	33.6	31.9	31.3	31.6	31	31.4	32.7	31.7	31.9
32.7	34.5	35	33	33.2	32.3	32.2	32.8	35	34	35
27.2	29.1	29	27.1	26.2	27.8	26.5	25.6	24.9	23.5	26.2
21	27	24.8	23.5	23.6	24.3	23.5	23.5	22.8	21	16.3
29.1	30.7	30.9	29.3	28.7	29.5	28.6	27.9	28.3	27.1	28.7
24.7	25.8	26.1	25.3	25.4	25.4	24.9	24.9	24.1	20.7	24.3
78	76	76	80	83	79	81	85	79	70	77.8
85	82	85	89	92	87	89	94	93	83	87.8
69	67	68	72	74	73	73	72	63	52	67
44	59	54	62	51	68	66	57	48	35	30
7.2	8.1	9.2	9.8	9.8	10	9.8	9	10.1	9.8	9
6.6	7.6	8.6	9.4	9.3	9.8	9.7	8.6	9.8	9.4	8.4
5	4	6	8	8	7	8	8	6	6	6.3
S	S	S	S,S	SW	S	S	N,S	N	N	-
4.1	5	5	4.6	3.7	6.5	4	1.7	1.3	2.5	3.7
13	12	17	35	28	22	16	24	19	16	35
145.5	172	163.3	143.7	128.8	162.9	128.1	113.6	131.2	130.3	1668.1
1.7	0	95.4	200.4	248.5	111.3	270.4	190.1	76.4	0.6	1308.5
3	0	7	19	20	11	14	20	10	2	116
1	-	61.7	30.3	68.1	53.6	105.9	42.8	32.2	0.6	105.9
-	-	-	-	-	-	-	-	-	-	-
0	0	0	0	0	0	0	0	0	0	0
4	4	3	0	0	0	0	1	2	9	42
0	0	0	0	0	0	0	0	0	0	0
2	0	9	10	9	7	9	16	8	0	71
0	0	0	0	0	0	0	0	0	0	0

Joint Crediting Mechanism Proposed Methodology Submission Form

Cover sheet of the proposed methodology form	
Host Country	Thailand
Name of the methodology proponent submitting this form	EX Research Institute Limited
Sectoral Scope(s) to which the proposed methodology applied	1. Energy Industry (Renewable / Non Renewable Sources) 13. Waste Handling & Disposal
Title of proposed methodology & Version No.	Waste Heat of MSW Incineration based Power Generation to displace grid electricity in Bangalore, India
List of documents to be attached to this form (please check)	☐ JCM－PDD ☐ Additional Information 1) 2) 3)
Date	26/02/2017

Revision History of Proposed Methodology

Version	Date	Contents revised
01.0	26/02/2017	1st Edition

A. Title of the Methodology

Waste Heat of MSW Incineration based Power Generation to displace grid electricity in Thailand

Version 1.0

B. Terms and Definition

Terms	Definitions
GHG	Greenhouse Gases
MSW	Municipal Solid Waste, which is a heterogeneous mix of different solid waste types, usually collected by municipalities or other local authorities. MSW includes household waste, garden/park waste and commercial/institutional waste.
SWDS	Solid Waste Disposal Site, which is Designated areas intended as the final storage place for solid waste.
WtE	Waste to Energy, which is a concept to utilize combustible waste as alternative fuel or source of energy for thermal use, including power generation

C. Summary of the methodology

Items	Summary
GHG Emission Reduction Measure	Project which the methodology can be applied is to achieve GHG emission reduction by power generation from waste heat from MSW incineration and export such power, in excess of internal consumption, to the national grid with higher GHG emission factor.
Calculation of Reference Emission	Reference Emission in the project is an amount of GHG to be emitted from power stations, where are connected to the national grid, generate power and export such power to the national grid. Reference Emission shall be quantified by an equation of "Amount of Electricity generated & exported" multiply "Gird emission factor"
Calculation of Project	Project emission in the project consists of (1) "an amount of

