Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

Final Report

Project on developing Joint Crediting Mechanism (JCM) seeds in the Water Supply Sector in the Kingdom of Cambodia

March 2014

Overseas Environmental Cooperation Center, Japan (OECC)

Executive Summary

The purpose of the "Project on developing JCM seeds in the Water Supply Sector in Cambodia" (hereinafter referred to as the "project") is to find and to formulate potential projects of the Joint Crediting Mechanism (JCM) in the Water Supply Sector in Cambodia, which is stated as one of the top priority sectors in the country's National Strategic Development Plan (NSDP) 2009-2013. The project focused on finding feasible projects for installation of renewable energy power generation, energy-efficient facility, and water leakage controlling system. Japanese technologies were introduced and experiences of the Japanese local government were shared with partnerships with Water and Sewer Bureau of the City of Kitakyushu and the members of Kitakyushu Overseas Water Business Association. The list of potential JCM projects identified in the project is in the table A.

Table A. The list of potential JCM projects identified in the project

Title	Installation of energy-efficient facility and renewable energy generation to water treatment and water intake	Prevention of water leakage in water distribution network
Facility	Water treatment and water intake in PPWSA.	Water distribution network of PPWSA
Technology	Ceramic membrane filtration system, inverter, transformer, solar power generation system	Water distribution monitoring system, GIS, a computer for monitoring, monitoring control panel, a flowmeter, transmission device
Cost estimation	Approx. JPY 0.5 - 1.5 billion	Approx. JPY 0.5 - 1.0 billion
MRV methodology	Comprehensive energy-efficient facility and renewable energy facility in water supply facilities (attachment 1)	N/A
GHG emission reduction (FS)	2,046 tCO2e	N/A
GHG emission	4,195 tCO2e	N/A

reduction (Scaling-up)		
Co-benefit	Improvement in management, reservation of water resources, and water quality by reduced electricity bill	Improvement in management, reservation of water resources, and water quality by reduced electricity bill

*Estimated by OECC according to result of interviews with companies.

There are common issues to consider for installation of different technologies; energy-efficient technology and renewable energy power generation in a water treatment plant and a water intake, and technologies for water leakage prevention. Basic design and detailed design for facility installation, as well as examining cost effectiveness of each technology and a financial plan are essential.

The table B shows the schedule of implementation of the JCM project. Detailed investigation will be conducted in the first half of the Japanese fiscal year (JFY) 2014, and start the JCM project between the last half of JFY2014 to the first half of JFY2015. The Ministry of the Environment (MOE)'s JCM supporting schemes could be utilized, such as the JCM Feasibility Study for the detailed investigation, and the JCM Model project for installing technologies. Moreover, after successful installation of technologies in PPWSA, the JCM project is expected to be expanded to the other areas in Cambodia, as well to neighboring countries.

Table B. Schedule for implementation of the JCM project

Items	2014		2015	
	First half	Second half	First half	Second half
(1) Detailed investigation				
- Basic design for installing technologies	◆→			
- Financial planning	◆→			
- Procurement process	◆→			
- Planning for monitoring	◆→			
(2) Implementation of the JCM project				
- Detailed design for installing technologies		◆→		
- Delivering and installing technologies		◆→		

- Commencing the technologies and evaluating its effect			◆——	——►
(3) Scaling-up the project to the other cities and countries				◆——►

Electricity rate in Cambodia is relatively expensive compared to the other countries in the Association of Southeast of Asian Nations (ASEAN): Electricity bill of the Phnom Penh Water Supply Authority (PPWSA) accounts for about 40% of the total operational expense (excluding depreciation cost). Therefore, needs for installing renewable energy power generation, energy-efficient facility, and water leakage controlling system in the Water Supply Sector is relatively high. Utilization of these technologies does not only reduce greenhouse gas (GHG) emissions but also generates co-benefit, as it contributes to operational improvement in water supply and providing safe water to Cambodian citizens.

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1. Overview of the Project

1.1 Objective of the Project

The purpose of the "Project on developing JCM seeds in the Water Supply Sector in Cambodia" (hereinafter referred to as the "project") is to find and to formulate potential projects of the Joint Crediting Mechanism (JCM) in the Water Supply Sector in Cambodia, which is stated as one of the top priority sectors in the country's National Strategic Development Plan (NSDP) 2009-2013. The project focused on finding feasible projects for installation of renewable energy power generation, energy-efficient facility, and water leakage controlling system. Japanese technologies were introduced and experiences of the Japanese local government were shared through partnerships with Water and Sewer Bureau of the City of Kitakyushu and the members of Kitakyushu Overseas Water Business Association.
Electricity rate in Cambodia is relatively expensive compared to the other countries in the Association of Southeast of Asian Nations (ASEAN): Electricity bill of the Phnom Penh Water Supply Authority (PPWSA) accounts for about 40% of the total operational expense (excluding depreciation cost). Therefore, needs for installing renewable energy power generation, energy-efficient facility, and water leakage controlling system in the Water Supply Sector is relatively high. Utilization of these technologies does not only reduce greenhouse gas (GHG) emissions but also generates co-benefits, as it contributes to operational improvement in water supply and providing safe water to citizens of Cambodia.

