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Report on

“Accelerating Implementation of Bangkok Master Plan on Climate Change”

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(Overseas Environmental Cooperation Center, Japan)

Feasibility Research Project on JCM Large-Scale Project Formation for Realization of Low-Carbon Society in Asia

Report on

"Accelerating Implementation of Bangkok Master Plan on Climate Change"

Contents

I. Summary of the Operations

1. Purpose of the Operations

In 1994, the Kingdom of Thailand (hereinafter called Thailand) ratified the United Nations Framework Convention on Climate Change (UNFCCC) and established the National Climate Change Subcommittee (upgraded to National Climate Change Committee on 2006 with the Prime Minister serving as chairperson), whose major missions are policy making and international negotiation concerning climate change. In January 2008, the Cabinet approved the National Strategic Plan on Climate Change (2008-2012), which includes the following 6 strategies – (1) capacity improvement to reduce and adapt to the risk of climate change, (2) promotion of activities to reduce GHG emissions for sustainable development, (3) promotion of research and development for understanding of climate change and its impacts, (4) promotion of citizen participation through promotion and enlightenment activities, (5) development functions to develop and coordinate human resources for relevant organizations and other parties, and (6) promotion of international cooperation for sustainable development and climate change mitigation. Moreover, in response to the appeal of the Cancun Agreements, reached in 2010 under UNFCCC, the Thai government is currently considering Nationally Appropriate Mitigation Actions (NAMAs) and it is hoped that there will be further efforts in the country.

In addition to the national-level efforts described above, the Bangkok Metropolitan Administration (BMA), the local government of Bangkok, the capital of Thailand, has also been making active efforts to address climate change, starting with the Bangkok Declaration on Climate Change Mitigation in 2007. The Bangkok Metropolitan Administration Action Plan on Global Warming Mitigation (BMA Action Plan 2007-2012) is a comprehensive plan covering the following 5 areas – (1) development of public transportation and improvement of transportation systems, (2) encouragement of the use of alternate fuels, (3) improvement of electric power use in buildings, (4) improvement of waste and wastewater treatment and (5) greening measures. Moreover, new Bangkok Metropolitan Master Plan on Climate Change 2013-2023 is being developed under a technical cooperation project of Japan International Cooperation Agency (JICA) and the new master plan will cover 5 areas – (1) sustainable transportation measures, (2) promotion of measures for energy saving and renewable energy, (3) measures for wastes and wastewater, (4) urban greening and (5) adaptation planning.

Meanwhile, in October 2013, the City of Yokohama and BMA signed a

memorandum of understanding concerning urban development in Yokohama and Bangkok to further deepen cooperation between the municipalities and take concrete actions for urban development in such fields as environment and low carbon. As the agreement includes provision of technical advice from Yokohama in such fields as energy management, public transportation, waste management and sewage management for sustainable development in Bangkok, it contributes to the establishment and implementation of the above-mentioned BMA Master Plan on Climate Change.

The purposes of the above-mentioned technical cooperation project of JICA are to provide support for the establishment of the master pan and to strengthen capacities of the implementation structure. BMA's own funds and subsidies from the Thai government are expected to be the major financial sources. However, there were not enough domestic public funds available for the implementation of the BMA Action Plan 2007-2012 and part of the actions have not been completed. Although the use of the Clean Development Mechanism (CDM) was considered at that time, it was not fully used partially because the use of CDM had become diminished. In other words, funding issues have to be solved for the smooth implementation of the BMA Master Plan on Climate Change.

Considering such background, the Joint Crediting Mechanism (JCM) seems to be a promising option as a funding scheme for the implementation of the BMA Master Plan on Climate Change. Assistance through the transfer of Japanese superior low-carbon technologies, products, services, etc. through JCM will be important to private business operators who have difficulty using public funds in Thailand for the implementation of the master plan. Considering the above-mentioned situation and the contents of the BMA Master Plan on Climate Change, this study was conducted to find items for JCM projects and investigate their feasibility in both public and private sectors.

2. Contents of the Operations

The following operations were implemented as major components of the study.

- Identification of items for JCM projects that will contribute to the implementation of the BMA Master Plan on Climate Change
- Matchmaking with Japanese companies that have low-carbon technologies
- Technical guidance by Japanese private companies based on the partnership between Yokohama and Bangkok

The progress of these major operations was also presented at an international conference and workshops as part of our operations. Details of such activities are shown below.

(1) Identification of items for JCM projects that will contribute to the implementation of the BMA Master Plan on Climate Change

To complete the Master Plan on Climate Change (2013-2023) in 2015, BMA is currently conducting such activities as planning, development of the implementation structure and capacity building with support from JICA. Especially in the four sectors of the master plan excluding adaptation, BMA is collecting data of greenhouse gases (GHGs) emitted from the Bangkok Metropolitan District as a business entity and data of GHGs emitted from private operators etc. in BMA as an administrative district, and is making proposals for temporary measures concerning such GHGs. JICA's support is focused on planning and capacity building, and BMA's own funds and financial support from the central government of Thailand are expected to be the major financial sources for the implementation of the master plan. However, as there are concerns that the master plan might not be fully implemented due to lack of funds, financial support through JCM is much needed. Considering such situation, we undertook ① identification of items for JCM projects and feasibility study, □ study to form JCM projects, and □ development of Proposals of MRV schemes, as described below.

① Identification of items and feasibility study

In this study, we first identified GHG emission reduction projects that will be part of the implementation processes of the BMA Master Plan on Climate Change and considered feasibility of these items as JCM projects. In the above-mentioned technical cooperation project of JICA, projects were selected mainly from among those for

facilities directly managed by BMA and such projects had to be separated according to appropriateness as a JCM project. In this project, we closely examined the items in multiple aspects including JCM's requirements and a viewpoint of MRV. Although BMA as a business entity does not directly emit GHGs, private operators of manufacturing facilities, office buildings, hospitals, etc. in the area have a high potential for GHG emission reduction. Therefore, the feasibility study also covered emissions from such private operators etc.

More specifically, we identified low-carbon technologies owned by Japanese private companies that address the needs of GHG emission reduction in such public and private sectors and created a long list of technologies. After that, considering such factors as needs, compatibility of the technologies and JCM's institutional requirements, we narrowed down the technologies and created a short list.

② Study to form JCM projects

From among the projects concerning GHG emission reduction identified during the preparation work for the BMA Master Plan on Climate Change, we selected those concerning energy saving at Bangkok Metropolitan Government Building, hospitals run by BMA, wastewater treatment facilities, etc. because some of these projects would likely get budget from the Committee for the Public Works and Utilities of BMA, and we considered the possibility to carry out the projects as JCM projects. Moreover, in private sectors, which have hospitals and companies who are operated on sound financial basis and willing to introduce low-carbon technologies, we also conducted more concrete study to form JCM projects including technical investigation concerning GHG reduction. We also studied the items identified in the process of matchmaking to be described in (2).

Moreover, to investigate these items for BMA project formation, in Thailand, we visited facilities that have a potential for GHG reduction in public and private sectors and interviewed relevant parties including BMA, the chamber of commerce and local bank branches.

③ Development of Proposals of MRV schemes

We identified highly feasible candidates for JCM projects through the above-described feasibility study and study to form JCM projects, and developed Proposals of MRV schemes, etc. More specifically, we collected necessary data and other information concerning specs and standards of the target technologies and examined settings of baseline and reference scenarios. Based on the results, we considered and developed proposals of MRV schemes etc.

(2) Matchmaking with Japanese low-carbon technologies

Technical experts from private business operators who have low-carbon technologies and from Yokohama city, which has signed a MOU with Bangkok for urban environment, were dispatched to Bangkok to present technologies and activities that seem effective for GHG reduction in Bangkok. More specifically, 2 groups of delegates dispatched for missions concerning low-carbon technologies for visits to local facilities where low-carbon technologies might be introduced and low-carbon technology workshops and matchmaking seminars to find items and form projects. Before conducting these missions, we also hold a meeting in Japan with participating private business operators and Yokohama city officials.

As for the visits to the facilities where low-carbon technologies might be introduced, we visited hospitals, factories, water and sewage facilities, railways and other facilities both in public and private sectors together with technical experts from private business operators and Yokohama city. At the low-carbon technology workshops, to promote information sharing and matchmaking among Japanese and Thai participants, Thai participants presented their needs concerning low-carbon technologies and Japanese participants made presentations about low-carbon technologies before we had matching sessions for individual companies. There were also presentations about other related matters such as the outline of the JCM system including subsidy schemes and loan schemes provided by a local bank that gives loan to energy saving and renewal energy projects so that incentives would be given to Thai participants to carry out JCM projects.

As preparation for the above-described low-carbon technology missions, we obtained assistance from local assistants for sending invitations to Thai participants, coordinating schedule, collecting presentation materials, etc. We also carried out questionnaire surveys and collected information after the missions to follow up Thai participants.

(3) Technical guidance from private companies based on the partnership between Yokohama and Bangkok

While we selected promising candidate projects and Japanese and Thai private business operators through the procedures described in (1) and (2), we also sent technical experts from private companies and Yokohama city to Bangkok to discuss introduction of concrete technologies and give technical guidance. More specifically, they conducted technical and energy saving diagnosis at hospitals run by BMA and food

processing plants in an industrial estate in Bangkok to collect basic information and data useful for JCM project formation. Moreover, we made sure that the incentives to introduce energy-saving technologies through JCM would be raised by sharing the results of such technical and energy saving diagnosis with the hospitals and plants we visited.

In addition to the above-mentioned visits to metropolitan hospitals and plants, we also invited a total of 5 trainees for training to Japan from power generation companies using renewable energy and investment firms. The training in Japan included compulsory programs for all participants to improve understanding of the activities in Yokohama to realize a low-carbon society and of JCM. It also provided opportunities to observe individual low-carbon technologies under the two major themes ng of the acing and waste/biomass power generation. As a result, not only did the knowledge and understanding of the trainees increase, we also found a secondary effect of deepened ties between Japanese and Thai business operators who are expected to jointly conduct JCM projects in the future.