<table>
<tr><td>Emission</td><td>electricity imported and consumed by the project” multiply “grid emission factor”, “an amount of fossil fuel consumed by the project” multiply “emission factor of fossil fuel consumed” and an amount of GHG emitted from combustion of plastic waste deprived RDF, for the case, any of those be utilized by the project.</td></tr>
<tr><td>Monitoring Parameters</td><td>Parameters to be monitored for the project are as follows;
<table>
<tr><th colspan="2">Parameter</th><th>Unit</th></tr>
<tr><td>EG_p</td><td>Amount of electricity generated and exported</td><td>MWh</td></tr>
<tr><td>$PE_{elec,plant,p}$
$PE_{elec,pre-t,p}$</td><td>Amount of electricity imported and consumed</td><td>MWh</td></tr>
<tr><td>$PE_{FF,plant,p}$
$PE_{FF,pre-t,p}$</td><td>Amount of fossil fuel consumed</td><td>Ton</td></tr>
<tr><td>$PP_{alt,p}$</td><td>Amount of RDF consumed</td><td>ton</td></tr>
</table></td></tr>
</table>

D. Eligibility criteria

This methodology is applicable for the project that satisfy all the following emission.

<table>
<tr><td>Criterion 1</td><td>Project shall generate power by utilization of waste heat deprived from incinerator, which is designed, constructed and operated for combustion of MSW</td></tr>
<tr><td>Criterion 2</td><td>For the case the project utilize existing old waste buried at landfills as alternative fuel (including RDF & RPF), then
1) The project participants shall establish organization and system to conduct appropriate monitoring operation for RDF deprived from old waste.
2) The Project participants shall not utilize RDF in excess of the upper limitation set up by the PDD
3) The project shall adopt default values for GHG emission from combustion of plastic waste as follow (as per default value set up by IPCC2006)
CF=0.85
FCF=1.00</td></tr>
<tr><td>Criterion 3</td><td>The project shall have facility to handle at least 300t/day of MSW including the</td></tr>
</table>

	incinerator with capacity of not less than 150tons/day with waste heat recovery system not less than 25% of total energy conversion efficiency in electricity form.
Criterion 4	For the case MSW incinerator would be constructed under the project, The project shall be proved either power generation is an addition to MSW incineration project or MSW to be combusted at the incinerator is combusted without waste heat recovery including power generation, without the project activity.
Criterion 5	For the case the project process / utilize RDF/RPF deprived from old landfilled waste, The project shall be proved that process and/or utilization of RDF/RPF deprived from old landfilled waste is BaU in the host country or shall not process / utilize in excess of the limitation set up for the project.

E. Emission Sources and GHG types

Reference Emission	
Emission Source	GHG Type
Power Stations connected to the National grid & generate electricity to be exported to the National Grid	CO_2
Project Emission	
Emission Source	GHG Type
WtE Plant	CO_2
Pre Treatment Facility	CO_2
Administrative Office & Others	CO_2

F. Establishment and calculation of reference emissions

F. 1. Establishment of reference emissions

Reference Emission in the project is an amount of GHG to be emitted from power stations, where are connected to the national grid, generate power and export such power to the national grid. Reference Emission shall be quantified by an equation of "Amount of Electricity generated & exported" multiply "Gird emission factor"

F. 2. Calculation of reference emissions

Reference emission for the project shall be quantified by the equation below;

$$RE = EG_p \times EF_{grid} \qquad \text{Equation (1)}$$

where

RE_p = Reference emission for period "p"(t CO_2)

EGp = Amount of electricity generated and exported to the national grid for period "p"(MWh)

EF_{grid} = Grid Emission Factor (t CO_2/MWh)

G. Calculation of project emissions

Project emission for the project shall be quantified as follows;

Project Emission shall be quantified by the equation below.

$$PE_p = PE_{elec,plant,p} + PE_{FF,plant,p} + PE_{elec,pre-t,p} + PE_{FF,pre-t,p} + PFalt,p$$

where

PE_p = Project Emission for the period "p"(t CO_2)

$PE_{elec,plant,p}$ = GHG emission from electricity consumption on site for period" p" (t CO_2)

$PE_{FF,plant,p}$ = GHG emission from consumption of fossil fuel on site for period "p" (t CO_2)

$PE_{elec,pre-t,p}$ = GHG emission from electricity consumption for pre-treatment for period "p" (t CO_2)