1.2 Selected Technologies and Policies

This project investigated feasibility of formulating the JCM project with below listed technologies in the table 1:

Table 1. List of technologies investigated

Terms	Definition
Ceramic membrane filtration system	A system that produces clean water using a ceramic membrane as a filter, typically consisting of membrane modules, a feed pump, a coagulation and flocculation basin and a treated water reservoir.
Inverter	An electronic devise that changes direct current (DC) to alternating current (AC).
Transformer	An electrical device that transfers energy between two circuits through electromagnetic induction.

Solar power generation system	A system that converts sunlight into electricity, typically consisting of solar modules, a power conditioner a junction box, and a power distribution panel.
Small-scale hydro power generation system	A system that produces electricity using natural flow of water, typically consisting of a water turbine, a generator and a power distribution panel.
Water distribution management system and Geographic Information System(GIS)	This system collects, stores, and monitors distribution flow, pressure, and quality of water in real time, while adjusting distribution pressure, estimating amount of water leakage, and identifying problems that allows prompt solutions.

1.3 Target Area

The Project targets the Phnom Penh City and surrounding areas.

2. Methods of the Investigation

2.1 Project Activities

The Project included the following components and activities:

Component 1: Conducting a preliminary study on assessment of low-carbon technology needs

Feasibility studies on Japanese low-carbon technologies in water sector for developing projects for the JCM was conducted through cooperation of experts from Water and Sewer Bureau of the City of Kitakyushu and Kitakyushu Overseas Water Business Association. Potential technologies were short-listed after careful consideration of current situation in Cambodia.

Component 2: Developing draft Measurement, Reporting and Verification (MRV) methodologies for introduction of water and energy saving measures under the JCM

Methods for quantitatively evaluate GHG emission reduction through installation of energy-efficient facility, renewable energy power generation, and water leakage prevention in the Water Supply Sector, were developed with cooperation of PPWSA. MRV methodologies for effective monitoring were also investigated.

Component 3: Organizing a workshop on the JCM and water and energy savings

Workshops and study sessions in Phnom Penh on the JCM and low-carbon technologies in the Water Supply Sector provided opportunities for discussions on formulation of the JCM projects by utilizing Japanese technologies and support required for implementation.

2.2 Implementation Arrangement

The implementation arrangement of the project is illustrated as the figure 1 and describe as follows:

(1) Implementation Organizations

The Project was implemented by two organizations: (i) the Phnom Penh Water Supply Authority (PPWSA), and (ii) the Overseas Environmental Cooperation Center, Japan (OECC). The Water and Sewer Bureau, City of Kitakyushu and the Pacific Consultants Co., Ltd. provided advice regularly to the PPWSA and the OECC for quality assurance of project outcomes.

(2) Advisory Organizations

The Ministry of Industry and Handicrafts, Cambodia (MIH), The Ministry of Environment, Cambodia (MOEC) will provide timely advice to the PPWSA and the OECC for smooth implementation of the Project.

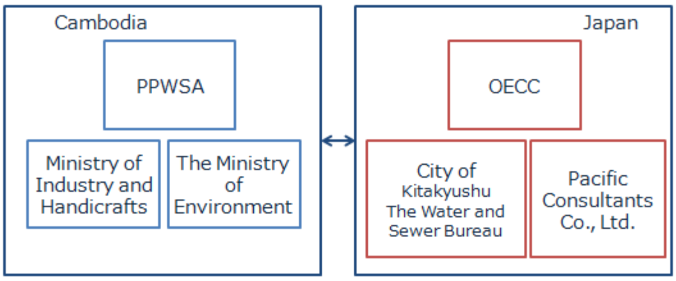

Figure 1. Implementation Arrangement

3. Result of the investigation

3.1 Activities

The table 2 describes activities of the project. Each activity progressed as planned: Workshop, study sessions on technical issues, and site visits were conducted in the three missions to Cambodia.

Table 2. Activities of the Project

<table>
<tr><th rowspan="2">Month</th><th colspan="3">Project activities</th></tr>
<tr><th>Component 1: Conducting a preliminary study on assessment of low-carbon technology needs</th><th>Component 2: Developing draft MRV methodologies for introduction of water and energy saving measures under the JCM</th><th>Component 3: Organizing a workshop on the JCM and water and energy savings</th></tr>
<tr><td>August (1st visit)</td><td colspan="3">Discussing project objectives, activities, time frame and implementation arrangement</td></tr>
<tr><td>September (2nd visit)</td><td rowspan="3">1-1 Conducting field surveys in Cambodia in corporation with technology experts</td><td>1-1 Collecting information</td><td>3-1 Organizing an inception workshop for introducing the JCM, water and energy saving measures</td></tr>
<tr><td>October</td><td rowspan="2">1-2 Quantifying GHG emission reductions by introducing water and energy saving measures</td><td>-</td></tr>
<tr><td>November</td><td>-</td></tr>
<tr><td>December (3rd visit)</td><td rowspan="2">1-2 Drafting JCM project proposals</td><td rowspan="2">1-3 Drafting MRV methodologies for introduction of water and energy saving measures under the JCM in Cambodia</td><td>3-2 Organizing study sessions on technical issues</td></tr>
<tr><td>January</td><td>-</td></tr>
<tr><td>February</td><td colspan="3">Reporting results of the project to relevant organizations</td></tr>
</table>

