Feasibility Study for NAMA in Waste and Wastewater Management Sector in Thailand - Summary -

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1. Overview of the Study

(1) Major activities for the study

Discussion about NAMA is one of the hot issues among international negotiations. The detailed definition is not fixed yet but three types of NAMAs are included; Domestic NAMA, Supported NAMA and Credited NAMA.. In this study, we propose a methodology to establish NAMA plan as well as to identify appropriate NAMA projects. The study focused on waste and wastewater management sector in Thailand. We proposed co-benefit type mitigation project candidates in the waste sub-sector which will be carried out by ODA, PPP and/or OOF. This feasibility study was implemented by PC-iGER in cooperation with Thailand Greenhouse Gas Management Organization (TGO).

(2) GHG emission reduction potential

(i) Municipal solid waste management:

- CH4 emission reduction by introducing semi-aerobic treatment system to sanitary landfill sites, CH4 and CO2 emission reduction by introducing incinerators with waste heat recovery - generation system to replace grid electricity, etc.

(ii) Organic waste management:

- CH4 emission reduction by introducing composting technologies, replacement of chemical fertilizer by organic compost to reduce N2O emission, CH4 emission reduction by introducing biomass power generation technologies/systems, and CO2 emission reduction by replacing grid electricity, etc.

(iii) Organic wastewater management:

- CH4 and CO2 emission reduction by replacing lagoon system to anaerobic digesting system, ultra high temperature aerobic fermentation system (YM Aerobes), or CH4 collection and power generation system to food related industries which emit high organic wastewater such as sugar, alcohol, palm oil mills

2. Outcomes of the Study

(1) Development of a methodology for NAMA planning

According to the collected data and information, we developed a methodology for NAMA planning in waste management sub-sector. The methodology should be suitable and feasible to the host (developing) countries considering the following points:

- Enable to pick up NAMA projects to support current policies and plans, and to integrate mitigation options in the NAMA sector to existing development policies plans,
- Enable to establish reference scenarios under limited availabilities of data and information in the host countries, and
- Enable to consider financial plans and practical schedule for the implementation of the projects which will enhance feasibility and realization potential of the projects

The draft methodology was developed through discussion with TGO and distributed at COP16 as a brochure.

(2) Application of the developed 7 Steps methodology to municipal solid waste management sub-sector

The developed methodology was applied to waste management sub-sector which enough data and information was collected. The methodology covers steps to review related policies/plans, set reference scenarios, set NAMA targets including calculation of GHG emission reduction potential, develop priority NAMA projects, establish MRV methodologies, identify financial resources and schedule as following pages. Among identified priority NAMA project candidates, composting by YM Aerobes and semi-aerobic treatment system were agreed as reasonable candidates. Participant to the Host Country Committee Meeting to the study asked to clarify potential of YM Aerobes to treat night soil in Bangkok. Another participant pointed out that introducing incinerators are rather difficult and unrealistic because of objection by local communities as well as ineffective treatment fee system.

Draft Methodology for Developing NAMA Plans and for Selecting Priority NAMA Projects

- Seven Steps for NAMA Planning -

STEP 1: Review related policies/plans and their progress in the NAMA sector

Sub-step 1: Examine existing **national policies, plans, and targets** in the NAMA sector
Sub-step 2: Understand/assess the **progress** of national policies/plan/targets in the NAMA sector based on existing data and information
Sub-step 3: Understand the methodology to manage the national policies/plans/targets

STEP 2: Set reference scenarios in the NAMA sector

Sub-step 1: **Identify barriers** to existing policies/plans/targets in the NAMA sector
Sub-step 2: Set "**reference scenarios**" in the NAMA sector
Sub-step 3: Consider **countermeasures** to address identified barriers in the NAMA sector

STEP 3: Set 'NAMA targets' in the NAMA sector

Sub-step 1: **Identify main GHG emission sources** in the NAMA sector
Sub-step 2: Select practical GHG mitigation measures in the NAMA sector
Sub-step 3: Estimate **GHG emission reduction potential** by identified practical GHG mitigation measures in the NAMA sector
Sub-step 4: Set "**NAMA Targets**" considering the possibility of realization of identified practical GHG mitigation measures in the NAMA sector

STEP 4: Develop priority NAMA projects in the NAMA sector

Sub-step 1: Establish selection methodology of priority NAMA projects
Sub-step 2: Collect priority NAMA project candidates from all over the country
Sub-step 3: **Select priority NAMA projects** in the NAMA sector