$PE_{FF,pre-t,p}$ = GHG emission from fossil fuel consumption for pre-treatment for period "p" (t CO_2)

$PEFalt,p$ = GHG emission from alternative fuel consumption for pre-treatment for period "p" (tCO2)

$$PE_{elec,,plant,p} = EL_{plant,p} \times EF_{grid}$$

where

$EL_{plant,p}$ = Amount of electricity imported from the national grid and consumed by the project for period "p" (MWh)

EF_{grid} = Grid Emission Factor(tCO2/MWh)

$$PE_{FF,plant,p} = FF_{plant,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{plant,p}$ = Amount of Fossil Fuel consumed as auxiliary on site for period “p”(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type “i” (Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type ”i”(tCO2/ton)

$$PE_{elec,,pre-t,p} = EL_{pre-t,p} \times EF_{grid}$$

where

$EL_{pre-t,p}$ = Amount of electricity imported from national grid and consumed for pre-treatment for period”p” (MWh)

EF_{grid} = Grid Emission Factor (tCO2/MWh)

$$PE_{FF,pre-t,p} = FF_{pre-t,p} \times NCV_{FFi} \times EF_{FF,i}$$

where

$FF_{pre-t,p}$ = Amount of Fossil Fuel consumed for pre-treatment for period “p”(ton)

$NCV_{FF,i}$ = Net Calorific Value for Fossil Fuel type ”i” (Gj/ton)

$EF_{FF,i}$ = Emission Factor for Fossil Fuel type “i”(tCO2/ton)

$$PE_{Falt,p} = F_{alt,dry,p} \times TC_{pla} \times FCF_{pla}\ x\ 44/12$$

where

$F_{alt,dry,p,}$ = Amount of Electricity imported from the national grid and consumed on site for period “p”(MWh)

TC_{pla} = Fraction of carbon for plastic in dry matter (%)

FCF_{pla} = Fraction of fossil carbon in total (%)

H. Calculation of emission reductions

Amount of GHG emission reduction is quantified by following equation, i.e. Reference Emission minus Project Emission

$$ER_p = RE_p - PE_p$$ Equation (3)

where

ER_p = Emission Reduction for period "p"(t CO_2)

I. Data & parameters fixed ex ante

Parameter	Description of data	Source
EF_{grid}	Published by DNA 0.5113 (tCO2/MWh)	Electricity Regulatory Board
NCV_{FFi}	IPPC Default Value i=軽油 (43.3GJ/ton)	IPCC
EF_{FFi}	IPPC Default Value (Max) i=軽油 (0.0748tCO2/GJ)	IPCC
TC_{pla}	IPCC Default Value (85)	IPCC
FCF_{pla}	IPCC Default Value (100)	IPCC
OF_{pla}	IPCC Default Value (100)	IPCC

A. Project description

A. 1. Title of the Project

MSW based Waste to Energy project in Rayong, Thailand

A. 2. General description of project and applied technologies and/or measure

General Description of the Project

The project is to achieve GHG emission reduction as well as optimization of municipal solid waste treatment in Rayong province, Thailand by employment of Waste Heat of MSW incineration based power generation system at Rayong Integrated Waste Management Center, located at Nong Taphan, Rayong District, Rayong Province in Thailand with coordination of Global Positioning System at East Longitude of 101.239091 and North Latitude of 12.748372.

