FY2019 Project for Ministry of the Environment Japan

FY2019
City-to-City Collaboration Programme for Low-Carbon Society

Support for the Realization of Low Carbon Society to Achieve Thailand 4.0

Report

March 2020

Nippon Koei Co., Ltd.
Osaka City

FY2019

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

Support for the Realization of Low Carbon Society to Achieve Thailand 4.0

Report

TABLE OF CONTENTS

Page

TABLES

FIGURES

APPENDIXES

1. Meeting with EEC in Tokyo in September, 2019
   - 1.1. Presentation material by Nippon Koei
   - 1.2. Presentation material by Osaka City
   - 1.3. Presentation material by Osaka Gas

2. Presentation Material of Field Survey in EEC
   - 2.1. Overview of the Study presented by Osaka City (the 1st trip)
   - 2.2. Overview of the Study presented by Osaka City (the 2nd trip)
   - 2.3. Support for EEC's Waste Management presented by Osaka City
   - 2.4. ABC of Waste Disposal Rules presented by Osaka City
   - 2.5. Introduction of JCM Formulation Studies by Nippon Koei
   - 2.6. Overview of the Study and JCM presented by Nippon Koei (the 1st trip)
   - 2.7. Overview of the Study and JCM presented by Nippon Koei (the 2nd trip)
   - 2.8. Progress reported to EEC by Nippon Koei

3. JCM Seminar on City-to-City Collaboration
   - 3.1. Presentation material by Nippon Koei
   - 3.2. Presentation material by EEC
   - 3.3. Presentation material by Osaka City

ABBREVIATIONS

Abb.	English
BOI	The Board of Investment, Thailand
CBG	Compressed Bio Gas
CNG	Compressed Natural Gas
COP	Conferenceof Parties
COP	Coefficient of Performance
DEDE	Department of Alternative Energy Development and Efficiency
DEQP	Department of Environmental Quality Promotion
EEC	Eastern Economic Corridor
FY	Fiscal Year
GDP	Gross National Product
GHG	Green House Gas
HVAC	Heating, Ventilation, and Air Conditioning
IEC	International Electrotechnical Commission
IPLV	Integrated Part Load Value
JCH	Johnson Control Hitachi, Thailand
JCHT	Johnson Control Hitachi, Thailand
JCM	Joint Crediting Mechanism
MRV	Measurement, Report and Verification
OG	Osaka Gas
POME	Palm Oil Mill Effluent
R&D	Research & DEvelopment
SDGs	Sustainable Development Goals
SOFC	Solid Oxide Fuel Cell
TGO	Thailand Greenhouse gas Organization
UNFCCC	United Nations Framework Convention on Climate Change
USD	U. S. dollar
VRF	Variable refrigerant flow

CHAPTER 1 BACKGROUND

1.1 BACKGROUND

Significance of city-to-city collaboraitons

All countries have participated in United Nations Framework Convention on Climate Change (UNFCCC) of the 21st Conference of the Parties (COP21) that held in the suburbs of Paris in France in December 2015, and adopted the Paris Agreement which is fair and effective for climate change mitigation after 2020. The agreement states that efforts should be made to keep the global temperature rise below 2 degree Celsius compared to before the industrial revolution, and even below 1.5 degree Celsius. Then, COP24 in Katowice, Poland in December 2018, a rulebook, which states the specific obligations of each country from 2020, was adopted.

At the COP21, it was recognized that the actions of non state bodies including cities welcomed the efforts of all non-government players (urban and other local governments) and its scale up. Urban areas are the places of activity that support socio-economic development, and live citizen. About half of the world's population lives in urban areas, which account for 2% of the world's total land area, and that proportion is expected to increase to 70% by 2050. And, it is estimated that more than 70% of the CO2 emissions are in the world emitted from cities as of 2006, and cities play a major role in climate avoiding change risks. Continuous implementation of climate change countermeasures in urban areas is key factor for total greenhouse gas (GHG) emission reduction and achieving the goals of the Paris Agreement.

City-to-city collaboration with EEC

The Kingdom of Thailand has rapidly developed and become middle-income countries by utilizing natural resources and is attracting foreign-owned enterprises. Then, the government has a sense of crisis on growth slowdown by transition to high-income countries. Aiming for the country's future socio-economic prosperity, the government has set a national strategy of “Thailand 4.0” since 2015, promoting economic growth over 20 years, and entering a high-income country by 2036. To lead the Thailand 4.0, three provinces (Chonburi, Chachoengsao, and Rayong) were selected as focal area of Eastern Economic Corridor (EEC)[1].

In the EEC region, there are many Japanese factories located that have become important production bases in Southeast Asia since the 1980s. Coastal area of the EEC is remarkably developed as an industrial zone, with regional Gross National Product (GDP) exceeding 15% of Thailand. And, there are many companies involved in the Japanese automobile industry, and many JCM projects have been implemented in this region. It is expected that the number of

[1] The EEC is a national strategy for the implementation of Thailand 4.0 in the Kingdom of Thailand, which has been established as a governmental organization and targets three (3) provinces in eastern Bangkok. For this reason, EEC assume a city to create city-to-city collaboration with Osaka City.

JCM projects will be developed in the future. In fact, it is confirmed that many companies are eager to join a JCM project.

Strategy of Osaka City government on city-to-city collaboration

Osaka city government (Osaka City) has implemented city-to-city cooperation with Ho Chi Minh city, Vietnam and Quezon city, Philippines, and has achieved steady results. And Osaka City has involved private entities and supported overseas business expansion etc., by utilizing the "Team OSAKA Network", a public-private partnership platform.

Osaka City has paid attention to the possibility of forming a JCM model project[2] in the EEC area, where industrial parks have been accumulating since a few years ago. This time, the Osaka City has been consulted from Johnson Controls Hitachi Air Conditioning Co., Ltd. (JCH) and Osaka Gas Co., Ltd. (Osaka Gas) to support business development in this region. In cooperation with Mizuho Bank, Ltd. (Mizuho Bank), the city has aimed to collaboration with EEC and support private company's business development.

1.2 OBJECTIVE

This project, City-to-city collaboration, is a study on the realization of a low carbon and zero carbon society in the collaboration between EEC and Osaka City, with the following objectives: (1) Deepening the cooperation between the two cities, and (2) Formulating a JCM model project that contributes to low and zero carbon society in the Kingdom of Thailand.

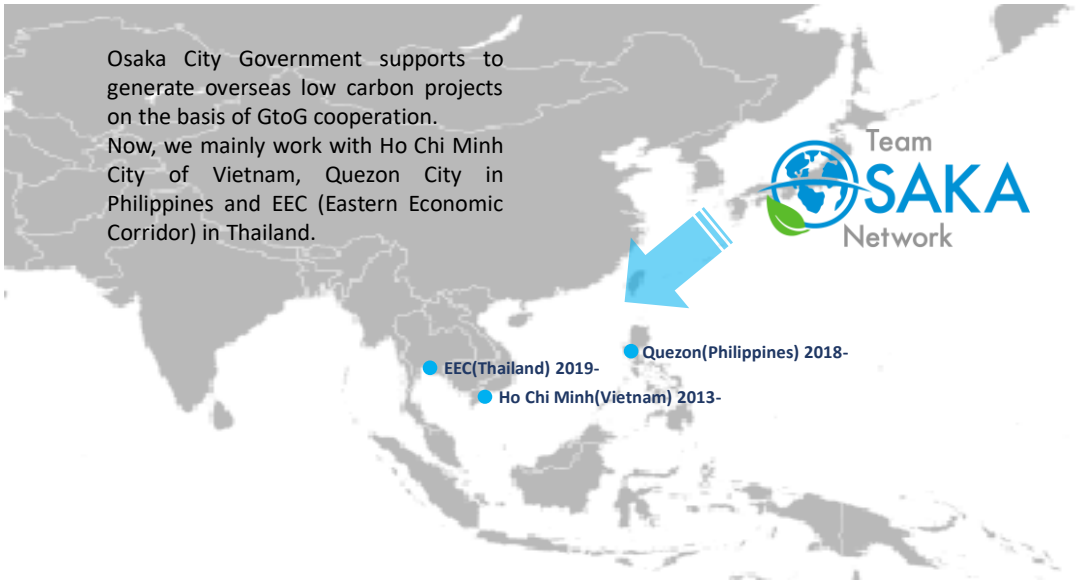
[2] JCM model projct is a project that is subsidized by Japanese government in accordance with introducing high efficiency products, renewable energy system etc. in the partner countries.

1.3 CITY/AREA PARTICIPATED IN THE COLLABORATION

1.3.1 Osaka City government

Osaka City has been promoting activities with Ho Chi Minh city in Vietnam and Quezon city in the Philippines through the city-to-city collaboration project. In particular, Environmental bureau of Osaka City, which is the main department in charge of this project, considers environmental issues not only in Osaka City but also as a matter of concern to the international community and aims to solve environmental issues in developing countries targeted by the JCM. Osaka City has been implementing various actions that support in cities and Japanese companies in packages that include low-carbon technologies.

Also, Osaka City has various urban aspects as one of the major cities in Japan. In terms of environment, it has a history of improving public health of citizens and overcoming pollution issues. It can provide useful insights and contributions to the challenges facing the Bangkok Metropolitan govermnent and the EEC region. Osaka City expects that supports overseas cities facing environmental problems and create opportunities for private companies to expand their business through cooperation between the cities and the accompanying international cooperation.



Sorce : Osaka City

Figure 1.1 International cooperation by Osaka City

Osaka City is building a public-private partnership platform (Team OSAKA network) to create and support projects for network participating companies while matching domestic and international support needs.

Following table shows contribution of Osaka City to EEC.

Table 1.1 Contribution of Osaka City

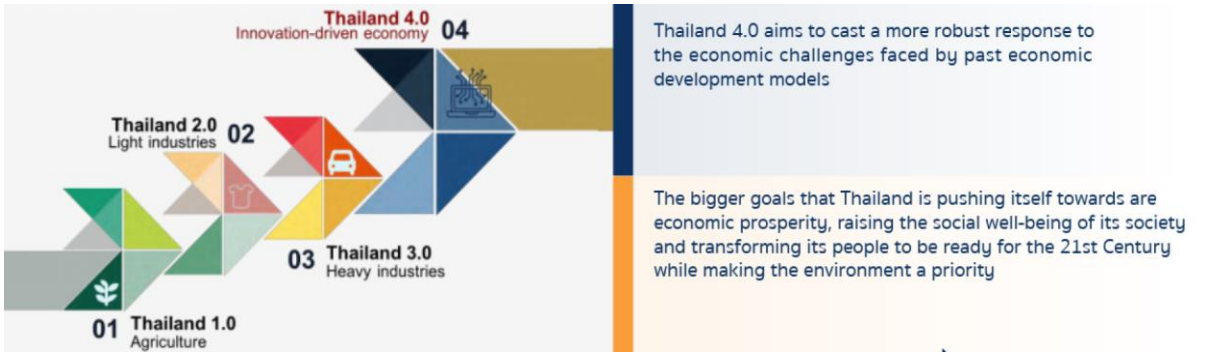
Osaka's contribution	Outlines
Enlightenment of JCM system and development of energy saving equipment	In cooperation with the EEC, the Osaka City and Japanese entities provide support for collecting information on factories, public facilities and buildings in the area, provide JCM incentives to local companies at seminars related to the collaboration, and promote project formulation by introducing the JCM incentives.
Introduction of Osaka City companies through Team OSAKA network	JCM project formulation contributes to realize by introducing the optimal technologies possessed by Japanese companies, including those participating in the Team OSAKA network, for various needs related to various facilities in factories and buildings in the EEC region.
Sharing knowledge and achievements related to energy saving / renewable energy equipment introduction	Osaka City contributes to share technical and financial effects of introducing energy-saving / renewable energy equipment with JCM scheme by sharing the experience of introducing energy-saving / renewable energy equipment at public facilities.
Introduction of public-private partnership projects	To share the knowledge of Osaka City's climate change-related activities and to educate the necessity and importance of countermeasures, Osaka City constructs a base for disseminating JCM project formulation. In addition, by sharing knowledge of the city-to-city collaboraiotn with other cities in the past, Osaka City also strive to build efficient cooperation.