STEP 5: Establish MRV methodologies for NAMA plans

NAMA Plan

STEP 6: Identify possible financial resources for implementing NAMA plans

STEP 7: Consider possible schedule for implementing NAMA plans

(1) STEP 1: Reviewing related policies/plans and their progress in NAMA sector

Objective: To understand and assess related policies/plans and their progress in NAMA sector by examining existing national policies/plans/targets, and by reviewing the present situation of the sector

Sub-steps:

Sub-step 1: Examining existing national policies, plans, and targets in the NAMA sector

Specific works: First, we examine existing national policies/plans to find the stipulations related to the NAMA sector such as waste management. In the feasibility study, corresponding policy/plan were "10th National Economic and Social Development Plan" and "Action plan of Pollution Control Department". Next, we extract "targets" from such policy/plan. In addition, if metropolitan government or local governments such as BMA or other cities have their own policies/plans related to the NAMA sector, we examine them and extract "targets" from them.

Sub-step 2: Understanding/assessing the progress of the national policy/plan/targets in the NAMA sector based on existing data and information

Specific works: We collect the data and information related to the NAMA sector for past five to ten years in order to understand/assess the progress of the national policy/plan/targets in the NAMA sector. In the feasibility study, the data and information at national level included past and present emission conditions of waste. In addition, if metropolitan government or local governments such as BMA or other cities have detailed data and information of the sector, we understand/assess the progress using them.

Sub-step 3: Understand the methodology to manage the national policy/plan/targets

Specific works: We try to understand how to manage the national policy/plan/targets in order to utilize it for developing MRV methodology of NAMA plan (Step 5). We will check indicators of the targets, reporting and verifying modalities and procedures (M/P) to manage them.

In this feasibility study, we divided the waste management sector into four activities as shown in Figure 1. The result of the exercise of the step 1 was shown in Table 1

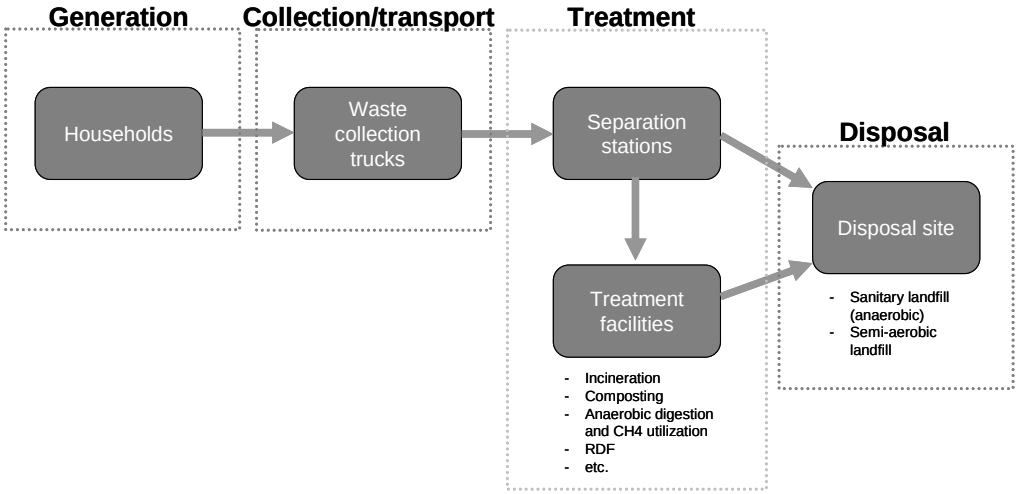

Figure 1 Activities of Waste Management Sector

Table 1: 7 Steps Methodology: Step 1

Waste management activities	STEP 1			
	Existing policy/plan	Targets	Progress of the policy/plan	M/P of the policy/plan