3.2 Outcome of the Activities: Overview

Through the project, potential JCM projects were identified in facilities of PPWSA, and methods for quantifying GHG emission reduction as well as MRV methodologies were developed in relation to "Comprehensive energy-efficient facility and renewable energy facility in water supply facilities". Furthermore, workshops, study sessions were convened to enhance understanding of officials of PPWSA and relevant Cambodian government organizations on technical issued and the JCM and Japanese technologies. Overview of the outcome of the activities is described in the table 3.

Table 3. Overview of outcome of the Activities

Activities		Outcome
(1)	Conducting a preliminary study on assessment of low-carbon technology needs	Identification of potential projects for the JCM
(2)	Developing draft MRV methodologies for introduction of water and energy saving measures under the JCM	Develop calculation methods for quantifying GHG emission reduction
(3)	Organizing a workshop on the JCM and water and energy savings	Workshops, study sessions on technical issues were conducted to enhance understanding

3.3 The result of the Component 1: Conducting a preliminary study on assessment of low-carbon technology needs

(1) Overview of potential JCM projects

The list of potential JCM projects identified through this project is illustrated in below table 4 – 8.

Table 4. The Potential JCM Projects in Phum Prek Water Treatment Plant

Technological needs	Current Situation	Proposed Technologies
Efficiency in power transmission between water treatment plants and an intake facility	The current water treatment facilities are old as they were built in 1990s. There is transmission loss between a water treatment plant to an intake facility, which is 1.3km away from each other.	Installation of high voltage substation facility, disconnector, electric receiving station, protective at intake facility to receive electricity directory from grid. This would reduce electricity consumption.

Improvement of operation & maintenance	Currently, backwash of a sand filter is conducted once in two days in dry season, and once in a day in rainy season.	Consumption of electricity could be reduced through decreasing frequency of backwash of a sand filter (could be reduced to once in two days for both seasons by adjusting amount of agglomerating agent usage).

Table 5. The Potential JCM Projects in Chamkamon Water Treatment Plant

Technological needs	Current Situation	Proposed Technologies
Alternate water purification method	Current purification method is inefficient as the process involves suspended solid contact clarifier and a filter, causing electricity cost to be relatively high.	Install membrane filtration method without consuming electricity.
Transmission between water intake and treatment plant	The current water treatment facilities are old as they were built in 1990s. There is transmission loss between a water treatment plant to an intake facility which is 0.8km away from each other.	Install a high voltage substation facility, a disconnector, an electric receiving station, a protective at intake facility to receive electricity directory from grid. This would reduce electricity consumption.

Table 6. The Potential JCM Projects in Churoy Chanwa Water Treatment

Technological needs	Current Situation	Proposed Technologies
Water supply system control	A high pump head is used to meet the maximum water demand.	Install an inverter that controls number of rotations of pumps, which would lower the height of the pump head at the minimum demand. This would contributes to reduction of electricity consumption.

Solar Power System	High dependency on electrical grid with high CO2 emission factor.	Installation of solar power on top roofs of a distribution reservoir and a pure water reservoir to reduce electricity consumption derived from fossil fuels.

Table 7. The Potential JCM Projects in Niroth Water Treatment

Technological needs	Current Situation	Proposed Technologies
Solar Power System	High dependency on electrical grid with high carbon dioxide (CO2) emission factor.	Installation of solar power on top roofs of a distribution reservoir and a pure water reservoir to reduce electricity consumption derived from fossil fuels.

Table 8. The Potential JCM Projects in Water Distribution Network

Technological needs	Current Situation	Proposed Technologies
Water distribution monitoring system	The current system was built in 1990s and does not have capacity to cover all required areas for water distribution. In addition, due to expansion of water distribution network, it is becoming difficult to manage the system with current human capacity.	Integrated water distribution monitoring system (has been installed in the City of Kitakyushu) and Geographic Information System (GIS) that adjusts water pressure and reduce water leakage.

3.4 The result of the Component 2: Developing draft MRV methodologies for introduction of water and energy saving measures under the JCM

This project identified potential MRV methodologies in the Water Supply Sector, which is listed below. The proposed JCM methodologies are described in the Attachment 1.

(1) GHG emissions reduction measures

The methodology is applicable to the project in which GHG emissions is reduced at water treatment plants and/or intake facilities in the Kingdom of Cambodia by implementing energy-saving and renewable energy measures.

(2) Eligibility criteria

Eligibility criteria of the proposed methodologies are listed in the table 9.