Source : Nippon Koei

1.3.2 Eastern Economic Corridor (EEC) region

(1) EEC

The Kingdom of Thailand has formulated a national strategy "Thailand 4.0" in 2016 with the aim of increasing incomes by upgrading the industrial structure of Thailand. This strategy is a policy vision that can be said to be the fourth industrial revolution in Thailand. Based on the previous transition, Thailand 4.0 was developed for aiming at upgrading and adding value to the industry.



Source : EEC presentation material

Figure 1.2 Transition of Thailand economic development model

EEC aims to create a value-added circular economy by not only giving priority to development in various activities in the region, but also giving due consideration to technological innovation accompanying industrial development.

Source : EEC presentation material

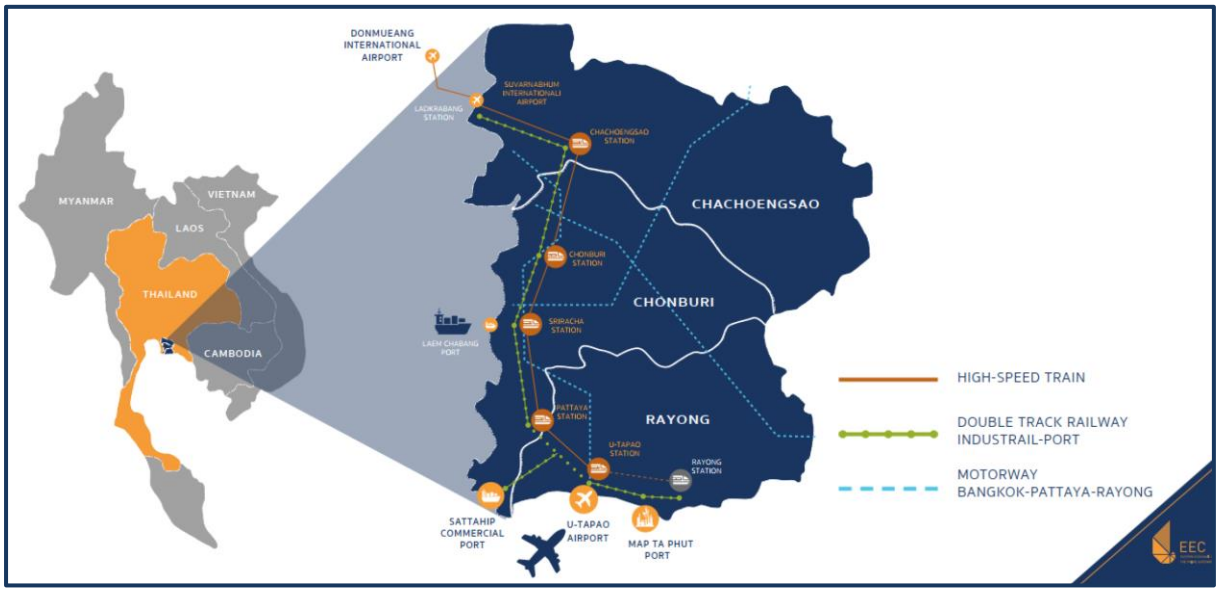
Figure 1.3 Strategic image of circular economy by EEC

Previous strategy, Thailand 3.0 focused on attracting domestic and foreign companies and developing industrial parks by focusing on the export of conventional heavy industries and industrial products.

On the other hand, Thailand 4.0 states that it will shift to innovation-led economic growth and aim to become a digital nation in 20 years from 2016. Its main pillars are the development of the digital economy and the fostering of a new generation of industries.

EEC is the leading organization to realize Thailand 4.0, and is a concept to promote investment in specific industries such as next-generation vehicles, high-tech industries, medical, aviation, robots, etc. Thailand 4.0 comprehensively develops various infrastructures.

As shown in the figure below, the EEC consists of three (3) provinces, Chachoengsao, Chonburi and Rayong, located on the eastern side of the capital city of Bangkok. The EEC has also begun infrastructure development to support industrial development in terms of social infrastructure. The main projects are the expansion of existing airports (Tapao Airport) and existing ports (Laem Chabang Port), and construction of a high-speed railway.

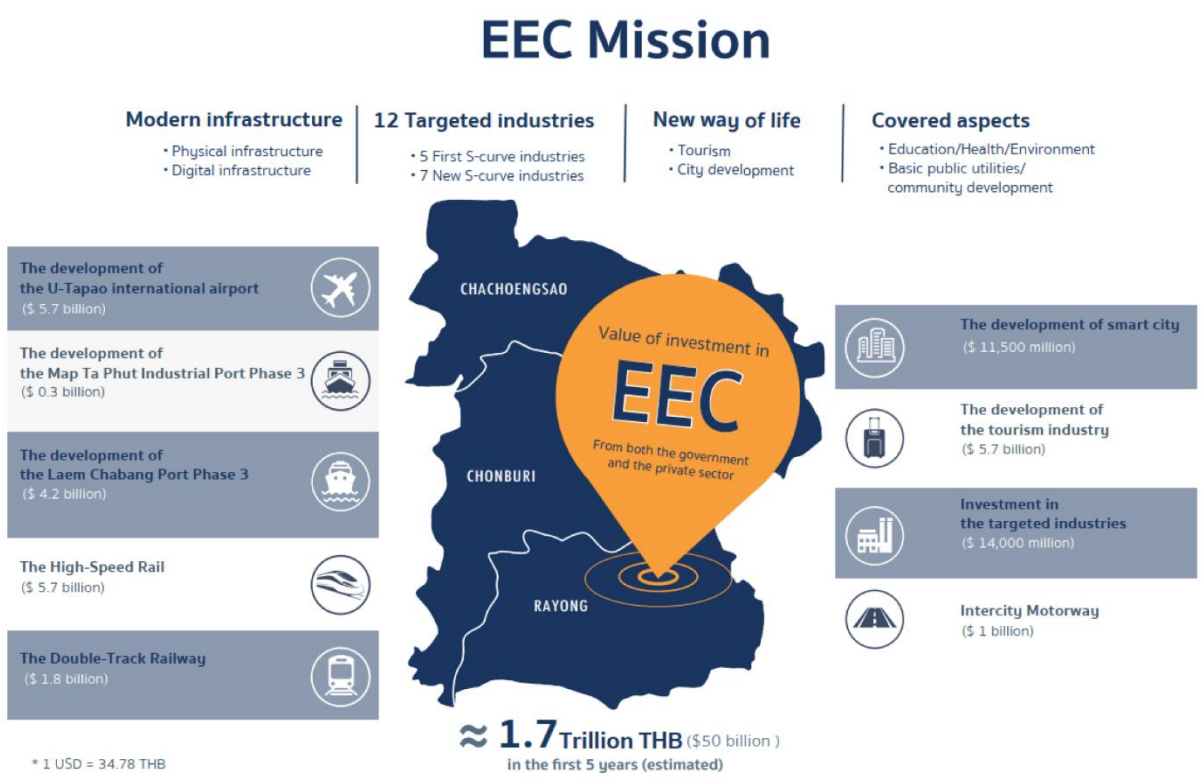


Source : EEC presentation material

Figure 1.4 EEC area

EEC is at the core area of Thailand's national strategy by 2035. Therefore, as shown in the figure above, large-scale projects are also linked to this strategy. It seems that JCM project formation is inferior to the above in scale, is however not only good opportunity to disseminate Japan's sophisticated technologies and products, but also contributes to the creation of an innovation-driven society that realizes Thailand 4.0.

Investment (public and private) to EEC area is not limited to social infrastructure but also others, such as industrial development (500 billion JPY) and new urban, medical and residential development (400 billion JPY). It is expected that this collaboration between the cities will be an clue to enhace business opportunity. Following figure shows EEC missions inside the region that EEC is currently setting up.



Source : EEC presentation material

Figure 1.5 EEC mission

(2) JCM potential in EEC

In Thailand, the Board of Investment of Thailand (BOI) has been established to increase investment in Thailand. When investing in the EEC region, it is taken to grant additional benefits (EEC packages) in addition to the BOI investment benefits. There are three target areas where the EEC package is awarded: (1) EEC special zone, (2) 21 designated industrial parks in the EEC, and (3) other industrial parks in the EEC. Thus, the EEC is a promising area for those doing business in Thailand.

As a focusing sector for the EEC, Thailand 4.0 has specified the following ten target industries that the government encourages.

[Target Industries]
1) Next-generation automotive, 2) Intelligent electronics, Advanced agriculture and biotechnology, 4) Food for the future, 5) High-value and medical tourism, 6) Automation and robotics, 7) Aviation and logistics, 8) Medical and comprehensive healthcare, 9) Biofuel and biochemical and 10) Digital

1) to 5) are are regarded as promising industries (First S-Curve industries) expected to be implemented at this time, and 6) to 10) are listed as new S-Curve industries expected to be promoted in the next generation. It aims to enhance the industry-upgrading and value-added

targets. It has been announced that "national defense industry" and "education and human resource development" will be added to the above 10 industries, and detailed plans for both industries are currently being formulated.

Source : EEC presentation material

Figure 1.6 12 target industries in EEC

EEC region is focusing a smart city development strategy in addition to Thailand 4.0. The strategy has its goals set out under the basic plan of smart city, and its benefits contributs to this city-to-city collaboration.

Smart city is in line with the low carbon and zero carbon concepts that this collaboration aims for. In addition, Smart Environment is listed as an essential item in smart city development, and is an important point that is required other than GHG emission reduction.

[7 smart in EEC]
a) Efficient transport (**Smart Mobility**), b) Education and social equitability (**Smart People**), c) Life security (**Smart Living**), d) Ease of doing business (**Smart Economy**), e) Efficient public services (**Smart Governance**), f) Green and safe energy (**Smart Energy**), g) Clean, efficient and balanced management of resources and the environment (**Smart Environment**)

From the above, the aim of the EEC is to develop new industries, including energy saving and renewable energy, and ideas represented by the seven smarts. Therefore, in development in EEC region, cooperation with the JCM scheme which is expected to reduce GHG emissions brings great potential to the EEC.

The goals and strategies for the collaboration between the cities are summarized below.

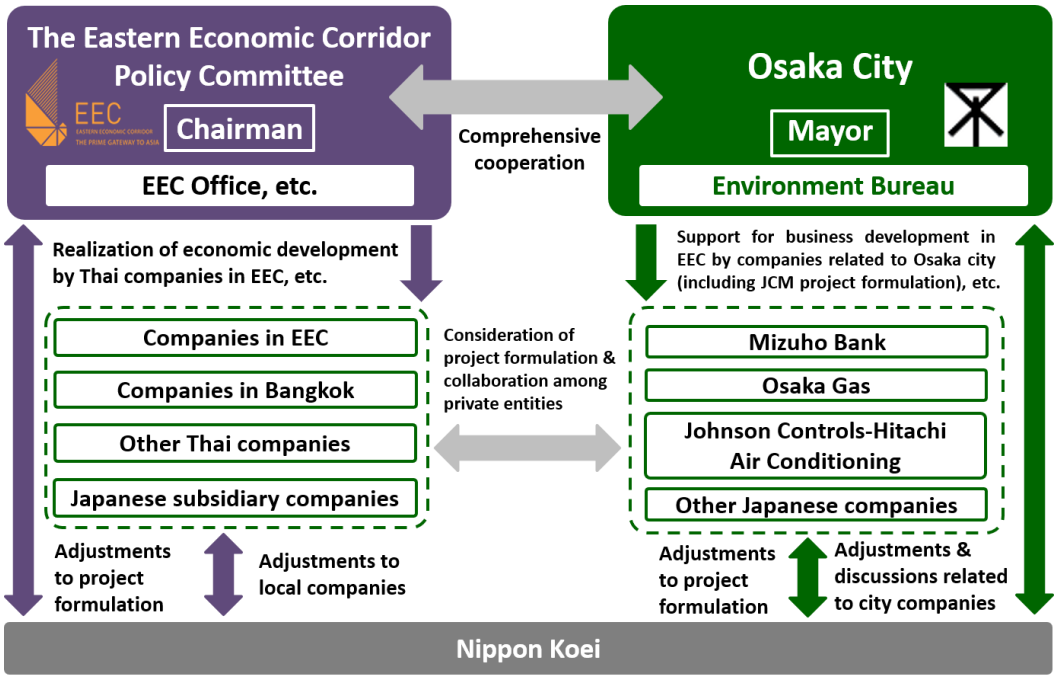
Goal	**Contribute to EEC economic development by formulation of JCM model project**
Strategy 1	**Utilization of city-to-city collaboration** To contribute to the Thailand 4.0, it seems that there is limitation by private companies. To this point, the project aims to contribute to the EEC through public-private partnership mainly in Osaka City.
Strategy 2	**Utilization of JCM model project** In economic development of EEC, it is expected that factories and companies will increase capital investment. Especially, the reduction of initial investment is attractive to local entities, it is an opportunity to introduce energy saving and renewable energy equipment. So JCM application brings new oppotunity to local entities.
Strategy 3	**Collaboration with Japanese entities** It seems to be difficult to solve issues/needs of Thai provate entity. Therefore, the cooperation with Japanese companies will be activated mainly in Osaka City. And this collaboration contributes to EEC's development.