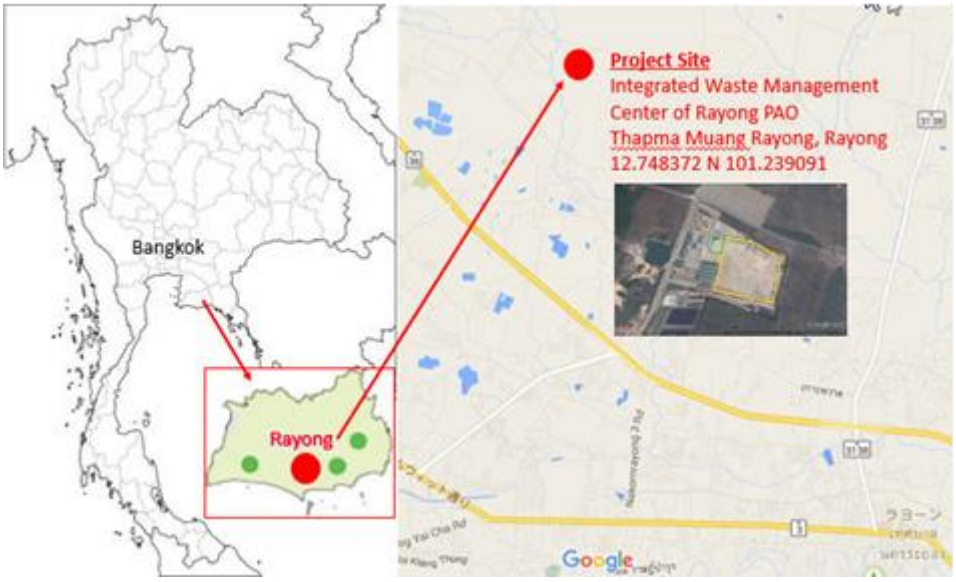


Figure 1. Location map of the project site

Italian-Thai Development Public Company Limited. Which is listed in Thai Stock Exchange Market as one of the leading general construction companies in Thailand is the owner of the project, and EX Research Instituted Limited from Tokyo, Japan will participate in the project as a Japanese representative for the project.

In the project, 500tons/day of municipal solid waste will be transported by Rayong PAO to the project site for processing, and about 150tons/day of combustible waste after separation will be incinerated at the plant. Heat generated by incineration of combustible waste will be collected by water tube boiler for energy conversion (power generation) to be exported to the national grid.

Technology to be applied

The core technologies to be applied for the project are from a set of Waste to Energy plant proposed by Nippon Steel & Sumikin Engineering Co., Ltd., consists of incinerator, waste heat recovery boiler, condensate turbine, alternator, and pipes for steam & water circulation as boiler & power generation islands, control unit, incinerator, flue gas treatment facilities, water treatment facilities, ash handling unit and pre-treatment unit for Municipal Solid Waste processing.

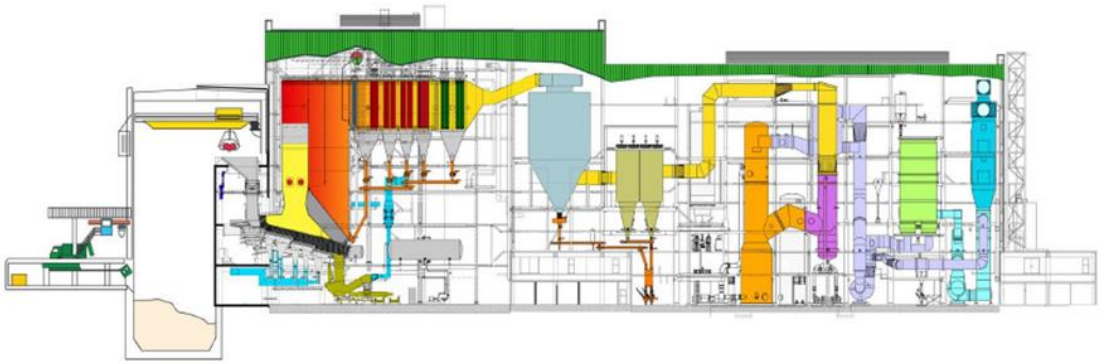


Figure 2. WtE plant proposed by Nippon Steel & Sumikin Engineering Co., Ltd.

WtE plant offered by the NSENGI realized 25-28% of generating efficiency by introduction of high temperature & high pressure boiler, improvement of material to be used for super heater, low air ratio incineration, lower flue gas temperature, low temperature economizer, lower turbine output steam pressure and no-catalyst denitrification facility.

