FY2018 Project for Ministry of the Environment Japan

FY2018 City-to-City Collaboration Programme for Low-Carbon Society

City-to-City Collaboration between Ho Chi Minh City and Osaka City

Promoting Energy Efficiency Equipment in Water Supply System

Report

February 2019

Nippon Koei Co., Ltd.
Osaka City

FY2018 City-to-City Collaboration Programme for Low-Carbon Society

City-to-City Collaboration between Ho Chi Minh City and Osaka City:
Promoting Energy Efficiency Equipment in Water Supply System

Report

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Abbreviations

Terms	Description
BAU	Business-as-usual
CDM	Clean Development Mechanism
DONRE	Department of Natural Resources and Environment
FIT	Feed-in-tariff
FS	Feasibility Study
GHG	Greenhouse Gases
HCMC	Co Chi Minh City
INDC	Intended Nationally Determined Contributions
JCM	Joint Crediting Mechanism
LCC	Lifecycle Cost
MEC	Meteorological Engineering Center Inc.
MGD	Million Gallon per day
MOU	Memorandum of Understanding
MRV	Monitoring, Reporting and Verification
NCCS	National Climate Change Strategy
NDC	Nationally Determined Contribution
NTP-RCC	National Target Programme to Respond to Climate Change
NK	Nippon Koei Co., Ltd.
PCS	Power Conditioners
PV	Photovoltaics
SAWACO	Saigon Water Corporation
USD	United States Dollars
VFD	Variable Frequency Drive
VND	Vietnam Don
WTP	Water Treatment Plant

CHAPTER 1 BACKGROUND AND OBJECTIVE OF STUDY

1.1 BACKGROUND

In December 2015, all countries participated in 21st Conference of the Parties (COP21) held in Paris, France. In the COP21, Paris Agreement was adopted as a legal framework of fair and practical countermeasure to climate change after 2020. Paris Agreement aims at keeping global warming below 2 degrees Celsius above pre-industrial level, furthermore, requires efforts to keep less than 1.5 degrees Celsius by promoting activities for decarbonization. In addition, it was decided that activities by non-state actors including cities and efforts by all non-governmental entities (cities and other local governments etc.) are acknowledged and encouraged to be scaled up in the COP21. Cities are the places to support social and economic growth since a lot of people live there. Although the total of urban areas is only 2% of all land in the world, approximately half of world population live in urban areas and the percentage is predicted to increase to 70% by 2050. Also, it is estimated that more than 70% of global CO2 emission are emitted from cities as of 2006, that is, cities have major roles for mitigation of climate change. Thus, implementation of countermeasures to climate change and greenhouse gas (GHG) emission reduction in cities are important for achievement of goal of Paris Agreement.

The Vietnamese national government has been working on countermeasures to climate change such as development of National Target Programme to Respond to Climate Change (NTP-RCC) in 2008, National Climate Change Strategy (NCCS) in 2011 and National Green Growth Strategy in 2012. Also, the country set a target of 8% of greenhouse gas (GHG) emission reduction compared to Business-as-Usual (BaU) level as Nationally Determined Contribution (NDC) and 25% reduction by international support including Joint Crediting Mechanism (JCM) which was signed in 2014 by 2030. Then, Action Plan for Paris Agreement was approved in the country in 2016.

Ho Chi Minh City (HCMC) located in south of the country is the biggest commercial city in Vietnam with population of 850 million. Because of recent economic growth, population concentration and urban sprawl have been occurring, which has been leading to environmental issues such as air pollution and water pollution, as well as the need for waste management and forest management. In addition to being geographically influenced by climate change, the amount of GHGs emission in HCMC is also increasing rapidly.

Osaka City and HCMC have been carrying out JCM City-to-City Collaboration Project regarding environment sector since 2011 and developed the Action Plan for Formulation of Low-carbon Society in HCMC in October 2013. Furthermore, in accordance with Memorandum of Understanding (MOU) which was concluded for comprehensive cooperation aiming at realization of steady urban growth, Osaka City supported the development of HCMC Action Plan for Climate Change Countermeasures 2016-2020 and Prospects until 2030. The MOU was updated as MOU on Cooperation between HCMC and Osaka City for Realization of Low-carbon City in HCMC in 2016 and the two cities are continuing their good cooperative relationship.

Table 1.1 Contribution of City of Osaka to HCMC

#	Month/Year	Overview
1	December 2009	Conclusion of MOU on technology exchange with Saigon Water Corporation (SAWACO)
2	April 2011	Launched JCM City-to-City Collaboration Project (Ongoing)
3	October 2013	Conclusion of MOU on Formulation of Law-carbon City in HCMC
4	December 2015	Update of MOU on technology exchange with SAWACO
5	September 2016	Update of MOU on Formulation of Law-carbon City in HCMC
6	September 2016	HCMC Climate Change Action Plan 2017-2020 and Prospects until 2030
7	December 2018	Update of MOU on technology exchange with SAWACO

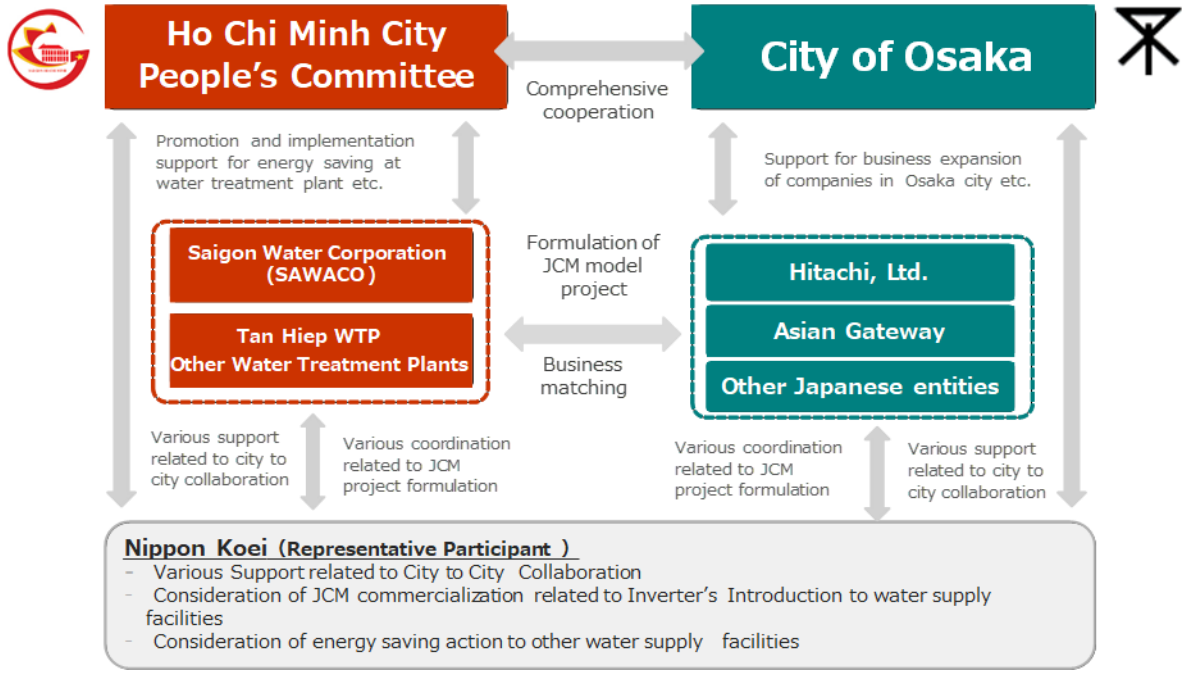
Source: Prepared by NK

1.2 PURPOSE

This project implements studies to effectively and efficiently support activities for formulation of low-carbon city in HCMC by taking advantage of experience and know-how of City of Osaka for promotion of environmental policies and low-carbon technologies of Japanese companies.

1.3 IMPLEMENTATION STRUCTUR

Table 1.1 shows implementation structure of this project. Department of Natural Resources and Environment (DONRE) of HCMC People's Committee and Environmental Bureau of City of Osaka participate in this project as representative department of each city and collaborate for solution of urban issues and formulation of low-carbon city in HCMC. In addition, in order to formulate a JCM model project, DONRE cooperates with Saigon Water Corporation (SAWACO) and support feasibility study for installation of inverters carried out by Hitachi. Also, Nippon Koei supports activities of study, project formulation of installation of energy-saving technologies as a JCM model project and consideration of MRV plan.



Source: Prepared by NK

Figure 1.1 Implementation structure

1.4 SCHEDULE

Schedule of this project is as follows.

Item		2018								2019	
(1) Study item		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	1 Confirmation of existing equipment and specification of new equipment for energy saving										
	2 Preparation of monitoring plan										
	3 License and approval matter										
	4 Coordination of International Consortium for JCM Model Project										
	5 Cost estimation, schedule preparation, budgeting procedure for JCM Model Project										
	6 Explanation about equipment operation and monitoring										
	7 Preparation of F/S for next fiscal year										
(2) Field survey/Workshop		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	1 Kick-off and Wrap-up meeting		★							★	
	2 Meeting with Ho Chi Minh City		▬		▬	▬		▬	▬	▬	
	3 Policy Dialogue		★			★					
(3) Monthly report・Meeting in Japan・Conference etc.		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	1 Monthly report	★	★	★	★	★	★	★	★	★	★
	2 Meeting in Osaka City		★	★					★		
	3 Coordination of Osaka city and Ho Chi Minh City										
	4 Progress Meeting in MOEJ	★			★			★			★
	5 JCM C2C Seminar						★				
	6 Invitation to Japan						★				
	7 Preparation of Final Report										★

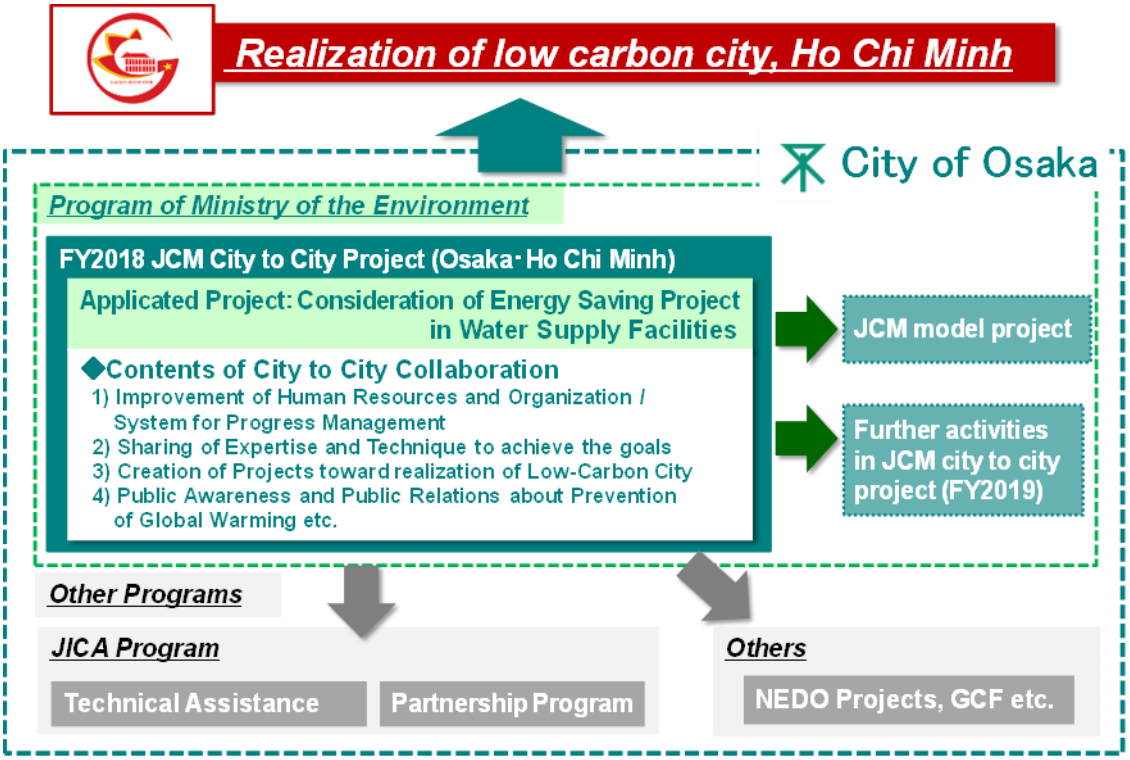
Source: Prepared by NK

Figure 1.2 Project schedule

CHAPTER 2 CITY-TO-CITY COLLABORATION FOR REALIZATION OF LOW-CARBON CITY

2.1 PURPOSE OF CITY-TO-CITY COLLABORATION

The absolute purpose of the city-to-city collaboration between HCMC and Osaka City is realization of low-carbon city formulation in HCMC thorough implementation of 'HCMC Climate Change Action Plan 2017-2020 and Prospects until 2030' and human resource development. To achieve this, both cities listed 4 contents of the city-to-city collaboration (the middle column of Figure 2.1) as main items of MOU.