Source : Nippon Koei

Figure 1.7 Support strategy through city-to-city collaboration

1.4 IMPLEMENTATION STRUCTURE

Under the collaboration between Osaka City and the EEC, the implementation structure for this year comprised of Osaka Gas and Johnson Controls Hitachi Air Conditioning Co., Ltd. (JCH) which studied JCM technical and financial applicability etc., with the support of Mizuho Bank. Then, Nippon Koei Co., Ltd. (Nippon Koei) coordinated the whole project as the representative of the Project. Image of the implementation structure is shown in the below.



Source : Nippon Koei

Figure 1.8 Implemenation structure

Based on the above figure, the Project team consists of Osaka City, Nippon Koei, Mizuho Bank, Osaka Gas and JCH.

(1) Nippon Koei

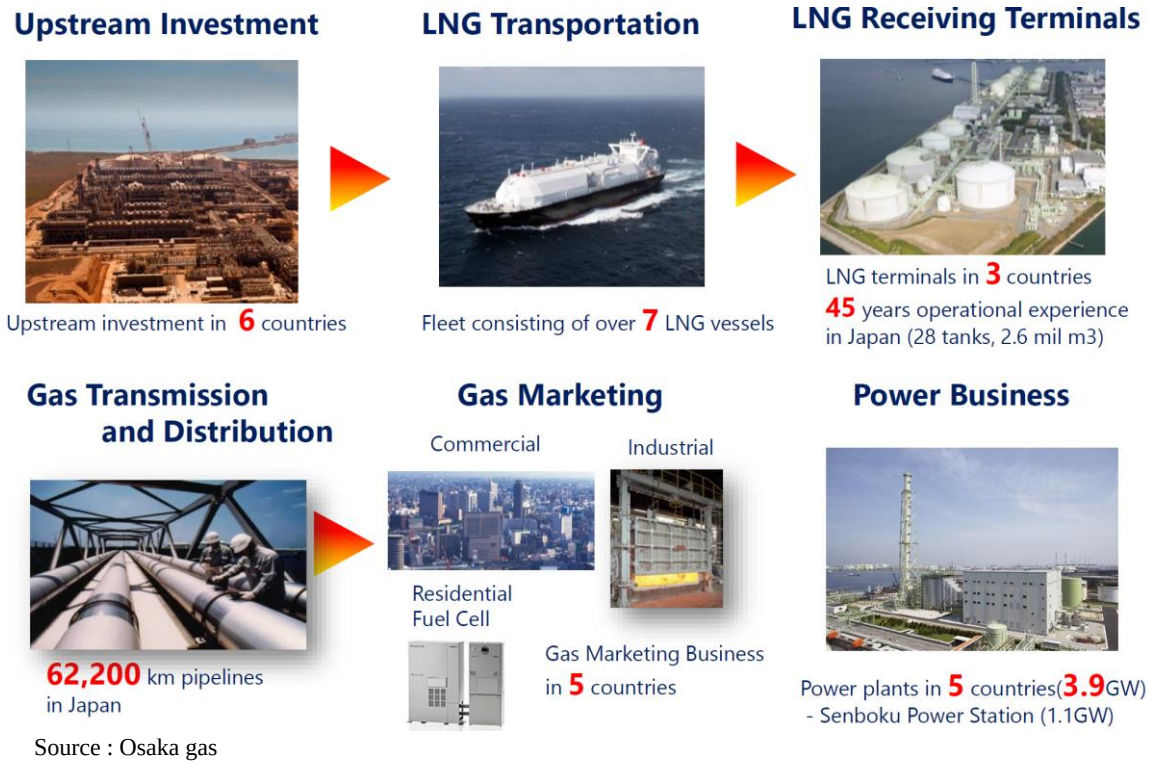
Nippon Koei took an inititive of discussions, coordination, and support between the two cities, and was in charge of supporting the formulation of JCM model projects in the EEC region. Nippon Koei has sales offices in Southeast Asian countries and has a track record of JCM city-to-city collaboration cooperation project (the Project) in Indonesia, Vietnam, and Myanmar. In the collaboration, Nippon Koei has made various efforts to form a JCM model project and provide support to the EEC, utilizing timely information from other city-to-city collaboration other than EEC.

Source : Nippon Koei

Figure 1.9 JCM city-to-city collaboration experience by Nippon Koei

(2) Osaka Gas

As a total natural gas supplier in the Kansai area, Osaka Gas is responsible for everything from gas mining to transportation, refining to retailing as a supplier, and gas-fired power generation, with a wide range of activities.



Source : Osaka gas

Figure 1.10 Business field by Osaka gas

Osaka Gas has already entered the Thai market and established a local subsidiary company, and is promoting business development for biogas refining technology that contributes to the development of the "biofuel and biochemistry" field is positioned as a target industry in Thailand 4.0. For details of the activities, see Section 3.2 below.

(3) Johnson Control Hitachi Air Conditioning

Johnson Controls-Hitachi Air Conditioning Co., Ltd. (JCH) is a joint venture between Johnson Controls, a major U.S. air conditioning manufacturer, and the air conditioning division of Hitachi Appliances, which was established on October 1, 2015. Utilizing the advantages of both companies, JCH has sells HVAC[3] products with a global network.

Since last year, JCH has actively engaged in JCM project formulation mainly in Ho Chi Minh city, Vietnam. This time, in the city-to-city collaboration in the EEC region, Johnson Controls-Hitachi Air Conditioning (Thailand) Co., Ltd. (JCHT), has promoted high-efficiency air-conditioning equipment with JCM scheme to contribute to low carbon and zero carbon in the EEC region.

(4) Mizuho Bank

Mizuho Bank, one of the major banks in Japan, concluded a memorandum on attracting corporate investment with the EEC in March 2018, and has been providing information and support to companies considering investment. In this city-to-city collaboration, Mizuho bank has supported to utilize their network established between EEC and Japanese companies in Thailand. The bank also has supported Japanese entities such as Osaka City, Nippon Koei, JCH and Osaka Gas.

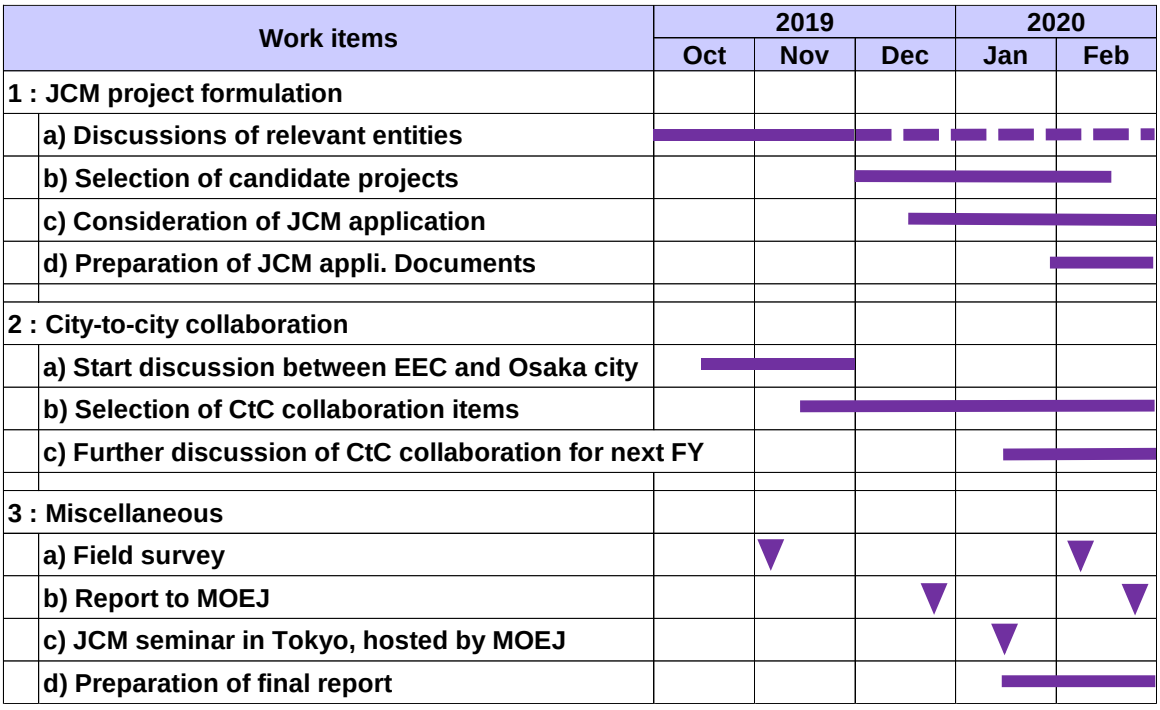
In addition, Mizuho bank launched the EEC-OSS (EEC-One Stop Service) in October 2019, which would enable various applications to Thai government agencies to be handled online, in connection with business development in the EEC region and other areas. In this way, Mizuho bank is pioneering measures for Japanese companies to enter the EEC and is expected to contribute to cooperation between cities.

[3] Heating, Ventilation and Air Conditioning

1.5 SCHEDULE

This city-to-city collaboration was adopted as a 2nd selection in FY 2019 (same as Reiwa first year), and its activities have begun in October 2019.

Before commencing the collaboration, there is no special relationship established between Osaka City and the EEC. For this reason, in this city-to-city collaboration, various activities were carried out this year, mainly to promote exchange opinions between Osaka City and EEC. The process of this Project is as shown in the figure below.



Source : Nippon Koei

Figure 1.11 Schedule

CHAPTER 2 CITY-TO-CITY COLLABORATION

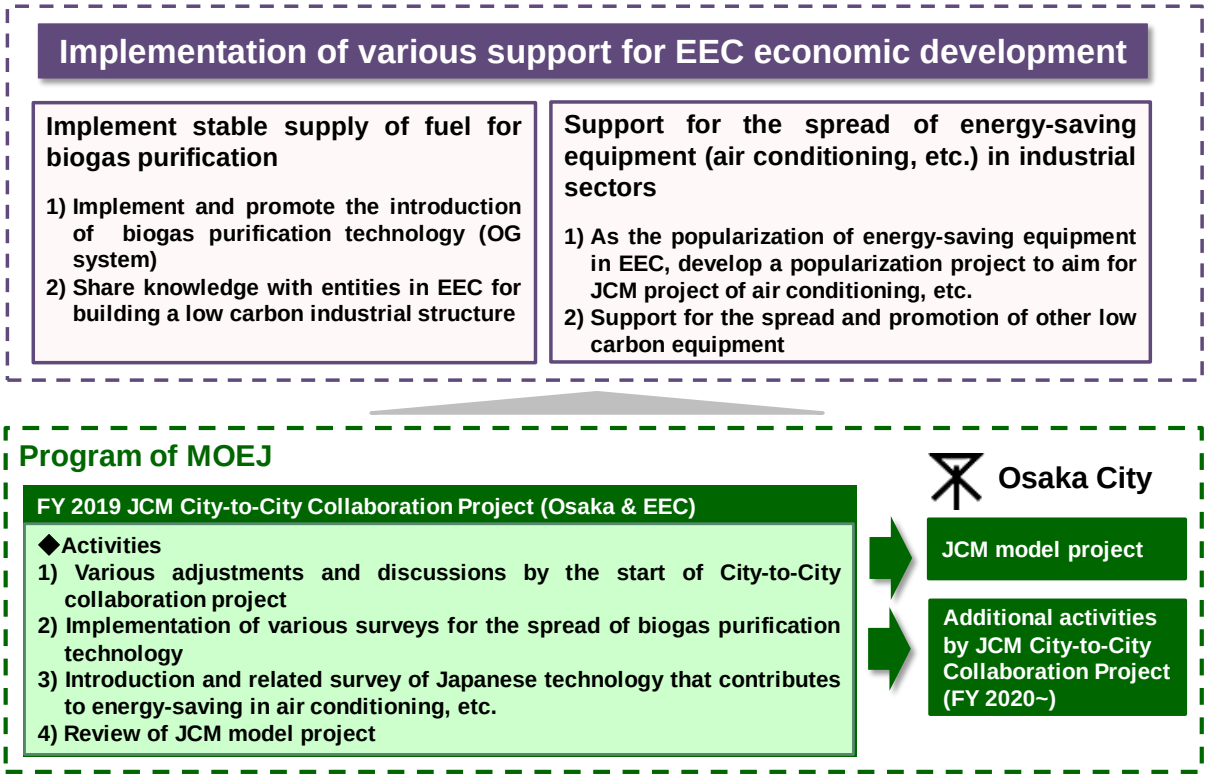
2.1 OBJECTIVE

This year is the first year for Osaka City and EEC to commence city-to-city collaboration. So it is necessary for both cities to know each other's characteristics and to promote effective exchanges through the collaboration for their mature relationship.