Generation	- Abhisit Vejjajiva`s Strategy Formation, the fifth policy on Land, Natural Resource and Environment [NESDB 2009]
	- The Tenth National Economic and Social Development Plan 2007 - 2011 [The 10th]
	- National Strategic Plan for Municipal General and Hazardous Solid Waste Management [ONEP 2005]
	- The Policy for Preventing and Eliminating Pollution under Enhancement and Conservation of National Environmental Quality 1997-2016 [PCD 199])
		- Limit the production of waste in urban areas no higher than 1 kg/person/day [Chapter 1, The 10th]
		- Key Performance Indicators (KPIs) from 2005 to 2014 [ONEP 2005]
		  - Bangkok, Pattaya city and other large municipalities: maximum of 1 kg/p/d,
		  - Muang municipalities: 0.8 kg/p/day,
		  - Tambon municipalities: 0.6 kg/p/day,
		  - TAOs (AORs, BORs, TORs): 0.4kg/p/day
		  - Total community generated solid waste: not to exceed 14 million tons/y.
			- National average amount of waste production is 0.64 kg/person/day in 2008. [PCD 2008]
			- However, some areas especially in urban areas produce more than 1 kg/person/day. Therefore, the target should be 1 kg to prevent increase of waste with promotion of recycle through 3Rs.
				-
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Collection/transport		- Not less than 90% of total waste in each local area (including those from large markets etc.) shall be collected, transported and disposed. [ONEP 2005] - 100% of MSW can be collected in a municipality [PCD, 1997] - No higher than 10% can be remained in an outer area [PCD, 1997]	- 84% of MSW was collected from municipality services and 16% remained. [PCD 2010] - Hazardous waste still mix with municipal waste, there are only 21 collection sites for hazardous waste for overall Thailand.	- - -
Treatment		- Reuse at least 30% of the waste throughout the country [Chapter 5, The 10th] - At least 40% of total generated waste = 5.6 million t/y will be segregated and recycled. [ONEP 2005] - Reuse at least 15% of the waste throughout the country [PCD, 1997] - Establishment of waste to energy (WTE) project must not be less than 100 MW, and at least 1 facility would be developed as WTE pilot model. [PCD 2010]	- Treatment method for MSW is focusing on recycle and composting. In 2009 there was approx. 25% of waste recovery potential. - Industrial waste recycle of approx. 68% - Only 38% of solid waste was treated and disposed properly.	- - -
Disposal		- Ensure proper disposal of at least 80 % of all hazardous waste from communities and industries [Chapter 1, The 10th] - The disposed residue after total waste segregation and recycle will not exceed 8.4 million t/y. [ONEP 2005] - Establishment of WTE project must not be less than 100 MW, and at least 1 facility would be developed as WTE pilot model. [PCD 2010]	- Collected municipal waste was disposed by sanitary disposal method of approx. 47% and 53% with improper disposal method. - In year 2010 there are 107 sanitary landfill sites, 3 incineration sites and 4 integrated system sites.	- - -

Source of information in the Step 1:

NESDB 2009: Abhisit Vejjajiva`s Strategy Formation, the fifth policy on Land, Natural Resource and Environment
The 10th: The Tenth National Economic and Social Development Plan 2007 - 2011, Office of the National Economic and Social Development Board
PCD 2009: Thailand Pollution Situation in 2009, Pollution Control Department
PCD 1997: The Policy for Preventing and Eliminating Pollution under Enhancement and Conservation of National Environmental Quality 1997-2016
ONEP 2005: National Strategic Plan for Municipal General and Hazardous Solid Waste Management, the Office of Natural Resources and Environmental Policy and Planning
PCD Jan.2011: Draft concept and direction on pollution management plan 2012-2016.(in Thai)
PCD 2010: Presentation paper on overview on Municipal Solid Waste Management in Thailand November 2010.

(2) STEP 2: Setting reference scenarios in NAMA sector

Objective: To set reference scenarios (baseline scenarios) based on barrier analysis of existing policy/plan in the NAMA sector

Sub-steps:

Sub-step 1: Identifying barriers to realize existing policy/plan/targets in the NAMA sector

Specific works: Considering the existing policy/plan/targets and its progress studied in STEP 1, we identify barriers to realize existing policy/plan/targets in the NAMA sector. Possible barriers may include “financial barrier”, “technical barrier”, “human resource related barrier”, and “prevailing practice related barrier”.

Sub-step 2: Setting “reference scenarios” in the NAMA sector

Specific works: First, we make a prediction of the future trend of the above identified barriers within after ten to twenty years. Next, we set “reference scenarios” in the sector based on the result of the prediction. If the realization of the existing policy/plan is going well, the reference scenarios may be almost as same as the “targets” of it. If the realization of it is very slow by critical barrier, the reference scenarios may be almost as same as “Business as Usual (BaU).
We set “reference scenario” to each activity. In the feasibility study, for example, we tried to set reference scenario to all activities such as “generation”, “collection/transport”, “treatment”, and “disposal”.

Sub-step 3: Considering countermeasures to address identified barriers in the NAMA sector

Specific works: We consider possible countermeasures to address barriers in the sector identified through above mentioned sub-steps. In the feasibility study, countermeasures may include “institutional countermeasures” such as increase of appropriate budget allocation for waste management system in local communities, “educational countermeasures” such as encouragement and enhancement awareness raising on solid waste separation to people, and “technical countermeasures” such as introduce and/or increase composting systems.