(4) Presentations at international conference and workshops

The purpose of the study is not to implement JCM as a single project but to use JCM to support the implementation of a climate change master plan of a local government unit. The package of “policies + implementation of mitigation projects through JCM (and MRV) in a local government unit in another country of the Asia-Pacific region will probably draw worldwide attention as a model case for the transfer of superior policies to address climate change of a local government unit in Japan. Considering this, we presented the case of this study at an international conference held in Yokohama during the Smart City Week in October 2014 and communicated information about how to utilize JCM based on cooperation between local government units. As instructed by the officer in charge at the Ministry of the Environment, we also arranged inspection tours to present superior low-carbon technologies in Japan to the BMA officials who visited Japan for the event.

II. Identification of JCM Projects Contributing to Implementation of Bangkok Master Plan on Climate Change

1. Summary of BMA Master Plan on Climate Change

(1) Background of development of BMA Master Plan on Climate Change

Approximately 10 million people live in Bangkok, the capital of the Kingdom of Thailand, and the city's GHG emissions accounts for 24% of the total of the country. In January 2008, the government formulated the National Strategy on Climate Change (2008-2012) and is currently working on Thailand Climate Change Master Plan (2012-2050) with a longer perspective. At the municipal level, the Bangkok Metropolitan Administration (BMA) is working on climate change. In particular, BMA with 35 organizations jointly signed the Bangkok Declaration on the Cooperation of Alleviating the Global Warming in May 2007, and developed a Bangkok Metropolitan Administration Action Plan on Global Warming Mitigation 2007-2012 (hereinafter called the "BMA Action Plan 2007-2012") in cooperation with the Japan International Cooperation Agency (JICA) to reduce GHG emissions by 15% of Business as Usual (BAU) in five years from 2007 to 2012. The BMA Action Plan 2007-2012 contained five initiatives: (1) Expand mass transit and improve traffic systems; (2) Promote the use of renewable energy; (3) Improve electricity consumption efficiency; (4) Improve solid waste management and wastewater treatment efficiency; and (5) Expand park areas. It was concluded that the plan helped BMA achieve the goals of three initiatives – that is, Initiative 2: Promote the use of renewable energy, Initiative 4: Improve solid waste management and wastewater treatment efficiency, and Initiative 5: Expand park areas. It was pointed out, however, that the tasks related to Initiative 1 (Expand mass transit and improve traffic systems) did not go well because of the difficulty in coordinating different organizations concerned. In light of these assessments of the BMA Action Plan 2007-2012, BMA is currently working to develop a Bangkok Master Plan on Climate Change 2013-2023 (hereinafter called the "BMA Master Plan 2013-2023") as a JICA technical cooperation project to deal with climate change more comprehensively. The master plan is expected to be finalized in 2015.

The BMA Master Plan 2013-2023 covers five key sectors: that is, (1) environmentally sustainable transport; (2) energy efficiency and alternative energy; (3) efficient solid waste management and wastewater treatment; (4) green urban planning; and (5) adaptation planning. A specialized taskforce takes the initiative in planning in each sector. Table 1 lists measures to alleviate climate change in Sectors (1) – (3), which are likely to be carried out as JCM projects.

Table 1 Climate Change Measures Assumed to Be Implemented under the BMA Master Plan 2013-2023

Sector	Category	Measure
Transport	Public transport (infrastructure development)	Development of railways and other mass transport systems
		Development and improvement of water transport
	Public transport (assistance measures)	Improvement of connections of public transport systems and introduction of a universal ticket system
		Improvement of bus services
		Development and expansion of a park and ride system
	Automobile measures	Introduction of electric vehicles as official vehicles of BMA
		Assistance measures to citizens and private companies
		Introduction of low-emission buses and other vehicles
		Promotion of eco-driving
	Road transport measures other than those related to automobiles	Development and expansion of bicycle lanes
		Expansion of rental bicycle business
		Expansion of air corridors
	Traffic volume and flow control	Development of roads, bridges and tunnels
		Improvement of the traffic signal system
		Introduction of area pricing
		Control of on-street parking
	Information dissemination and enlightenment	Promotion of the use of public transport
		Introduction of “Car-Free Day”
		Implementation of education on environment and transport
Energy	Upgrading of existing facilities	Heat insulating measures for buildings
		Air-conditioning measures
		Lighting measures
		Water saving measures
	Energy saving for new facilities	Introduction of energy-saving standards for new buildings
	Information dissemination and enlightenment	Information dissemination and enlightenment to citizens

		Information dissemination and enlightenment to civil servants
	Promotion of low-carbon city	Establishment of model areas for low-carbon city
	Measures for housing and commercial buildings	Promotion of energy-saving buildings and houses
		Promotion of energy-saving repair works
		Promotion of energy-saving home appliances
		Promotion of energy-saving activities
	Measures for industrial sector	Promotion of energy-saving factories
		Promotion of energy-saving repair works
		Promotion of energy-saving activities
Wastewater and waste	Wastewater discharge measures	Promotion of reduction in water consumption at home
		Promotion of collection of wastewater treatment fees
	Wastewater collection measures	Introduction of an energy-saving wastewater control system
		Promotion of decentralized wastewater collection systems
	Wastewater treatment measures	Promotion of efficiency of wastewater treatment plant (WWTP) business
		Introduction of high-efficiency equipment in existing WWTPs
	Measures for sewage sludge	Promotion of the use of sludge as fertilizer
	Reuse of sewage	Promotion of use of treated water
	Emission of waste	Promotion of reduction of waste sources and waste separation
		Reduction of plastic waste
	Collection and transport of waste	Efficient use of fuel for collection and transport of waste
	Intermediate treatment	Promotion of use of organic waste
		Construction of waste incineration power plants
		Construction of waste separation plants
	Final disposal	Establishment of eco-friendly waste reclamation facilities

2. JCM Project Identification and Feasibility Study

(1) Review of the BMA Master Plan 2013-2023 in light of institutional requirements of the JCM and creation of a long list of relevant GHG emissions reduction measures

The BMA Master Plan 2013-2023 contains a wide range of measures in different sectors related to climate change mitigation and has important suggestions for identifying items for JCM projects. In light of the institutional requirements of the JCM, however, not all the expected measures in the plan are eligible for JCM projects. Those measures are required to be sorted out whether they can be a candidate for JCM project or not. To this end, this survey has used the following criteria in judging the eligibility of the GHG emissions reduction measures, which are expected to be included in the Master Plan, for JCM projects.

① Assumed project cost

Japan's Ministry of the Environment earmarked 3.6 billion yen for three years starting in FY2014 for subsidized projects to develop JCM facilities, which can be used for assistance to JCM project formulation. The ministry also has budgets of 4.2 billion yen and 1.8 billion yen, respectively for the fund for dissemination of low-carbon technology, a fund to financially assist the realization of a low-carbon society in a leap-frog way, and the trust fund of Asian Development Bank (ADB). Despite these funds earmarked, Japan signed bilateral agreements on JCM (or BOCM) with the governments of as many as 12 countries as of February 2015. Thus, it appears to be difficult to implement projects worth several billion yen or more under the JCM. For that reason, for example, "development of railways and other mass transport systems" and "development of roads, bridges and tunnels" in the BMA Master Plan 2013-2023 will be difficult to be carried out as JCM projects.

② Possibility of measuring, reporting and verification (MRV) of the amount of GHG emissions reduction

A major requirement for JCM projects is that the project can incorporate the MRV framework. From this viewpoint, it appears to be difficult to carry out measures for information dissemination and enlightenment, for example, "implementation of education on environment and transport" and "promotion of energy-saving activities" for households and other parties, as JCM projects because they are difficult to quantify.

③ Contribution to CO2 emissions reduction from energy sources

Any JCM project to be subsidized by the JCM facility subsidy program of the Ministry of the Environment must contribute to CO2 emissions reduction from energy sources. In other words, projects contributing solely to reductions of methane and other global warming gases are not eligible for the subsidy program. From this viewpoint, it appears to be difficult to carry out, for example, “promotion of the use of sludge as fertilizer” and “Promotion of reduction of waste sources and waste separation” as JCM projects.

④ Scope and scale of the implementation of measures

This aspect is related to the MRV framework mentioned above, but any JCM project to be subsidized by the JCM facility subsidy program must be implemented as a project (i.e., at the project level). In other words, it is difficult to carry out, for example, “introduction of energy-saving standards” and “establishment of model areas for low-carbon city” as JCM projects because they cannot be carried out at the project level but are measures at a higher policy level.

Based on the criteria □-□ above, the study team has narrowed down the measures to be incorporated in the BMA Master Plan 2013-2023 and has created a long list of low-carbon technologies as Table 2.

Table 2 Long List of GHG Emissions Reductions Measures Expected to Be Implemented by JCM Projects in Bangkok

Sector	Category	Measure
Transport	Public transport (assistance measures)	Improvement of connections of public transport systems and introduction of a universal ticket system
	Automobile measures	Introduction of electric vehicles as official vehicles of BMA
		Introduction of low-emission buses and other vehicles
Energy	Upgrading of existing facilities	Heat insulating measures for buildings
		Air-conditioning measures
		Lighting measures
		Water saving measures
	Measures for housing and commercial buildings	Promotion of energy-saving buildings and houses

		Promotion of energy-saving repair works
		Promotion of energy-saving home appliances
	Measures for industrial sector	Promotion of energy-saving factories
		Promotion of energy-saving repair works
Wastewater and waste	Wastewater collection measures	Introduction of an energy-saving wastewater control system
	Wastewater treatment measures	Promotion of efficiency of wastewater treatment plant (WWTP) business
		Introduction of high-efficiency equipment in existing WWTPs
	Reuse of sewage	Promotion of use of treated water
	Collection and transport of waste	Efficient use of fuel for collection and transport of waste
	Intermediate treatment	Construction of waste incineration power plants

(2) Creation of a Short List of Low-Carbon Technologies in Light of Japanese Companies' Incentives to Business Expansion to Bangkok

In any project financed by the JCM facility subsidy program, Japanese and Thai private companies are required to form an international consortium, and the Japanese company are also required to represent the project implementing parties to take the initiative in calling for a contractor and implementing the project. In other words, together with the long list created in section (1), low-carbon technologies applicable to JCM projects must be narrowed down further in light of technologies of Japanese private companies which are eager to expand their business to the city of Bangkok. Accordingly, the study team has created a short list of low-carbon technologies as Table 3 in light of low-carbon technologies owned by Japanese private companies, which have participated in two low-carbon technology missions to Bangkok.