2.2 IMPLEMENTATION POLICY

In this city-to-city collaboration, the Project aimed to support promotion and implementation of Thailand 4.0, which EEC is particularly interested in, utilizing the knowledge of Osaka City's experiences on JCM city-to-city collaboration.

In case of identifying new needs contribute to low carbon and zero carbon development in the EEC region, Osaka City has not only supported itself but also seeked information through Team OSAKA network etc., as a multifaceted support. Then, the Project tried to solve the problems of EEC and connected to new business creation. Image of the activities of the city-to-city collaboration is shown in the figure below.



Source : Nippon Koei

Figure 2.1 Image of city-to-city collaboration

To formulate JCM model project, as shown in the figure above, promotion of high-efficiency air-conditioning equipment and consideration of the biogas refining technology has been conducted.

In addition, in January 2020, the Project has received a request from EEC on information /knowledge sharing on waste management. Details are stated in the Sections 2.3.7 below.

2.3 REUSULTS OF THE COLLABORATION

2.3.1 Outlines

Following table below summarizes the main activities of this year's activities in this city-to-city collaboration, including meetings, field survey, and JCM city-to-city collaboration seminar.

Table 2.1 Major activities in this collaboration

Activities	Date	Outlines
1st field survey in Thailand	Nov. 17 to 22, 2019	Kick off meeting with EEC, business meeting with JCHT etc.
Kick-off meeting with MOEJ in Tokyo	Dec. 20, 2019	---
Business meeting between EEC secretariat and Japanese companies in Tokyo	Jan. 15, 2020	Business meeting with Japanese three companies which are interested in doing business in EEC region.
JCM city-to-city collaboration seminar in Tokyo	Jan. 16 to 17, 2020	---
Disucssion meeting between EEC secretariat and MOEJ in Tokyo	Jan. 17, 2020	Discussion meeting between EEC and EEC secretariat on EEC's interests, such as waste management, water supply business, smart city etc.
2nd field survey in Thailand	Feb. 2 to 7, 2020	Discussion on further collaboration etc.
Final meeting with MOEJ in Tokyo	Feb. 21, 2020	---

Source : Nippon Koei

2.3.2 1st field survey

The first survey of the city-to-city collaboration has been done from November 17 to 22, 2019, its schedule was shown below.

Table 2.2 Schedule of 1st field survey

Date	Activities	Accomodation
November 17, 2019	Move, Japan to Thailand	Bangkok
November 18	Meeting with TGO, EEC etc.	Bangkok
November 19	Participation of business meeting held by JCHT	Bangkok
November 20	Meeting with Osaka gas Thailand, Mizuho bank Thailand etc.	Bangkok
November 21	Internal meeting with Osaka etc. Move (Thailand to Tokyo)	Overnight flight
November 22	Back to Japan	---

Source : Nippon koei

(1) Meeting with EEC secretariat

Kick-off meeting between Osaka City and EEC held to share the outline, objective and major activities of the Project. In addition, Osaka Gas, which is planning a JCM project formultion study this year, explained its technology (Biogas refiniing technology).

Osaka City explained that the Project contributes to EEC' policy and target through the collaboration.

Meeting with EEC secretariat

Meeting with EEC secretariat

(2) Meeting with TGO

The Project team visited the Thai Greenhouse Gas Management Organization (TGO), which prepares GHG inventory, manages JCM activities in Thailand and explained the outline of city-to-city collaboration and exchanged opinions. TGO welcomed the Project team and contributes to Thailand GHG emission reduction.

Meeting with TGO

(3) Meeting with DEDE

The biogas refining technology (OG system) planned by Osaka Gas Thailand is an effective technology for improving biogas refining in the process of refining bioethanol etc. To search potential custmer on the above technology, the Project team visited Department of Alternative Energy Development and Efficiency (DEDE) and confirmed prospective factories in Thailand, especially EEC region.

Meeting with DEDE

(4) Meeting with Japanese entity

During the first field survey, the Project team interviewed with local industrial park developer which is invested by Japanese company. The developer owns and operates several industrial parks in Thailand. About 300 companies (including about 150 Japanese companies) are located in the industrial park.

2.3.3 Kick off meeting with MOEJ

A kick-off meeting was held with the Ministry of the Environment, Japan (MOEJ), as a report on various activities related to the city-to-city collaoration this year. The main contents of the discussion are shown below.

Date	: December 20, 2019
Venue	: Meeting room of MOEJ
Attendance	: MOEJ, Osaka City and Nippon Koei
Minuites	: At the kick-off meeting, Osaka City and Nippon Koei explained the background that proposed as a city-to-city collaboration with Osaka City, and explained how Osaka City would expand to their contribution in Thailand including the EEC. In addition, the two private companies (Osaka Gas and JCH) in charge of JCM feqasibility study explained how they would develop their business through the collaboration. In response to the explanation, MOEJ made a comment on expectations for further collaboration with EEC.

2.3.4 Business meeting with EEC secretariat

With the visit of the EEC secretariat to the city-to-city collaboration seminar in January 2020, the Project held business meeting with several Japanese companies. Participating companies were selected from those that have already implemented their business in Thailand or wish to expand their business in Thailand in the future. Outline of the business meeting is shown below.

Date : January 15, 2020

Venue : Meeting room of AP Shinagawa Annex

Attendance : EECsecretariat, Osaka City, Nippon Koei and some Japanese companies who are interested in EEC business, such as Major electric company, Major plant manufacturer and Major home appliance manufacturers.

Minutes Minutes of the meetings are summarized below.

Major power company :
Explanation of various power generation and waste power generation in Thailand. EEC secretariat commented on the expectation of project implementation with waste power generation.

Major plant manufacturer :
After explaining their experience in Osaka and elsewhere, they exchanged opinions on future business in Thailand. In particular, there were many questions from EEC participants regarding the technical aspects of waste management system.

Major home appliance manufacturer :
Explanation of various experience and activities of the group companies in Thailand, and they exchanged the technologies and business models that can contribute to EEC. In addition, the EEC asked about the feasibility of research & development (R & D) and showcase initiatives in the EEC.

2.3.5 Participation of JCM city-to-city collaboration seminar in Japan

Two attendance, Ms. Mook and Ms. Kornviker, from the EEC secretariat participated in the JCM city-to-city collaboration seminar including factory inspection of waste treatment facilities in Tokyo on January 16 and 17, 2020.

Participation scenary of JCM seminar

Participation scenary of JCM seminar

2.3.6 Discussion meeting between EEC secretariat and MOEJ

With the participation in the JCM seminar held in January 2020, discussion meeting between EEC secretariat and the Ministry of the Environment, Japan (MOEJ) was held.

As first participation of JCM city-to-city collaboration seminar in Tokyo, EEC and MOEJ exchange opinions on global warming countermeasures and the environment. Outline of the meeting is as follows.

Date	: January 17, 2020 17:00 to 19:00
Venue	: Meeting room of AP Shinagawa Annex
Attendance	: EEC secretariat, MOEJ, Osaka City and Nippon Koei
Minutes	: After a briefing of the JCM scheme by MOEJ, the participants exchanged opinions on environmental issues in Thailand and EEC. During the discussion, the possibility of adopting JCM model project in the water business where the EEC is interested was discussed. Also it is explained that EEC is interested in smart city development, based on their strategy.

Meeting between MOEJ and EEC

Meeting between MOEJ and EEC

2.3.7 2nd field suevry

The second field survey of this year was conducted from February 2 to 7, 2020. Schedule of the survey is shown below.

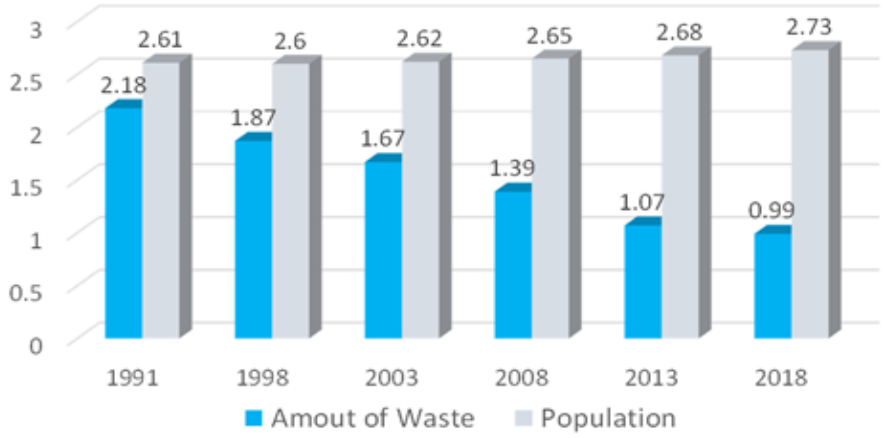
Date	Activities	Accommodation
February 2, 2020	Move (Japan to Thailand)	Bangkok
February, 3	Meeting with Japanese specialized trading company (Thai office), Japanese food company (Thai subsidized company) and Osaka gas Thailnad	Bangkok
February, 4	Meeting with Japanese general trading company (Thai subsidized company) Visit ethanol production company in Chachoengsao.	Bangkok
February, 5	Meeting with Japanese plant manufacturer (Thai subsidized company) etc.	Bangkok
February, 6	Discussion with EEC secretariat and DEQP Move (Thailand to Japan)	Overnight flight
February, 7	Return to Japan	---

Source : Nippon Koei

The main activities during this field survey are shown below.

(1) Meeting with EEC secretariat

During this visit, the Project team reported on activities related to city-to-city collaboration to EEC secretariat and proposed activities for the next fiscal year, and exchanged opinions on the direction of cooperation between the two cities. In particular, Osaka City explained the waste management activities of the city, which the EEC is currently interested in. It is confirmed that they would continue to cooperate/discuss on this matter from the next fiscal year. The following figure is some of the explanatory material.



Source : Osaka City

Figure 2.2 Transition of solid waste in Osaka City

Amount of solid waste in Osaka has been decreasing since peaking in 1991 regardless of its population. This is due to the implementation of appropriate waste management such as recycling, especially reduction and reuse, and separate collection. For reference, the cost of waste disposal management in Osaka City in FY2018 was about JPY 22.5 billion (about USD 225 million).

In addition, as the activities of Osaka City to increase the efficiency of waste management, the following measures and activities such as enlightenment activities to the citizen are being carried out.


Waste to Energy Plant


Mobile Application Household Waste Disposal


Environmental Education in Schools


Zero Waste Leader in Community


Osaka Declaration toward Zero Plastic Waste

Enlightenment materials etc. of Osaka City


Meeting with EEC secreatriat

Commemorative photo

In addition to the biofuel technology promotion etc., from the next fiscal year, the Project has focused on support activities on smart city and waste management which are selected as one of the items of the EEC's strategy.

(2) Meeting with Thailand entity who produces biogas

Since November 2019, Osaka Gas Thailand has been trying to contact some factories with biogas refining technology introduced by DEDE as a full-scale biogas survey in the EEC region. However, the response of Thai private companies was not sufficient, and interviews were not implemented easily. Therefore, the meeting has set gradually with the support of the EEC secretariat since January this year, and interviews are conducted.