Source: Prepared by NK

Figure 2.1 Direction of city-to-city collaboration between Osaka City and HCMC

To implement 2) Sharing of Expertise and Technique to achieve the goals and 4) Public Awareness and Public Relations about Prevention of Global Warming etc., the approaches below were carried out with focus on waterworks.

Table 2.1 Strategies of this project

Strategy	Approach
Strategy 1	To share achievements and current situation of energy-saving countermeasures as knowledges of Osaka City and to propose update and improvement of facilities with JCM scheme, for water sector of HCMC.
Strategy 2	To make opportunities to discuss water sector of HCMC with same acknowledgement and understandings of the both cities by introducing achievements of Osaka Municipal Waterworks Bureau as a model case of water sector and to proceed activities to achieve goals in the shortest time
Strategy 3	To consider optimization in terms of technology and finance regarding energy saving of water facilities of SAWACO (especially installation of inverters to non-inverter pumps), and to consider installing other technologies and products of Japanese companies in order to solve newly arising issues.
Strategy 4	To consider developing projects for energy-saving technologies with subsidiary scheme of JCM in order to mitigate anxieties of Vietnamese companies regarding financial aspects such as initial investment

Source: Prepared by NK

2.2 OVERVIEW OF CITY-TO-CITY COLLABORATION ACTIVITIES

Overview of city-to-city collaboration activities is shown below.

Table 2.2 Overview of city-to-city collaboration activities

Contents	Time	Overview
Kick-off meetings with related Japanese entities	April-May 2018	Kick-off meetings with related entities were implemented multiple times during the period between April and May.
Kick-off meeting with MOE (Tokyo)	10 May 2018	Based on contents of the project proposal, concrete purpose, activities and schedule of this project were explained to MOE.
1st site study (HCMC)	9-16 June 2018	1st site study was implemented by Nippon Koei, Osaka City and Hitachi. Director-level Policy Dialogue between Osaka City and HCMC and meetings with local and Japanese entities based in HCMC related to candidate JCM model projects were carried out.
2nd site study (HCMC)	13-17 August 2018	Nippon Koei implemented study for development of JCM model project with installation of 19.2MW PV by local developer, introduced by DONRE. Also, installation of Hitachi's inverters was explained to sugar factory. Furthermore, meeting with DONRE was carried out and arrangement for Mayor-level Policy Dialogue in September and City-to-city collaboration Seminar were discussed.
1st reporting meeting with MOE (Tokyo)	28 August 2018	Progress of this project after kick-off meeting was reported to MOE.
3rd site study (HCMC)	3-8 September 2018	3rd site study was implemented by Nippon Koei, Osaka City and Hitachi. Mayor-level Policy Dialogue between Osaka City and HCMC and study for formulation of JCM model Projects were carried out.

Contents	Time	Overview
Mayor-level Policy Dialogue between Osaka City and HCMC (HCMC)	6 September 2018	Mayor-level Policy Dialogue between Osaka City and HCMC was held in HCMC. Vice-chairperson of HCMC People's Committee, Mr. Hyunh Cach Mang and Vice-mayor of Osaka City, Mr.Seigo Tanaka attended to the event. Presentation and discussion regarding this project and city-to-city collaboration until 2020 were carried out.
City-to-City Collaboration Seminar and Site Visit (Yokohama and Osaka)	23-27 October 2018	2 staff of DONRE were invited to City-to-City Collaboration Seminar held in Yokohama. Before the seminar, invitees visited Osaka and site visit to company in Osaka was carried out. Also, staff of Osaka City and HCMC had presentation regarding activities of this project.
4th site study (HCMC)	12-17 December 2018	During the 4th site study, 1) Discussion regarding current situation and schedule of candidate JCM model projects, 2) Discussion with DONRE regarding request for participation to Japan Environment Week and wrap-up meeting, cooperation for development of rainfall prediction system of HCMC and sector of study in next fiscal year, 3) Meeting with SAWACO for requesting data sharing for development of JCM model project and confirming processes of tender, were carried out.
2nd reporting meeting with MOE (Tokyo)	12 November 2018	Progress of this project after 1st reporting meeting was explained to MOE.
5th site study (HCMC)	6-12 June 2018	Wrap-up meeting of this project, study for development of JCM model projects (project proposal to SAWACO) and meeting with candidate entities participating in study in the next fiscal year were carried out.
Wrap-up meeting (HCMC)	9 September 2018	Wrap-up meeting of this project was held and countermeasures to climate change in HCMC, study for development of JCM model project and study in next fiscal year were discussed.
Japan Environment Week (Hanoi)	10 January 2018	Osaka City and Hitachi participated in Japan Environment Week held by MOE and had a presentation about this project.

Source: Prepared by NK

2.3 MAYOR-LEVEL POLICY DIALOGUE BETWEEN OSAKA CITY AND HCMC

On 6 September 2018, Mayor-level Policy Dialogue between Osaka City and HCMC was held in HCMC. Vice-chairperson of HCMC People's Committee, Mr. Hyunh Cach Mang and Vice-mayor of Osaka City, Mr.Seigo Tanaka attended the event.

Agenda of this event was as follows.

Date: 6 September 2018
Venue: REX Hotel Saigon
Agenda:

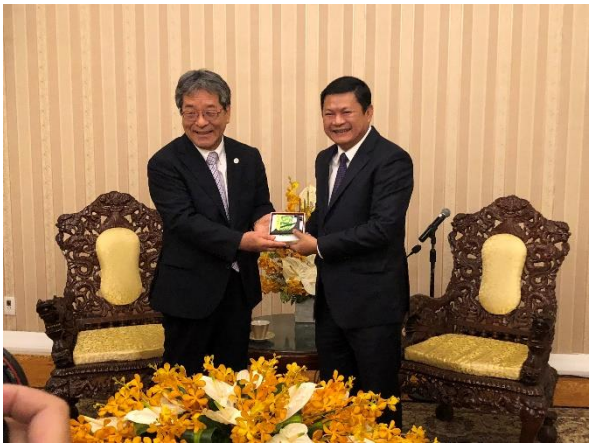
Time	Program	Presenter
8:00-8:30	Registration	
8:30 -8:40	Introduction of participants	**HA MINH CHAU** (DONRE)
8:40-9:00	Opening remarks	**HUYNH CACH MANG** (Vice Chairperson of HCMC People's Committee) **SEIGO TANAKA** (Vice-mayor of Osaka City)
Section 1: City-to-City Collaboration in FY2018 **Facilitator: MR. HA MINH CHAU (DONRE)** **MR. MASARU ISHIKAWA (Nippon Koei)**		
9:00-9:15	Activities according to HCMC Action Plan for Climate Change Countermeasure and prospect	**HA MINH CHAU** (DONRE)
9:15-10:00	City-to-City Collaboration with Osaka City for formulation of low-cabon city in HCMC	**AKIKAZU IKEGAMI** (Environmental Bureau of City of Osaka)
	Feasibility study for installation of low-carbn technologies for formlation of low-carbon city in HCMC through city-to-city collaboration	**MASARU ISHIKAWA** (Nippon Koei)
	JCM model project through city-to-city collaboration (Promotion of energy-saving technologies at waterworks facilities)	**KAZUNORI SUDO** （Hitachi Asia） **YUKO TOSHISHIGE** (Hitachi)
10:00-10:20	**Discussion**	
10:20-10:40	**Photo session and break**	
Section 2: **City-to-City Collaboration between Osaka City and HCMC until 2020 for formulation of low-carbon carbon city in HCMC** **Facilitator: MR. HA MINH CHAU (DONRE)** **MR. MASARU ISHIKAWA (Nippon Koei)**		
10:40-11:10	Rainfall prediction system for HCMC	**NOZUMU TAKADA** (Meteorological Engineering Center)
	Countermeasure to climate change adaptation ～Utilization of software for disaster preparedness～	**MAKOTO HIHARA** (Environmental Bureau of Osaka City)
11:10-11:30	**Discussion**	
11:30-11:40	**Closing remarks**	**NGUYEN THI THANH MY** (Vice-director of DONRE) **AKIKAZU IKEGAMI** (Environmental Bureau of City of Osaka)
11:40-13:30	**Reception party**	

Source: DONRE

In the policy dialogue, following the opening remarks by the vice-chairman of HCMC people's Committee and vice-mayor of Osaka City, DONRE, Environmental Bureau of Osaka City, Nippon Koei and Hitachi presented the direction of this project, overview and progress of the study etc. Discussion during discussion session covered: revision of tender system, which is considered to be a bottleneck of JCM model projects implemented by Business to Government (B to G) such as installation of inverters to facilities of SAWACO. Vice-mayor of Osaka City proposed to utilize comprehensive evaluation system (evaluation of function and cost of installed equipment and influences on project sites (capacity building of workers etc.)).

During Section 2, Mr.Tanaka of Meteorological Engineering Center from Osaka City explained the detail of rainfall prediction system which has been one of interests of HCMC since before. After that, Mr.Mihara of Osaka City had a presentation in regard to utilization and result of disaster preparedness application developed by Osaka City

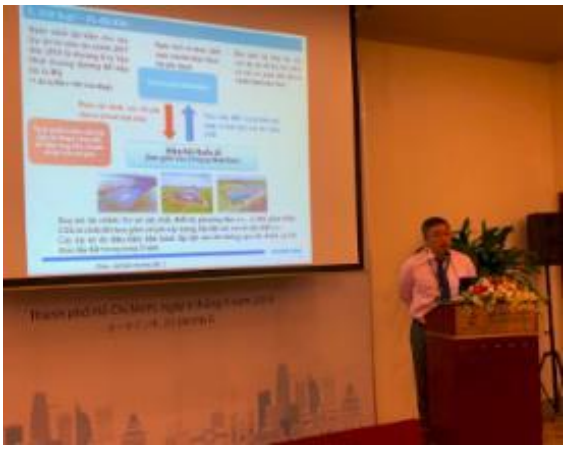
In closing remarks, vice-director of DONRE, Ms.Thanh mentioned that: 1) DONRE will internally discuss solutions to solve antinomy between policies and JCM schemes in order to crystallize JCM model project, 2) DONRE would like to implement FS regarding sewage facilities, transportation and energy saving of buildings in addition to study targets until now, 3) DONRE would like to develop project for installation of PV system to Binh Dien Wholesale Market by utilizing JCM subsidy., 4) DONRE will encourage for formulation of JCM model projects, and 5) DONRE would like to share more experiences of Osaka City regarding countermeasures to climate change.



Mr.Tanaka, vice-mayor of Osaka City and Mr.Cach vice-chairperson of HCMC People's Committee

Presentation by Mr.Chau (DONRE)

Presentation by Mr. Ikegami (Osaka City)



Presentation by Mr.Ishikawa (Nippon Koei)

Presentation by Ms.Toshishige (Hitachi)

Group photo

2.4 JCM CITY-TO-CITY COLLABORATION SEMINAR

When JCM City-to-city Collaboration Seminar was held by Ministry of the Environment Japan (MOE) on 25 and 26 October 2018, 2 staff of DONRE below were invited and stayed in Japan from 23 - 27 October.

Mr. Tran Vinh Sa : Division of Meteorology, Hydrology and Climate change, DONRE
Ms. Au Ngoc Lien : Division of Solid Waste Management, DONRE

The two invitees stayed in Osaka on 23 October and visited buildings owned by Daibiru and were explained about measures and technologies regarding green building.

On 25 October, City-to-city Collaboration Seminar was held in Yokohama and participants from cities implementing City-to-City Collaboration projects had presentations regarding their activities and results. For this project, Mr.Nakaaki of Environmental Bureau of Osaka City presented overview of activities through collaboration with HCMC and study activities

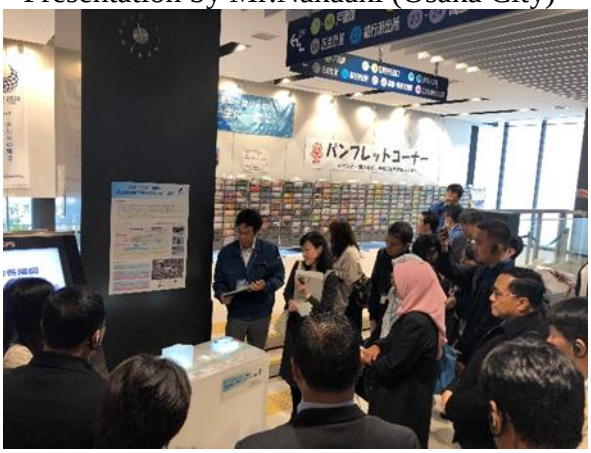
of this year while Ms.Lien of DONRE presented about overview of HCMC and expectation to support of Osaka City through collaboration with Osaka City.

The invitees participated in site study session on 26 October. In this session, overview and revision of Yokohama City Action Plan for Global Warming were explained at first. Then, they visited to the Minami Ward Office Building which achieved S Rank by CASBEE Yokohama and installed technologies for energy saving and rooftop garden were explained.