Table 3 Short List of Low-Carbon Technologies Expected to Be Used in JCM Projects in Bangkok

Sector	Category	Measure	Example(s) of low-carbon technology
Transport	Automobile measures	Introduction of electric vehicles as official vehicles of BMA	Electric vehicle (EV)
		Introduction of low-emission buses and other vehicles	
Energy	Upgrading of existing facilities	Air-conditioning measures	Absorption refrigerator and inverter-driven air conditioner
		Lighting measures	LED
	Measures for housing and commercial buildings	Promotion of energy-saving buildings and houses	Building energy management system (BEMS) at hospital, commercial buildings, etc.
	Measures for industrial sector	Promotion of energy-saving factories	Heat storage system, high-efficiency compressor and regenerative burner
Wastewater and waste	Wastewater treatment measures	Promotion of efficiency of wastewater treatment plant (WWTP) business	Advanced energy-saving sewage treatment system
		Introduction of	High-efficiency pump

		high-efficiency equipment in existing WWTPs	blower
	Intermediate treatment	Construction of waste incineration power plants	Biomass incineration power generation

3. Project Formulation Study

Following the review of the BMA Master Plan 2013-2023 in line with the JCM institutional requirements stated in section II.2. “Identification of items for JCM projects and feasibility study” and dispatch of the two low-carbon technology missions to Bangkok as stated in section III. “Matchmaking with Low-Carbon Technologies in Japan”, the study team has specified the following projects as the candidates for JCM projects in Bangkok.

(1) Energy saving at metropolitan and private hospitals
(2) Energy saving at food processing plants

In each candidate projects above, the assumed contents, CO2 emissions reduction methods and future process are as follows:

(1) Energy saving at metropolitan and private hospitals

① Project contents

The study team has surveyed the possibility of introducing energy-saving equipment to metropolitan and private hospitals in Bangkok. More specifically, the survey was addressed to a Bangkok metropolitan hospital and a private international hospital in Bangkok, which will be explained below.

(a) Metropolitan hospital

The metropolitan hospital is under the management of BMA. The land area is 18,592m^2, with 460 beds. The workforce totals 1,783. Air conditioning covers 27% of all the land area of the metropolitan hospital. The hospital consumed 7,491,000kWh of electricity (2014) and 91,269Fuel/L of fuel (2014), the former accounting for 88.26% of all the energy consumption. By purpose, chillers account for 36.57% of all the energy consumption, medical equipment for 27.33%, air-conditioning for 22.1% and lighting for 13.92%. On the other hand, 95.95% of fuel is spent on boilers. The electricity cost totals 31,507,610 THB, and the fuel cost totals 2,809,286 THB. Table 4 lists devices installed at the hospital, which can potentially save energy consumption.

Table 4 List of Energy-Saving Potentials at Metropolitan Hospital

Device name	No. of devices
Air compressor	4
Vacuum pump	2
Boiler	2
Chiller	3
Chiller pump	3
Decentralized air conditioner	525
Solar heater	1

A series of energy saving projects were implemented in the past: In 2011, one chiller (160 tons) was replaced, T5 fluorescent lamps were introduced (5,028 lamps), and air conditioners were replaced (18 air conditioners). In 2012, water lines for coolant water were laid among buildings; 380 old-typed fluorescent lamps were replaced by 190 high-efficiency fluorescent lamps. In 2013, old chillers were replaced by two high-efficiency chillers (160 tons). In 2014, water lines for coolant water for chiller systems were laid, and 29 modules were replaced. In 2015, the metropolitan hospital is currently planning to renew its once-through boiler, hot water supply tank and three chiller pumps.

(b) Private hospital

The private hospital has a total of 260 beds and 1,300 staff members. The hospital is fairly eager to save energy. In 2013, it invested 18,865,349 THB in energy-saving devices, for which it received ASEAN Energy Award 2014. Aiming to acquire LEED, ISO5001 and ISO14001, the hospital formulates long-term energy-saving plans. To date, it carried out energy-saving projects including introducing inverter devices, installing and integrating high-efficiency chillers, replacing fluorescent lamps with LED lamps, and introducing photovoltaics hot-water supply systems. Thanks to these projects, the hospital saved energy in comparison with the levels in 2010 by 34.4% at outpatients' wards and 24.9% at inpatients' wards. The hospital is planning other energy-saving projects for, in the order of the investment amount, establishment of new power generators, replacement of chillers by high-efficiency chillers, repair of coolant towers (replacement of parts by chemical substances that do not deplete the ozone layer), replacement of fluorescent lamps by LED lamps and introduction of inverter devices.

② CO2 emissions reduction method

A CO2 emissions reduction will be realized by introducing Japan's energy-saving devices to the energy-saving potentials stated above. For example, a high-efficiency once-through boiler recommended by Japanese technical specialists features low excess air combustion (high turn down ratio of 5:1) and can achieve the boiler efficiency rate of 98% and reduce the blower power by approximately 10%. A substantial CO2 emissions reduction can also be realized by replacing heavy oil with LPG. High-efficiency water pumps control the operation of pumps to save energy. In the case of ordinary water pumps for heat conveyance equipment, on the other hand, the load on water pumps during most of the operating time is not maximal, and the operation of water pumps produces energy loss. High-efficiency water pumps can control the operation when the load is not maximal and thus realize highly efficient operations.

③Finance scheme and project structure

JCM model project by MOEJ is considered as finance scheme for energy saving in the public hospital. Thai side participants in this project are including BMA because BMA manage hospital budget. The project is required a bid so that it is necessary to survey detail bid condition. On the other hand, ESCO scheme is very popular in Japan, which is business model that company invest in energy saving machine and installation, and benefit from electric saving fee. It needs to study its applicability. As for the private hospital, quick decision for purchase is possible because of its self finance. In addition, private Thai bank, Kashikon bank, facilitate to make project by using a loan. Japanese company expected to provide technology, and manage overall project.

④ Future project process

The metropolitan hospital plans to replace its once-through boiler, hot-water supply tank and three chiller pumps with new ones in its investment plan for 2015. Japanese technical specialists are conducting a feasibility survey to see if it is possible to introduce energy-saving effect once-through boiler and pumps. Staff members of OECC held a meeting with the representatives of the Taksin Hospital to give an account of JCM. The meeting was attended by the director and other managerial executives of the hospital, who were highly interested in JCM. It will be necessary to determine the MRV framework, as well as the ways of initial investment and competitive bidding if it is decided to launch this project. At this point, therefore, the Japanese parties must promote the superiority of the project by presenting the financial scheme taking advantage of JCM.

The private hospital plans to replace its once-through boiler, install a new power

generator, replace existing chiller with a high-efficiency chiller, repair a coolant tower, replace fluorescent lamps with LED lamps and introduce inverter devices. Staff members of OECC held a meeting with a representative of the hospital to give an account of JCM. The meeting was attended by the manager in charge of purchasing energy-saving devices, who showed high interest in JCM. As in the case of the metropolitan hospital, the hospital needs to determine the MRV framework for devices to be introduced.

(2) Energy saving at food processing plants

① Project contents

The study team has surveyed the possibility of introducing energy-saving equipment to a food processing plant in Bangchan Industrial Estate located in Bangkok. The food processing plant is financed by a Japanese food manufacturer, and manufactures instant noodles. It sells original brand products, accounting for a large share in the market in Thailand. It has three noodle making factories. Factory 1 has the land area of 19,408m^2, with 800 workers. Factory 2 has the land area of 9,217m^2, with 300 workers, and Factory 3 has the land area of 18,680 m^2 with 20 workers. Factory 3 is still under construction and thus is expected to have many devices installed. According to the construction plan, Factory 3 will have a high-efficiency boiler, high-efficiency chiller and air compressor. Of the energy consumption of the entire plant, fuel accounts for 70% and electricity for 30%. The food processing plant is fairly eager to reduce energy consumption with impressive records of receiving environmental awards. The plant also plans to introduce energy-saving devices to the new facility.

② CO2 emissions reduction method

As in the case of the hospitals, a CO2 emissions reduction will be realized by introducing Japan's energy-saving devices to the energy-saving potentials described above. For example, an air compressor recommended by Japanese technical specialists emits less CO2 by reviewing the necessary pressure, streamlining the rotation frequency through controlling the inverter, and highly efficiently operating multiple compressors. A substantial CO2 emissions reduction can also be realized by introducing once-through boilers, again as in the case of the hospitals.

③Finance scheme and project structure

JCM model project by MOEJ is considered as finance scheme for energy saving in the factory. They make quick decision for purchase because of its self finance. In

addition, private Thai bank, Kashikon bank, facilitate to make project by using a loan. Japanese company expected to provide technology, and manage overall project.