Table 9. Eligibility criteria

Criterion	Description	Reason for selection
Criterion 1	The project implements two or more of the following equipments with maintenance plans: (1) Ceramic membrane filtration system (2) Inverter (3) Transformer (4) Solar power generation system (5)Small-scale hydro power generation system	Requirement of a positive list of potential technologies that could be adopted in the JCM projects.
Criterion 2	The projects include training programs on operation and maintenance and develops SOP (Standard Operation Procedures) for the selected equipments.	Requirement of developing SOP and conducting training sessions on operation and management to maximize amount of GHG emission reduction.
Criterion 3	The project is implemented at water treatment plants and/or intakes facilities.	Requirement of facilities that are one of the target areas of the JCM projects.
Criterion 4	The project determines electricity consumption, fossil fuel consumption and total quantity of output at selected plants and/or facilities.	Availability of data necessary for evaluating amount of GHG emission reduction through the JCM projects.

(5) Emission sources and GHG types

Types of GHG and emission sources included in the proposed methodologies are listed in the table 10, and those being excluded are listed in the table 11.

Table 10. Types of GHG and emission sources included in the proposed methodologies

Emission sources	GHG types	Description
Grid electricity consumption	CO_2	Influenced by installations of energy-efficient facilities and/or renewable energy generation.
Fossil fuel consumption for backup generators	CO_2	Influenced by installations of energy-efficient facilities and/or renewable energy generation.

Table 11. Types of GHG and emission sources excluded in the proposed methodologies

Emission sources	GHG types	Description
Consumption of fossil fuel by vehicles	CO_2	Not influenced by installations of energy-efficient facilities and/or renewable energy generation.
Release of methane from waste water and sludge	Methane (CH_4)	Not influenced by installations of energy-efficient facilities and/or renewable energy generation.

(6) Establishment of reference emissions

Reference emissions are calculated from specific electricity consumption at water treatment plants and/or intake facilities which would stay at the same level as the past 3 years.

Generally, ability of a water supply facility on energy efficiency decreases gradually even with adequate maintenance. As shown in the figure 2, a scenario for decreased efficiency in energy consumption (increased electricity consumption per amount of water supply) has been set as BaU (Business-as-Usual). As conservative scenario, reference has been set for electricity consumption per amount of water supply to stay as the same level as before implementing the project.

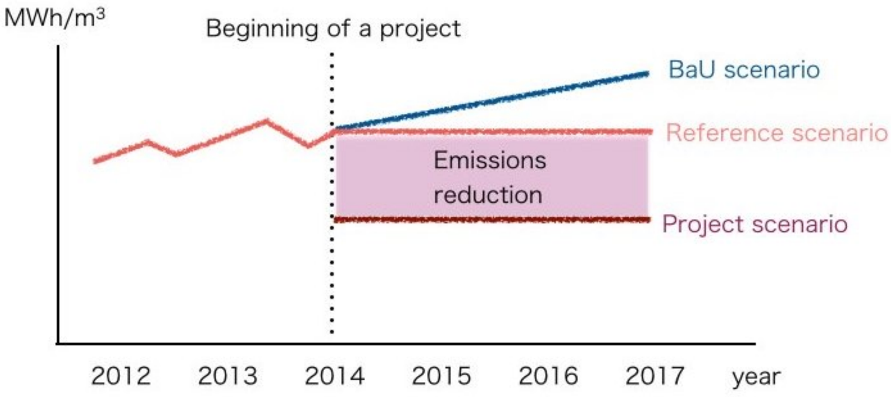

Figure 2. Concept of setting a reference scenario

(7) Calculation of reference emissions

The reference emissions are calculated as follows.

$$RE_y = SEC_{RE} * Q_{PJ} * EF_{RE}$$

$$SEC_{RE} = \frac{EG_{RE,grid} + EG_{RE,backup}}{Q_{RE}}$$

$$EF_{RE} = \frac{EF_{grid} * EG_{RE,grid} + \sum_i (SFC_{RE,i} * NCV_i * EF_{fuel,i})}{EG_{RE,grid} + EG_{RE,backup}}$$

Where:

RE_y	Reference emissions	tCO_2e/y
SEC_{RE}	Specific electricity consumption for the reference	MWh/m^3
$EG_{RE,grid}$	Electricity consumption from a Cambodian regional grid system for the reference	MWh
$EG_{RE,backup}$	Electricity consumption from backup generators using fossil fuel *i* for the reference	MWh
Q_{PJ}	Total quantity of output for the project	m^3
Q_{RE}	Total quantity of output for the reference	m^3
EF_{RE}	CO_2 emission factor for total electricity for the reference	tCO_2e/MWh
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	tCO_2e/MWh
$SFC_{RE,i}$	Fossil fuel *i* consumption for the reference	Liter

NCV_i	Net calorific value of fossil fuel i	MJ/Liter
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel i	tCO_2e/MJ

(8) Calculation of project emissions

The amount of project emissions in the proposed methodologies is considered as amount of GHG emission reduction after installation of facilities. Explanation of the calculation of the project emission is shown below. The project emission is calculated by multiplying CO2 emission factor to electricity consumption of regional grid system after implementation of the project and consumption of fossil fuel.

