FY2018 Project for Ministry of the Environment Japan

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

City-to-City Collaboration between Toyama City and Semarang City
Introduction of Energy Saving Equipment in Industry Sector of Semarang

Report

February 2019

Nippon Koei Co., Ltd.
Toyama City

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

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Abbreviations

Abbreviation	Description
AIM	Asia-Pacific Integrated Model
BAPPEDA	Regional Development Planning Agency
BAU	Business-as-usual
BTU	British Thermal Unit
CNG	Compressed Natural Gas
COP	Coefficient of Performance
DDF	Dual Diesel Fuel
ESDM	Ministry of Energy and Mineral Resources
FSRU	Floating Storage Regasification Unit
GHG	Greenhouse Gases
GNDP	Gross Regional Domestic Product
IDR	Indonesian Rupia
IEA	International Energy Agency
IGES	Institute for Global Environmental Strategies
INDC	Intended Nationally Determined Contributions
JCM	Joint Crediting Mechanism
KADIN	Chamber of Commerce and Industry
kTOE	Kilo tonne of oil equivalent
MGD	Million Gallon per day
mmBTU	Million British Thermal Unit
MOEJ	Ministry of the Environment, Japan
MOU	Memorandum of Understanding
MRV	Monitoring, Reporting and Verification
MW	Mega Watt
NK	Nippon Koei Co., Ltd.
ORF	Onshore Receiving Facility
PCS	Power Conditioners
PGN	Perusahaan Gas Negara
PV	Photovoltaics
RAN-GRK	National Action Plan for Reducing Greenhouse Gas Emissions
RAD-GRK	Regional Action Plan for Reducing Greenhouse Gas Emissions
SDGs	Sustainable Development Goals
UN	United Nations
USD	United States Dollars
USRt	United States Refrigeration ton

CHAPTER 1 BACKGROUND AND OBJECTIVE

1.1 BACKGROUND OF THE STUDY

In December 2015, all countries participated in United Nations Framework Convention on Climate Change 21st Conference of the Parties (COP21) which was 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, and it requires efforts to keep it below 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 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 emissions are emitted from cities as of 2006, that is, cities have important 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 the goal of Paris Agreement.

In Indonesia, the Government of Indonesia established National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK), and each regional government enacted Regional Action Plan for Reducing Greenhouse Gas Emissions (RAD-GRK) in 2013. In addition, Grand National Energy Plan 2015-2050 (RUEN) formulated in January 2017, particularly considers promoting energy saving and utilization of natural gas in Indonesia as priority countermeasures.

Semarang city is a provincial capital of Central Java in Indonesia and is located 450 km east from Jakarta. Population of Semarang city is approximately 1.7 million (census 2015), and it is the fifth largest city in the country. There are 9 Industrial Parks in Semarang, and energy demand and fuel consumption in industry sector have been increasing along with the growing manufacturing industry.

On the other hand, Toyama city which is located along the coast of the Japan Sea has many types of industries and has been promoting energy saving actions very well. The following table shows achievements of Toyama city for development of sustainable low carbon society.

Table 1.1 Award for Toyama City related to Sustainable City

Year	Award	Description
2008	Environmental Model City	Toyama city's activities for "low-carbon society" and concept of "compact city" are recognized as good examples for energy saving.
2011	Environmental Future City	The strategy of "compact city" is recognized as a good solution for the issues of all local cities.
2014	UN's SE4ALL	The plan for improvement of energy efficiency was developed to achieve the goal which is proposed by UN's SE4ALL.
2016	Host city for G7 Environment	Development of resilient city has been promoted in Toyama city. Mr. Mori, Toyama city Mayor, summarized the contents of a parallel

Year	Award	Description
	Minister's Meeting	session at the Minister's meeting as "the role of cities".
2018	SDGs Future City	On 15 June 2018, Toyama city was selected for "SDGs Future City" to contend comprehensively with many issues related to economy, society, environment sector. In addition, Toyama city is selected "Municipality SDGs Model Business" as well.

Source: Prepared by NK based on information from Toyama City

In addition to the above achievements, Toyama city is promoting "City cooperation programme by utilizing the package of Environmental Future City's knowledge". Also, Toyama city and Semarang city were selected as one of "100 Resilient Cities" by the Rockefeller Foundation.

Then, "FY2017 City-to-City Collaboration Programme for Low-Carbon Society between Toyama city and Semarang city" was adopted to realize low carbon society in Semarang city by sharing Toyama city's experiences and knowledge. In this programme, the activities on "Compact city type transportation system" and "Low carbonization resilient city construction" in Semarang were implemented.