Site study at building owned by Daibiru

Presentation by Mr.Nakaaki (Osaka City)

Presentation by Ms.Lien (DONRE)



Site study at Minami Ward Office Building

2.5 WRAP-UP MEETING

On 9 January 2019, wrap-up meeting of this project was carried out in the office of DONRE. In the meeting, climate change adaptation measures, FS for JCM model projects formulation in this project and FS in next fiscal year were discussed.

1) Discussion regarding climate change prediction

Regarding prediction technology of climate change adaptation, additional explanation and opinion exchange through cooperation were carried out.

Meteorological engineering center based at Osaka has been proceeding development of application which can be used in HCMC. In this meeting, MEC reported what they confirmed up to this day and requested for rainfall data in order to improve accuracy of prediction (repeatability). DONRE recommended them to directly contact to Southern Weather Forecasting Station of HCMC for data sharing. Also, it was confirmed that the chairperson of HCMC approved this activity and further cooperation continues.

2) Progress report of this project

Progress of FS for installation project of inverters to Tan Hiep 1 WTP managed by SAWACO as JCM model project was reported. Dr.Ann of DONRE promised to share the progress report with the director of DONRE and to continue cooperation for development of JCM model project.

Although it was confirmed that SAWACO is considering installation of Hitachi's inverter positively, implementation of tender according to procurement system of SAWACO could become a future concern. To solve this concern, stakeholders of both Japan and Vietnam sides understood importance of cooperation for procurement by SAWACO. According to section 3.3, supports for application to JCM model project are carried out from now on.

3) Cooperation request for the project in next year 2019

CCAP of HCMC set numeric goals such as 'to let 10% of main energy-consuming companies obtain the certificate of ISO50001', 'to increase rate of renewable energy to 1.74% of total consumed energy' and 'to decrease to 5% of electricity loss rate' To achieve these goals, City of Osaka proposed hotels, data center and cement factories as a target of FS in FY 2019.

It was agreed that DONRE share information with Department of Industry and Trade (DOIT), Department of Tourism (DOT) and HCMC Export Processing and Industrial Zone Authority (HEPZA) and request for support and introduction of FS target. Scheme for next fiscal year and collection of related information are launched from now on.

For individual technology, participation and its schedule of Japanese companies, which are extending their business in HCMC, were explained.

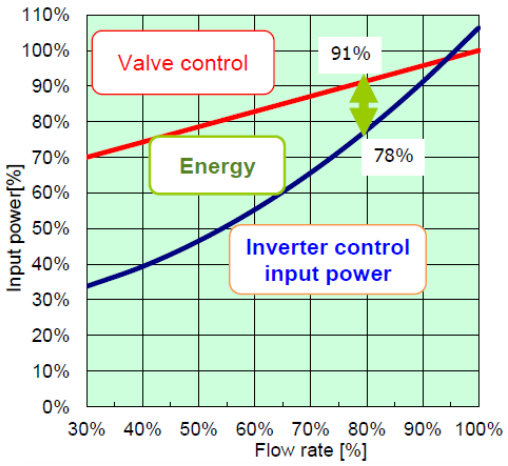
CHAPTER 3 JCM PROJECT FORMULATION STUDY

3.1 APPLIED TECHNOLOGY (INVERTER)

In case there is no inverter for pumps, flow rate of pumps and fans is controlled by valves and dampers respectively. At that time, the motors that drive the pumps or fans rotate and consume energy, while the valve or damper reduces flow rate mechanically. Large energy loss is occurred at valves and dampers. when the flow becomes lower than the rated capacity of pump or fan, the loss becomes larger.

The variable-frequency-drive (VFD) inverter can control motor rotation speed by changing frequency, which can adjust the flow rate. Theoretically, power consumption is proportional to the cube of the rotation speed. By reducing motor rotation speed according to the flow rate, VFD inverter can save energy compared to valve/damper control.

An example of power consumption comparison between valve control and inverter control is shown in the figure to the right.



Source: Hitachi Ltd.

Figure 3.1 Energy Saving by the Inverter Control

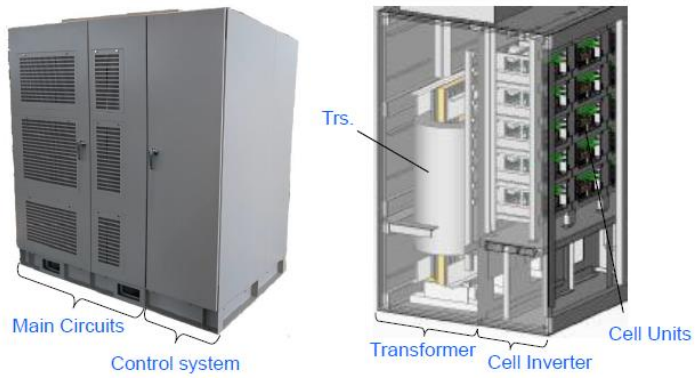
The VFD inverter to be considered in the formulation of JCM project has the following characteristics.

1) High performance and high efficiency

   The efficiency of the inverter is 97% and the power factor is 95% or above

2) Compact, lightweight, all-in-one

   The VFD inverter unit is compact compared with the conventional unit. It can fit to even low ceiling and small rooms. The volume of the inverter is smallest among the same types of products by different companies. All-in-one structure is enabled through unique parts layout and cooling techniques, which enables transportation by a forklift. Thus, construction and installation cost is lower than other product. Workability is good in installation, operation and maintenance.



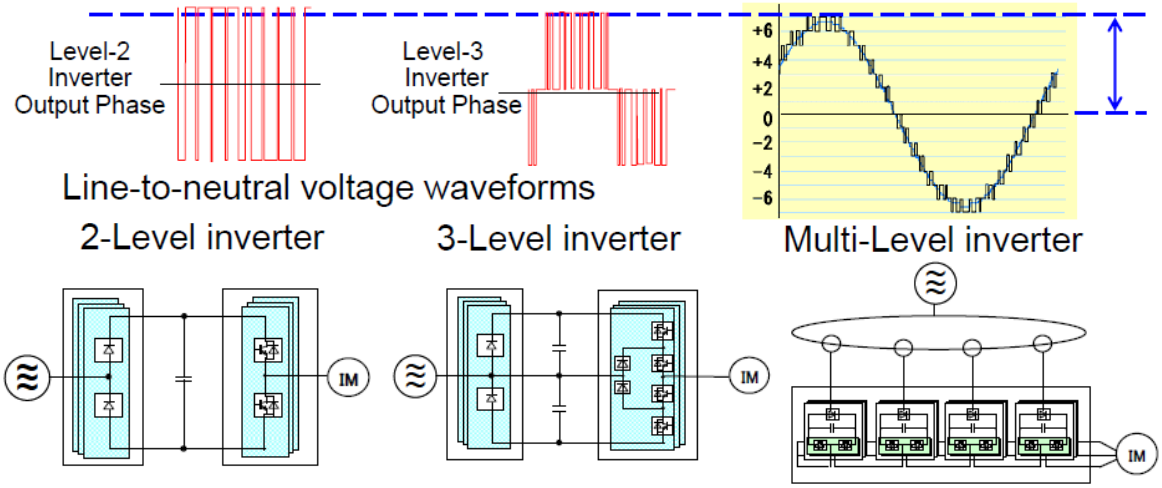
Source: Hitachi Ltd.

Figure 3.2 Appearance of VFD Inverter

3) Smooth sine waveform, no need harmonic filtering

By multi-level transformers in the inverter, harmonic wave sent to the demand side is suppressed. Both voltage and current wave become similar to sine curve, and no harmonic wave filter for power source is necessary.

By the combination of inverter cells, the output wave will be near to sine curve, and the stress to control target motor is reduced. Special heat prevention or insulation are not necessary.



Source: Hitachi Ltd.

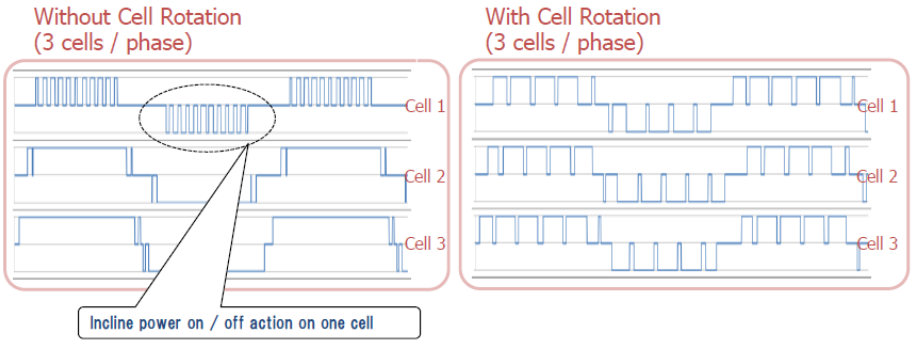
Figure 3.3 Output Sin Curve and Circuit of Inverter

4) Reliability, Availability, Serviceability (RAS) Function

RAS function supports the maintenance such as collection of operation data, trace-back data, and display of malfunction factors.

5) Cell-rotation and cell power homogenization control

Cell-rotation helps to equalize power-on duration and heat generation in each power cell, and reduces possibility of specific power cell failure.



Source: Hitachi Ltd.

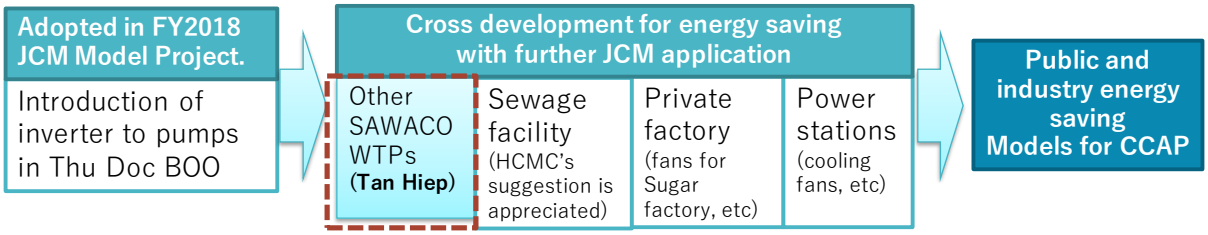
Figure 3.4 Cell Rotation Function of Inverter

3.2 SELECTION OF JCM MODEL PROJECT

In Ho Chi Minh city, energy saving potential by installation of inverters are thought to be large in public facilities including water supply system and roads, private factories, and power stations.

In the water supply system, Saigon Water Corporation (SAWACO) supplies 2,400,000 m^3/day water to Ho Chi Minh city. It intakes water from Saigon River and Don Nai River, and processes water at water treatment plants (WTP), and distribute water with pumps. Of the water treatment plants, Thu Duc BOO WTP has already installed inverters in JCM Model Project FT2018 for energy saving of pumps.

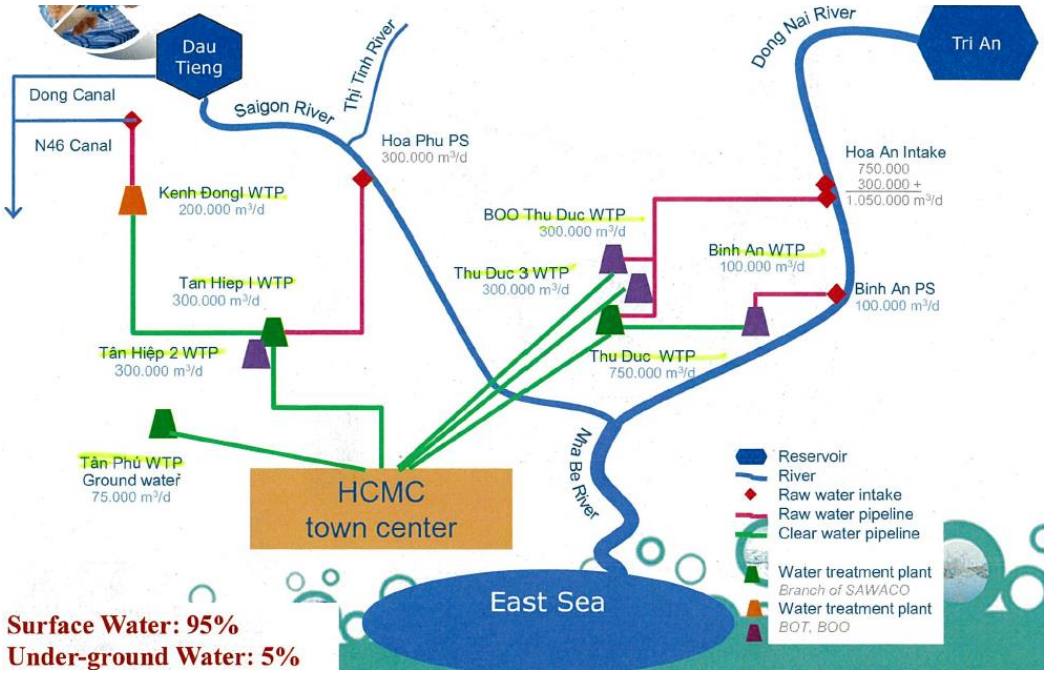
In this study, as the cross development of Thu Duc BOO, additional possibility for introduction of inverters in SAWACO water treatment plant was studied. In addition, the energy saving potential by inverters in other public facility and private factories were also investigated.