Parameters used for the business evaluation are as follows;

- Amount of MSW to be received ; 500t/day
- Amount of Combustible Waste in MSW ; 150t/day
- Capacity of Incinerator : 150t/day
- Net Calorific Value for MSW (after segregation) ; 16,710kj/kg[1]
- Working days ; 330 days / year
- Power Generation efficiency of the facility ; 28%
- Amount of electricity consumed on site ; 0.89MWh/h

With parameters mentioned above, 64,468.8MWh of electricity will be generation from operation. While 388MWh of electricity to will consumed for operation per year, thus, 64,080MWh of electricity will be exported to the national grid per year, as replacement of grid electricity. Outline of the project is as per Figure 3

[1] NCV for Fresh combustible waste after segregation

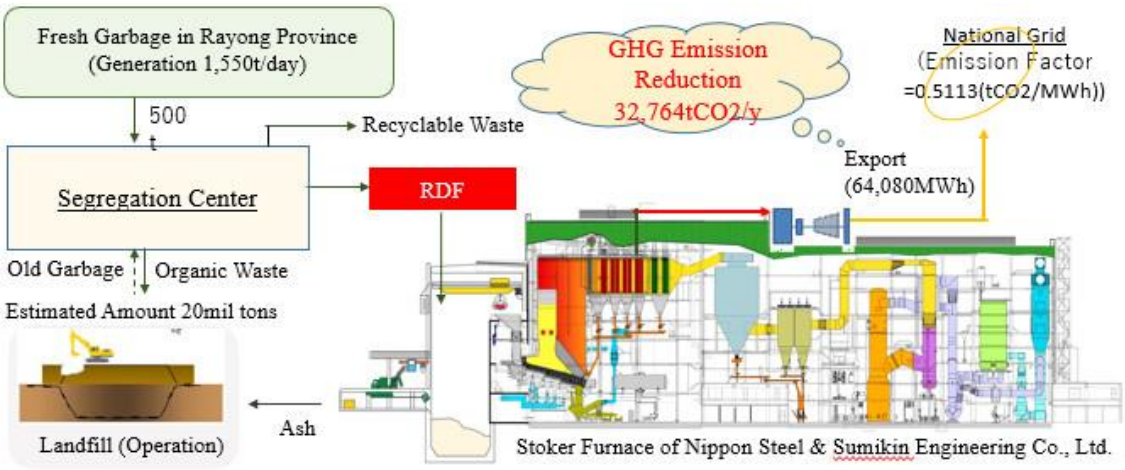


Figure 3. Operation Flow

A. 3. Location of the project, including coordinates

Country	Thailand
Region/State/Province etc.	Rayong Province
City/Town/Community	Nong Taphan District
Latitude/Longitude	101.239091 / 12.748372

A. 4. Name of project participants

Thailand	Italian-Thai Development PLC
Japan	EX Research Institute Limited

A. 5. Duration

Starting Date of the Project Operation	
Expected operation lifetime of the project	17 years

A. 6. Contribution from Developed country

A complete set of intermediate municipal waste treatment system with high energy conversion efficiency, developed by a Japanese EPC contractor, would be introduced and employed for the project. The Japanese EPC contractor would provide technical assistance for operation and appropriate maintenance work for the employed system.

B. Application of an approved methodology(ies)

B. 1. Selection of methodology(ies)

Selected approved methodology No.	N/A

Version No.	N/A
Selected approved methodology No.	N/A
Version No.	N/A
Selected approved methodology No.	N/A
Version No.	N/A

B. 2. Explanation how the project meets eligibility criteria of the approved methodology

Eligibility Criteria	Description specified in the methodology	Project information
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