④ Future project process

The food processing plant surveyed plans to introduce a high-efficiency boiler, high-efficiency chiller and air compressor to the factory to be built. Japanese technical specialists are conducting a feasibility survey to see if it is possible to introduce an energy-saving effect once-through boiler. Staff members of OECC held a meeting with representative of the food processing plant to give an account of JCM. The meeting was attended by the plant director and technical staff members, who were highly interested in JCM. It will be necessary to determine the MRV framework, as well as the ways of initial investment and competitive bidding if it is decided to launch this project. At this point, therefore, the Japanese parties must promote the superiority of the project by presenting the financial scheme taking advantage of JCM.

4. Development of Proposals of MRV Schemes

The study team has considered and prepared MRV schemes (proposal) to introduce high-efficiency boilers to the hospitals and plants. The results of the review are outlined as follows. The JCM schemes (proposal) are presented in Appendix 2.

(1) Reference MRV schemes

The study team has referred to the existing schemes of CDM/J-credit shown in Table 5 when considering MRV schemes (proposal).

Table 5 Reference MRV Schemes

System	Name
CDM	AM0044: Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors AM0056: Efficiency improvement by boiler replacement or rehabilitation and optional fuel switch in fossil fuel-fired steam boiler systems AMS III-B: Switching fossil fuels
J-credit	EN-S-001 : Introduction of boilers

(2) Methods of GHG emissions reduction

This scheme (proposal) will be applied to projects that aim to install high-efficiency boilers at hospitals, plants and other sites in Thailand to reduce the consumption of fossil fuels and GHG emissions.

(3) Eligibility requirements

Table 6 shows the eligibility of requirements and reasons for choosing the scheme (proposal).

Table 6 Eligibility Requirements and Reasons for Choosing This Scheme

Requirement	Contents	Reasons
Requirement 1	Condition 1: The boiler unit will be newly installed or upgraded. ・ The fuel will also be changed. ・ In the case of upgrading, the	To introduce high-efficiency boilers and reduce GHG emissions at hospitals, plants and other sites covered by this scheme

	boiler to be installed will be more efficient than the existing one. ・ Requirements for the boiler functions	
Requirement 2	Vapor, hot water or heat of heat-transfer oil generated by the boiler will be consumed in whole or in part on the site.	In the case the party introduced the boiler under the project supplies vapor, hot water or heat of heat-transfer oil generated by the boiler to a third-party operator, only the quantity of heats of self-consumption will be subject to certification of emissions reduction. Because of this requirement, any project chiefly aiming to supply produce energy to outside parties will be excluded from the coverage of the project.

(4) GHG emission sources and types of GHG

Table 7 lists GHG emission sources and types of GHG covered by this scheme (proposal).

Table 7 GHG Emission Sources and Types of GHG Covered by the Scheme

GHG emissions source	Type of GHG	Type of emission volume
Consumption of fossil fuel by boiler	CO2	Reference emission amount
Consumption of fossil fuel by boiler	CO2	Project emission amount

(5) Setting of reference emission amount

The reference emission amount of the scheme (proposal) has been set at the amount of GHG emitted from a standard boiler that would be generally introduced in Thailand. However, a different amount of emission will be adopted if there is any justifiable reason in light of the penetration of facilities, general conditions related to economic efficiency of capital investment, or any circumstances unique to the project concerned.

The “Business as Usual (BaU)” scenario under the scheme is that the present boiler continues to be operated without implementation of the project. The BaU emission amount will be, therefore, the amount of GHG emission in case fossil fuel would be used without implementation of the project.

(6) Calculation of reference emission amount

The reference emission amount will be calculated according to the following formulae:

$$Q_{RE,heat} = Q_{PJ,heat} = F_{PJ,fuel} * HV_{PJ,fuel} * \frac{\varepsilon_{PJ}}{100}$$

$$EM_{RE} = Q_{RE,heat} * \frac{100}{\varepsilon_{RE}} * CEF_{RE,fuel}$$

$Q_{RE,heat}$	Quantity of heat generated by reference boiler	GJ/year
$Q_{PJ,heat}$	Quantity of heat generated by boiler after implementation of the project	GJ/year
$F_{PJ,fuel}$	Fuel consumption of boiler after implementation of the project	t/year, kL/year, Nm^3/year, etc.
$HV_{PJ,fuel}$	Unit heat value of fuel used by boiler after implementation of the project	GJ/t, GJ/kL, GJ/Nm^3, etc.
ε_{PJ}	Energy consumption efficiency of boiler after implementation of the project	%
EM_{RE}	Reference emission amount	tCO2/y
$Q_{RE,heat}$	Quantity of heat generated by reference boiler	GJ/year
ε_{RE}	Energy consumption efficiency of reference boiler	%
$CEF_{RE,fuel}$	CO2 emission coefficient per unit heat value of fossil fuel used by reference boiler	tCO2/GJ

(7) Setting and calculation of project emission amount

The project emission amount of the scheme (proposal) will be calculated in accordance with the fuel consumption volume of the boiler after the facilities are introduced. In the case multiple types of fuels are used, the amount of emission after implementation of the project will be calculated in accordance with the consumption of each fuel of the boiler after implementation of the project (FPJ, fuel) and the unit heat

value of each type of fuel used by the boiler after implementation of the project (HVPJ, fuel).

$$EM_{PJ} = F_{PJ,fuel} * HV_{PJ,fuel} * CEF_{PJ,fuel}$$

EM_{PJ}	Emission amount after implementation of the project	tCO2/y
$F_{PJ,fuel}$	Fuel consumption of the boiler after implementation of the project	t/year, kL/year, Nm^3/year, etc.
$HV_{PJ,fuel}$	Unit heat value of fuel used by the boiler after implementation of the project	GJ/t, GJ/kL, GJ/Nm^3, etc.
$CEF_{PJ,fuel}$	CO2 emission coefficient per unit heat value of fossil fuel used by the boiler after implementation of the project	tCO2/GJ

(8) Calculation of the emission reduction amount

The emission reduction amount will be calculated in accordance with the following formula. As stated earlier, to exclude the GHG emissions reduction amount for voluntary activities, the theoretical value of emissions reduction thanks to the project has been calculated in advance and regarded as the upper limit. Any emissions reduction above the limit has been regarded as reduction for voluntary activities and excluded from the evaluation.

$$ER = EM_{RE} - EM_{PJ}$$

ER	Emission reduction amount	tCO2/y
EM_{RE}	Reference emission amount	tCO2/y
EM_{PJ}	Project emission amount	tCO2/y

⑨ Calculation Basis of Reference Emissions

The emission reduction amount will be calculated in accordance with the following formula.

	Value

Fuel consumption of boiler after implementation of the project	702.6 t
Unit heat value of fuel used by boiler after implementation of the project	50.8 GJ/t
Energy consumption efficiency of boiler after implementation of the project	95.5 %

$$Q_{RE,heat} = Q_{PJ,heat} = F_{PJ,fuel} * HV_{PJ,fuel} * \frac{\varepsilon_{PJ}}{100}$$

=702.6×50.8×95.5/100

=34088.3621

	Value
Energy consumption efficiency of reference boiler	71.5%
CO2 emission coefficient per unit heat value of fossil fuel used by reference boiler	0.0693

$$EM_{RE} = Q_{RE,heat} * \frac{100}{\varepsilon_{RE}} * CEF_{RE,fuel}$$

=34088.3621×100/71.5×0.0693

=3303.94

⑩ Calculation Basis of Project Emissions

$$EM_{PJ} = F_{PJ,fuel} * HV_{PJ,fuel} * CEF_{PJ,fuel}$$

=702.6×50.8×0.0495

=1766.88

⑪ Emissions Reduction

$$ER = EM_{RE} - EM_{PJ}$$

=3303.94 - 1766.88

=1537.06 tCO_2/y

This value is GHG reduction from single boiler.

⑫ Cost-effectiveness of CO2 emissions reduction

The cost-effectiveness of the CO2 emissions reduction of the potential project was considered with the following assumptions: 1) the installment cost of 6 boilers is 100 million yen; 2) the amount of JCM subsidies is 50 million yen; 3) the CO2 emissions reduction is 9222,36 ton/year; and 4) the statutory useful life of the boilers is 15 years. The cost effectiveness (yen/total ER of 15 years) is 361.44 according to the following formula:

Cost effectiveness=JCM subsidies (yen)/CO2 emissions reduction/useful life of boilers

(2) Survey Results related to JCM PDD Preparation

① Project Implementation System and Project Participants

Project is assumed that Japanese project participants manage the project. Boiler manufacturer supposed to provide its technology and after service. As for Thai side, it is supposed for hospital and factory to join project.

②Project Commencement and Implementation Period

Operations under this project are expected to commence in 2015, and the implementation period is expected to be 1 year.

③Qualification Requirements

The qualification requirements of this methodology are described below:

Table 8 Eligibility Requirements and Reasons for Choosing This Scheme

Requirement	Contents	Reasons
Requirement 1	Condition 1: The boiler unit will be newly installed or upgraded. ・ The fuel will also be changed. ・ In the case of upgrading, the boiler to be installed will be more efficient than the existing one. ・ Requirements for the boiler functions	To introduce high-efficiency boilers and reduce GHG emissions at hospitals, plants and other sites covered by this scheme
Requirement 2	Vapor, hot water or heat of heat-transfer oil generated by the boiler will be consumed in whole	In the case the party introduced the boiler under the project supplies vapor, hot water or heat

	or in part on the site.	of heat-transfer oil generated by the boiler to a third-party operator, only the quantity of heats of self-consumption will be subject to certification of emissions reduction. Because of this requirement, any project chiefly aiming to supply produce energy to outside parties will be excluded from the coverage of the project.

④ Source of Project Emissions and Monitoring Points

Emission reduction in the project is as follows.

$$ER = EM_{RE} - EM_{PJ}$$

EM_{RE} is GHG from mainly oil consumption. EM_{PJ} is GHG from mainly LPG consumption. The required monitoring points for this methodology for calculating project emissions and reference emissions after project implementation are as follows.