$$PE_y = PE_{PJ,grid} + PE_{PJ,backup}$$

$$PE_{PJ,grid} = EG_{PJ,grid} * EF_{grid}$$

$$PE_{PJ,backup} = \sum_i (SFC_{PJ,i} * NCV_i * EF_{fuel,i})$$

Where:

PE_y	Project emissions	tCO_2e/y
$PE_{PJ,grid}$	Project emissions from a Cambodian regional grid system	tCO_2e/y
$PE_{PJ,backup}$	Project emissions from backup generators	tCO_2e/y
$EG_{PJ,grid}$	Electricity consumption from a Cambodian regional grid system for the project	MWh
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	tCO_2e/MWh
$SFC_{PJ,i}$	Fossil fuel i consumption in the project	Liter
NCV_i	Net calorific value of fossil fuel i	MJ/Liter
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel i	tCO_2e/MJ

(9) Calculation of emission reductions

Amount of emission reduction will be calculated as shown below. Firstly, theoretical value of the project emission reduction was calculated to exclude voluntarily activities and set as the maximum value. All excessive value is considered as emissions from voluntarily activities.

$$ER_y = RE_y - PE_y$$

Where:

ER_y	Emission reductions	tCO_2e/y
RE_y	Reference emissions	tCO_2e/y
PE_y	Project emissions	tCO_2e/y

(10) Data and monitoring points for the calculation of GHG emission

The table 12 shows necessary data for calculating GHG emission reduction. The Figure 3 illustrates a concept for monitoring points.

Table 12. List of data necessary for calculating GHG emission reduction

Parameter	Description of data	Default value /Monitored value	Source
$EG_{RE,grid}$	Electricity consumption from a Cambodian regional grid system for the reference	Default value (P1)	Phnom Penh Water Supply Authority: the mean value in the past 3 years
$EG_{RE,backup}$	Electricity consumption from backup generators using fossil fuel i for the reference	Default value (P2)	Phnom Penh Water Supply Authority: the mean value in the past 3 years
$SFC_{RE,i}$	Fossil fuel i consumption for the reference	Default value (P3)	Phnom Penh Water Supply Authority: the mean value in the past 3 years
Q_{RE}	Total quantity of output for the reference	Default value (P4)	Phnom Penh Water Supply Authority: the mean value in the past 3 years
$EG_{PJ,grid}$	Electricity consumption from a Cambodian regional grid system for the project	Monitored value (P1)	Phnom Penh Water Supply Authority
$SFC_{PJ,i}$	Fossil fuel i	Monitored	Phnom Penh Water Supply

	consumption in the project	value (P1)	Authority
Q_{PJ}	Total quantity of output for the project	Monitored value (P1)	Phnom Penh Water Supply Authority
EF_{grid}	CO2 emission factor for electricity from a Cambodian regional grid system	Default value	Ministry of Environment, Cambodia: 0.6257 tCO2e /MWh (Operating Margin)
NCV_i	Net calorific value of fossil fuel *i*	Default value	IPCC 2006 Guidelines
$EF_{fuel,i}$	CO2 emission factor for fossil fuel *i*	Default value	IPCC 2006 Guidelines

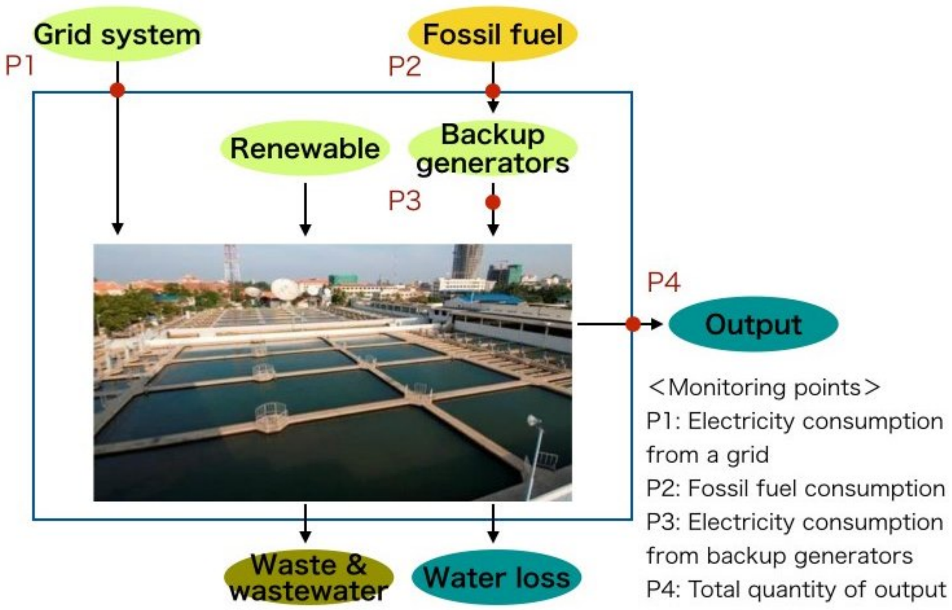

Figure 3. A concept for monitoring points

(11) Preliminary calculation of GHG emission reduction of PPWSA

PPWSA's emission reduction after implementation of the project was estimated based on the proposed methodologies mentioned above.