The technical cooperation agreement between Toyama and Semarang for low-carbon society

Furthermore, a technical cooperation agreement was established between Toyama city and Semarang city. Mr. Masashi Mori (Toyama city Mayor) and Mr. Hendrar (Semarang city Mayor) signed on the agreement at Toyama International Conference Center in December 2017. On the same day, Toyama city and IGES also signed the technical cooperation agreement aimed towards the realization of sustainable, decarbonized development.

Major achievements of the City-to-City collaboration are summarized in the following table.

Table 1.2 History of Toyama and Semarang City-to-city Collaboration

#	Year and Date	Description
1	8 August 2017	"FY2017 City-to-City Collaboration Programme for Low-Carbon Society between Toyama city and Semarang city" was adopted. It aimed to develop "compact city type transportation system" and "low carbonization resilient city construction" in Semarang city.
2	14 December 2017	The technical cooperation agreement between Toyama and Semarang for low-carbon society was established.
3	3 March 2018	Letter of Intent for the FY 2018 City-to-City Collaboration Programme was received by Semarang city.
3	25 June 2018	"Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" was selected as FY2018 JCM model project

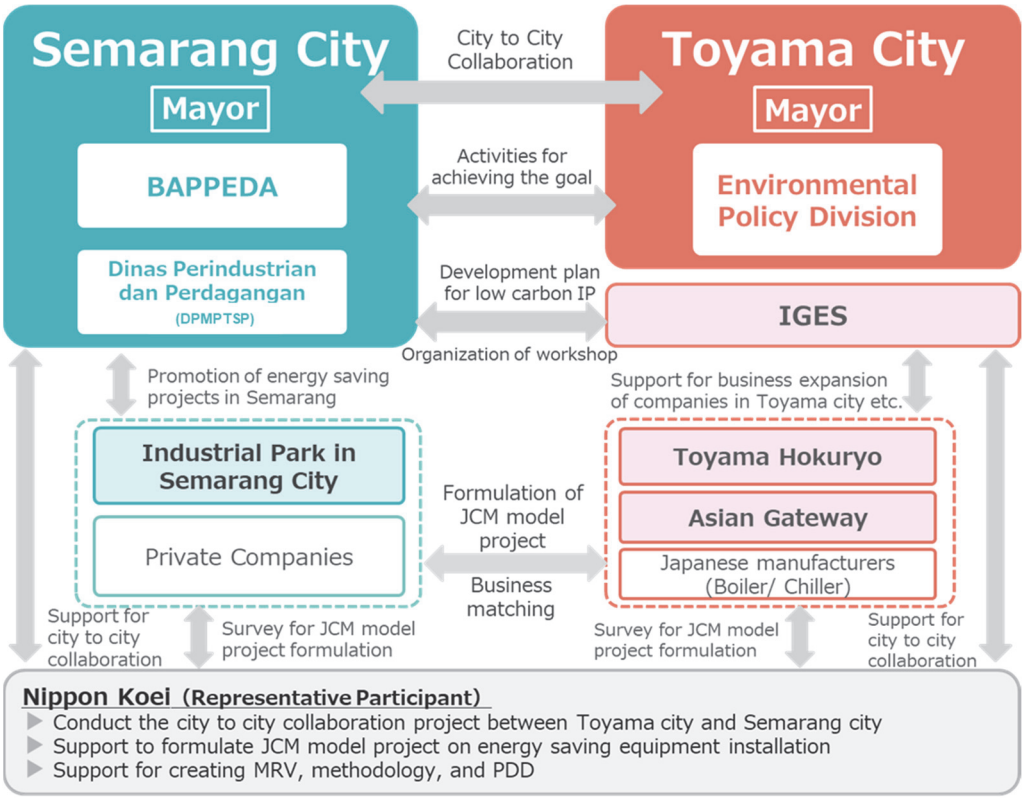
Source: Prepared by NK based on information from Toyama City

1.2 OBJECTIVE OF THE STUDY

"The City-to-City Collaboration Programme for Low-Carbon Society" (hereinafter called "the Study") aims to implement investigations for developing a low carbon society in foreign cities by Japanese cities who have valuable knowledge and experiences. Japanese cities also collaborate with Japanese research institutes, private companies, and universities in order to conduct the surveys in an effective and efficient manner.