$F_{PJ,fuel}$	Fuel consumption of the boiler after implementation of the project	t/year
ε_{PJ}	Energy consumption efficiency of boiler after implementation of the project	%

These parameters are supposed that hospitals and factories manage monitoring data.

⑤Monitoring plan

It is necessary to survey monitoring, storage method and monitoring structure.

⑥Environmental Impact Assessment

Still in progress.

⑦Comments from Stakeholders

Still in progress.

III. Matchmaking with Low-Carbon Technologies in Japan

We dispatched two low-carbon technology missions in October 2014 and January 2015 to Bangkok for the purposes of sending Japanese technical experts from private business operators that have superior low-carbon technologies and from the city of Yokohama to present technologies and activities effective for GHG emission reduction in Bangkok and of promoting matchmaking between Japanese and Thai business operators.

The missions held seminars to make presentations about the outline of the JCM system, technical needs of Thai business operators, low-carbon technologies of Japanese operators, etc. There were also matchmaking sessions for individual discussion between Japanese and Thai operators about introduction of technologies, and visits to sites where low-carbon technologies would likely be introduced through JCM. The outline of these low-carbon technology missions are shown below.

1. Dispatch of the 1st Low-Carbon Technology Mission

(1) Schedule

The 1st Low-Carbon Technology Mission was dispatched from October 14th (Tue) to 17th (Fri) as scheduled in Table 10 below. The workshop on October 16th (Thu) was the only event that required full participation of the Japanese companies and inspection tours and follow-up interviews were optional for those who wanted to participate.

Table 10 Schedule of the 1st Low-Carbon Technology Mission (Outline)

<table>
<tr><th>Date</th><th>Contents</th></tr>
<tr><td>Oct.14th (Tue)</td><td>Visits to sites in the area of water and sewage or the area of transportation

[Option 1: Water and sewage]
<table><tr><td>AM</td><td>Visits to Metropolitan Water Works Authority and Bangken Water Treatment Plant</td></tr><tr><td>PM</td><td>Visit to Din Daeng Wastewater Treatment Plant</td></tr></table>
[Option 2: Transportation]
<table><tr><td>All day</td><td>Visit to Bangkok Mass Transit System Public Company</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td>[Option 3: Visit to Industrial estates]<table><tr><td>AM</td><td>Visit to Isuzu Engine Manufacturing (Thailand) in Lat Krabang Industrial Estate</td></tr><tr><td>PM</td><td>Visit to an instant noodle factory of Wan Thai Foods Industry in Bangchan Industrial Estate</td></tr></table></td></tr>
<tr><td>Oct.15th (Wed)</td><td>Visits to sites in the area of building energy saving

[Building energy saving]<table><tr><td>AM</td><td>Visit to Bangkok Metropolitan Administration Building (BMA 2)</td></tr><tr><td>PM</td><td>Visit to Taksin Hospital
Visit to Amari Watergate Hotel Bangkok</td></tr></table></td></tr>
<tr><td>Oct.16th (Thu)</td><td>Low-carbon technology workshop and matchmaking session</td></tr>
<tr><td>Oct.17th (Fri)</td><td>Follow-up meetings between Japanese and Thai companies</td></tr>
</table>

(2) Participating companies from Japan

As shown in Table 11 below, 16 Japanese companies participated in the 1st Low-Carbon Technology Mission.

Table 11 List of Japanese Participants in the 1st Low-Carbon Technology Mission

	Company	Technologies and services presented
1	JFE ENGINEERING Corporation	Waste-to-energy technologies
2	EJ Business Partners Co., Ltd.	Waste-to-energy consulting
3	Mitsubishi Heavy Industries, Ltd.	Refrigerating machine for air conditioning
4	Japan Development Institute Ltd. (JDI)	Development consulting
5	METAWATER Co., Ltd.	Wastewater treatment technology – PTF system
6	Finetech Inc.	Biomass power generation technologies
7	ANEST IWATA Corporation	Air compressor
8	Hitachi, Ltd.	Car sharing “ChoimobiinContainer-type data center

9	JAPAN NUS Co., Ltd.	Energy saving technologies that can be used for hospitals
10	Takasago Thermal Engineering Co., Ltd.	Low-carbon technologies such as a heat storage system
11	Sumitomo Electric Industries, Ltd.	Large battery system
12	TOYO DENKI SEIZO K.K.	Eco-drive motor
13	MEIDENSHA Corporation	Yokohama Smart City Project
14	Yokogawa Solution Service Corporation	Energy optimization at plants using IT
15	PALTEK Corporation	Smart energy solution
16	CTI Engineering Co., Ltd.	Construction consulting

(3) Overview and results

① Low-carbon technology workshop and matchmaking session

On October 16th (Thu), a workshop was held at S31 Sukhumvit Hotel in Bangkok. There were about 170 participants from BMA, Yokohama City, private companies in Japan and Bangkok, etc. In the opening addresses, Dr. Supachai Tanticom, Advisor to the Governor of Bangkok, and Mr. Yoshihiko Nomura, Head of the Climate Change Policy Headquarters of Yokohama City, expressed expectation for promotion of actions to address climate change in Thailand and technical transfer through implementation of JCM projects. At the workshop, 4 Thai companies and 8 Japanese companies presented their low-carbon activities.

Following the workshop, a matchmaking session was held for Japanese and Thai companies. Each participating Japanese company had a booth to present its businesses and technologies. There was also Q&A about technologies and individual discussion about future cooperation through JCM etc.

Business matching

Deligates from BMA and Yokohama City

② Visits to facilities where low-carbon technologies might be introduced

(a) Water and sewage

The mission visited the Metropolitan Water Works Authority and the Bangken Water Treatment Plant, managed by the authority, in the morning and the Din Daeng Wastewater Treatment Plant in Bangkok in the afternoon. They saw devices and systems currently used at each facility and checked their needs concerning energy saving.

Tour at Bangken Water Treatment Plant

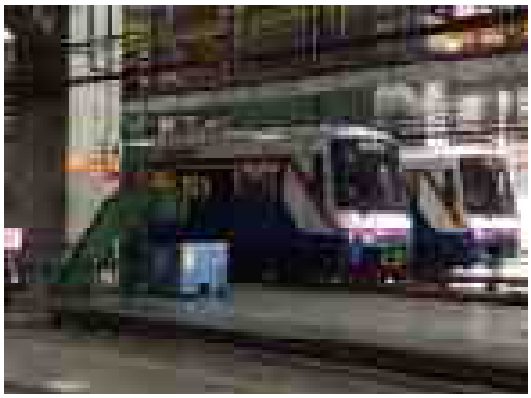
Visitors to Bangken Water Treatment Plant

(b) Transportation

The mission visited Bangkok Mass Transit System Public Company, who operates the mass-transit system in Bangkok (BTS). After BTS presented its company overview, there was Q&A and information exchange concerning the potential of the introduction

of regenerative brake and other energy-saving technologies and then a tour at the BTS vehicle maintenance facility.

Meeting at BTS



BTS vehicle maintenance facility

(c) Industrial estates

In the morning the mission visited Isuzu Engine Manufacturing (Thailand), located in the Lat Krabang Industrial Estate, and met persons in charge of manufacturing. They explained their engine and other products produced at the plant and their energy saving needs (boilers, motors, air compressors with inverter, LEDs, drainage pumps, etc.) and there was discussion about possibility of technology introduction. After that, the mission had a tour at the manufacturing plant. The company is planning to expand the plant and considering introduction of energy-saving equipment.

Then, the mission visited an instant noodle plant of Wan Thai Foods Industry, located in Bangchan Industrial Estate, and met the plant manager and other staff. After they explained existing energy-saving measures and energy-saving efforts they are going to make in the future, there was Q&A and the mission observed instant noodle production processes at the plant.

(d) Energy saving

The mission visited the Bangkok Metropolitan Administration Building (BMA2) and received a presentation about existing energy saving equipment. Although the construction of the building is currently suspended, it is expected to be resumed as soon as additional budget is secured.

After that, the mission visited the second destination, Taksin Hospital, and met the deputy director and engineers. They explained their energy-saving activities and needs (boilers, tanks, cooling pumps, LEDs etc.) and had discussion about possibility of technology introduction. The hospital has its own budget in addition to the budget from

BMA and is considering using its own budget for the purchase of boilers. After the meeting, the mission observed operating boilers and chillers. There is a plan to expand the hospital and they are considering introduction of energy-saving equipment.

The mission visited the last destination, Amari Watergate Hotel Bangkok, and met the person in charge of energy saving. The hotel explained about existing energy saving equipment (boilers, chillers, heat pumps, LEDs, drainage pumps, etc.) and the mission inspected such equipment.

③ Collection of additional information for follow-up

To follow up the opinion exchange between Japanese and Thai companies held during the workshop and business matching session, the mission had meetings with attendance of OECC staff as shown in Table 12.

Table 12 The 1st Low-Carbon Technology Mission Follow-Up Meetings

	Date	Summary
1	Oct. 17th	Meeting with Prime Road Capital (Summary: There was discussion with Prime Road Capital, carrying out multiple renewable energy projects in Thailand and overseas, about feasibility of a biomass power generation project through JCM.)
2	Oct. 20th	Meeting with Taksin Hospital (Summary: It was the 2nd meeting with Taksin Hospital after the inspection tour of Oct. 15th and OECC explained the outline of JCM again. The hospital plans to replace boilers and agreement was made to continue information exchange to promote projects through JCM.)
3	Oct. 20th	Meeting with DCAP (Summary: There was discussion with DCAP, a facility management company for the Suvarnabhumi International Airport, about the feasibility of the utilization of JCM when installing new refrigerating machines for air conditioning at the airport.)
4	Oct. 21st	Meeting with PHYATHAI INTERNATIONAL HOSPITAL (Summary: It was a meeting with PHYATHAI INTERNATIONAL HOSPITAL, who made a presentation at the workshop of Oct. 16th. OECC explained the overview of JCM. An executive and the person in charge of energy saving of the hospital attended the meeting and agreed to continue cooperation.)