Meeting in Osaka gas Thailand

During the 2nd field survey, Osaka Gas interviewed a Thai private company that manufactures and sells bioethanol for automotive fuel. Thai company says that a large amount of biogas is generated during the ethanol refining process, and that it is used as energy for the plant and as fuel for its related facilities. In the future, it was decided to continue discussions with a local ethanol production company and consider the technical superiority of the OG system.

Meeting with local ethanol entity

Local ethanol production factory

(3) Meeting with DEQP

By sharing the waste management knowledge by the Osaka City with the people concerned in the Kingdom of Thailand, an interview was held with the Ministry of the Environment, Thailand's Environmental Protection Agency (DEQP) to confirm the current status of waste management in the EEC area. DEQP is currently in charge of pollution control of EEC region such as PM2.5, noise etc., since 2010.

During the discussion, Osaka City explained the materials shown on the actual situation of waste management. Both parties exchanged views on recycling in Thailand. The current state of recycling in Thailand is to sort whether the items to be recycled can be easily sold or not to be sold.

As a result, what can be sold is processed (recycled), but what can not be sold is shown in the left figure at the intermediate sorting facility.

Publicity of solid disposal rules

In Thailand, disposable diapers for elderly people and disposal of hazardous materials have become a problem, and it is necessary to consider ways to deal with this issue properly.

Meeting with DEQP

Commorative photo

2.3.8 Final meeting with MOEJ

As a report on various activities related to the city-to-city collaboration this fiscal year, a final meeting was held with the Ministry of the Environment, Japan (MOEJ). Main contents of the discussion are shown below.

Date	: February 21, 2020
Venue	: Meeting room of MOEJ
Attendance	: MOEJ, Osaka City and Nippon Koei
Minutes	: The final report of the city-to-city collaboration between the EEC and Osaka City in this fiscal year and the contents of the collaboration in the next fiscal year onward were explained. At the same time, it was also explained that new companies to be joined and JCM candidate projects to be developed in the next fiscal year.

2.3.9 Support of future JCM candidate projects

This year was the first year of the city-to-city collaboration, and since it started in October 2019, the actual activity period was aapproximately four months. Therefore, while supporting the formation of JCM projects by Osaka Gas and JCH, the Project has tried actively to select JCM candidate projects from the next fiscal year onward.

There are many Japanese companies in the EEC region and surrounding areas including the Bangkok metropolitan. However, it was not easy to identify for potential JCM model projects in four month, however interviews were conducted with companies through networks of Osaka City and Nippon Koei.

The following is information on JCM candidate projects as of February 2020. In addition, for cases that are still confidential to the relevant parties after receiving specific consultations, the outline is indicated abstractly with the company name, target area, etc.

(1) Japanese major electronics manufacturer

Given the interest of the major electrinics manufacturer, Osaka office, the Project team visited the company's local subsidiary in Thailand, and exchanged opinions on JCM project formulation, together with the city-to-city collaboration with the EEC.

The company is currently focusing on selling solid oxide fuel cells (SOFC) in cooperation with major power plant manufacturers. SOFC is a fuel cell that operates at high temperature and is a high-efficiency power generation system that combines with a fuel cell and a micro gas turbine.

Also the company is currently discussing the introduction of the SOFC into the Thai government's facilities. In the future, it is expected that SOFC will be disseminated to the EEC market.

(2) Japanese major specialized trading company

The Project team had an interview with a major specialized trading company of Thailand office with a track record in JCM business in Thailand. Since the company already has a track record of JCM model project, it has discussed future activities in Thailand based on their experience.
Currently, the company plans to apply for a JCM model project for the biomass power generation business (Approx. 2 MW).

Meeting photo

Through the discussion, both parties agreed to promote various cooperation and information exchange in the framework of city-to-city collaboration in the future. In addition, as a major specialized trading company of Thai local company, it is aware that the smart city strategy advocated by the EEC region will be a great business opportunity. In this regard, Mizuho Bank outlined the benefits of the BOI and preferential investment in the EEC.

(3) Japanese major food company, Thailand office

There are several factories of major food companies located in entire area of Thailand, and there is still no EEC region. Therefore, opinions were exchanged on the formulation of a JCM model project at the current factory.

As an example, the power generation scale of the company's factory is approximately 8 MW and it is placed on the roof of the factory and warehouse. In the future, the company will proceed with discussions on the introduction of JCM model project.

Meeting photo

(4) Japanese major general trading company, Thailand office

Japanese major general trading company, Thailand office has been considering a biomas power generation project, energy saving/renewable energy project at retail stores etc., the Project team will support these project because it is expected to be a promising JCM projects in the next fiscal years between Osaka City and EEC.

CHAPTER 3 JCM PROJECT FORMULATION STUDY

3.1 CONSIDERATION OF AIR CONDITIONING EQUIPMENT

3.1.1 Johnson Controls Hitachi Air Conditioning

Johnson Controls-Hitachi Air Conditioning Co., Ltd. (JCH) has begun to take an interest in the JCM scheme since last year through the city-to-city collaboration between Osaka City and Ho Chi Minh City. Through this collaboration, JCH has developed two JCM model projects on air conditioning system.

An overview of JCH and its local subsidiary in Thailand (Johnson Controls-Hitachi Air Conditioning (Thailand) Co., Ltd .: JCHT) is shown below.

Name	Johnson Controls-Hitachi Air Conditioning Co., Ltd. (JCH)
Service	Manufacture and sales of multi-air conditioning systems (VRF) for buildings, package air conditioners for stores, and chiller units that produce cold and hot water for building air conditioning and industrial cooling of factories.
Establish	October 1, 2015
Staff	Approx. 15,000 (as of Oct. 2018)

Name	Johnson Controls-Hitachi Air Conditioning (Thailand) Co., Ltd.
Service	Sales of multi-air conditioning systems for buildings and chiller units that produce cold and hot water for building air conditioning and industrial cooling of factories.
Location	719 KPN Tower, 8th Floor, Rama Road, Bangkapi, Huaykhwang, Bangkok

3.1.2 Study outlines

Since the latter half of last year, JCH has been forming a JCM project mainly in Ho Chi Minh City, Vietnam, with its Vietnamese subsidiary participating in Osaka-HCMC city-to-city collaboration. This time, Osaka City has implemented the collaboration with the EEC, JCHT would commence business negotiations with existing customers in Thailand including the EEC region, to formulate a JCM model project.

3.1.3 Specifications

High-efficiency variable refrigerant flow (VRF) air conditioning sytem for general buildings manufactured by the JCH maintains industry-leading performance and can be flexibly adapted to the scale of use by combining units according to customer requirements. It is a space-saving type, low noise type, equipped with a defrosting function, etc. and is promising for application of JCM model project as a high-efficiency air conditioning system.

Series	Centrifugal	Water cooled Screw	Air Cooled Screw	VRF
Appearance				
High efficiency Type	300RT-2500RT	50-500RT	45-450RT	8HP-88HP

Source : JCH presentation material

Figure 3.1 JCH's products

The following table summarizes the general seles points (supeiority) of JCH air conditioning equipment.

Table 3.1 Superiority of JCH products

Superiority	Outlines
High efficiency	Realizing top class energy saving
Flexible support to custmer's needs	Introducing flexibile design to combine several units with different outputs
Saving space	Realizing space saving according to customer needs by combination of several units with different outputs
Low noise	Considering the motor and the structure of the equipment with low noise indoor and outdoor unit
Others	Equipped with a defrosting function and implement customer-oriented after-sales service

Source : Nippon Koei prepared based on the JCH's paper.

3.1.4 Study results

JCH sells its products on a daily basis to local businesses and local subsidiaries through local staff. Based on the market research implemented by the JCH, as an opportunity to actually explain the procedures for applying for JCM model project and specific incentives, etc., a business negotiation was held at a JCHT office by invititation of local business operators. Outlines of the business meeting is shown below.

Date : November 19, 2019

Venue : Meeting room of JCHT office

Attahdance : Osaka City, JCH, Mizuho Bank, Nippon Koei and local business operators below.

Company	Industry
Entrust Intercorp Co,Ltd.	Hitachi Parthner (Distributor)
One Origin Company Limited	Developper
Taokaenoi Food&Marketing PLC	Food
Penpark Co,Ltd	Medichine and Beverage
Kao Mai Thai Dessert Co,Ltd	Food

Commorative photo on JCH meeting

Photo on JCH business meeting

At the business meeting at JCHT office, many local companies who had already purchased JCH's products and evaluated their products and services participated were gathered. During the meeting, questions were mainly focused on various procedures and responses related to the application for the JCM model project. In this regard, JCH provided results in the JCM model project in Vietnam this year, and provided easy-to-understand information based on actual experiences.

At this time, no candidate projects to apply for JCM model project early in the next fiscal year have been identified, but the JCH will continue to formulate future projects with local businesses network.

Items	
Project application	Office building
Air-conditioning Area	m2
Product	VRF (Commercial Air-conditioning System
Project budget	14B VND ≒ 64M JPY
Schedule	Construction start : August 2020 Opening : April 2021

			A	B		C	D=(C x 15)	E=B÷D
		Project Budget VND	Project cost JPY	Applying Subsidy	%	Yearly CO2 Reduction	15 years CO2 Reduction	Target <4000
1	A	14B VND	64,400,000	19,320,000	30%	**325**	4,875	3,963

Source : JCH presentation material

Figure 3.2 Presentation material on JCH's business meeting

3.1.5 JCM application plan

At present, there is no candidate for JCM model project in the EEC region or Bangkok Metropolitan implemented in this fiscal year as early as the next fiscal year. However, during the survey period this year, the following Thai corporations and Japanese local companies other than the companies that participated in the business meeting are considering a proactive and JCM application for the purchase of JCH products.

Thai company

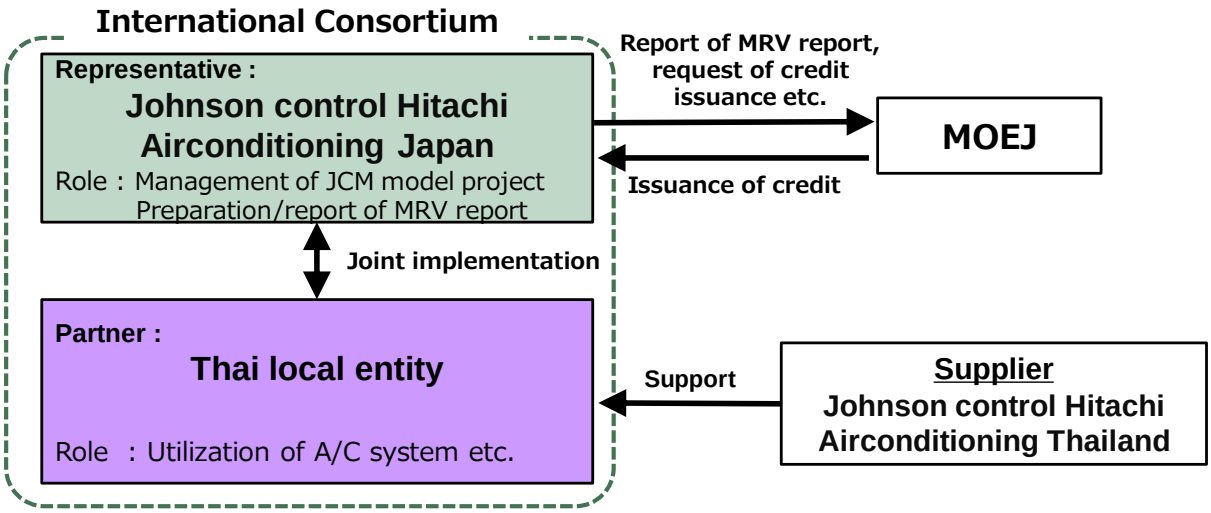
1) Dusit Thani Laguna
2) Boat Pattana Co., Ltd
3) Longwood Health Co., Ltd.
4) Siam Business Administration Technological College
5) Origin Property Public Company Limited
6) Villa Market JP Co., Ltd.

Japanese local company

7) Yokohama Tire Manufacturing Thailand
8) AGC Automotive (Thailand) Co., Ltd / AGC Micro Glass (Thailand) Co., Ltd.
9) Bridgestone Tire Manufacturing (Thailand) Co., Ltd.

Based on the above, the Project will plan to support the formulation of the JCM model projects in the following years.