Source: Prepared by NK

Figure 3.5 Cross Development of Energy Saving Project by Inverter

Operation conditions of pumps in each WTP managed by SAWACO and sewage treatment plant under DONRE were studied and the target site for inverter installation was selected after the discussion with SAWACO accordingly. The outline of SAWACO WTP are shown in the figure below.



Source: SAWACO

Figure 3.6 Water Supply in Ho Chi Minh City

The result of the study about inverter application in 10 WTPs of SAWACO and sewage treatment plant of DONRE is summarized in Table 3.1.

It is necessary to obtain data such as pump flow and operation hours to investigate the energy saving amount by inverters. When multiple number of pumps are controlled and pump are stopped or operated at load around its rated capacity, the energy saving effect by inverters is small. When pump is operated at low load for a long time, energy saving effect by inverter will be large. In addition, inverter has small effect for low voltage pump. Thus, high voltage pump is preferred for energy saving project.

Accordingly, target facility was selected considering the following matters.

- Operation data acquisition is possible throughout a year
- High voltage pump (more than 3.3 kV) is installed
- Low load operation is conducted, without economic control by multiple number of pumps operation

As the result of above study, it was concluded that two 1,500 kW pumps and one 1,411 kW pump in Tan Hiep-1 WTP under SAWACO have large potential of energy saving by inverters. Thus, inverter application in Than Hiep-1 WTP was selected as the candidate of FY2019 JCM Model Project.

Table 3.1 Result of Study for Inverter Application in Water Facility in Ho Chi Minh

Location	Capacity m3/d	Ownership	Pump / equipment	Remark
Hoa An Intake	750,000	SAWACO 100%	6 pump, 4.16 kV	No needs
Hua An In(TDW)	300,000	Manila water, other	4 pumps, Inverter to be installed	No possibility
Thu Duc WTP	750,000 (Current 500-600,000)	SAWACO 100%	1500kW x2 pumps New 4160V 3 pumps	No possibility
Thu Duc BOO	300,000	Manila water, other	Inverters to be installed	FY2018 JCM model project
Thu Duc 3 SWIC	300,000	SWIC, SAWACO60%	Inverters already installed.	No possibility
Hua Phu PS	300-600,000	SAWACO 100%	5 pumps	No needs
Kenh Dong WTP	250,000 x 2	Manila water ,other	Low voltage only	Plan for 6.6 kV
Tan Hiep 1 WTP	150-300,000	SAWACO 100%	6kV 1500kW x2units 6kV 1411kW x 1 unit	3 pumps evaluated
Tan Hiep 2 WTP	300,000	SAWACO25%	3 pumps	No possibility
Tan Phu WTP	75,000	SAWACO 100%	Low voltage only	No possibility
Binh Gung waste water treatment	--	Government	3.3 kV Blower	Operation data is requested

Source:: Prepared by NK based on information from Hitachi and SAWACO

The location on Hiep-1 Water Treatment Plant and photos of the location and target pump is shown in the figure below.

Source: Prepared by NK using https://www.abysse.co.jp/world/map/country/asia/vietnam.html, Google Map

Figure 3.7 Site Location of Tan Hiep-1 WTP

Figure 3.8 View of Tan Hiep-1 WTP and Target Pumps for Inverter

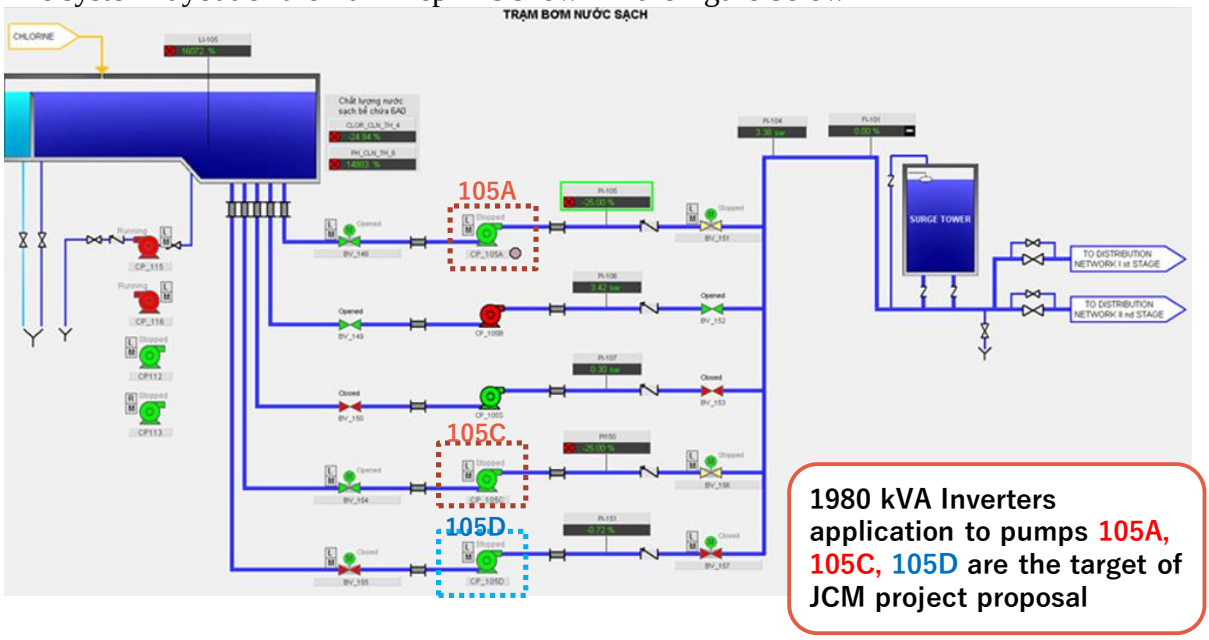
3.3 JCM MODEL PROJECT PLAN

3.3.1 Equipment Specification

(1) Target Pumps for Inverter Application

Tan Hiep-1 Water Treatment Plant (WTP) provide water at 300,000 m^3/day with five pumps. The project plans to install inverters to two or three pumps in the WTP.

The system layout of the Tan Hiep-1 is shown in the figure below



Source:: Prepared with SCADA system monitor in Tan Hiep-1

Figure 3.9 Target Pumps for proposed VFD Inverters in Tan Hiep-1 WTP

(2) Inverter Specification

The equipment to be installed is variable-frequency-drive (VFD) inverter. The specification of the VFD inverter is summarized in the following table.

Table 3.2 Specification of VFD Inverter

No.	ITEM	SPEC
1	Application	Pump
2	Motor ratings	1500 kW, 6000 V, 3 Phase, 6P, 50 Hz, Rated motor current: 179 A
3	VFD Voltage class	Input: 6000 V, Output: 6000 V
4	VFD Rated capacity	1980 kVA
5	VFD Rated current	191 A
6	VFD overload capability	110% for 1 min. (100% = 191 A)
7	VFD topology	Cascaded H-Bridge multilevel IGBT drive
8	Structure	Type: Self-standing cubicle type Protection: IP20 Cooling method: Forced ventilation by integral fan Cable entry: From bottom Cable entry plate: Steel

Source:: Hitachi Industrial Equipment System

(3) Monitoring Plan

The VFD inverter will be installed at the input side of the pump motor. The monitoring is conducted with a measurement of input power consumption of pumps. The data such as power consumption after the inverter introduction will be collected and transmitted to management building through the existing SCADA, which makes remote monitoring possible.

(4) Operation and maintenance

Hitachi has already installed its inverter to other SAWACO water facility, and has already provided operation training to SAWACO. Hitachi and EPC contractor will also conduct trainings on operation and maintenance to engineers in Tan Hiep-1 WTP too. General spare parts necessary during equipment life will be included in the investment cost. Other repairing necessary dues to incidents not foreseen will be taken care through EPC contractor with an additional order.

3.3.2 Calculation of CO2 Emission Reduction

There are no approved methodologies concerning energy saving by inverter application to water pump. Accordingly, the CO2 emission reduction calculation formula is prepared in this study with the following method.

The reference emission reduction is calculated with the following formula.

$$RE_p = \sum_{\alpha}\sum_{i}(PP_i \times VR_{\alpha,i} \times t_{\alpha,i} \times \frac{1}{1000} \times EF_{elec})$$

RE_p *: Reference emissions during the period p [tCO2/p]*

PP_i *: Power of Pump i [kW]*

$$PP_i = \frac{SP_i}{ME_i}$$

SP_i: Shaft Power of Pump i [kW]

ME_i: Motor Efficiency of the inverter for Pump i [-]

$VR_{\alpha,i}$ *: Valve Power Ratio of pump i at operation rage* α

EF_{elec} *: CO_2 emission factor for consumed electricity [tCO_2/MWh]*

$t_{\alpha,i}$ *: Operation hour of pump i at the operation range* α

α *: Range of flow rate x%, as shown in the table above*

Table 3.3 Flow Range, Flow, Valve Power Ratio, and Inverter Power Ratio

Flow Rate Range α	Flow Rate x%	Valve Power Ratio VR%	Inverter Power Ratio IR %
1	0≦x<30	70	34
2	**30≦*x*<40**	74	39
3	**40≦*x*<50**	79	47
4	**50≦*x*<60**	83	55
5	**60≦*x*<70**	87	66
6	**70≦*x*<80**	91	78
7	**80≦*x*<90**	96	91
8	**90≦*x*<100**	100	106

Source:: Prepared by NK based on information from Hitachi

The project emission PE_p is calculated with the following formula.

$$PE_p = \sum_{\alpha}\sum_{i}(PP_i \times IR_{\alpha,i} \times t_{\alpha,i} \times \frac{1}{1000} \times EF_{elec})$$

PE_p : Reference emissions during the period p [tCO_2/p]

PP_i : Power of Pump i [kW]

$$PP_i = \frac{SP_i}{ME_i}$$

SP_i : Shaft Power of Pump i [kW]

ME_i: Motor Efficiency of the inverter for Pump i [-]

$IR_{\alpha,i}$: Inverter Power Ratio of pump i at flow rate rage α

EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

$t_{\alpha,i}$: Operation hour of pump i at the operation range α

α : Range of flow rate x%, as shown in the table above

The emission reduction is calculated with the following formula.

$$\mathbf{ER_p = RE_p - PE_p}$$

In the above proposed methodology, the operation range is set every 10% step of pump flow rate (ex. 30-40%, 40-50%, 50-60%). The minimum value of the difference between power consumption by valve control and that of VFD control is applied in each range.

Deep color area as shown in the figure in the right indicates conservative calculation for the energy saving.

The pump power consumption with the valve control is assumed from the pump data of WTP. The pump power consumption with VFD is according to the manufacture's specification.

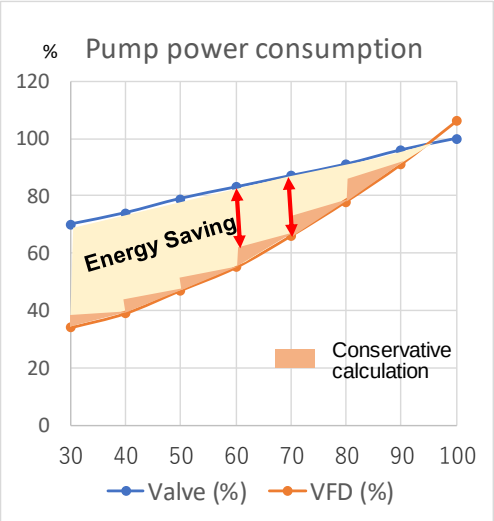


Figure 3.11 Conservative Energy Saving Calculation according to Ranges of Pump Flow Rate

Based on the above proposed methodology, CO2 emission reduction amount was calculated as shown in the table below. The target number of pumps for inverter control is two pumps or three pumps, which is depending on budget of SAWACO.