2. Dispatch of the 2nd Low-Carbon Technology Mission

(1) Purpose

Based on the results of the 1st Low-Carbon Technology Mission in October 2014 and training in Japan in December 2014, the 2nd Low-Carbon Technology Mission was dispatched to promote formation of concrete JCM projects between Thai and Japanese companies. The mission carried out the following activities.

- Organization and discussion of information that has to be submitted to the Ministry of the Environment at the time of application for JCM equipment subsidy project, project planning study (PS) and feasibility study (FS)
- Understanding of needs of Thai participants and presentation of Japanese technologies
- Consideration about funds to be used for the implementation of JCM projects in addition to JCM subsidies
- Close opinion exchange between Japanese and Thai participants
- Visits to and energy diagnosis at sites where Japanese low-carbon technologies are expected to be introduced through JCM

(2) Schedule

The 2nd Low-Carbon Technology Mission was dispatched from January 27th to 29th with a focus on two themes – ① energy saving at hospitals and factories and ② waste and wastewater management – and carried out activities in separate groups. Table 13 below shows detailed schedule.

Table 13 Schedule of the 2nd Low-Carbon Technology Mission

Date	Contents
Jan.27th (Tue)	**[Lecture: Improvement of understanding about JCM and its subsidy scheme]** Opening address (BMA・OECC) Group photo (all participants) Lectures about JCM (detailed explanation of the subsidy scheme) (OECC) Lecture about JCM (explanation of information to be prepared when applying for subsidy) (OECC) Q&A Lecture about financing schemes available for energy saving projects (Kasikornbank)

	Lecture about GHG reduction activities by Thailand Greenhouse Gas Management Organization (TGO) Q&A Closing address (OECC)
Jan.28th (Wed)	**[Presentation of technical needs and low-carbon technologies]** **[Group 1: Energy saving]** Opening address (OECC) Presentation about technical needs (Phayathai Hospital 2) Presentation about technical needs (Wan Thai Foods Industry) Presentation about energy-saving pumps (Yokogawa Solution Service) Q&A Presentation about energy-saving boilers (NIPPON THERMOENER) Presentation about emergency power generators (PALTEK) Q&A Closing address (Yokohama city) **[Group 2: Biomass, wastes and wastewater]** Opening address (OECC) Presentation about technical needs (PEA ENCOM International) Presentation about technical needs (Prime Road Capital) Presentation about technical needs (Industrial Estate Authority of Thailand) Q&A Presentation about waste-to-energy power generation (JFE Engineering) Presentation about biomass semi-carbonization equipment and power generation (FINETECH) Presentation about energy-saving wastewater treatment technologies (METAWATER) Q&A Closing address (Yokohama city)
Jan.29th (Thu)	**Visits to candidate sites for the introduction of low-carbon technologies and energy-saving diagnosis** **[Group 1]** Left hotel in Bangkok. Visited a site and conducted energy-saving diagnosis (destination: Taksin Hospital). Lunch and travel

	Visited a site and conducted energy-saving diagnosis (destination: Wan Thai Foods Industry). Arrived at hotel in Bangkok. **[Group 2]** Left hotel in Bangkok. Visited Research and Development Centre for Space and Aeronautical Science and Technology of Royal Thai Air Force. Arrived at hotel in Bangkok.

(3) Participants

[Participants from Thailand]

Participants from Thailand are as shown below. For a more detailed list of participants, see uipment subsidy p

- BMA staff
- Delegates from organizations in Thailand that fall into any of the following categories
  - ✓ Companies and hospitals that participated in training in Japan in December 2014
  - ✓ Other private companies, hospitals and public organizations with strong interest in energy saving
  - ✓ Participants who expressed strong interest in JCM in the questionnaire conducted after the workshop of October 2014

[Participants from Japan]

Participants from Japan are personnel from the city of Yokohama and OECC and delegates from the companies listed in Table 14.

Table 14 Japanese Participants in the 2nd Low-Carbon Technology Mission

	Company	Low-carbon technology	Notes
1	Yokogawa Solution Service Corporation	Energy-saving engineering etc.	Able to provide comprehensive energy-saving technologies for buildings and plants.

2	NIPPON THERMOENER Co., Ltd.	High-efficiency boiler	Have boiler technologies that can be introduced both to hospitals and plants.
3	PALTEK CORPORATION	Emergency power generator	High demand especially for hospitals
4	Azbil (Thailand), Co., Ltd.	BEMS etc.	Able to provide comprehensive energy-saving technologies for buildings and plants.
5	Mitsubishi Heavy Industries, Ltd.	Chiller for air-conditioning, etc.	Considering introduction at airports, large commercial facilities, etc.
6	JFE ENGINEERING Corporation	Waste-to-energy power generation	One of the world's leading companies in the field of waste-to-energy power generation technologies
7	METAWATER	Energy-saving wastewater treatment	One of Japang wastewater treatmentf waste-to-energy power generation ttechnologies
8	Finetech	Biomass power generation	Can be used for various biomass materials including food waste.

(4) Overview and Results

① Low-Carbon Technology Workshop Day 1 (understanding of JCM and its support scheme)

The workshop was held at S31 Sukhumvit Hotel in Bangkok on January 27th (Tue). There were about 60 participants from BMA, the city of Yokohama, Japanese and Thai companies, etc. In the opening addresses, Mr. Makoto Kato, OECC Senior Researcher, explained the purpose of the workshop and the progress of signing of a bilateral agreement for JCM, and Dr. Supachai Tanticom from BMA, Advisor to the Governor of Bangkok, expressed expectations for the promotion of measures to address climate change in Bangkok through the implementation of JCM projects and appreciation to the Japanese government and the city of Yokohama.

Next, Mr. Mizushi Satoh, OECC Researcher, explained about the JCM subsidy scheme, and Mr. Shinichi Kimura, OECC Researcher, explained about preparation for

application for JCM subsidy, followed by an active Q&A session. Then, Mr. Mek Meksarikul, Vice-President of Kasikornbank in Thailand, presented funding schemes available for energy-saving projects and Mr. Puttipar Rotkittikhun, Senior Researcher of Thai Greenhouse Management Organization (TGO), presented activities for GHG reduction, followed by opinion exchange about technical details.

Left: Dr. Supachai Tanticom (Advisor to the Governor of Bangkok)

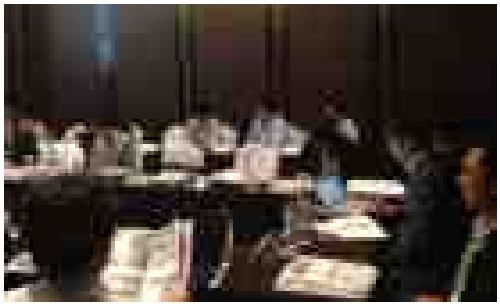
Mr. Mek Meksarikul (Vice-President of Kasikornbank)

Photo of all participants

② Low-Carbon Technology Workshop Day 2 (low-carbon technology matching)

On January 28th (Wed), Workshop Day 2 was held at S31 Sukhumvit Hotel in Bangkok at the same venue as Day 1. There were about 70 participants from BMA, the city of Yokohama, Japanese and Thai companies, etc. Participants were divided into 2 groups – the energy-saving group and the waste and wastewater group. Thai companies presented their needs for low-carbon technologies and Japanese companies presented their advanced low-carbon technologies. There was also active Q&A.

Energy-Saving Group



Waste and Wastewater Group

③ Visits to Candidate Sites for the Introduction of Low-Carbon Technologies and Energy-Saving Diagnosis

(a) Visit to Thaksin Hospital, run by BMA

The visit to Thaksin Hospital started with the explanation about the size of the hospital, facilities and situation of energy use. The hospital has four buildings, including the oldest, which was built 46 years ago. The total area is about 64,000 square meters. As to energy consumption, the hospital uses about 7,400,000 kWh of electricity and about 3,324,000 MJ of heat each year. The hospital explained their energy improvement efforts (in 2011-2015) and mentioned that the hospital won the Thailand Energy Award in 2011 for their energy improvement activities. They also said they are considering replacing inefficient boilers in 2015. After that, the group inspected solar heaters (on the roof), boilers, chillers and emergency power supply systems and conducted energy-saving diagnosis.

Group photo at Thaksin Hospital

Energy-saving diagnosis

(b) Visit to Wan Thai Foods Industry

During the visit to Wan Thai Foods Industry, the group received explanation about

the size and facilities of the factory, situation of energy consumption, energy-saving activities and improved energy-saving equipment. As the revenue increases, a new noodle factory (the third factory) is being constructed and purchase of about 6 new boilers is being considered. Purchase of new chillers is also being considered as existing chillers show deterioration. After Wan Thai made presentations about the company and facilities, the group inspected boilers, chillers and noodle-making processes, followed by an active Q&A session about factory improvements and how to proceed with JCM projects, etc.

Chiller at the factory

Group photo

(c) Visit to Research and Development Centre for Space and Aeronautical Science and Technology (RTAF) of Royal Thai Air Force

Group 2 visited RTAF, a research center of Royal Thai Air Force. RTAF is an air force research center, and yet it conducts extensive research of renewable energy, specifically on solar power generation, wind-power generation, biogas and biodiesel. RTAF does not only conduct research but generates electric power from the renewable energies on the premises to provide all the power required. They also receive visitors for the facility tours and other activities.. They actually receive an average of about 2 groups of visitors per week. The majority of such tours have an educational purpose for school students. About 5,000 soldiers and other staff live on the premises of the Royal Air Force. Since their general wastes are all put into open dumps, the improvement of the waste method has become a critical issue.