The result of the exercise of the step 2 was shown in Table 2.

Table 2: 7 Steps Methodology: Step 2

Legend for Countermeasures column (E): Educational, (I): Institutional, (T): Technical

Waste management activities	STEP 2			
	Identified barriers	Predicted condition of barriers	Reference scenarios	Countermeasures to address barriers
Generation	- Some consumers prefer non-renewable products, and do not trust the quality of recycled products. [ONEP 2005] - It is inconvenient to find products made from recycled materials. [ONEP 2005T] - People do not well-cooperate in separating household solid waste. [ONEP 2005T]	- As it is not easy to change preference of consumer, the barrier will exist in the long term. - As it is not easy to expand market for recycled materials, the barrier will exist in the long term. - As it is not easy to change human behavior, the barrier will exist in the long term.	- Amount of MSW increase according to the population and economic growth. - The increase rate is higher in local communities. - Preference/behavior of consumers does not change dramatically. - Therefore, the target will able to be accomplished in larger cities, but it might not be easy to accomplish the targets in local communities.	- ***Bring in regulations requiring manufacturers and the public to segregate waste at source [ONEP 2005] (I)*** - Improve ability of LAOs concerning waste reduction, re-use and recycle (E) - ***Increase appropriate budget allocation for waste management system in local communities (I)*** - Encourage and enhance awareness raising on solid waste separation to people.[ONEP 2005] (E) - Improve education scheme concerning consumer packaging for recycling or deposit refund scheme [ONEP 2005] (E)
Collection/transport	- Waste collection and transport are not available everywhere, especially in small communities. [ONEP 2005] - The organizations of waste collection and transport make source segregation of waste difficult, and are operates in ways that cause disturbance. [ONEP 2005] - Local Administration Organizations (LAOs) do not allocate budgets properly to collect and transport waste. [ONEP 2005]	- Improvement of collection and transport system including LAOs, can be expected in major cities within relatively short term. However, will be difficult in small communities. Therefore, the barrier will exist in the long term in small communities.	- Collection and transportation system will remain inadequate condition especially in small communities. - Therefore, the target will able to be accomplished in larger cities, but it might not be easy to accomplish the targets in local communities.	- ***Specify solid waste disposal fee which reflects actual cost, and set up new service rates for solid waste collection. [ONEP 2005] (I)*** - ***Develop criteria and a toolkit for waste collection and transport for LAOs, and bring regulations to control private sector waste collection and disposal [ONEP 2005] (I)*** - Improve ability of LAOs concerning effective waste collection scheme (E) - ***Increase appropriate budget allocation for waste management system in local communities (I)*** - **Introduction of high efficient collection vehicles appropriate to the amount of waste and road condition (such as narrow space) of local communities (T)**
	- Waste collection routes are often repetitive and complicated, and in some communities access route for collection is too narrow or parking is prohibited. [ONEP 2005] - Waste collection vehicle maintenance budgets are inadequate and there are not enough vehicles, overall or in good condition for use. [ONEP 2005]	- Local governments do not clearly allocate the budget for the solid waste management and design. [ONEP 2010] Therefore, the barrier will exist in the long term. - Government and private investments are limited for comprehensive solid waste management and also inexplicit investment coordination between governmental and private sectors. [ONEP 2010] Therefore, the barrier will exist in the long term.	- Waste collection routes will remain under complicated and inefficient condition. - Narrow access and limited parking will not be improved. - The numbers of collection vehicle will increase due to population growth and increase of waste. However, the condition of the vehicles will not be improved dramatically, in particular, those in small communities.	
	- Fee collection is ineffective and cannot reflect the actual capital cost. [ONEP 2010] - Tax tariff from contractors, tax and fee for local collections are not successful and cannot reflect the actual cost.[ONEP 2005T]	- As there are many conflicts of interest among stakeholders, improvement of fee/tax related issues is not easy and the barrier will exist in the long term.	- Fee and tax system remain under inefficient condition. - Business chance for private sectors will be limited due to inadequate fee and tariff system.	