Table 3.4 Calculation of CO2 Emission Reduction by Inverter Control

(1) Inverter for Two Pumps

Pump	Shaft power (kW)	Motor efficiency assumed by Inverter	100% of Power consumption (kW)	Flow rate (%)	Annual operation time (hr)	Power consumption with valve VR (%)	Power consumption with VFD IR (%)	Power saving (kW)	Energy saving (kWh/year)	CO2 Reduction (tCO2/year)
105A	1411	0.95	1485	35	3,370	74	39	520	1,751,558	1,428
105C	1500	0.95	1579	50	3,822	83	55	442	1,689,783	1,377
TOTAL									3,441,340	2,805

(2) Inverter for Three Pumps

Pump	Shaft power (kW)	Motor efficiency assumed by Inverter	100% of Power consumption (kW)	Flow rate (%)	Annual operation time (hr)	Power consumption with valve VR (%)	Power consumption with VFD IR (%)	Power saving (kW)	Energy saving (kWh/year)	CO2 Reduction (tCO2/year)
105A	1411	0.95	1485	35	3,370	74	39	520	1,751,558	1,428
105C	1500	0.95	1579	50	3,822	83	55	442	1,689,783	1,377
105D	1500	0.95	1579	50	3,445	83	55	442	1,523,103	1,241
TOTAL									4,964,444	4,046

Source: Prepared by NK

From the above table, the project emission reduction amount and cost performance in JCM Model Project is estimated as shown in the table below.

Table 3.5 Project CO2 Emission Reduction and Cost Performance

Item	for 2 pumps	for 3 pumps	unit
CO2 grid emission factor	0.815		tCO2/MWh
Annual Emission Reduction	2,805	4,046	tCO2
Legal Life	15	15	years
Project CO2 Emission Reduction	42,070	60,690	tCO2
Cost Performance	1,511	1,533	JPY/tCO2

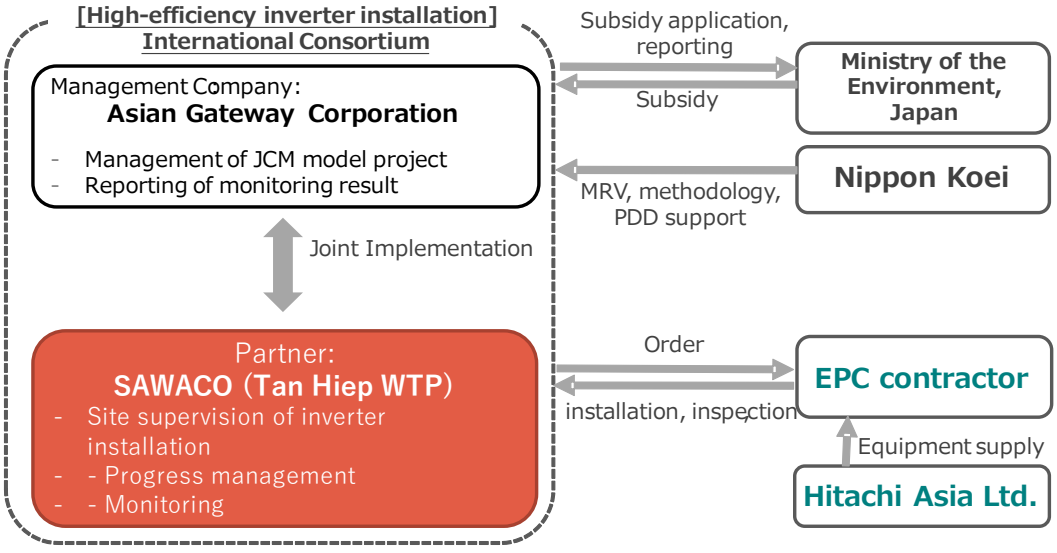
Source: Prepared by NK

From the above table, the annual CO2 emission reduction is calculated to be 2,805 tCO2/year for inverters for two pumps and 4,046 tCO2/year for inverters for three pumps. In both cases, the cost performance will be less than 2,000 JPY/tCO2, which will meet the requirement of JCM Model Project Application.

3.3.3 International Consortium for JCM Model Project

The international consortium structure for the application on JCM Model Project is assumed as shown in the figure below.

Asia Gateway Corporation will be the representative company and manages JCM Model Project implementation, confirmation and reporting of monitoring result. The project participant is SAWACO, and it manages budget allocation, progress management, and monitoring. Hitachi Asia will supply the VFD inverters. Local EPC contractor will conduct electrical works and installation of VFD inverters. . Nippon Koei Co., Ltd. will support the preparation of Project Design Document (PDD), validation, project registration, preparation of the monitoring report, and verification.



Source: Prepared by NK

Figure 3.12 International Consortium Structure for Inverter Installation

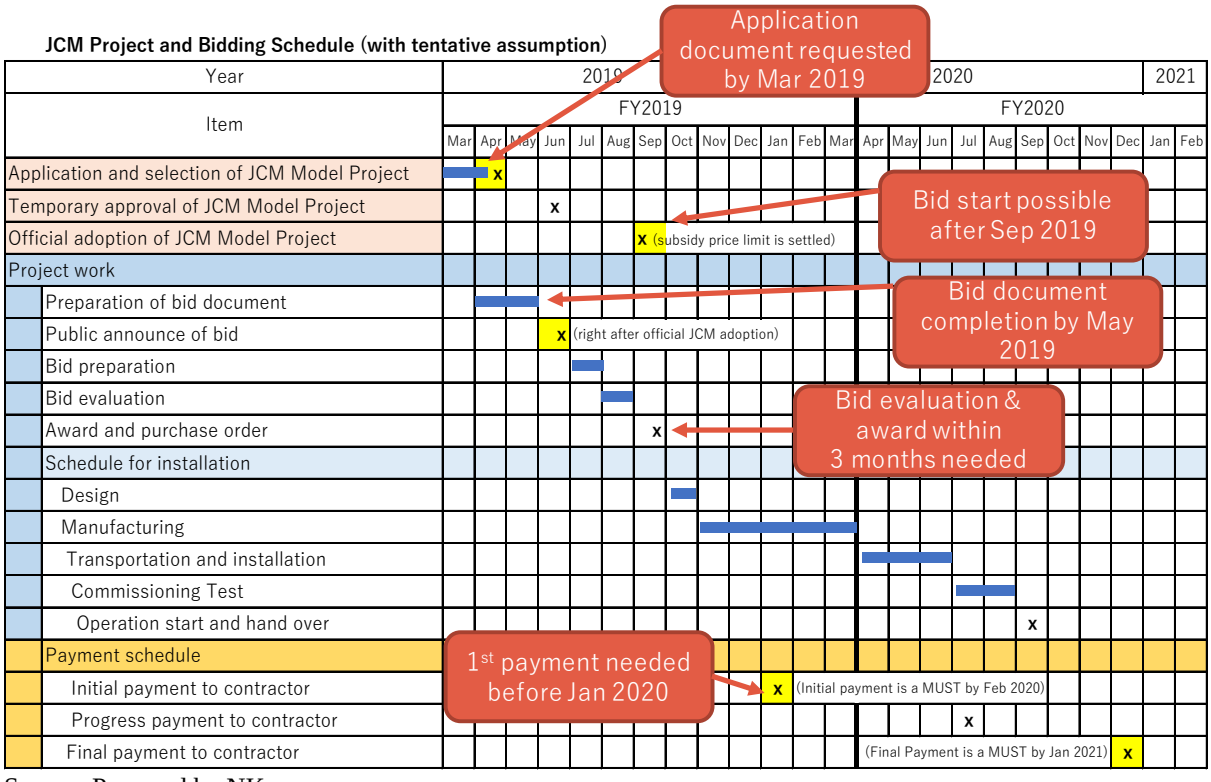
3.3.4 Schedule of JCM Model Project

Since SAWACO is public company, it cannot avoid conducting bidding according to Vietnamese law and regulation of Ho Chi Minh city. For the JCM Model Project application with bidding, it is necessary to coordinate the schedule of bidding with the process of JCM Model Project. Especially, it needs to take account of the following matters.

- Budget approval in SAWACO has to be done before the timing of the application of JCM Model
- By the temporary approval notice, SAWACO needs to complete bidding document and the bidding document needs to be approved in SAWACO
- Right after the temporary approval, public announcement of bidding has to be conducted
- Public announcement of bidding, bid submission, bid evaluation, holding bid evaluation committee, bid result approval, award, and contract negotiation have to be completed before December 2019
- Initial payment has to be made by January

Period necessary for SAWACO's bid preparation is assumed. Considering above matters, the draft schedule for the application of JCM Model Project in FY2019 is shown below.

Table 3.6 Implementation Schedule of JCM Model Project



Source: Prepared by NK

It needs to confirm the SAWACO budget allocation in FY2019 for implementation of JCM Model Project and determine the bidding schedule. As soon as the coordination with bid schedule is conducted, they will prepare the application of JCM Model Project in FY2019.

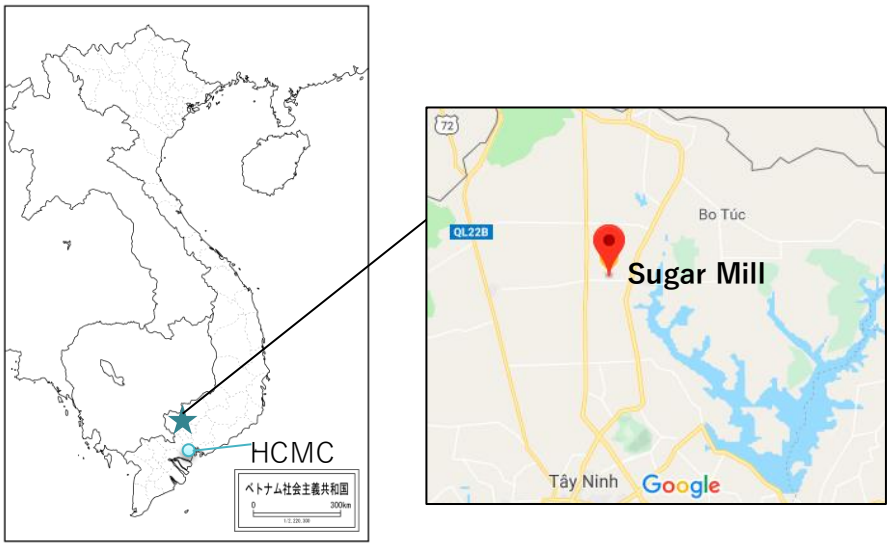
3.4 OTHER CANDIDATE JCM MODEL PROJECTS

In addition to the project formulation about inverter application in SAWACO water treatment plant, additional JCM project formulation activities were conducted during the Study period for (i) introduction of inverter for fans in a sugar mill in Ho Chi Minh area and (ii) 19.2 MW solar PV generation system. In this section, such additional JCM project formulation studies are described.

3.4.1 Energy Saving by VFD Inverter in Sugar Mill

A sugar factory owns nine sugar mills in and outside of Vietnam. Of them, a sugar mill located 50 km north to Ho Chi Minh has steam fans (680 kW and 1,550 kW). It has a plan to install the inverters for respective fan and reduce energy consumption. Thus, energy saving and CO2 emission reduction project was formulated for the sugar mill.

The location of the target sugar mill is shown in the figure below.



Source: Prepared with map from http://www.freemap.jp/itemFreeDlPage.php?b=asia&s=vietnam, Google Map

Figure 3.13 Location of Sugar Mill

The result of CO2 emission reduction calculation in the above sugar mill is shown in the table below.

Table 3.7 Result of CO2 Emission Reduction in Sugar Mill by Inverter

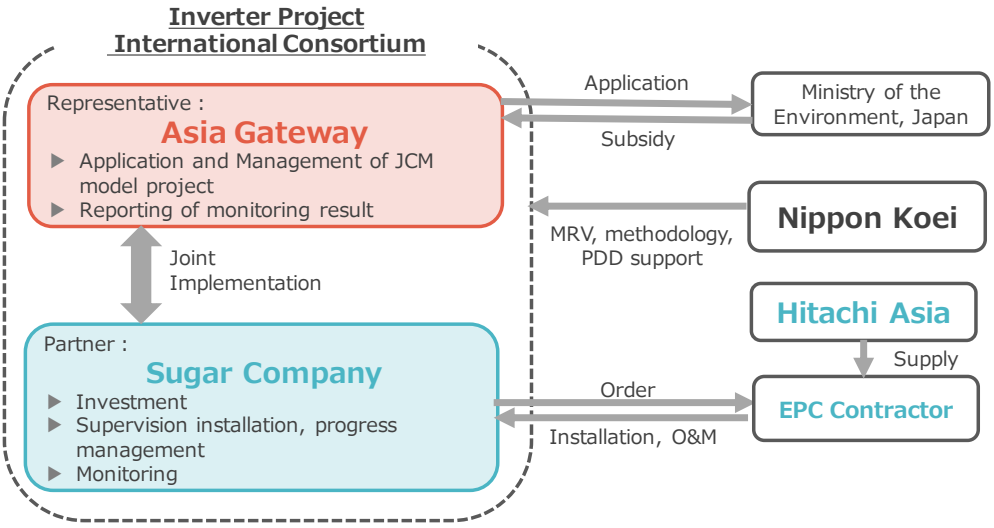
Item	Amount	Unit
Energy Saving Amount	4,094,595	kWh
CO2 Grid Emission Factor	0.815	tCO2/MWh
Annual emission reduction	3,337	ton CO2/yr
Operation years	10	years
Total emission reduction	33,371	ton CO2
Subsidy %	40%	
Subsidy amount	800,000	
Cost Performance	2,673	JPY/tonCO2

Source: Prepared by NK

In the above factory, a 20 MW biomass generation system is installed for internal power supply in the factory. The fuel is bagasse. Most of the generated energy is sold to the grid. By the introduction of inverter, the energy saving reduces the internal power consumption. The saving of internal power equals to the increase of grid power supply. Thus, same concept of grid energy saving is applied in the above CO2 emission reduction calculation.