Considering such situation, a participating Japanese company proposed to RFAF the use of the company's semi-carbonization equipment to treat general wastes from the air force site and the use of the semi-carbonized materials produced as energy resource. As the introduction of such technology will not only contribute to the improvement of the treatment method of general wastes from the site of the air force and to GHG

emission reduction but will also be good for tours like those described above, it can be significant in education and enlightenment about climate change and waste treatment.

Solar power generation equipment

Wind-power generation equipment

IV. Technical Guidance from Private Companies Based on the Partnership between Yokohama and Bangkok

1. Energy Saving Diagnosis at a Hospital

As part of the 2nd low-carbon technology mission, Japanese technical experts conducted energy-saving diagnosis at a hospital run by BMA. Highly detailed diagnosis was conducted because the hospital, founded long ago, was expected to have many obsolete devices. The energy consumption at the whole hospital is shown in Table 15. The diagnosis results are also shown below.

Table 15 Energy Consumption (2014)

	Cost (Baht/Y)	CO2 emission (t-CO2/Y)
Electricity	31,507,609	3,893
Diesel	2,809,287	246
Total	**34,316,896**	**4,139**

(1) Installation of high-efficiency lighting

The hospital has a 20-story building and a 17-story building, where 1,137 and 1,260 fluorescent lights are installed respectively. If they are replaced with LED, 232.0 MWh of electric power consumption, 120.6 t-CO2 of CO2 emissions, and 974.5 k Baht of the cost can be saved every year.

(2) High-efficiency control of primary pumps

There are two primary pumps at the hospital. Table 16 shows changes in electricity consumption, CO2 emissions and the cost with high-efficiency control including review of unnecessary pipes and introduction of inverters.

Table 16 High Efficiency Control of Primary Pumps

	Electricity (MWh/Y)	CO2 emission (t-CO2/Y)	Cost (kBaht/Y)
Before	252.9	131.5	1,062.4
After	152.0	79.0	638.5
Reduction	100.9	52.4	423.9

(3) High-efficiency control of conveying pumps

The hospital has 2 conveying pumps. Table 17 shows changes in electricity consumption, CO2 emissions and the cost with high-efficiency control including introduction of inverters.

Table 17 High-Efficiency Control of Conveying Pumps

	Electricity (MWh/Y)	CO2 emission (t-CO2/Y)	Cost (kBaht/Y)
Before	172.0	89.4	722.4
After	103.8	54.0	436.2
Reduction	68.1	35.4	286.2

(4) Introduction of heat pumps

The hospital has 2 boilers for hot water supply. If heat pumps are introduced, cold water can be heated and fuel use for boilers can be reduced. Although the introduction of heat pumps will increase electricity consumption by 47.4MWh/Y, CO2 emission will be reduced by 42.8 t-CO2/Y and the cost will be reduced by 772.8 KBaht/Y.

(5) Introduction of high-efficiency PAC

The hospital has 525 split air conditioners (COP[10]: 3.27). Table 18 shows changes in electricity consumption, CO2 emissions and the cost with the introduction of high-efficiency air conditioners (COP: 4.90).

Table 18 Introduction of High-Efficiency PAC

	Electricity (MWh/Y)	CO2 emission (t-CO2/Y)	Cost (kBaht/Y)
Before	1,557.9	809.7	6,543.3
After	997.1	518.2	4,187.7
Reduction	560.9	291.5	2,355.6

(6) Summary

Table 19 shows the summary of the results of the above-described diagnosis.

Table 19 Summary of the Results of Energy-Saving Diagnosis

Energy saving method	Reduction in	Reduction in	Reduction in	CO2 emission

[1] Coefficient of performance of energy consumption

	electricity consumption (kWh/Y)	fuel consumption (MJ/Y)	CO2 consumption (t-CO2/Y)	reduction rate (%)
Installation of high-efficiency lights	232,020		120.6	2.9%
High-efficiency control of primary pumps	100,918		52.4	1.3%
High-efficiency control of conveying pumps	68,148		35.4	0.9%
Introduction of heat pumps	-47,365	909,400	42.8	1.0%
Introduction of high-efficiency PAC	560,851		291.5	7.0%
Total	**914,572**	**909,400**	**542.7**	**13.1**

2. Implementation of Training in Japan

(1) Schedule of Training in Japan

Training in Japan was conducted from December 15th (Mon) to 19th (Fri) according to the schedule shown in Table 20 below. Trainees were divided into 3 groups under 3 themes – Theme 1 "Energy-saving measures at plants and hospitals", Theme 2-1 "Biomass power generation" and Theme 2-2 "Waste incineration power generation", and training was conducted for each group.

Table 20 [Theme 1: Energy-saving measures at plants and hospitals]

Date	Time	Content	Place
Dec 15th Mon	11:20	Leave Suvarnabhumi Airport (Thailand)	Bangkok
	18:55	Arrive at Haneda Airport	Tokyo
	20:30	Arrive at hotel	Yokohama
Dec 16th Tue	10:00-10:30	Hotel → Yokohama City Office	Yokohama
	10:30-12:30	**Welcome meeting: Guidance about training in Japan and JCM**	
	15:00-16:30	**Site visit: Air compressors and vacuum pumps in a hospital**	
	17:00	Arrive at hotel	
Dec 17th Wed	8:30	Hotel → Yokohama City University Hospital	Yokohama
	9:00 -12:00	**Lecture: Energy-saving facilities in Yokohama City University Hospital**	
	14:30-15:30	**Lecture: Boilers**	
	16:00	Arrive at hotel	
Dec 18th Thu	8:15	Hotel → Site visit	Yokohama
	9:30-11:30	**Lecture and site visit: Energy-saving**	

		pumps	
	14:00 -16:00	Observation of a power generation system to be used for the event of power failure	
	18:00	Arrive at hotel	
Dec 19th Fri	7:30	Hotel → Haneda Airport	Yokohama → Tokyo
	10:50	Leave Haneda Airport	Tokyo
	16:50	Arrive at Suvarnabhumi Airport (Thailand)	Bangkok

[Theme 2-1: Biomass power generation]

Date	Time	Content	Place
Dec 15th Mon	22:55	Leave Suvarnabhumi Airport (Thailand)	Bangkok
Dec 16th Tue	6:40	Arrive at Haneda Airport	Tokyo
	8:30	Arrive at hotel	Yokohama
	10:00-10:30	Hotel → Yokohama City Office	Yokohama
	10:30-12:30	**Welcome meeting: Guidance about training in Japan and JCM**	
	14:00-16:00	**Lecture about biomass power generation equipment**	
	17:00	Arrive at hotel	
Dec 17th Wed	9:50	Hotel → Resource recycling waste disposal facility	Yokohama Yokohama
	10:00-12:00 14:30-16:30	**Lecture and site visit: Resource recycling waste treatment facility** **Lecture and site visit: Mechanism of a**	Yokohama City Resources and Recycling Board

		biomass power generation plant	Kanazawa
	17:00		Plant
		Arrive hotel	Research
			organization
Dec 18th	9:00	Hotel → Biomass power generation plant	Ashikaga
Thu			
	13:30-15:30	**Site visit: Biomass power generation plant**	Green Plant
	18:00	Arrive at hotel	
	21:00-22:00	Hotel → Haneda Airport	
Dec 19th	0:25	Leave Haneda Airport	Tokyo
Fri	5:45	Arrive at Suvarnabhumi Airport (Thailand)	Bangkok

[Theme 2-2: Waste incineration power generation]

Date	Time	Content	Place
Dec 15th	11:20	Leave Suvarnabhumi Airport (Thailand)	Bangkok
Mon	18:55	Arrive at Haneda Airport	Tokyo
	20:30	Arrive at hotel	Yokohama
Dec 16th	10:00-10:30	Hotel → Yokohama	Yokohama
Tue			
	10:30-12:30	**Welcome meeting: Guidance about training in Japan and JCM**	
	13:30-16:30	**Lecture: General knowledge of waste treatment technologies**	
	17:00	Arrive at hotel	
Dec 17th	9:50	Hotel → Resource recycling waste treatment facility	Yokohama
Wed			
	10:00-12:00	**Lecture and site visit: Resource recycling waste treatment facilities**	Yokohama City Resources and Recycling
	12:00-17:00	**Lecture and site visit: Industrial waste**	Board

		treatment facilities	Kanazawa Plant
	18:00	Arrive at hotel	
Dec 18th Thu	9:00	Hotel → Fluorescent light recycling plant	
		Site visit: Fluorescent light recycling plant	Yokohama
	13:00-17:00	**Visits to low-carbon facilities, etc. in Tokyo Metropolitan Area**	Tokyo Metropolitan Area
	18:00	Arrive at hotel	
Dec 19th Fri	7:30	Hotel → Haneda Airport	Yokohama
	10:50	Leave Haneda Airport	Tokyo
	16:50	Arrive at Suvarnabhumi Airport (Thailand)	Bangkok

(2) List of Invitees

[Theme 1: Energy-saving measures at plants and hospitals]

	Company	Post
1	Taksin Hospital	Deputy Director of Taksin Hospital
2	PHAYATHAI 2 Hospital	Service Support Division Manager
3	Wan Thai Foods Industry CO.,LTD.	Engineering Manager

[Theme 2-1: Biomass power generation]

	Company	Post
1	PRIME Road Capital Co., Ltd.	Chairman & CEO

[Theme 2-2: Waste incineration power generation]

	Company	Post
1	PEA (Provincial Electricity Authority)	Project Engineer

(3) Contents of the Training in Japan

[Theme 1: Energy-saving measures at plants and hospitals]

① Site visit: Air compressors and vacuum pumps for hospitals and plants

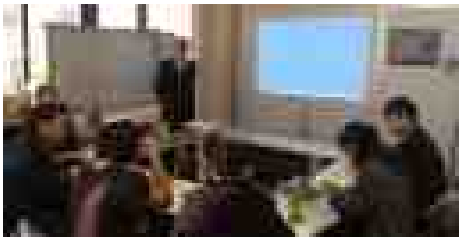
The trainees visited a showroom for air compressors, vacuum pumps, etc. There was explanation about functions and uses of air compressors used to supply gas and medical air at hospitals, plants, etc. The compressors are designed to be silent not to disturb hospital patients, etc. and high-level energy-saving technologies are used. Participants from the hospital asked questions about Nitrogen gas to be supplied to patients and detailed technical specifications and detailed technical and other specifications were checked. As air compressors are used at the BMA-run hospital that the invitees work, needs for future equipment replacements were also checked.