If amount of electricity consumption derived from fossil fuel is reduced by 10% per amount of water supply due to implementation of the project, the total annual emission reduction is estimated as 2,064tCO2e. Calculation formulas and parameters are described below:

1) Reference emissions

$$RE_y = 0.266 \times 121{,}117{,}730 \ \times \ 0.6257/1{,}000 = 20{,}158\ tCO_2e$$

$$SEC_{RE} = \frac{29{,}488{,}883}{110{,}854{,}485} = 0.266\ kWh/m^3$$

Table 13. Values used to calculate the reference emission

Parameter	Description of data	Value	Source
$EG_{RE,grid}$	Electricity consumption from a Cambodian regional grid system for the reference	29,488,883 kWh	Phnom Penh Water Supply Authority: the mean value from 2010 to 2012
$EG_{RE,backup}$	Electricity consumption from backup generators using fossil fuel i for the reference	0	Phnom Penh Water Supply Authority: the mean value from 2010 to 2012
$SFC_{RE,i}$	Fossil fuel i consumption for the reference	0	Phnom Penh Water Supply Authority: the mean value from 2010 to 2012
Q_{RE}	Total quantity of output for the reference	110,854,485 m^3	Phnom Penh Water Supply Authority: the mean value from 2010 to 2012
Q_{PJ}	Total quantity of output for the project	121,117,730 m^3	Phnom Penh Water Supply Authority: 2012
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	0.6257 tCO2e/MWh	Ministry of Environment, Cambodia
NCV_i	Net calorific value of fossil fuel i	43.0 kg TJ/Gg	IPCC 2006 Guidelines: Diesel
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel i	74,100 $kgCO_2e/TJ$	IPCC 2006 Guidelines: Diesel

2) Project emissions

$$PE_y = 0.239 \times 121{,}117{,}730 \times\ 0.6257/1{,}000 = 18{,}112\ tCO_2e$$

*This is under an assumption of 10% reduction of Specific Electricity Consumption (SEC) per amount of water supply at facilities through installation of ceramic membrane filtration system, inverter, transformer, and solar power generation system.

3) Emission reductions

$$ER_y = 20{,}158 - 18{,}112 = 2{,}046\ tCO_2e$$

(12) Calculation of emission reduction after scaling up the JCM project
The total amount of water supply in all cities in Cambodia was estimated based on the amount of water supply of 95m3 per capita in Phnom Penh in 2009 (calculated by OECC based on data of 2009 received by PPWSA and referring a report of ADB). Estimation of amount of emission reduction after scaling up the JCM project to all cities in Cambodia was calculated by using calculation formulas and parameters stated in (11). In 2009, the number of population with access to water supply was 2,614,027, with annual water demand of 248,332,565m3.
After completion of the project, if amount of electricity consumption derived from fossil fuel per amount of water supply in all cities is decreased by 10%, emission reduction is estimated as 4,195 tCO2e.

3.5 The result of the Component 3: Organizing a workshop on the JCM and water and energy savings
Workshops and study sessions conducted in Phnom Penh, on the JCM and low-carbon technologies in the Water Supply Sector provided opportunities for discussions on development of the JCM projects that utilize Japanese technologies and required support for implementation. The overview of the workshop is described in the table 14, and the contents of study sessions on technical issues are shown in the table 15. The agendas, the list of participants, and presentation materials are shown in the attachment 2.

Table 14. Overview of the workshop

Time and	Monday, 2 September, 2013, 8：30-13：00

Date:	
Venue:	Raffles Hotel Le Royal, Phnom Penh
Participants:	【Cambodian side】 Ministry of Industry and Handicrafts, the Ministry of Environment, Phnom Penh Water Supply Authority (PPWA), regional local governments (Siem Reap Water Supply Authority, Sihanoukville Water Supply, Kampot Water Supply, Kampong Cham Water Supply, Kampong Thom Water Supply, Svay Rieng Water Supply, Battambang Water Supply, Pursat Water Supply) 【Japanese side】 Embassy of Japan in Cambodia, Water and Sewer Bureau, City of Kitakyushu, Japan International Agency (JICA), JICA Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 3) , OECC
Objective:	Enhance understanding of Ministry of Industry and Handicrafts, the Ministry of Environment, Phnom Penh Water Supply Authority (PPWA), and regional local governments on the JCM and its supporting schemes. List of potential JCM projects in facilities of PPWSA is shared with Ministry of Industry and Handicrafts and regional local governments

Table 15. Overview of the study sessions on technologies

Time and Date:	Wednesday, 18 December, 2013, 14：00-16：30
Venue:	Meeting room in PPWSA
Participants:	【Cambodian side】 PPWSA 【Japan side】 Geocraft, Co., Ltd., OECC
Objective:	Enhance understanding of PPWSA officials on Japanese low-carbon technology in Water Supply Sector (water distribution monitoring system and GIS).

4. Potential JCM projects

4.1 Overview of potential implementation of the JCM projects

The list of potential JCM is listed in the table 16.