Treatment	- The constructed system locates unsuitable place (to close to local communities). [ONEP 2010] - Knowledge of and budgets for waste treatment system maintenance are lacking.	- Local governments do not clearly allocate the budget for the solid waste management and design. [ONEP 2010] Therefore, the barrier will exist in the long term. - Currently 2 of 3 existing incinerators are dysfunction [PCD 2010].	- It will be difficult to install incineration facilities. - Installed number of other treatment system such as composting system will be limited and will not increase dramatically.	- **Introduce and/or increase incineration facilities in adequate scale at appropriate sites (T)** - **Introduce and/or increase composting systems (T)** - **Introduce/increase anaerobic treatment systems (T)** - **Consider the feasibility to introduce RDF systems (T)**
	- Lack of knowledge, technology and/or capital funding to support and promote manufacturing production from secondary resources. - As low quality of domestic secondary resources, such as high impurity content, manufacturers prefer to use primary resources. - Manufacturers need to develop and adjust the production processes to use secondary resources and it raises costs.	- As it is not easy to change preference of consumer, and decision makers of private companies often prefer short term payback period, they will reluctant to invest modification of production processes to use secondary resources do not increase easily. Therefore, the barrier will exist in the long term.	- Manufacturers will be reluctant to use secondary resources and demand for the secondary resources will remain low.	- Improve ability of LAOs concerning effective waste collection scheme (E) - ***Increase appropriate budget allocation for waste management system in local communities (I)*** - ***Set up standards for waste treatment operations [ONEP 2005] (I)*** - ***Bring in regulations for the use of secondary resources and/or provide tax or investment incentives for manufacture where they can replace primary resources [ONEP 2005] (I)***
	- Public cooperation is lacking and public participation is inadequate in waste segregation at source. [ONEP 2005]	- Glass, paper and plastic are relatively easy to re-use and recycle but food waste is difficult. [ONEP 2005] - As it is not easy to change human behavior, the barrier will exist in the long term.	- Some types of waste such as glass, plastic and paper will be re-used and recycled but food waste will remain and increase. - Therefore, the targets for 3R will able to be accomplished for above mentioned materials but it might not be easy concerning food wastes.	- ***Requiring government units to purchase products made from recycled and/or environment friendly materials, [ONEP 2005] (I)***
Disposal	- People's disagreements and opposing to solid waste disposal facilities, because their locations are close to communities or natural water resources. [ONEP 2010]	- As it is not easy to change people's opinion from disagreement to agreement and understanding of solid waste disposal facilities, the barrier will exist in the long term.	- The number of landfill sites will increase but most of them will be small and medium scales.	- **Introduce and/or increase sanitary landfill sites (T)** - **Introduce and/or increase semi-aerobic treatment systems, as a measure to reduce environmental pollution (T)**
	- The number of operating landfills is inadequate. - There are insufficient sanitary landfills, especially those offering full disposal operations. - It is very difficult to locate sanitary landfills, though suitable sites exist, because of robust defense by local populations.	- Food waste is difficult to re-use and recycle. [ONEP 2005] It will cause more demand of landfill sites but as the reason mentioned in left column, the barrier will exist in the long term.	- Landfill sites in operation will be maintained properly but the capacity will be overflowed, especially in small cities according to population and economic growth. - Therefore, the target will able to be accomplished in larger cities, but it might not be easy to accomplish the targets in local communities.	- Improve ability of LAOs concerning effective waste collection scheme (E) - ***Increase appropriate budget allocation for waste management system in local communities (I)*** - ***Bring regulations for landfill monitoring, management and control post closure (I)*** - ***Set up standards for waste disposal operations, and a system of waste disposal fees that matches actual operating costs [ONEP 2005] (I)***
	- When landfills are completed and closed, there is no effort to control long term environmental impacts.	- Inappropriate control of closed landfill sites causes more opposition by local communities. It brings vicious cycle and the barrier will exist in the long term.	- It is difficult to introduce anaerobic treatment system to closed sites.	- Provide technical and management back up knowledge for LAOs. [ONEP 2005] (E)
	- Disposal fees do not cover landfill operating and maintenance costs. - Knowledge of and budgets for waste	- As there are many conflicts of interest among stakeholders, improvement of fee/tax related issues is not easy and	- Fee and tax system remain under inefficient condition. - Business chance for private sectors	

	disposal system maintenance are lacking. - Laws concerning general and hazardous municipal solid waste disposal are inconsistent, and cooperation and coordination among offices are lacking. [ONEP 2005]	the barrier will exist in the long term. - Local governments do not clearly allocate the budget for the solid waste management and design. [ONEP 2010] Therefore, the barrier will exist in the long term.	will be limited due to inadequate fee and tariff system. - Policies, strategies and plans will be promoted but practical solution will be limited.	