3.1.6 International consortium



Source : Nippon Koei

Figure 3.3 International consortium on JCH project

JCH has bundled several air conditioning projects with a subsidy amount of less than 50 million JPY based on the results in Vietnam this year, and linked them to the application for JCM model project. This is considered to be one of the measures to obtain JCM model project application in the air conditioning equipment business where the size of each B to B business is not so large scale enough.

In the future, it is expected that JCM model projects will be formed in the EEC region using a similar approach.

3.1.7 MRV plan

JCH has already implemented a JCM model project for air conditioning equipment in Vietnam since this year. Therefore, the company already has the know-how of Measurement, Report and Verification (MRV) and expects to transfer its knowledge to Thai projects. Specifically, it is assumed that the power consumption accompanying the operation of the air conditioner is measured by a kWh electric meter (power meter) conforming to international standards (IEC or equivalent).

After starting the operation, it is assumed that the local business operator is requested to periodically check of the meter and acquire data. In addition, as much as possible, it is assumed

that the acquisition of electronic data is supplemented, and a request for visual measurement by a local business operator is also assumed.

3.1.8 GHG emission reduction

JCM scheme has already developed several methodologies of the air conditioning equipment (refrigerators, etc.). For this reason, GHG emission reductions can be calculated for JCM model projects for which approved methodologies can be used, based on the following methodologies.

For reference, the following are the reference emissions and project emissions for calculating GHG emission reductions by the approved methodology (AM_TH005: Energy Saving by Introduction of High Efficiency Non-Inverter Type Centrifugal Chiller, Version 02.0) in Thailand.

Reference emissions

$$RE_p = \sum_i \left\{ EC_{PJ,i,p} \times \left(COP_{PJ,tc,i} \div COP_{RE,i} \right) \times EF_{elec} \right\}$$

RE_p : Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller i during the period p [MWh/p]
$COP_{PJ,tc,i}$: COP of project chiller i calculated under the standardizing temperature conditions [-]
$COP_{RE,i}$: COP of reference chiller i under the standardizing temperature conditions [-]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

Project emissions

$$PE_p = \sum_i \left(EC_{PJ,i,p} \times EF_{elec} \right)$$

PE_p : Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller i during the period p [MWh/p]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

In addition, JCH is envisioning the use of JCM for the sale of building multi-air conditioners (VRF). In the future, the GHG emission reduction will be calculated separately by comparing the coefficient of performance (COP) of the reference chiller and the project chiller. In the existing methodology, the COP of the reference chiller is set to a constant value according to the cooling capacity of the project chiller under standard rated conditions.

On the other hand, by using VRF, the operating load is not actually constant, but varies depending on the operating load factor of the air conditioner and the outside air temperature. In chillers for air-conditioning system, operation at 100% load is small, and most of the time it is operating at from 50% to 75% load. In order to calculate the energy saving effect with a value closer to the actual condition, it is necessary to consider the actual air conditioning operation load.

Based on this point, it is desirable to calculate energy savings for VRF machines in consideration of partial load operation. Generally, a standard term coefficient of performance (Integrated Part Load Value : IPLV) is used. IPLV is calculated by the following formula.

$$IPLV = \alpha A + \beta B + \gamma C + D\delta$$

A : COP of 100% load, B : COP of 75% load, C : COP of 50% load, D : COP of 25% load
α : 100% load, β : 75% load%, γ : 50% load%, δ : 25% load of operation hours , same as weights

In case of a JCM application is made for a specific VRF machine, the calculation of GHG emission reductions by IPLV will be considered after the next fiscal year.

3.1.9 Issues on JCM application

JCHT has already accumulated know-how on JCM model project. For this reason, it is recognized that there are no significant issues related to JCM applications.

On the other hand, in the air conditioning equipment business, the size of each project is slightly small, so there is concern about the burden of bundling multiple projects and applying as a JCM model project.

In this fiscal year, the JCM candidate project has not yet been identified due to limited time, but in the next fiscal year, it is expected that the JCM model project will be formulated through the results and business meeting and JCH's network.

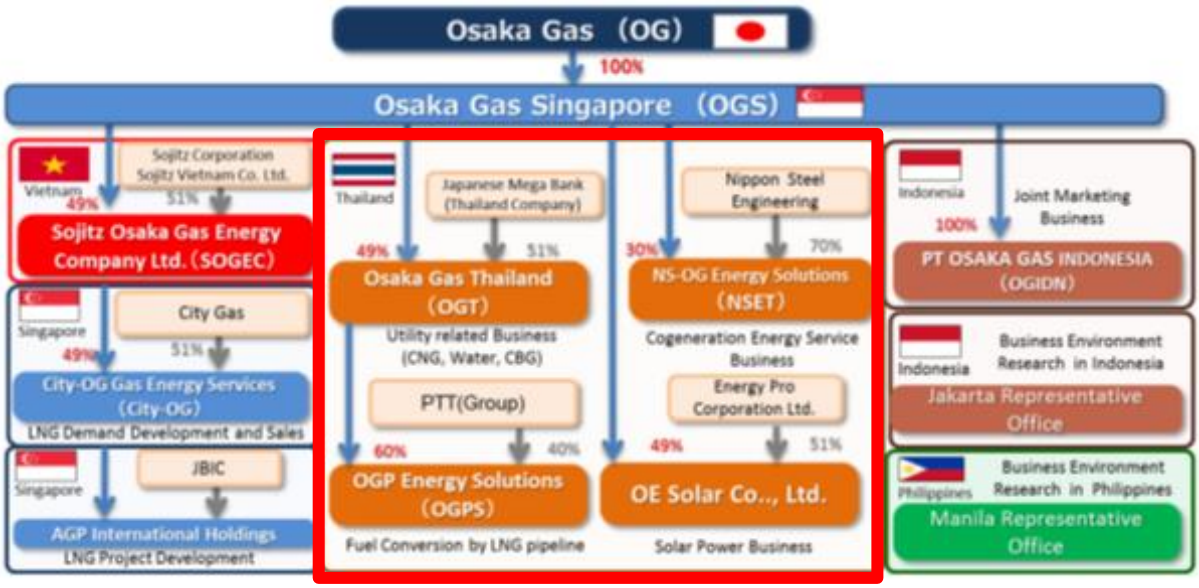
3.2 CONSIDERATION OF BIOGAS REFINING TECHNOLOGY

3.2.1 Osaka gas

Osaka Gas supplies natural gas to more than 7 million general households in the Kansai area, centered on Osaka City. Leveraging its know-how in the gas supply and gas-related businesses over many years, the company is expanding its gas business in the Kingdom of Thailand.

An overview of Osaka Gas and its subsidiary in Thailand (Osaka Gas Thailand) is provided below.

Company name	Osaka Gas Co., Ltd.
Services	Domestic energy and gas: Manufacture, supply and sale of city gas, sale of gas equipment, gas piping work, sale of LNG, sale of LPG, sale of industrial gas Domestic energy and electricity: Generation and sales of electricity Overseas energy: Development and investment in natural gas and oil, energy supply, leasing of LNG transport tankers Life & Business Solutions: Real estate development and leasing, information processing services, sales of fine materials and carbon materials
Establish	April 10, 1897
Staff	5,392 (non-consolidated), 20,224 (consolidated)
Capital	132 billion 166 million JPY



Source : Osaka gas presentation material

Figure 3.4 Osaka gas's business structure in south east asian

Company name	Osaka Gas (Thailand) Co., Ltd.
Services	Utility (energy) related business for industrial customers
Location	10F, Wave Place Building, 55 Wireless Road, Lumpini, Pathumwan, Bangkok 10330 Thailand
Establish	October, 2013

The biogas refining business currently underway by Osaka Gas Thailand is shown below.

Source : Osaka gas presentation material

Figure 3.5 Appearance of biogas refining plant in Thailand

A local subsidiary of Osaka Gas (Osaka Gas Thailand) is currently compressing and refining biogas obtained from waste fluid (POME[4]) discharged from a local palm oil manufacturing plant in Nakhon Si Thammarat Province, to produce fuel for natural gas vehicles.

4 Palm Oil Mill Effluent : POME

Source : Osaka gas presentation material

Figure 3.6 Process of biogas refining plant in Thailand

In this fiscal year, Osaka Gas Thailand aims to contribute to the spread of biofuels advocated by the EEC by implementing and deploying a new biogas refining business.

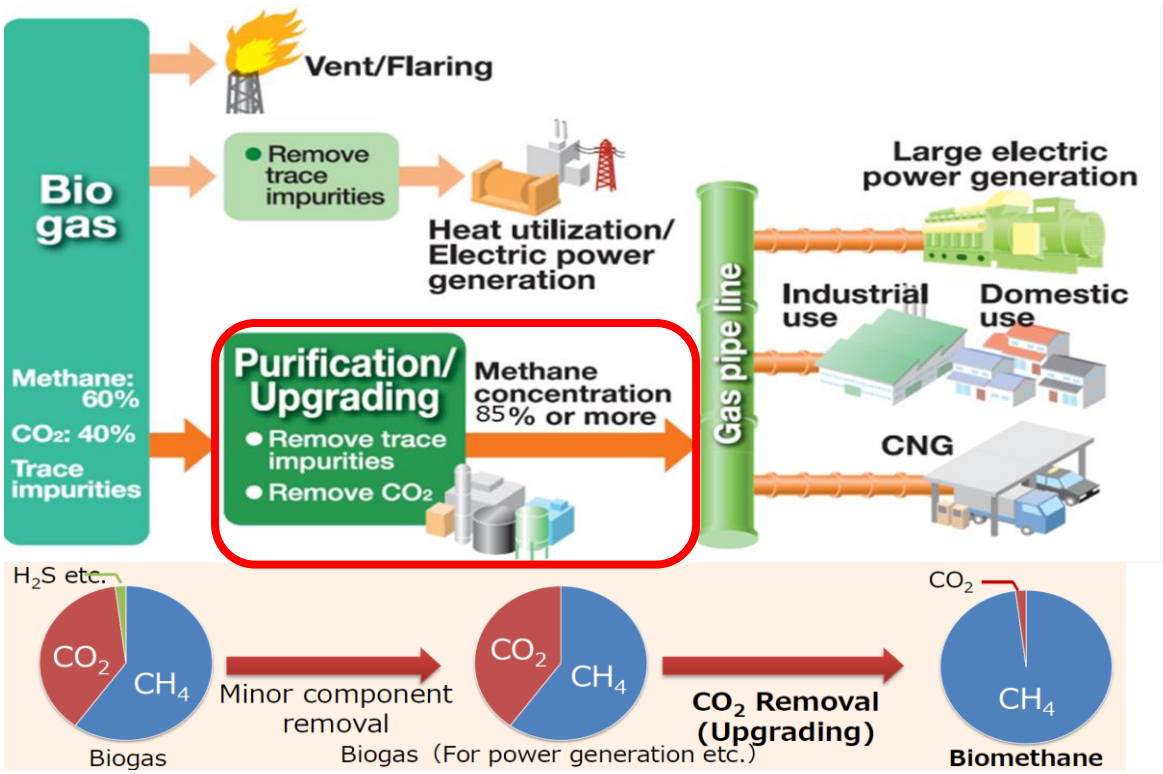
3.2.2 Study outlines

This time, with the cooperation of Osaka Gas Thailand, it is examined whether the biogas refining technology can be commercialized and established as JCM model project in the EEC region or not. One of the major industries in Thailand and other Southeast Asian countries is biomass-related business. In particular, Thailand has a greater track record of introducing biogas production facilities than other Southeast Asian countries and has abundant raw materials.

Therefore, effective utilization of biomass and biogas is expected as an activity contributing to low carbon and zero carbon in the EEC. In the use of biogas, carbon dioxide and impurities are contained in addition to methane gas, and they must be removed in order to use city gas. It is however not done at present.

Osaka Gas has developed "biogas refinign system" to remove impurities from biogas and increase methane concentration, and is introducing it to biomass factories in Thailand and other countries. Osaka Gas's proprietary biogas refining technology (OG system) has been pilot-tested in Thailand from FY2017 to FY2018, and commercialization has been completed.