1.3 IMPREMENTATION STRUCTURE

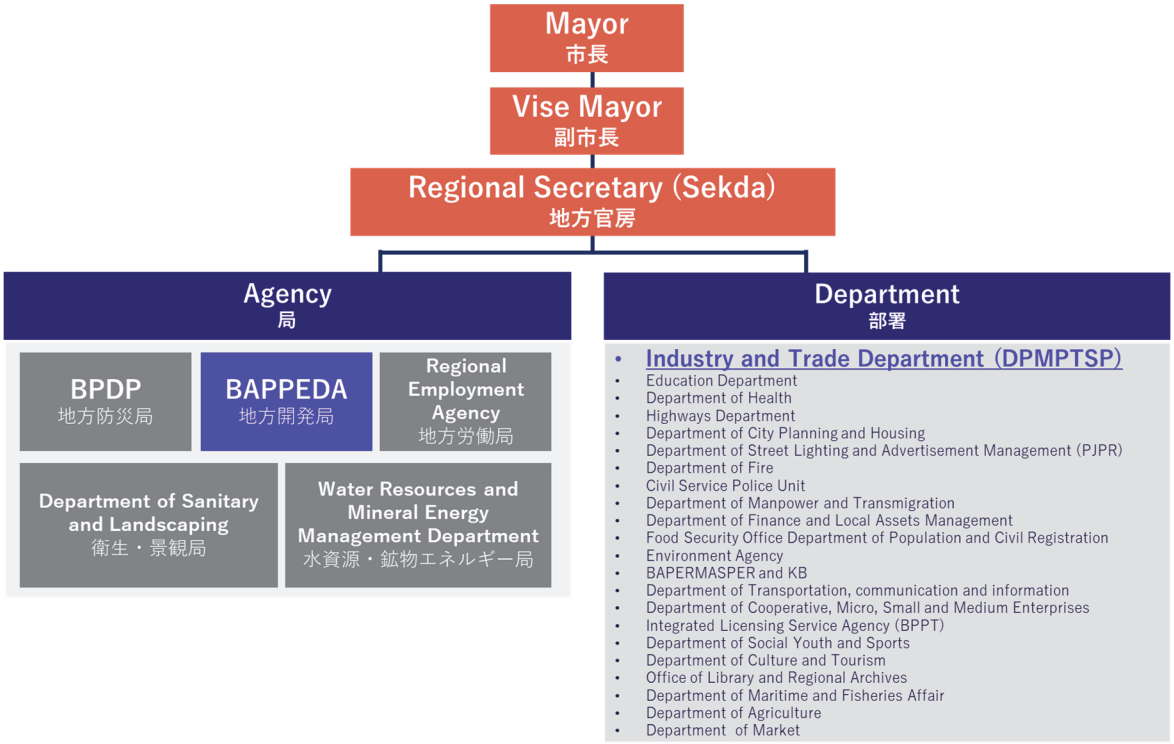
The Regional Development Planning Agency (BAPPEDA) and the Industry and Trade Department (DPMPTSP) of Semarang city were the main counterpart of the Study. Furthermore, Industrial Parks and the Chamber of Commerce and Industry (KADIN) in Semarang city were involved in the Study as well. Toyama city introduced private companies located in Toyama which have good environmental technologies to solve environmental issues in Semarang city. Nippon Koei Co., Ltd. supported all activities of the City-to-City Collaboration, feasibility studies for JCM model project formulation, and consideration of MRV plan. Also, IGES supported to establish "Low Carbon Action Plan for Semarang City".



Source: Prepared by NK

Figure 1.1 Implementation Organization

The organization structure of Semarang City is as follows.



Source: Prepared by NK

Figure 1.2 Organization Structure of Semarang City

1.4 STUDY SCHEDULE

The Study schedule is as follows.

Study Item		2018									2019	
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Item (1) : JCM model project formulation												
1)	Selection of JCM Model Project in Industrial Park											
2)	Preparation of International Consortium											
3)	Confirmation of environmental approval and SDIP											
4)	Energy saving equipment installation and fuel switch potential study											
5)	Business matching between Toyama companies and Indonesian companies				☆			★				
6)	Formulation of energy saving promotion program											
7)	Invitation of Semarang city officers to Japan				☆				☆			
Item(2) : Others												
1)	Monthly report			☆	☆	☆	☆	☆	☆	☆	☆	☆
2)	Progress meeting (MOEJ)		☆			☆			☆			☆
3)	Workshop in Semarang										★	
4)	JCM seminar organized by MOEJ								☆			
(3) Field survey, meetings, final report												
1)	Field survey			★		★	★	★			★	
2)	Meeting in Toyama city or Tokyo		☆	☆	☆	☆			☆			☆
3)	Final report											☆