C. Calculation of emission reduction

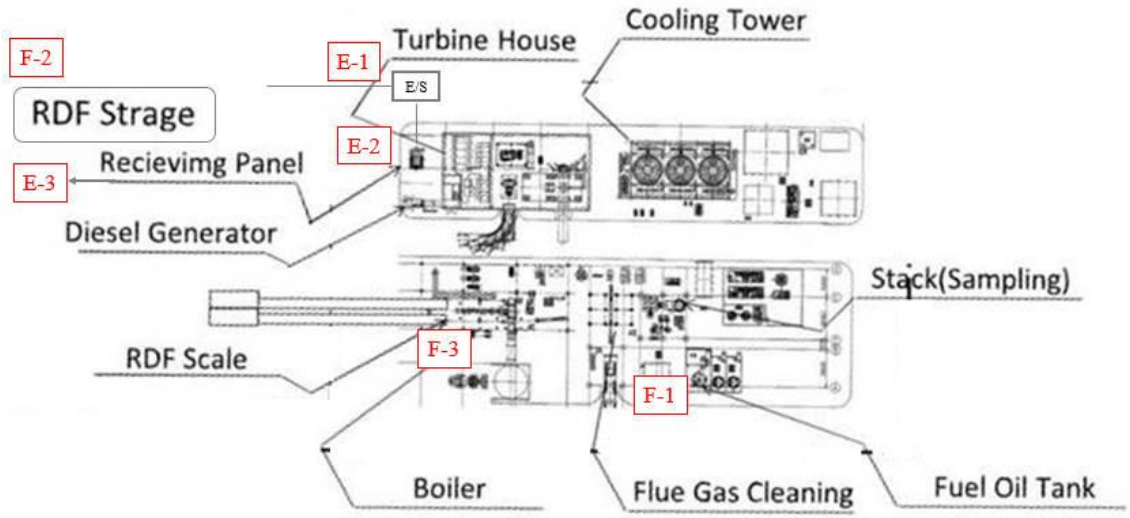
C. 1. All emission sources and their associated greenhouse gases relevant in the JCM project

Reference Emission	
Emission Source	GHG Type
Power Stations connected to National Grid & generate electricity to be exported to the National Grid	CO_2
Project Emission	
Emission Source	GHG Type
WtE Plant	CO_2

Pre-Treatment Facility	CO_2
Administrative Office & Others	CO_2

C. 2 Figure of all emission sources and monitoring points relevant to JCM project

All emission source for the project and monitoring points are as follows;



Point	Parameter		Unit	Frequency	Instrument
E-1	EG_p	Amount of electricity generated and exported to national grid	MWh	Daily	Accumulated Electricity Meter
E-2	$EC_{plant,p}$	Amount of electricity imported from national grid and consumed at plant	MWh	Once/day when used	Accumulated Electricity Meter
E-3	$EC_{pre-t,p}$	Amount of electricity imported from national grid and consumed at pre-treatment facility	MWh	Once/day when used	Accumulated Electricity Meter
F-1	$FF_{aux,i,p}$	Amount of fossil fuel consumed at plant	L	Once/day when used	Accumulated Flow Meter

F-2	$FF_{pre-t,,i,p}$	Amount of fossil fuel consumed at pre-treatment facility	L	Once/day when used	Accumulated Flow Meter
F-3	$AF_{aux,i,p}$	Amount of RDF manufactured from old MSW	Mt	Once/day when used	Weighing Machine

C. 3 Estimated mission reduction in each year

Year	Estimated Reference Emission (tCO2)	Estimated Project Emission (tCO2)	Estimated Emission Reduction (tCO2)
2020	32,810	37	32,773
2021	32,810	37	32,773
2022	32,810	37	32,773
2023	32,810	37	32,773
2024	32,810	37	32,773
2025	32,810	37	32,773
2026	32,810	37	32,773
2027	32,810	37	32,773
2028	32,810	37	32,773
2029	32,810	37	32,773
2030	32,810	37	32,773
2031	32,810	37	32,773
2032	32,810	37	32,773
2033	32,810	37	32,773
2034	32,810	37	32,773
2035	32,810	37	32,773
2036	32,810	37	32,773
Total (tCO2)	557,770	629	557,141

D. Environmental Impact Assessment

Legal requirement of environmental impact assessment for the proposed project	No

E. Local stakeholder commitment

E. 1 Solicitation of comments from local stakeholders

Four times of stakeholders meeting for the residents living near the project site were organized for the 1st phase of the project on village basis. Since the project site is next to Rayong Integrated Waste Management Center and Rayong PAO keep good relationship with villagers in the area, it is reported that the project owner received comments as for business operator's compliance with environmental standard, especially flue gas to be emitted from incinerator.

E.2 Summary of comments received and their consideration

Stakeholders	Comments received	Considered of comments received
Villagers	Compliance with environmental standard, especially for flue gas from incinerator	The project owner will secure technology for flue gas treatment in order to observe environmental standard and committed as for disclosure of environmental information in public

F. Reference

Not available

Annex

Not available

Revision History of PDD

Version	Date	Contents Revised
1.0	2017/2/26	1st Edition