Source of information in the Step 2:

ONEP 2010: Chapter 4, Publication on Technology of Solid Waste Management Disposal, the Office of Natural Resources and Environmental Policy and Planning

ONEP 2005: Executive Summary: National Strategic Plan for Municipal General and Hazardous Solid Waste Management, the Office of Natural Resources and Environmental Policy and Planning (*PDF file is created in 2005.)

ONEP 2005T: Thai Version: Background and Justification, National Strategic Plan for Municipal General and Hazardous Solid Waste Management, the Office of Natural Resources and Environmental Policy and Planning.

(3) STEP 3: Setting 'NAMA Targets' in NAMA sector

Objective: To set "NAMA Target" after identifying main GHG emission sources and practical GHG mitigation measures in NAMA sector

Sub-steps:

Sub-step 1: Identifying main GHG emission sources in the NAMA sector

Specific works: Based on the 2006 IPCC guidelines for National Greenhouse Gas Inventories and other appropriate references, we identify main GHG emission sources in the NAMA sector. In the feasibility study, for example, we can identify "CO_2 emissions from MSW collecting trucks", and "CH_4 emissions from landfill site".

Sub-step 2: Selecting practical GHG mitigation measures in the NAMA sector

Specific works: According to identified main GHG emission sources, we select types of practical GHG mitigation measures in the NAMA sector. The measures can be classified into the following three categories:

i) Implementation of the countermeasure against the identified barrier directly reduces GHG emissions (quantitative reduction) (ex. composting of municipal wastes)

ii) Introduction of new and/or advanced technology directly reduces GHG emissions (quantitative reduction) (ex. semi-aerobic landfill system)

iii) Implementation of the countermeasure against the identified barrier indirectly reduces GHG emissions (qualitative contribution) (ex. increase of appropriate budget allocation for waste management system in local communities, awareness raising, education)

Sub-step 3: Estimating GHG emission reduction potential by identified practical GHG mitigation measures in the NAMA sector

Specific works: We roughly estimate the potential of GHG emission reductions within next ten years by identified practical GHG mitigation measures in the NAMA sector. We tried to estimate the potential of GHG emission reductions of all activities, but estimated activities were "treatment", and "disposal".

Sub-step 4: Setting "NAMA Target" considering the possibility of realization of identified practical GHG mitigation measures in the NAMA sector

Specific works: According to the result of the estimation of GHG emission reduction potential, we set "NAMA Target" considering the possibility of realization of identified practical GHG mitigation measures in the NAMA sector.
In the feasibility study, for example, we tried to set the NAMA target to all activities such as "generation", "collection/transport", "Treatment", "disposal" but set activities were "treatment", and "disposal"

The result of the exercise of the step 3 was shown in Table 3.

Table 3: 7 Steps Methodology: Step 3

Waste management activities	STEP 3			
	Identified main GHG emission sources	Practical GHG mitigation measures	GHG emission reduction potential	NAMA Target
Generation	- *CH_4 emissions from landfill sites can be reduced by the countermeasures at this stage*	- 3R promotion campaign in BMA - 3R promotion campaign in Phuket - 3R promotion campaign in small and medium size municipalities	- to be estimated - to be estimated - to be estimated	- to be determined - to be determined - to be determined
Collection/transport	- **CO_2 emissions from MSW collecting trucks**	- Introduction of CNG trucks for MSW collection - Optimization of truck sizes for MSW collection, and of collection routs - Utilization of bio-fuels by MSW collecting trucks	- about 20% CO2 emission reduction compare to diesel fueled trucks - to be estimated - to be estimated	- to be determined - to be estimated - to be estimated
Treatment	- *CH_4 emissions from landfill sites can be reduced by the countermeasures at this stage*	- Introduction of incineration plant in major municipalities including BMA - Introduction of composting plants in BMA - Introduction of composting facilities in small and medium size municipalities - Introduction of anaerobic digestion plants in major municipalities including BMA - Introduction of RDF production facilities in BMA	- **3,000,000 tCO_2/year** (introduce 30 plants) - **1,000,000 tCO_2/year** (all BMA MSW) - **3,500,000 tCO_2/year** (all MSW except BMA) - **1,050,000 tCO_2/year** (introduce 30 plants)- - **900,000 tCO_2/year** (introduce 30 plants)-	- **1 incineration plant in BMA by 2020** - **5 composting plants in BMA by 2020** - **10 composting plants in major municipalities by 2020** - **10 anaerobic digestion plants in major municipalities by 2020** - **1 RDF production facilities in BMA by 2020** ***Targeted ER: tCO_2/year***
Disposal	- **CH_4 emissions from landfill site**	- Introduction of LFG recovery system and power generation in closed major sanitary landfills - Introduction of semi-aerobic system in closed and operating sanitary landfills - New construction of semi-aerobic landfills system in small and medium size municipalities - New construction of semi-aerobic landfills system in BMA	- **500,000 tCO_2/year** (introduce 10 plants) - **4,800,000 tCO_2/10 year** (ER: 2011-2020) - **1,830,000 tCO_2/year** - **500,000 tCO_2/year**	- **2 LFG recovery system and power generation in closed major sanitary landfills by 2020** - **20 semi-aerobic system in closed and operating sanitary landfills by 2020** - **30 new construction of semi-aerobic landfills system in small and medium size municipalities by 2020** - **5 new construction of semi-aerobic landfills system in BMA by 2020** ***Targeted ER: tCO_2/year***