Table 16. The list of potential JCM projects

Title	Installation of an energy-efficient facility and renewable energy generation to water treatment and a water intake	Prevention of water leakage in a water distribution network
Facility	Water treatment and water intake in PPWSA	Water distribution network of PPWSA
Technology	Ceramic membrane filtration system, inverter, transformer, solar power generation system	Water distribution monitoring system, GIS, a computer for monitoring, monitoring control panel, a flowmeter, transmission device
Cost estimation	Approx. JPY 0.5-1.5 billion	Approx. JPY 0.5-1.0 billion
MRV methodology	Comprehensive energy-efficient facility and renewable energy facility in water supply facilities (attachment 1)	N/A
GHG emission reduction (FS)	2,046 tCO_2e	N/A
GHG emission reduction (Scaling-up)	4,195 tCO_2e	N/A
Co-benefit	Improvement in management, reservation of water resources, and water quality by reduced electricity bill	Improvement in management, reservation of water resources, and water quality by reduced electricity bill

*Estimated by OECC according to result of interviews with companies.

4.2 Issues related to the potential JCM projects

Further investigation is required for implementation of the identified JCM projects as stated below.

(1) Issues to consider for installation of technologies

There are common issues to consider for installation of the following technologies, namely energy-efficient technology and renewable energy power generation in a water treatment plant and a water intake, and technologies for water leakage prevention. Basic design and detailed design for facility installation, as well as examining cost effectiveness of each technology and a financial plan are essential. Furthermore, although PPWSA is interested in Japanese technologies, they are required to go through international tender process for purchasing technologies to comply their procurement guideline. Therefore, to use the JCM supporting scheme, procurement process needs to be taken into consideration for adopting Japanese technologies.

[Issues to consider for the technologies]

- Basic design and detailed design for facility installation
- A financial plan
- Procurement process
- Policy for promoting installation of Japanese technologies
- A monitoring plan

(2) Issues related to reduction of water leakage in water distribution network

Below is the list of issues related to reduction of water leakage in a water distribution network. Water distribution management system and GIS are technologies in high demand in PPWSA. However, to install the technologies as a JCM project, development of a methodology to quantify amount of water leakage prevention, made by the technologies, is essential. Moreover, development of employees' capacity to conduct operation and maintenance is indispensable for updating data sustainably after installation of the technology.

[Issues related to reduction of water leakage in water distribution network]

- Development of a methodology to quantifying amount of leakage prevention made by the technology
- A plan for employees' capacity development to conduct operation and

maintenance

4.3 Schedule for implementation of the JCM project

The table 17 shows the schedule of implementation of the JCM project. Detailed investigation will be conducted in the first half of the Japanese fiscal year (JFY) 2014, and start the JCM project between the last half of JFY2014 to the first half of JFY2015. The Ministry of the Environment (MOE)'s JCM supporting schemes could be utilized, such as the JCM Feasibility Study for the detailed investigation, and the JCM Model project for installing technologies. Moreover, after successful installation of technologies in PPWSA, the JCM project is expected to be expanded to the other areas in Cambodia, as well to neighboring countries.

Table 17. Schedule for implementation of the JCM project

Items	2014		2015	
	First half	Second half	First half	Second half
(1) Detailed investigation				
- Basic design for installing technologies	◆→			
- Financial planning	◆→			
- Procurement process	◆→			
- Planning for monitoring	◆→			
(2) Implementation of the JCM project				
- Detailed design for installing technologies		◆→		
- Delivering and installing technologies		◆→		
- Commencing the technologies and evaluating its effect			◆→	→
(3) Scaling-up the project to the other cities and countries				◆→

Attachment 1

Joint Crediting Mechanism

Proposed Methodology Form

20 February, 2014
OECC

Joint Crediting Mechanism Proposed Methodology Form

A. Title of the methodology

Energy-saving and renewable energy measures at water treatment plants (Draft)

B. Terms and definition

Terms	Definition
Ceramic membrane filtration system	A system that produces clean water using a ceramic membrane as a filter, typically consisting of membrane modules, a feed pump, a coagulation and flocculation basin and a treated water reservoir.
Inverter	An electronic devise that changes direct current (DC) to alternating current (AC).
Transformer	An electrical device that transfers energy between two circuits through electromagnetic induction.
Solar power generation system	A system that converts sunlight into electricity, typically consisting of solar modules, a power conditioner a junction box, and a power distribution panel.
Small-scale hydro power generation system	A system that produces electricity using natural flow of water, typically consisting of a water turbine, a generator and a power distribution panel.

C. Summary of the methodology

Items	Summary
GHG emissions reduction measures	The methodology is applicable to the project which reduces GHG emissions at water treatment plants and/or intake facilities in the Kingdom of Cambodia by implementing energy-saving and renewable energy measures. CDM methodology AMS-II.C. "Demand-side energy efficiency activities for specific technologies" is used as a reference for developing this draft methodology.