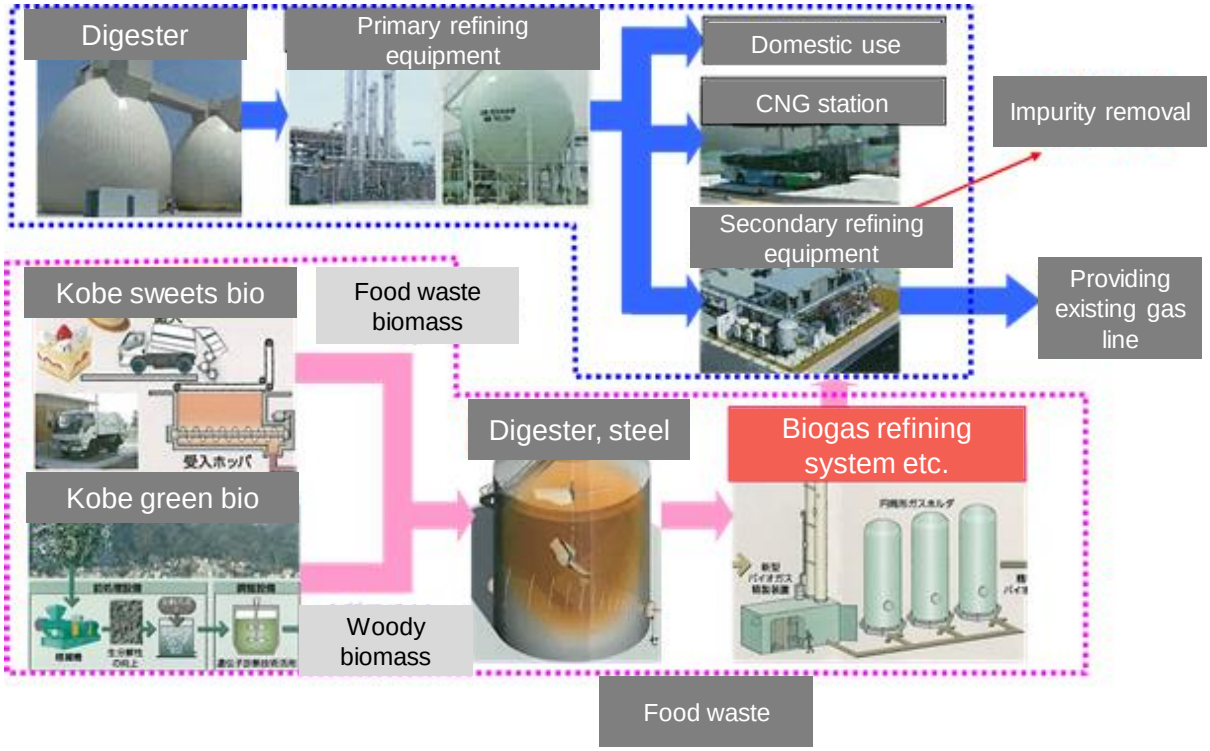
In addition, feasibility of OG system has been confirmed through the JCM scheme. In the future, in order to expand the scope of application of this technology, it is planned to clarify effective utilization methods other than fuel applications for natural gas vehicles and related laws and regulations, and consider commercialization, in Thailand and other countries.



Source : Osaka gas presenattion material

Figure 3.7 Outlines of OG system

For reference, the following is an example of the introduction of the OG system in Japan by Osaka Gas. In Japan, the government recommends that biogas be refined and then directly injected into gas pipelines. For this reason, an OG system has been introduced and the gas (derived from sewage sludge) generated by Higashinada Biogas is being injected into the gas pipe. On the other hand, there is no track record of the pipe injection in Thailand, and it is necessary to confirm with relevant regulations under the ministries and agencies on its application.



Source : Osaka gas presentation material

Figure 3.8 Example of OG system in Japan

3.2.3 Study results

To promote the implementation of the OG system, Osaka Gas Thailand has confirmed the potential of biogas in Thailand.

In particular, the potential amount of biogas in the EEC is said to be 133.0 [million m3 / year], and commercialization involving JCM is expected. The amounts of biogas in Chachoengsao, Chonburi and Rayong are 66.4 [million m3/year], 31.8 [million m3/year] and 34.8 [million m3/year] respectively.

In case that installation of the OG system is not sufficient to meet the capital investment, the benefits of introducing a biogas refining plant would be diminished. From this point, it is examined the biogas-related facilities that are highly likely to introduce this system, and confirmed the following results.

As shown in the table below, automotive ethanol purification plants distributed in the Kingdom of Thailand have high biogas production per plant. It is said that the plants can be promising candidates of OG system.

Table 3.2 Outlines of type of biogas plant in Thailand

Type of biogas plant	No. of plant	Gas production [Mil. m3/year]	Average gas production per plant [Mil. m3/year/unit]
Starch	56	364.5	6.5
Ethanol	19	243.8	12.8
Live stock	1,250	217.6	0.2
Palm oil	72	177.3	2.5
Others	80	126.6	1.6
Total	1,477	1,130.0	0.8

Source : DEDE

Based on the above, this year, the following candidate factory in the EEC were selected. Since it was not easy to approach private companies in Thailand by Osaka Gas Thailand so far, the Project plans to actively consider commercialization with the support of the EEC secretariat.

Table 3.3 Factory information in EEC which expects to apply OG system

#	Name	Type	Location	Digestor volume [m3]	Registered Capital [THB]
1	Candidate factory A	Fruit	Chonburi	225,000	237,000,000
2	Candidate factory B	Slaughterhouse	Chonburi	200,100	100,000,000
3	Candidate factory C	Ethanol	Chachoengsao	54,000	942,000,000
4	Candidate factory D	Cassava starch	Chachoengsao	50,000	750,000,000
5	Candidate factory E	Ethanol	Rayong	30,000	975,000,000
6	Candidate factory F	Rubber	Chonburi	20,400	394,788,000
7	Candidate factory G	Food	Rayong	19,500	9,291,530,318

Source : Osaka gas presentation material

3.2.4 JCM application plan

As of the end of February 2020, discussions have been ongoing with several companies on the business development of the OG system promoted by Osaka Gas Thailand in the Kingdom of Thailand including the EEC region. Therefore, the JCM application plan are shown below when the OG system is applied to JCM model project in the future.

It is expected to pursue refining quality of biogas and providing a stable fuel (compressed biogas: CBG) because the quality of the biogas derived from agricultural wastes distributed in Thailand. Osaka Gas's new biogas refining technology (OG system) has advantages over similar technologies related to biogas purification in the points shown in the table below.

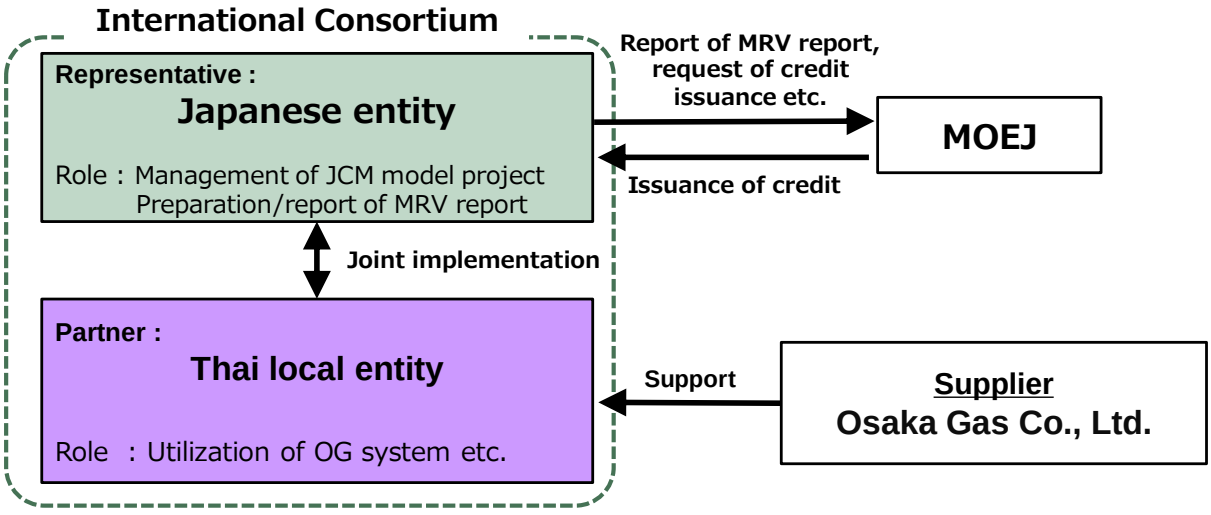
Table 3.4 Technical superiority of OG system

Type	Pressure fluctuation absorption Competitor A	Membrane Competitor B	High pressure water absorption Competitor C	OG system
Feature	CO2 is absorbed and removed by the adsorbent. Suitable for small to medium systems	Separation based on the difference in the transmission speed of the polymer membrane between CH4 and CO2. Suitable for small systems	High pressure water absorbs CO2 and removes it. Suitable for large-scale systems	Combination of PSA and membrane. Concentration to high purity and high CH4 recovery rate
Actual performance	50 prj in worldwide	10 prj in Europe	More than 50 prj in worldwide	Under preparation
Rate of CH4 collection	93%	99%	98%	99%
Price [JPY/Nm3]	11.9	21.4	9.7	9.0

Source : Osaka gas presetation material

3.2.5 International consortium

The project for Osaka Gas Thailand is scheduled to proceed with the investigation and review of the JCM model project in EEC region from the next fiscal year onward. At this time, the assumed organizational chart of the international consortium is shown below.



Source : Nippon Koei

Figure 3.9 International consortium

3.2.6 MRV plan

Providing fuel in the OG system is expected to contribute to the creation of a low carbon/ zero carbon society in the EEC region. Quantitatively measuring of the refined biogas can be handled in the category of the system and is not a problem. Therefore, it is considered that the point is to establish a system to ensure that Measurement, Report and Verification (MRV) is realized by the introducing companies.

In this regard, it will be promoted to implement appropriate MRV in the future by explanation of the appropriate MRV implementation measures to the identified local operators.

3.2.7 Issues on JCM application

OG system is an effective technology to promote low carbon in the Kingdom of Thailand or the EEC region. In the country, there are many potentials of biogas usage such as refining vehicle fuel for ethanol (generating biogas at the production stage), biogas using agricultural waste etc. Therefore, the market targeted by the OG system is expected to be large enough.

From the next fiscal year onwards, the Project plans to provide support for project formation as a city-to-city collaboration project by actively conducting market surveys and explaining technical advantages this year. The spread of the OG system is expected to promote low carbon /zero carbon in the EEC region.

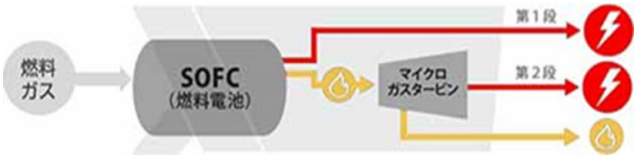
3.3 OTHER JCM CANDIDATE PROJECTS

In this fiscal year's survey, the Project team has interviewed with several public organizations and private companies, including the EEC secretariat, and confirmed activities that could become JCM model projects.

The followings are a summary of JCM candidate projects that are expected to be implemented /studied in the next fiscal years.

(1) Fuel cell project

EEC is aiming at industrial promotion centered on the target area and is also inetrested in advanced technology. A solid oxide fuel cell (SOFC) is a high-temperature operating one, a product of a major power plant manufacturer, was introduced through Japanese major electronics manufacturer in Thailand.



Source : Website of power generation plant manufacturer

Figure 3.10 Structure of SOFC

There is also a high-efficiency power generation system that combineswith a fuel cell and a micro gas turbine. The features of SOFC are shown in the above figure.

Injecting fuel gas into the SOFC generates power in the first stage. After that, using the exhaust gas from the SOFC power generation, the gas turbine can be operated to perform secondary power generation. Then, heat from the turbine can be extracted as hot water or steam. Any gas serving as a fuel can be used, such as natural gas, biogas, hydrogen, propane, butane, etc.

In addition, SOFC can use the various gases generated as by-products in industrial activities as fuel to contribute to the supply of additional electricity, heat, steam and hot water to the target factories. The company is currently in discussions with the government building to introduce the SOFC. It is expected that support will be provided in the city-to-city collaboration from the next fiscal years.

(2) Biomas power generation projects

During the collaboration between the cities, a major general trading company (Thailand) has been consulting on the JCM application of biomass power generation business that the Japanese general trading company is considering and implementing. Outline is summarized below.

Outline : Biomass power generation business utilizing agricultural residues (cassava, firewood, etc.) that is planned to be several MW class at several locations. The generated power will be sold to the grid.