(4) STEP 4: Developing priority NAMA projects in NAMA sector

Objective: To develop priority NAMA projects using selection methodology

Sub-steps:

Sub-step 1: Establishing selection methodology of priority NAMA projects

Specific works: We establish the selection methodology using score formulation such as the following "Evaluation Table"

Evaluation items (tentative)	1	2	3	4	5	weighting	total
1. Urgency			○			×2	6
2. GHG emission reduction					○	×2	10
3. Technological advantage					○	×2	10
4. Co-benefit effect					○	×1	5
5. Cost-benefit			○			×1	3
Total score	34						

Sub-step 2: Collecting priority NAMA project candidates from all over the country

Specific works: We collect priority NAMA project candidates, especially in cooperation with the counterparts, by informing this matter to resource persons and stakeholders all over the country especially capital city and other major municipalities. In the feasibility study, we discussed this matter with TGO and BMA members of the Host Country Committee.

Sub-step 3： Selecting priority NAMA projects in the NAMA sector

Specific works: We select priority NAMA projects in the NAMA sector using above mentioned selection methodology. We selected the priority NAMA projects, and TGO/BMA confirmed their appropriateness.

(5) STEP 5: Establishing methodologies of MRV for NAMA plan

Objective: Study and establish methodologies of MRV for NAMA target and priority NAMA projects under NAMA plan

Notes: We will establish progress management methodologies (assumed as MRV methodologies) for comprehensive target in the sector (e.g., annual amount of waste per capita) and MRV methodologies for priority NAMA projects. As the former includes from data collection, recording to verifying modalities and procedures, we will consider to evolve the methodology which has considered at the Sub-step 3 of Step 1; management methodology for national policy/plan/targets. For the latter we establish simplified MRV methodologies for practical project, referring to the approved CDM methodologies.
In the feasibility study, we developed the tentative MRV methodologies according to the CDM for the latter. The former has been under discussion.

(6) STEP 6: Identifying possible financial resources for implementing the NAMA plan

Objective: Identify financial planning for the NAMA plan including priority NAMA projects

Notes: Possible financial sources for priority NAMA projects may include (i) Own funds by host country's government and/or private entities, (ii) Support from developed

countries and/or international financial organizations, and (iii) Cooperation between private entities from host country and other country. Combining these options, we will identify appropriate utilization of financial resources for the sector and sub-sectors. In addition, the amount of GHG emission reduction compared to the reference scenario may be supplied to the bilateral mechanisms which Japanese government is considering.
In the feasibility study, we proposed the utilization of PPP/PFI financed by JBIC GREEN under the “bilateral crediting mechanism” between Japan and Thailand for the priority NAMA project candidates of the “treatment”, and “disposal” activities

(7) STEP 7: Considering possible schedule for implementing NAMA plan

Objective: Settle the schedule for the implementation of priority NAMA projects under NAMA plan

Notes: Based on the above mentioned financial plans for the priority NAMA projects, we will consider appropriate schedule for the implementation of these projects, as well as considering the feasibility of the projects.
In the feasibility study, the schedule has been under discussion.

The result of the exercise of the step 4 to step 7 was shown in Table 4.
Finally, as a summary of the selected countermeasures was shown in Table 5.