Calculation of reference emissions	Reference emissions are calculated from specific electricity consumption at water treatment plants and/or intake facilities which would stay at the same level as the past 3 years.
Calculation of project emissions	Project emissions consist of electricity and/or fossil fuel used in the project equipment.
Monitoring parameters	Electricity consumption, fossil fuel consumption and total quantity of output are monitored.

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	The project implements two or more of the following equipment with maintenance plans: (1) Ceramic membrane filtration system (2) Inverter (3) Transformer (4) Solar power generation system (5) Small-scale hydro power generation system
Criterion 2	The projects includes training programs on operation and maintenance and develops SOP (Standard Operation Procedures) for the selected equipment
Criterion 3	The project is implemented at water treatment plants and/or intakes facilities.
Criterion 4	The project determines electricity consumption, fossil fuel consumption and total quantity of output at selected plants and/or facilities.

E. Emission sources and GHG types

Reference emissions	
Emission sources	GHG types
Grid electricity consumption	CO_2
Fossil fuel consumption	CO_2
Project emissions	
Emission sources	GHG types
Grid electricity consumption	CO_2
Fossil fuel consumption	CO_2

F. Establishment and calculation of reference emissions

F.1 Establishment of reference emissions

Reference emissions are calculated from specific electricity consumption at water treatment plants and/or intake facilities which would stay at the same level as the past 3 years. Business-as-Usual (BaU) scenario assumes that the specific electricity consumption would increase in Cambodia without the assistance from international development partners.

F.2 Calculation of reference emissions

The reference emissions are calculated as follows.

$$RE_y = SEC_{RE} * Q_{PJ} * EF_{RE}$$

$$SEC_{RE} = \frac{EG_{RE,grid} + EG_{RE,backup}}{Q_{RE}}$$

$$EF_{RE} = \frac{EF_{grid} * EG_{RE,grid} + \sum_i (SFC_{RE,i} * NCV_i * EF_{fuel,i})}{EG_{RE,grid} + EG_{RE,backup}}$$

Where:

RE_y	Reference emissions	tCO_2e/y
SEC_{RE}	Specific electricity consumption for the reference	MWh/m^3
$EG_{RE,grid}$	Electricity consumption from a Cambodian regional grid system for the reference	MWh
$EG_{RE,backup}$	Electricity consumption from backup generators using fossil fuel *i* for the reference	MWh
Q_{PJ}	Total quantity of output for the project	m^3
Q_{RE}	Total quantity of output for the reference	m^3
EF_{RE}	CO_2 emission factor for total electricity for the reference	tCO_2e/MWh
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	tCO_2e/MWh
$SFC_{RE,i}$	Fossil fuel *i* consumption for the reference	Liter
NCV_i	Net calorific value of fossil fuel *i*	MJ/Liter
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel *i*	tCO_2e/MJ

G. Calculation of project emissions

Project emissions consist of electricity and/or fossil fuel used in the project equipment, determined as follows.

$$PE_y = PE_{PJ,grid} + PE_{PJ,backup}$$

$$PE_{PJ,grid} = EG_{PJ,grid} * EF_{grid}$$

$$PE_{PJ,backup} = \sum_i (SFC_{PJ,i} * NCV_i * EF_{fuel,i})$$

Where:

PE_y	Project emissions	tCO_2e/y
$PE_{PJ,grid}$	Project emissions from a Cambodian regional grid system	tCO_2e/y
$PE_{PJ,backup}$	Project emissions from backup generators	tCO_2e/y
$EG_{PJ,grid}$	Electricity consumption from a Cambodian regional grid system for the project	MWh
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	tCO_2e/MWh
$SFC_{PJ,i}$	Fossil fuel i consumption in the project	Liter
NCV_i	Net calorific value of fossil fuel i	MJ/Liter
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel i	tCO_2e/MJ

H. Calculation of emission reductions

The emission reductions achieved by the project activity shall be determined as the difference between the baseline emissions and the project emissions.

$$ER_y = RE_y - PE_y$$

Where:

ER_y	Emission reductions	tCO_2e/y
RE_y	Reference emissions	tCO_2e/y
PE_y	Project emissions	tCO_2e/y

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below:

Parameter	Description of data	Source
$EG_{RE,grid}$	Electricity consumption from a Cambodian regional grid system for the reference	Phnom Penh Water Supply Authority: the mean value in the past 3 years
$EG_{RE,backup}$	Electricity consumption from backup generators using fossil fuel *i* for the reference	Phnom Penh Water Supply Authority: the mean value in the past 3 years
$SFC_{RE,i}$	Fossil fuel *i* consumption for the reference	Phnom Penh Water Supply Authority: the mean value in the past 3 years
Q_{RE}	Total quantity of output for the reference	Phnom Penh Water Supply Authority: the mean value in the past 3 years
EF_{grid}	CO_2 emission factor for electricity from a Cambodian regional grid system	Ministry of Environment, Cambodia: 0.6257 tCO_2e /MWh (Operating Margin)
NCV_i	Net calorific value of fossil fuel *i*	IPCC 2006 Guidelines
$EF_{fuel,i}$	CO_2 emission factor for fossil fuel *i*	IPCC 2006 Guidelines