Venue	: Thailand
Operator	: Joint venture of Japanese major general trading company and Thai company
Schedule	: Construction (Mid 2021), Operation (End 2022)

(3) Energy saving projects in retail stores

A major general trading company etc. are planning and studying low carbon and zero carbon retail stores that promote energy saving and renewable energy at retail stores in Thailand.

Outlines	: Introduction of energy-saving / renewable energy equipment at convenience stores. Specifically, inverter control of showcases and air-conditioning equipment, introduction of rooftop solar power generation, etc.
Location	: Urban area of Thailand
Operator	: Joint venture of Japanese major general trading company, Japanese major home appriance manfacturer and Thai company
Schedule	: Construction (Mid 2021), Operation (End 2022)

(4) Solar power generation project in factory

The company has been considering JCM application for rooftop solar photovoltaic (PV) power generation project (2 MW scale) with air conditioning at factories in Thailand. In the future, the above project might be joined the city-to-city collaboration.

CHAPTER 4 FUTURE ACTIONS

The city-to-city collaboration between Osaka City and EEC has been commenced since October 2019. The Kingdom of Thailand, which leads Southeast Asian countries, is currently the center of industrial development, is expected to have great potential for JCM application and low/zero carbon society development. Based on the activities and results in this fiscal year, some points were summarized for the plan for the next fiscal year.

4.1 ISSUES AND FUTURE ACTIONS ON CITY-TO-CITY COLLABORATION

This year, with the support of Osaka City, the city-to-city collaboration project has started discussions and exchanges of opinions with the EEC region of the Kingdom of Thailand.

At present, the Project has been received EEC' requests on support for waste-related management, support for smart cities, and consultation on water works projects. In the future, Osaka City will support EEC on their Green Plan below.

Source : EEC presetation material

Figure 4.1 EEC Green Plan

In the EEC region, where rapid economic growth is expected in the future, it is not easy to consider "Green". However, with the cooperation of Japanese companies and organizations such as Osaka City, it is expected that useful contributions can be made in EEC. Based on the above, it is assumed that support related to the EEC Green Plan will be provided as a consultation items for city-to-city collaboration in th next fiscal years.

4.2 ISSUES AND FUTURE ACTIONS ON JCM PROJECT FORMULATION

The EEC is a region where renowned Japanese companies are already operating as production bases in Southeast Asia, and its scale has been continuously expanding. Therefore, construction of new factories and development of industrial parks are expected in the future. On the other hand, the EEC has started planning and constructing high-speed railways, expansion of airports and ports, and extension of expressways as infrastructure development that connects the three prefectures.

In such a situation, the JCM model project is regarded as an opportunity to purchase Japanese products at a slightly discounted rate by local Japanese factories and major Thai companies that can afford to purchase Japanese products. However, Bangkok and the EEC region have been intensely marketed by foreign companies such as Europe, the United States, India, China, and South Korea.

Accordingly, in formulating JCM model projects, the city-to-city collaboration project will assess market trends and work with Japanese companies to select appropriate markets and Japanese products and technologies that will respond to Thai company's requirements. And the Projecy plans to promote efficient and effective JCM model project scheme. It is also important to disseminate the JCM scheme to Thai society, which is only partially recognized.

Finally, the following table summarizes the current status of the JCM model project identified through this year's activities.

Table 4.1 List of prospective JCM candidate projects

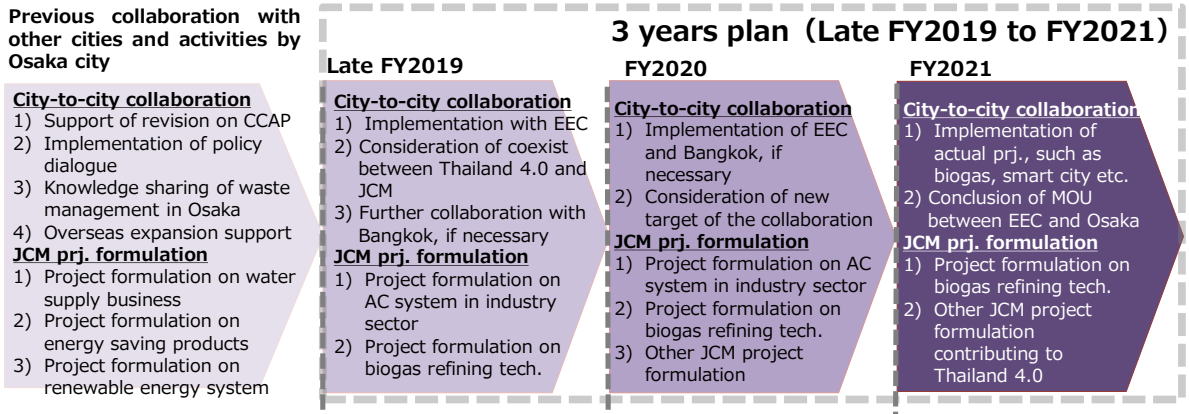
#	Type	Company involved	Location	Specification	JCM feasibility
1	Biomass power project	Major general trading company etc.	Northern Thailand	Several MW scale power plant	Apply to JCM model project in 2020
2	Fuel cell project	Major electronics manufacturer etc.	Bangkog etc.	---	Apply to JCM model project in 2020
3	Solar power project	Major specialized trading company	Bangkok and suburbs	MW scale	Apply to JCM model project in 2020
4	Energy saving/renewable enery project in retail store	Major general trading company, major home appriance manufacturer etc.	Bangkok and suburbs	Showcase and AC control by invertor, solar power system etc.	Apply to JCM model project in end 2020 or later

Source: Nippon Koei

4.3 3 YEARS PLAN

At the beginning of the city-to-city collaboration, various activities were started assuming the three-year plan shown below. However, in order to know the number of Japanese companies in the EEC region and the administrative position/situation of the EEC in Thailand, it is necessary to reconsidered further actions of policy of the collaboration in the next fiscal year.

From the above, as a conclusion of this report, the three years plan was reviewed below.



#	Candidate projects	1st year	2nd year	3rd year
1	Energy-saving equipment in the industrial sector (factory, etc.) in the EEC region	JCM FS	Application of JCM model prj.	Application of JCM model prj. and horizontal development
2	Biogas refining technology in EEC region	Market research and JCM FS	Application of JCM model prj.	Application of JCM model prj.
3	Energy saving/renewable energy in EEC region	Market research and JCM FS	Application of JCM model prj.	Application of JCM model prj.
4	Project contributing to Thailand 4.0	Market research and JCM FS	Application of JCM model prj.	Application of JCM model prj.

Source : Nippon Koei

Figure 4.2 3 year's plan prepared in August 2019

Since Osaka City and the EEC have not been any administrative contacts so far, two cities therefore tried to have deepen exchanges, and will make use of Osaka's knowledge and network to respond to topics of particular interest of the EEC. Because EEC especially have an interest in waste management, water works project and smart city, it is recognized that further discussions with the related three provinces, Chonburi, Chachoengsao and Rayong, will be had in the next fiscal year.

Taking the above into consideration, the city-to-city collaboration between Osaka City and EES have steadily progressed, identified new discoveries and exchanges. It is expected that this situation would be continued in the next year.

Regarding another pillar of the Project, JCM project formulation activities, the Project has confirmed some progress with the with the cooperation of Osaka Gas and JCH.

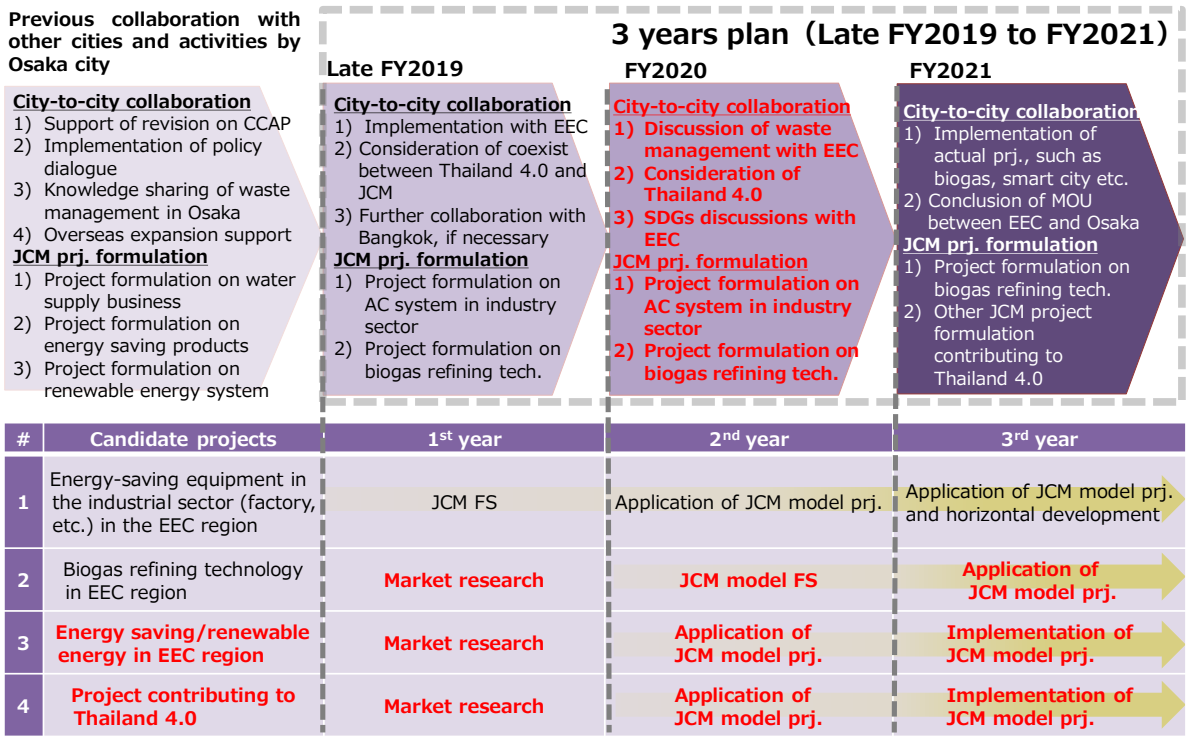
As for Osaka Gas project, the company has already commenced contacts with local factories and companies that will introduce biogas refining technology. It may take some time to explain its technological advantages and application to the prospective custmers. For this reason, it is desirable to support formulation of JCM model projects within one or two years so that the survey progresses steadily in the next fiscal year and beyond.

JCH has been conducting aggressive activities such as holding business meeting at a local subsidiary (JCHT). At present, it is not identified new JCM model project with purchasing or renewal of their equipment, but it is expected that the projects will be formulated in the next fiscal year based on their performance so far. Accordingly, the Project continue to support JCH activities in the next fiscal year.

In addition to the activities of the above two companies, during this project period, the Project team has contacted some companies which have been interested in the JCM scheme (see section 3.3). It is also pointed out that the market competition in the EEC region is not only other Asia companies but also European/western companies. For this reason, many Japanese companies in EEC region expect the use of JCM subsidy as their incentives.

Based on the above, with the consent of Osaka City, the Project hope to support all Japanese companies which are interested in JCM application, to contribute to low/zero carbon society development in EEC region.

Image of the city-to-city collaboration project for the next fiscal year is summarized in the figure below.



Source : Nippon Koei
Note : Red characters indicates the portions revised comparing with FY2019.

Figure 4.3　3 year's plan prepared in February 2020

In the city-to-city collaboration, with the EEC and Osaka City's exchanges deepened, the Project will take the next step to concrete the works in the next fiscal years.

In particular, the Project will support Osaka's experience and achievements in waste management works. In addition, the Project will discuss bureau of waste management in the three provinces of Chonburi, Chachoengsao and Rayong through the EEC secretariat, if necessary.

Regarding the SDGs, the Project has not been introduced in the activities of Osaka City and deeped discussions due to limited time in this fiscal year. For this reason, in the next fiscal year, the Project will consider specifying the department in charge and proceed with discussions on the SDGs.

As mentioned above, JCM project formulation will support as much as possible companies that are expected to participate in the JCM model project in the EEC region from the next fiscal year onward. In addition, the Project plans to introduce the convenience of the JCM and hold JCM seminars and business meeting in Bangkok area or the EEC region to introduce advanced technologies and products of Japanese companies.