The annual emission reduction is more than 3,000 tCO2/year and the cost performance is less than 3,000 JPY/tCO2. This amount is preferable as the JCM Model Project.

The proposed International Consortium structure is shown in the figure below.



Source: Prepared by NK

Figure 3.14 International Consortium Structure for the Installation of Inverters in Sugar Mill

There is a plan to replace the target fan in the above factory. It is necessary to review the fan operation mode after the replacement for confirmation of emission reduction amount. In addition, the subsidy amount for the inverter installation project in sugar mill will not leach 50 million JPY, which is the indication of the scale requirement in JCM Model Project. Accordingly, it is considered to combine the same type of projects of other sugar mills which is owned by the same company in Vietnam to make the project scale large.

JCM Model Project application will be conducted after confirming the above aspects.

3.4.2 19.2 MW Solar PV Generation System

In Viet Nam 7th Power Development Plan (PDP7), the target of renewable energy percentage is set to be 21% in 2030[1]. It stipulates about Feed-in-Tariff (FIT) of PV system at 2,086 VND/kWh with the power purchase period at 20 years, on condition that the grid connection and commencement is done by 30 June 2019. The cell efficiency has to be more than 17%. The PV energy will be purchased by Vietnam Electricity (EVN).

An electrical equipment supplier company with head office located in Ho Chi Minh city is planning 19.2 MW PV generation project to apply FIT as a developer. The PV system site was once utilized as fish cultivation pond in Quang Nguay province. F/S was already conducted and basic design was completed. The land use permission has been obtained from local government, and the connection agreement with EVN was completed. However, funding procurement is an issue. Thus, the project developer requested the subsidy from JCM scheme, and the project was studied for the possibility of application to JCM.

Source: : https://www.abysse.co.jp/world/map/country/asia/vietnam.html, Google Map

Figure 3.15 Location of 19.2 MW PV Generation System

Figure 3.16 Photos of PV Generation System Site

[1] Presidential Order 11/2017/QD-TTg was issued on 1 June 2017 concerning solar PV generation.

For the PV system, VN_AM007 "Installation of Solar PV System" has been approved in October 2017 as the methodology. The CO2 emission reduction calculation with the solar PV system is conducted in accordance with VN_AM007 as follows.

The reference emission reduction amount is calculated as follows.

$$RE_p = \sum_i \left(EC_{i,p} \times EF_{RE,i} \right)$$

RE_p : *Reference emissions during the period p [tCO_2/p]*
$EC_{i,p}$: *Quantity of electricity consumed or sold to the power company from electricity generated by the project solar PV system i during the period p [MWh/p]*

$EF_{RE,i}$: *Reference CO_2 emission factor for the project solar PV system i [tCO_2/MWh] = 0.333 [tCO_2/MWh]*

The project emission is considered to be negligible, and thus counted as zero.

$$PE_p = 0$$

PE_p : *Project emissions during the period p [tCO_2/p]*

The emission reduction amount is calculated as follows.

$$ER_p = RE_p - PE_p = RE_p$$

ER_p : *Emission reductions during the period p [tCO_2/p]*
RE_p : *Reference emissions during the period p [tCO_2/p*
PE_p : *Project emissions during the period p [tCO_2/p]*

In the methodology VN AM007, in case the renewable energy is used not for self supply, the emission factor is settled to be 0.333 tCO2/MWh.

The result of annual generation energy and CO2 emission reduction calculation is shown in the table below. The generated energy amount is about 29.4 GWh.

Table 3.8 Generation Amount by 19.2 MW PV System

Month	Solar irradiation (kWh/m2/d)	Generation (kWh/month)	Sales/month (USD)	CO2 reduction (ton-CO2)
Jan	3.5	1,802,412	166,260	600.20
Feb	4.3	2,000,096	184,495	666.03
Mar	5.2	2,677,870	247,015	891.73
Apr	5.8	2,890,505	266,629	962.54
May	6.4	3,295,840	304,018	1,097.51
Jun	5.9	2,940,341	271,226	979.13
Jul	6.5	3,347,337	308,768	1,114.66
Aug	5.7	2,935,357	270,766	977.47
Sep	5.2	2,591,487	239,046	862.97
Oct	4.2	2,162,895	199,512	720.24
Nov	3.1	1,544,925	142,508	514.46
Dec	2.5	1,287,437	118,757	428.72
Average	4.86	2,456,375	226,583	818
Total		**29,476,502**	**2,718,999**	**9,816**

Source: Prepared by NK

The project CO2 emission reduction amount and cost performance is shown in the table below. Since the project is power supply to the national grid, the legal year which is required to set as lifetime in JCM Model Project is settled to be 17 years.

Table 3.9 Project Emission Reduction Amount and Cost Performance

Item	Value	Unit
PV output	19,200	kW
Mobule output	320	W/panel
Nos of module	60,000	nos
Design Coefficient	0.865	
Average Solar Irradiation	4.858	$kWh/m^2/d$
Electricity tariff (FIT)	2,086	VND/kWh
Grid Emission Factor	0.333	tCO2/MWh
Emission reduction per a year	9,816	tCO2/yr
Legal operation life	17	years
Total emission reduction amount	166,866	tCO2
Subsidy %	20%	
Cost efficiency (<4000)	3,736	JPY/tCO2

Source: Prepared by NK

The cost efficiency 4,000 JPY/tCO2 is required in the application of JCM Model Project. To fulfill the requirement, the subsidy percentage has to be about 20%. With this subsidy amount, the amount of own funds is insufficient, so the project owner needs to seek other investors. After financing arrangement is prepared, the application to JCM Model Project will be considered.

CHAPTER 4 STUDY FOR REALIZATION OF LOW CARBON SOCIETY AND CLIMATE CHANGE ADAPTATION

4.1 POLICY DIALOGUE BETWEEN OSAKA AND HO CHI MINH CITY

Osaka City concluded Memorandum of Understanding (MoU) with Ho Chi Minh City in September 2016 about the establishment of low carbon city with the commencement of city-to-city collaboration activity.

The MoU is based on former MoU agreed in 2015 between Ho Chi Minh City and Osaka City toward low carbon society. The parties to the MoU in 2016 aim to corporate about formulation of Climate Change Action Plan of Ho Chi Minh City (2016-2020) between both cities with cooperation of university and research institute.

Especially, the MoU stipulates to cooperate about activities for the following four items until December 2020.

(1) Capacity building and organization establishment for the progress management

(2) Sharing professional knowledge and technology for achievement

(3) Project formulation toward establishment of low carbon society

(4) Information offering and education about prevention of global warming.

Ho Chi Minh City and Osaka City continue annual mayor level policy dialogue and officer level meetings. The activities confirm climate change actions of Ho Chi Minh City and city-to-city collaboration progress, and problem solution for establishment of low-carbon society of Ho Chi Minh City is discussed. The following table summarizes the activities in FY2018.

Table 4.1 Outline of Policy Dialogue and City-to-city Collaboration in FY2018

Item	Year/Month	Description in Policy Dialogue
1st Site Survey	Jun 2018	Opinion was exchanged for the outline of policy dialogue in FY2018 between cities. Preparatory meeting for the mayor level policy dialogue was held.
2nd Site Survey	Aug 2018	Coordination was done for the mayor level policy dialogue in September and invitation for City-to-city collaboration seminar in Yokohama in October 2018.
Mayor Level Policy Dialogue by Osaka city and Ho Chi Minh city	Sep 2018	The mayor level policy dialogue between Osaka City and Ho Chi Minh City was carried out. Vice Chairman of People's Committee Mr. Huynh Cach Mang and Vice Mayor Mr. Seigou Tanaka attended. Presentation and discussions were held concerning JCM Model Project and city-to-city collaboration until 2020.
4th Site Survey	Nov 2018	Requests for (i) attendance of Japan Environment Week (ii) holding Wrap-up Meeting, and (iii) cooperation about rainfall prediction system were made.
5th Site Survey	Jan 2018	For study target in FY2019, information collection and meeting with relevant organization were held with hotel, IT industry, and cement industry.

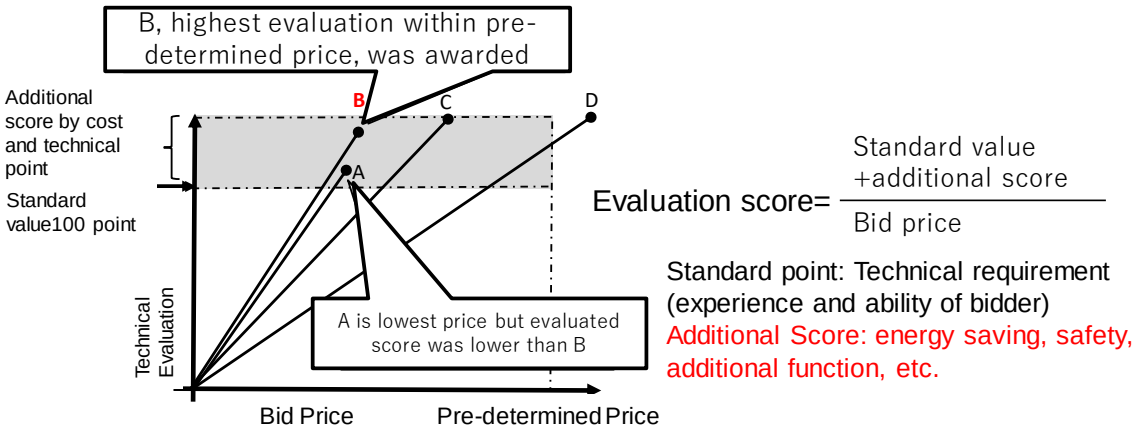
Source: Prepared by NK

4.2 POLICY DIALOGUE IN FY2018

As the contents of policy dialogue in FY2018, Osaka City conducted (i) introduction of equipment procurement considering lifecycle cost, (ii) introduction of rainfall prediction model contributes to climate change adaptation by a company in Osaka City, and (iii) introduction of smart-phone application for function of disaster prevention that Osaka City distributes to its citizens.

4.2.1 Introduction of Equipment Procurement considering Lifecycle Cost

Lifecycle cost (LCC) including energy cost and maintenance cost is large in durable equipment used for long time. For equipment introduction, in needs to consider not only initial cost but also LCC in the procurement. Osaka City introduced Ho Chi Minh City about Overall General Value Method in public procurement considering LCC in a water supply facility of Osaka City as an example.



Source: Prepared by Osaka City

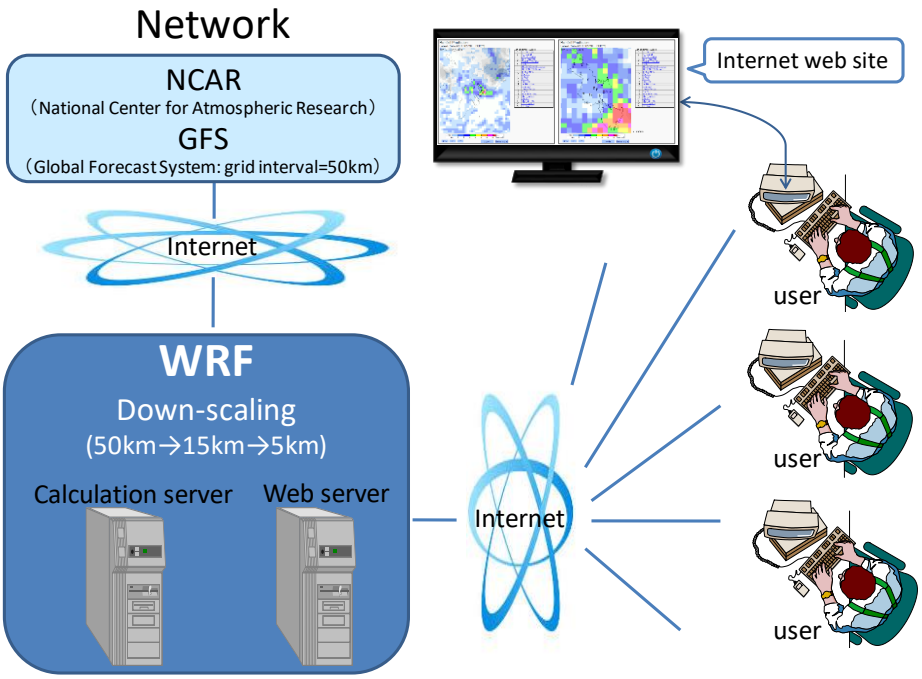
Figure 4.1 Overall General Value Method in Public Procurement considering LCC

4.2.2 Introduction of Rainfall Prediction Model

Ho Chi Minh City has requested the establishment and practical realization of rainfall prediction model as one of the adaptation measurement of climate change in the policy dialogue.