Table 4: 7 Steps Methodology: Step 4-7

Waste management activities	STEP 4		STEP 5	STEP 6	STEP 7
	Priority NAMA project candidates	Priority score	Methodologies of MRV	Financial resources	Possible schedule
Generation	- to be considered		- to be considered	- to be considered	to be considered
Collection/transport	- Introduction of CNG trucks for MSW collection in BMA	55	- CDM: AMS-III.C, III.S	- Budget of Thai Gov. and financing of Japanese private companies under the "Bi-lateral crediting mechanism (tentative)" between Japan and Thailand	- to be decided
	- Introduction of large size trucks for MSW collection in BMA	60	- CDM: AMS-III.C, III.S		
	- Utilization of bio-fuels by MSW collecting trucks in BMA	70	- CDM: AMS-III.T, III.AK		
Treatment	- Introduction of MSW incineration plant in BMA	68	- CDM: AM0025,	- **Utilization of PPP/PFI financed by JBIC GREEN under the "Bi-lateral crediting mechanism (tentative)" between Japan and Thailand**	- to be decided
	- Introduction of MSW composting plants in BMA	80	- CDM: ACM-III.F		
	- Introduction of night soil composting plants in BMA	88	- CDM: ACM-III.F		
	- Introduction of composting facilities in Chiang mai	85	- CDM: ACM-III.F		
	- Introduction of composting facilities in Chanthaburi	86	- CDM: ACM-III.F		
	- Introduction of anaerobic digestion plants in Phuket	62	- CDM: ACM-III.AO		
	- Introduction of RDF production facilities in Ayutthaya	71	- CDM: ACM-III.E		
Disposal	- Introduction of LFG recovery system and power generation in closed major sanitary landfills in Nonthaburi	79	- CDM: ACM 0001, AMS-III.G	- **Utilization of PPP/PFI financed by JBIC GREEN under the "Bi-lateral crediting mechanism (tentative)" between Japan and Thailand**	- to be decided
	- Introduction of semi-aerobic system in closed and operating sanitary landfills in Nakhon Si Thammarat.	86	- CDM: NM0333, ACM 0001, AMS-III.G; IPCC		
	- Introduction of semi-aerobic system in closed and operating sanitary landfills in Songkhla	85	- CDM: NM0333, ACM 0001, AMS-III.G; IPCC		
	- New construction of semi-aerobic landfills system in BMA	82	- CDM: NM0333, ACM 0001, AMS-III.G; IPCC -		
	- New construction of semi-aerobic landfills system in Chon Buri	80	- CDM: NM0333, ACM 0001, AMS-III.G; IPCC		

Table 5: Summary of the Selected Countermeasures

Generation	Collection/transport	Treatment	Disposal
Institutional Countermeasures			
- Increase appropriate **budget** allocation for waste management system in local communities - Bring in **regulations** requiring manufacturers and the public to segregate waste at source	- Increase appropriate **budget** allocation for waste management system in local communities - Bring **regulations** to control private sector waste collection and disposal - **Specify** solid waste disposal **fee** - Set up **new service rate**s for solid waste collection. - **Develop criteria** and a toolkit for waste collection and transport for LAOs,	- Increase appropriate **budget** allocation for waste management system in local communities - Bring in **regulations** for the use of secondary resources - Set up **standards** for waste treatment operations - **Provide tax** or **investment incentives** for manufacture where they can replace primary resources - **Requiring** government units to purchase products made from recycled and/or environment friendly materials	- Increase appropriate **budget** allocation for waste management system in local communities - Bring **regulations** for landfill monitoring, management and control post closure - Set up **standards** for waste disposal operations, and a system of waste disposal fees that matches actual operating costs
Educational Countermeasures			
- **Improve** ability of LAOs concerning waste reduction, re-use and recycle - Encourage and enhance **awareness raising** on solid waste separation to people - **Improve** education scheme concerning consumer packaging for recycling or deposit refund scheme	- **Improve** ability of LAOs concerning effective waste collection scheme	- **Improve** ability of LAOs concerning effective waste collection scheme	- **Improve** ability of LAOs concerning effective waste collection scheme (E) - **Provide** technical and management back up **knowledge** for LAOs
Technical Countermeasures			
	- Introduction of high efficient **collection vehicles** appropriate to the amount of waste and road condition (such as narrow space) of local communities	- Introduce and/or increase **incineration facilities** in adequate scale at appropriate sites - Introduce and/or increase **composting systems** - Introduce/increase **anaerobic treatment systems** - Consider the feasibility to introduce **RDF systems**	- Introduce and/or increase **sanitary landfill** sites - Introduce and/or increase **semi-aerobic treatment systems**, as a measure to reduce environmental pollution

For the wastewater management sub-sector, the necessary data and information was not collected during the study. The above mentioned methodology should be applied in a similar way to identify appropriate and probable NAMA project candidates in the wastewater sub-sector in near future.