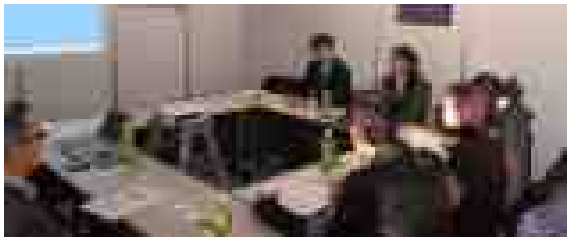
 Lecture and site visit: ESCO project and energy-saving equipment at Yokohama City University Hospital

Through the introduction of the city of Yokohama, the trainees visited Yokohama City University Hospital, which has been working on ESCO projects. First, their energy-saving efforts through ESCO projects were explained, and then Yokohama City Housing and Architecture Bureau lectured on the ESCO project scheme employed at the hospital and explained how energy-saving activities using private companies have been producing good results. Next, the person in charge of ESCO projects explained the projects implemented through equipment introduction and repair. More specifically, there was detailed explanation about the engineering technologies that achieve reduction in air conditioning load, efficient heat and power generation and efficient power transmission. After that, the trainees observed devices in the energy control room and the boiler room, heat pumps, refrigerating machines, air conditioning pumps, etc. in the hospital.

② Lecture: Boilers

The trainees visited a manufacturer of high-efficiency boilers. After greetings of the city of Yokohama and OECC, there was an explanation about high-efficiency boilers in terms of differences from other companies' technologies, energy-saving effect on investment, etc. For boilers, the trainees recognize clear needs in their purchase planning at the BMA-run hospital, expansion of plants and others. There was an active Q&A session on the introduction of technologies.



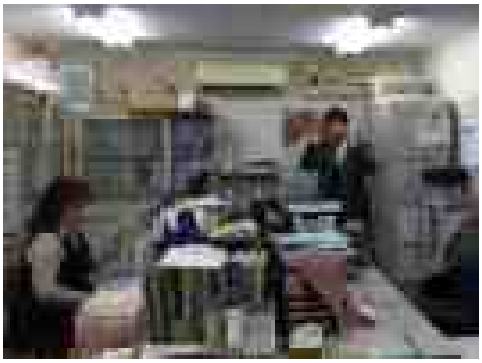


③ Lecture and site visit: Energy-saving pumps

The trainees visited facilities with a showroom and a global after-the-sale service department that have been working on energy-saving pump or ESCO projects. At the facilities, they explained about energy-saving equipment that can be easily added (Econo-Pilot), ESCO project schemes, etc. After that, the trainees visited the showroom and the global after-the-sale service center, where high-level after-the-sale services of Japan were presented.

④ Site visit: Power generation system to be used for the event of power failure

The trainees visited a plant with a demonstration facility for a power generation system to be used for the event of power failure. They actually cut off power and demonstrated the operation of the power generation system before the trainees observed other power generation equipment and manufacturing floors. In a Q&A session, there was active exchange of opinions including frequency of power failure in Thailand and differences in regulations related to power failure. In Thailand, a system to restore power within 5 seconds of power failure is required, which is different from a Japanese regulation that requires power restoration within 10 seconds. It was confirmed that minor system changes would be required.

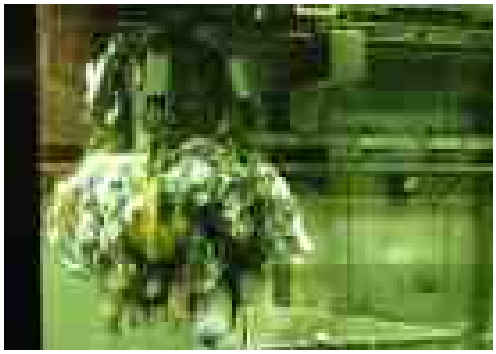


[Theme 2-1: Power generation with wastes]

 Lecture and site visit: Resource recycling waste treatment facility (Yokohama City Resources and Recycling Board Kanazawa Plant)

We visited Yokohama City Resources and Recycling Board Kanazawa Plant with personnel from PRIME Road Capital, PEA ENCOM International and others. First, there was explanation about waste incineration facilities at the plant, status of facility operation and waste recycling, followed by a Q&A sessions about how to collect and sort

out wastes as well as resource recycling rate. After that, they observed the control tower and how wastes are actually collected in the facilities.



 Lecture: Mechanism of a biomass power generation plant

We visited a biomass power generation plant research organization with personnel from PRIME Road Capital. Personnel from the research organization explained about the plant that the trainees would visit on December 18th and biomass gasification power generation conducted at the plant. After that, there was a Q&A session about the green nano carbon generation process and the product and also about biomass gasification power generation using waste coffee grounds.

 Site visit: Biomass power generation plant

The trainees visited the green plant explained about during the lecture of December 17th described above. The plant was completed in March 2011. At the plant, food wastes (mainly waste coffee grounds) are used to secure long-term stable supply of biomass feedstock and synthetic gas generated through direct gasification with superheated steam is used as a fuel for power generation. This method is superior to

methane fermentation power generation because the processes from gasification to power generation can be conducted in a short time. Finetec's technologies are used in soft-side aspects (monitoring and control system of the plant), and the difference is that real-time status of power generation and facilities is visualized in the monitoring room so that the status can be understood at a glance. After detailed explanation about the facilities, there was very active Q&A session with the personnel from PRIME Road Capital.

[Theme 2-2: Power generation with wastes]

① Lecture: General knowledge of waste treatment technologies

A lecture was given to the invitee from PEA ENCOM International about general knowledge of waste treatment technologies focusing on garbage burning generation. After active questions and answers, the trainee visited waste treatment facilities.

② Lecture and site visit: Waste treatment plant

The trainee visited an industrial waste treatment plant. A person in charge of the plant explained the waste treatment operation and lectured about waste treatment technologies, especially treatment of low concentration PCB. After that, there was a plant tour and Q&A.

③ Lecture and site visit: Fluorescent light recycling plant

The trainee visited a fluorescent light recycling plant and staff of the plant showed them around. The plant is one of the largest plants for recycling of florescent lights and mercury-vapor lights in Japan. Plant staff explained about its operations and made a presentation about treatment flows and various facilities.

V. Presentation and Other Activities at International Conferences and Workshops

1. Presentation at an International Conference during Yokohama Smart City Week in October 2014

The feasibility study to form large JCM projects in Bangkok is not a JCM-related activity for a single project but to use JCM as part of the implementation of a master plan on climate change of a local government unit. The package of "policies + implementation of mitigation projects through JCM (and MRV)" in a local government unit in another country of the Asia-Pacific region will probably draw worldwide attention as a model case for the transfer of superior policies to address climate change of a local government unit in Japan. Considering this, we invited a BMA official to an international conference during Smart City Week in October 2014 to present activities related to JCM projects and observe low-carbon technologies in Japan.

On October 28th, the BMA official and we participated in the JCM Workshop (closed event) and summarized achievements and expected roles of cooperation among local governments (cooperation between Bangkok and Yokohama in this case). On the 29th, the BMA official and we participated in the Local Government Seminar (open event), where the progress of JCM projects and low-carbon technologies are presented and the knowledge regarding the issues and advantages in low-carbon technology transfer to other Asian countries through JCM was shared. They also participated in a seminar focused on the activities to develop a low-carbon city carried out by local government in the country and overseas. In Session 1, six local governments in Japan shared their activities to support low-carbon city development in other Asian countries through city-to-city cooperation using JCM (cases of 9 Asian cities). In Session 2, information was shared about activities for low-carbon city development in local governments in the country and overseas that contribute to planning and about trends of GHG quantification.

The destinations of the inspection visits were a green roof at Tokyu Capitol Tower, Omohara no Mori at Tokyu Plaza, Kawasaki Eco Gurashi Mirai-kan and energy saving facilities at Tokyo Skytree. The green roof at the Tokyu Capitol Tower won the prize of the Minister of Land, Infrastructure, and Transport in Green Roof for such activities as (1) layout planning that utilized existing environmental assets, (2) formation of a stereoscopic base for greening and (3) creation of sustainable environment. Omohara no Mori at Tokyu Plaza reduces CO2 by over 220t every year (equivalent to about 40,000 beech trees) with such actions as rooftop gardening, wind-power generation and power

saving using natural light. It also contributes to “biodiversity conservation” with birdhouses and watering places, connecting surrounding greeneries. As the BMA Master Plan on Climate Change is focused on urban planning and urban greening as well as CO2 emission reduction, Omohara no Mori was selected to study advanced urban development in Japan. At Kawasaki Eco Gurashi Mirai-kan, where activities are conducted to raise public awareness of global warming and renewable energy, they visited its photovoltaic power plant, Mega Solar. The district heating and cooling system of Tokyo Skytree is the first case in Japan for which geothermal heat system was introduced. Installation of the world’s top-level high-efficiency heat source equipment and large-capacity water thermal energy storage tanks that effectively use night-time power has significantly reduced energy consumption and CO2 emission, achieving top-level energy saving and CO2 reduction in Japan. This destination was selected to deepen understanding for the future introduction of district heating and cooling systems in Bangkok, which has many industrial estates.

To promote public awareness of the operations, study results of the Project were released through presentations and exhibition at a booth during the Smart City Week.

Presentation by a BMA official

Participants