For that, Meteorological Engineering Center Inc. (hereinafter, MEC) located in Osaka City introduced its experience in Japan and explained about rainfall prediction system development applied to Ho Chi Minh City. MEC is the group company of Kansai Electric Power Corporation. MEC develops and sales rainfall prediction system for particular areas.

The system predicts rainfall for 72 hours (3 days) ahead, with updating every six (6) hours. In the system, detailed calculation and analysis are conducted with local geographical information and space matrix of which resolution is from 50 km, 15 km, to 5 km. The result of the prediction consists of: (i) rainfall data table of every hour, (ii) time series graph with every hour rainfall prediction data, and (iii) forecast rainfall distribution map.

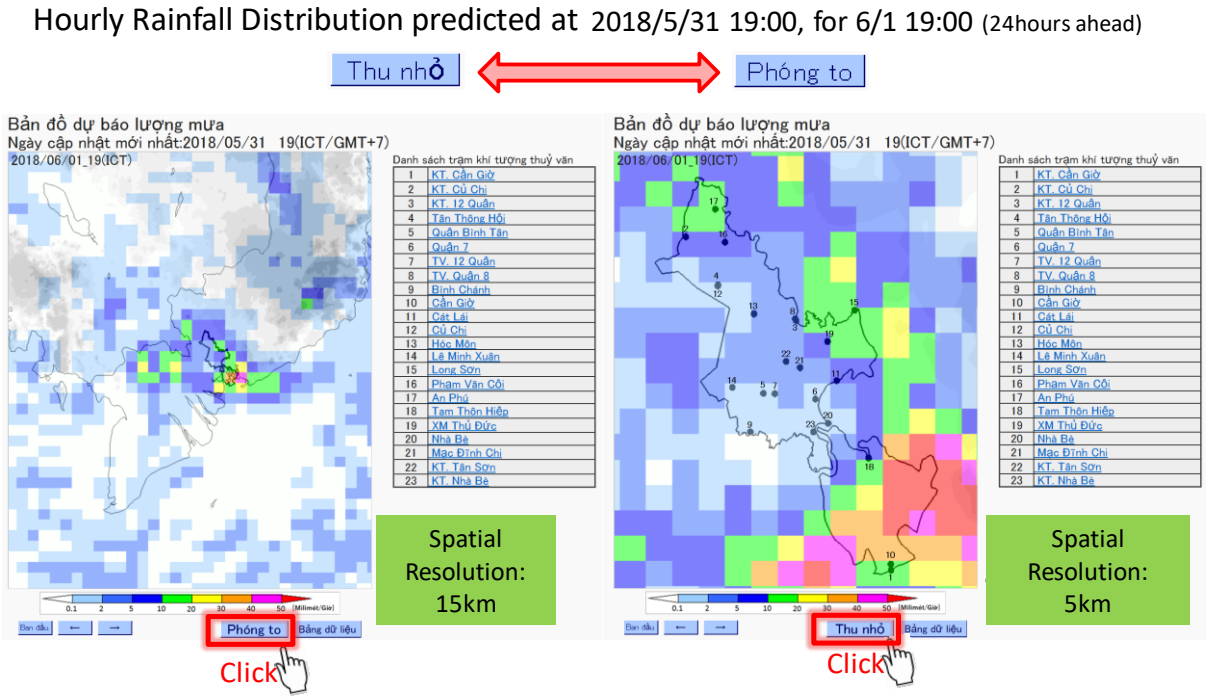


Source: Presentation Material by MEC

Figure 4.2 Outline of Rainfall Prediction Model

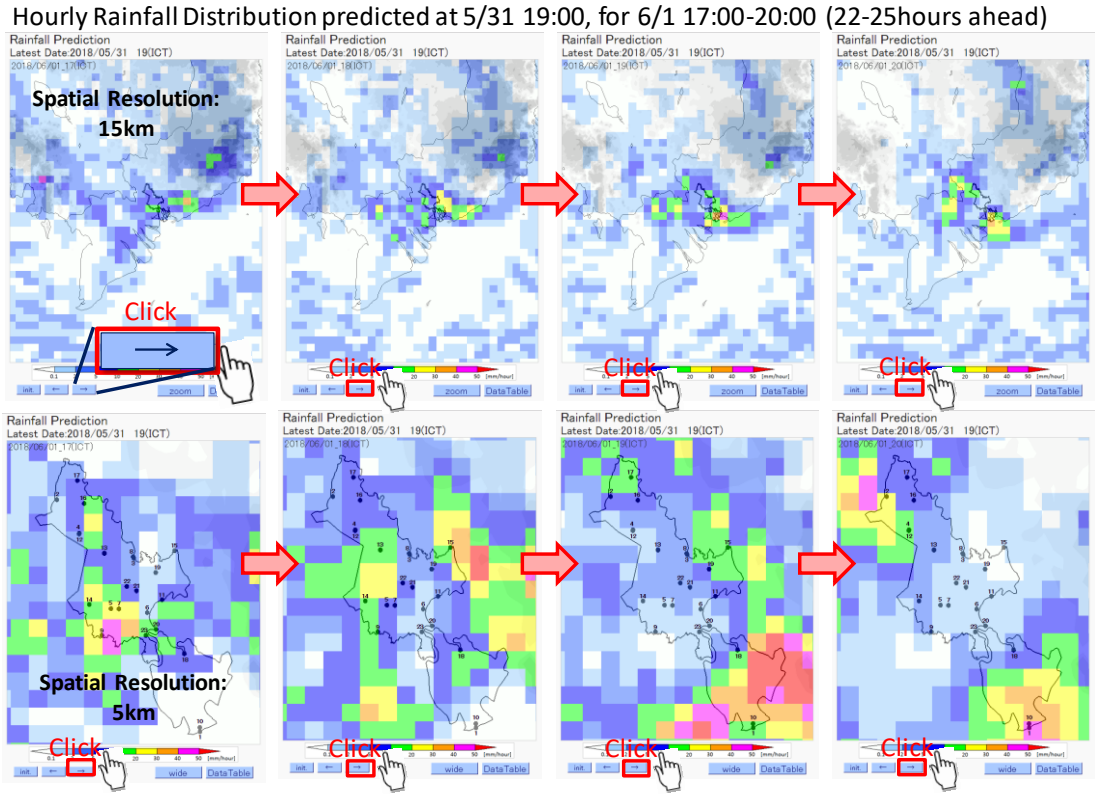
MEC explained the result of rainfall prediction analysis based on the acquired data from 13 observation stations in Ho Chi Minh city, which can be seen in the internet.

Based on the rainfall data obtained from Ho Chi Minh City, MEC developed models and verifies the prototype system with two rainfall examples in 2017 for repeatability.



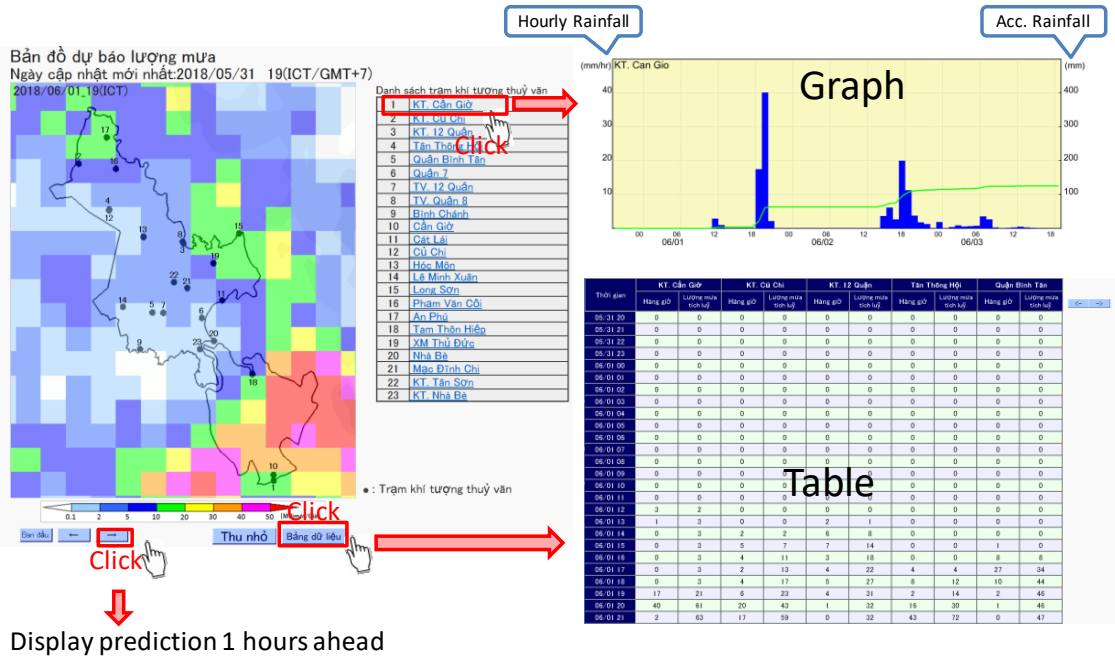
Source: Presentation Material by MEC

Figure 4.3 Example of Output of Rainfall Prediction Model (by Space)



Source: Presentation Material by MEC

Figure 4.4 Example of Output of Rainfall Prediction Model (25 Hours Ahead)



Source: Presentation Material by MEC

Figure 4.5 Example of Output of Rainfall Prediction Model (3 days ahead)

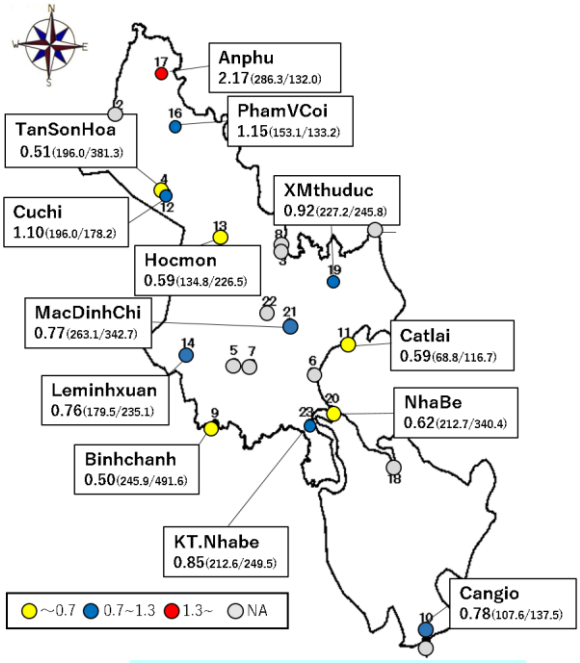
As shown above, the rainfall prediction with 5 km mesh level and maximum 3 days ahead was presented to Ho Chi Minh City that has issues from recent municipal floods.

In addition, to show the accuracy of repeatability of the rainfall prediction model targeting Ho Chi Minh City, comparison between predicted value and actual value were presented as shown in the figure to the right.

In the figure, the predicted result by MEC system is shown on the left side, while the result of actual rainfall data is shown on the right side for respective 13 rainfall observation stations in Ho Chi Minh City.

From this, most of the values are predicted slightly less than the actual value, which is about 70% of actual data, and repeatability is within ±30%.

The model will be verified to seek higher accuracy with additional related data in the next stage.



Source: Presentation Material by MEC

Figure 4.6 Verification of Output

4.2.3 Introduction of Disaster Prevention Smart-phone Application by Osaka City

Disaster management is regarded as one of the most significant issues in recent years. Osaka City has provided disaster prevention smart-phone application to expand disaster prevention knowledge for appropriate and fast evacuation of citizens since March 2016.

Ho Chi Min City is interested in the administrative service to prepare for disaster such as municipal flood. Thus, disaster prevention smart-phone application of Osaka City was introduced in the policy dialogue.

In the disaster prevention application, disaster information in Osaka City such as flood possibility map, shelter locations, and buildings for evacuation are supplied to citizens. Osaka city provides useful information and notice at the time of evacuation beforehand.

For example, the following information can be received according to time path from disaster occurrence.

1) To prepare for disaster: former information collection, preparation for flood, prevention of furniture falling, evacuation path, and so on
2) At a critical moment: disaster information, river water level, cloud movement
3) At the time of evacuation: flood map, shelter condition, notice at the time of evacuation
4) After evacuation: safety confirmation, information about life under evacuation, communication board with pictogram

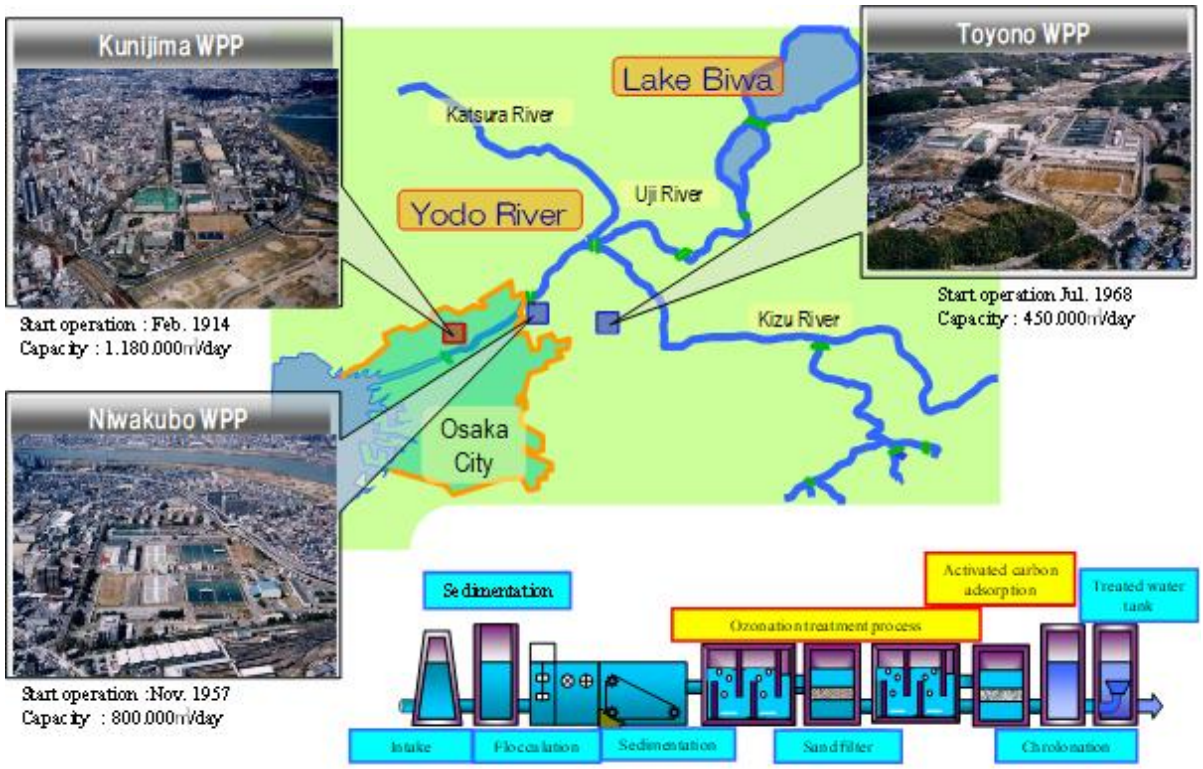
Source: Osaka City

Figure 4.7 Monitor of Disaster Prevention Application

In addition to the above, the application provides disaster prevention map, e-mail distribution about disaster evacuation information, anti-clime whistle function, information collection from Osaka City and Meteorological Bureau, and safety confirmation function.

4.2.4 Introduction of Energy Saving in Water Supply Facility in Osaka City

In the policy dialogue, Osaka City introduced their experience of energy saving in water supply facility, since the target sector of JCM Model Project in this year 2018 is energy saving in the municipal water supply.



Source: Osaka City

Figure 4.8 Main Water Treatment Plant in Osaka City

Osaka city intakes water from Yodogawa River System, sourced from Lake Biwa which is called “Water Jar of Kansai Region.”

The water purification process applies not only to general sand filtration from sedimentation pond but also to advanced ozone pond and activated carbon absorption pond. It enables high quality water supply with an appropriate process.

Osaka City promotes energy saving in various city activities and it prepares concrete target values. The following table shows the target of 2020 in water business compared with 2013.

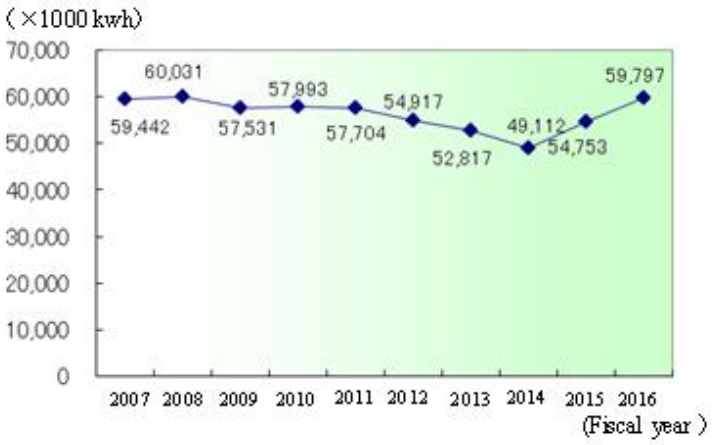
Table 4.2 Energy Saving Target by Osaka City

	FY2013 emissions	**Reduction goal 2013⇒2020**	FY2020 Target emissions	Main actions
City Admin. Offices	**126.1**	**－8.4%**	**115.5**	
Environment Bureau (including some association offices)	45.2	**－11.7%**	39.9	• Decrease the amount of refuse incinerated • Waste power generation
Transportation Bureau	27.8	**－4.5%**	26.6	• Energy-saving/CO2 reduction in station buildings, subways, city buses
Construction Bureau	26.4	**－11.5%**	23.3	• Energy-saving/CO2 reduction at wastewater treatment plants • Change of water treatment method at wastewater treatment plant • Promotion of the introduction of LED lights • ESCO Project • Introduction of digestion gas power generation
Waterworks Bureau	10.6	**-4.5%**	10.2	• Energy-saving/CO2 reduction at water purification plant • Improved operation of facilities and equipment • Introduction of small hydroelectric power
Board of Education	5.4	**＋4.0% or less**	5.6	• Energy-saving/CO2 reduction at schools • Proper placement and merging of schools • Control increase of CO2 emissions through installation of new air conditioners at elementary and junior high schools
Economic Strategy Bureau	3.0	**－4.5%**	2.9	• Energy-saving/CO2 reduction at sports facilities
Welfare Bureau	1.4	**－0.8%**	1.4	• Energy-saving/CO2 reduction at care facilities • ESCO project
Other Departments/Bureaus	6.2	**Maintain at 2013 levels or lower**	6.2	• Enhancement of environmental management by staff
Introduction of LED lighting at all bureaus			－0.6	• Introduction of LED lighting and promotion of improved operations through energy- saving audit based on policy determined by Osaka Global Warming Prevention HQ

Source: Osaka city

As an example, Osaka City has been applying inverters in pump facilities owned by the city for more than 10 years, and saves energy for pump operation. It expects to achieve emission reduction at 6,000 tCO2 from 2013 to 2020.

Pump facility



Source: Osaka City

Figure 4.9 Effect of Energy Saving by Inverter for Water Supply Pump

CHAPTER 5 ISSUES AND WAY FORWARD

5.1 ISSUES

5.1.1 Simplification for Project Combination

In Vietnam, factories with large capital are manly located in northern region which includes Hanoi and Hai Phong. In and around Ho Chi Minh City, there are many medium and small manufacturers for assembling or other light industries. There are a limited number of large-scale factories that consume a large amount of power and heat. Several industry parks (IP) are located in Ho Chi Minh City, Don Nai Province, and Ba Ria Vung Tau Province. Many of factories in those IPs are also assemble and are light industries. If there are any large-scale commercial facilities and factories, most of them are public companies.

As one of the conditions of JCM Model Project, it is preferable that the subsidy amount be above 50 million JPY. Hence, when the subsidy percentage is 40% of equipment cost for example, the initial investment for the equipment needs to be more than 125 million JPY. There are quite few private factories that have an investment of this scale. Although a great deal of industrialization occurs in and around Ho Chi Minh City, energy consumption of such factories is not large and possible investment scale is relatively small.

Accordingly, it is necessary to consider combining several candidate projects in one project to achieve the necessary scale in JCM project formation.

When the application of combined JCM Model Project is prepared, the work load on the Representative Company of JCM Model Project will be quite heavy, since coordination and document preparation are necessary. This includes international consortium agreement, material for financial status, business and fund procurement plan, document for intention of project participation, etc. for several participant companies.

It is desirable to ease and simplify the document requirement, when the investment of a participant company is small in the combined JCM Model Project application. (This approach is similar to “Small-scale CDM” scheme.)

In addition, when cross-development of JCM scheme is started and rapidly spread in international society, it is expected to be promoted more under the city-to-city collaboration framework. The first particular project in the same city or region can be considered as the “Master Idea”. If the scheme can accept simplified application for the same type of JCM project in the different cities in the same country based on the Master Idea, it will facilitate the application from various entities. (The approach is referred to “Program CDM” scheme.)

5.1.2 Preparation for Bidding

In JCM Model Project, it is preferable to achieve a scale more than 1,000 tCO2/year emission reduction. Considering the size of energy saving requirement to meet the scale, large-scale

facility in terms of energy consumption is the first condition as the project candidate.In Vietnam, the private owners of large-scale equipment in factories and commercial facilities are limited to companies with foreign investment, and most large factories and facilities are owned by public companies.

In public companies of Vietnam, as well as other countries, bidding is necessary in most procurement. When bidding is necessary for the energy saving equipment procurement in JCM Model Project, detailed coordination about scheduling and document preparation among stakeholders are necessary in the project formulation stage. Especially in public procurement, schedule delay is possible due to delay in preparation of bidding document, delay in bid evaluation and approval, re-tender of bidding due to cost over, and contract disagreement. This is a hurdle for JCM Model Project considering its schedule requirements.

In the JCM project formulation through city-to-city collaboration, Japanese cities are in the position to raise the issue and discuss about bidding system with the partner city, which private sector cannot do so. In the policy dialogue between Osaka City and Ho Chi Minh City, Osaka City proposed lifecycle-cost-basis. Further discussion for more flexible evaluation and bidding system will be discussed, which is expected to help for smooth implementation of JCM Model Project.

To promote JCM Model Project formulation in city-to-city collaboration, it is preferable to design and operate the JCM Model Project system considering conditions of the bidding system and schedule flexibility. For example, acceptance of application throughout the year according to local procurement conditions in partner countries could facilitate the implementation.

5.2 PROPOSAL FOR FUTURE

5.2.1 Application of JCM Model Project

(1) Installation of Inverter for Pumps in Tan Hiep-1 WTP

Financial and technical presentation to SAWACO about the inverter installation in Tan Hiep-1 WTP was provided in January 2019, and SAWACO was positive for installation of two or three inverters. SAWACO is preparing the budget for FY2019 accordingly (Fiscal year in Vietnam starts in January and ends in December). As soon as the budget for inverter installation is approved in SAWACO, the application for the JCM Model Project for FY2019 will be prepared. At the same time, procurement document preparation and bidding schedule details will be confirmed so that it can coordinate the schedule requirements of JCM Model Project.

(2) Installation of Inverter for Fans in Sugar Mills

After confirmation of data for new fan and needs of sugar mills in other areas in Vietnam, the JCM Model Project for inverter installation for fans in sugar mills will be prepared

considering combination of several factories. Its aim is to apply at the timing of the second public announcement (expected to be September 2019) for JCM Model Project.

5.2.2 Proposal for City-to-City Collaboration in FY2019

In FY2018, the city-to-city collaboration activity continued regular policy dialogue between Osaka City and Ho Chi Minh City. For the JCM Model Project formulation, the study covered inverter application for energy saving of water distribution pumps in water supply facilities. In addition, the study for the inverter application for fans of sugar mills and PV generation system by a developer in Ho Chi Minh City was also conducted. For application of the JCM Model Project in WTP and other projects, discussions with SAWACO will continue together with coordination of both cities, to materialize the JCM Model Project through city-to-city collaboration.

In the study period in FY2018, information and opinions were collected from Vietnamese and Japanese business owners about possible ideas for JCM Model Project in FY2019 as follows.

- In Ho Chi Minh city where urbanization is rapidly expanded, efficient cooling systems for whole building have not commonly been installed yet. The demand for such service has not been general and building owners are not much interested in energy saving in their building.
- In suburb areas of Ho Chi Minh City, energy consumption in industry sector including IT is increasing. Some managers of factories and IT facilities are starting to recognize the need to improve energy cost for healthy business operation, and energy saving equipment is starting to be introduced gradually.
- It is desirable for energy saving equipment to be applied for JCM Model Project to be widely utilized and compatible in various buildings and facility. Utilization ratio of air conditioning equipment is high throughout a year in tropical monsoon areas such as Ho Chi Min City. There are various types of air conditioning equipment in office and factory buildings such as (i) central control type, (ii) respective room control type, (iii) driving condensing unit and entering cool air inside building, and (iv) air ventilation only. For respective facility and building, it is necessary to find partners and conduct study depending on various needs about replacement and improvement of air conditioning system. This will make the project formulation study more efficient.

Therefore, for project formulation and feasibility study for JCM Model Project in FY2019, we propose to conduct project formulation in industry sector with air conditioning replacement as main equipment menu, which will contribute to the realization of low carbon society for Ho Chi Minh City.