★ : Activities in Indonesia/Semarang ☆ : Activities in Japan

Source: Prepared by NK

Figure 1.3 Study Schedule in FY2018

CHAPTER 2 CITY TO CITY COLLABORATION FOR THE LOW CARBON SOCIETY

2.1 OBJECTIVE OF THE CITY TO CITY COLLABORATION

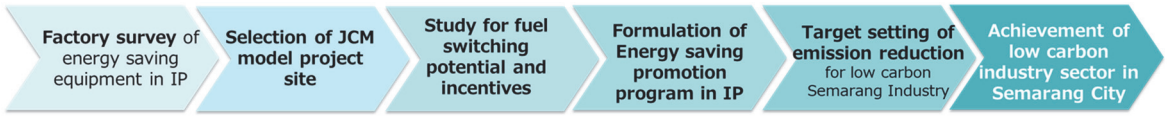
The objectives of the Study in FY2018 were as follows.

- Promotion of energy saving equipment installation in Semarang Industrial Parks and formulation of JCM model projects
- Support for business expansion of Toyama companies having energy saving technologies under the City-to-City Collaboration
- Target setting of emission reduction for low carbon society by utilizing Toyama city's knowledge

In the Study, factories in Semarang Industrial Parks which had the potential of energy saving were selected as model factories to promote energy saving equipment in Semarang city. If a high-efficiency boiler or chiller are installed into a factory by utilizing JCM model project, the factory can become a good example of low carbonized factory.

Also, sectoral emission reduction target in Semarang city was set under the Study.

Strategic steps for achievement of low carbon society are shown in the following table.



Source: Prepared by NK

Figure 2.1 Strategic Steps for Achievement of Low Carbon Society

Key steps in the above strategy are as follows

Table 2.1 City-to-City Collaboration between Toyama and Semarang

Item	Description
Selection of JCM model project site	To expand JCM model projects in Indonesia, data collection about Semarang companies at the industrial parks in Semarang city was conducted through DPMPTSP. Based on the data, model factories of JCM model projects are selected. Especially, **large companies which consume much electricity are priority to promote energy saving.**
Consideration of incentives for private companies by fuel switch or installation of high-efficiency equipment	Financial incentive by fuel switch or installation of high-efficiency equipment is investigated. Emission factor of each fuels are 0.0909 t-CO2/GJ for coal, 0.0726 t-CO2/GJ for diesel oil, and 0.0543t-CO2/GJ for gas, so it means that **fuel switch from coal or diesel oil to gas is very effective for GHG emission reduction.** The promotion of fuel switch along a plan about construction of pipelines to industrial parks in Semarang city is implemented.
Target setting of emission reduction for low carbon Semarang Industry	Amount of CO2 emission from industrial sector in Semarang city is bigger than other sectors, so **GHG emission reduction in industrial**

Item	Description
	parks can contribute to make Semarang city low carbon society. Target of GHG emission reduction of industrial sector is set based on quantitative data.
Support for FY2018 JCM model project ("Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang") and expansion of the similar project	Toyama city and Semarang city supports the FY2018 JCM model project to proceed it smoothly, and the possibility of expansion of the project to other area is considered.

Source: Prepared by NK

2.2 OVERVIEW OF THE CITY TO CITY COLLABORATION

Results of the City-to-City Collaboration activities conducted during the Study are presented in the following table.

Table 2.2 Overview of the City-to-City Collaboration

Content	Schedule	Description
Kick-off meeting (Toyama)	17 - 18 May 2018	Proposed scheme and schedule were explained, and issues, goals, methodologies were confirmed among the Study members. Also, the meetings with Toyama companies (Toyama Hokuryo Co., Ltd., Hokusan Co., Ltd.) was implemented.
Kick-off meeting with MOEJ (Tokyo)	31 May 2018	Nippon Koei explained to MOEJ about proposed activities, goals, candidate JCM model projects, estimated issues.
The 1st Field Survey (Semarang)	4 - 9 June 2018	The purpose of this field survey was having a kick-off meeting with Semarang city, introduction of JCM scheme to Semarang city, arrangement of business matching in July in Toyama, feasibility study for JCM model project formulation. The meetings with BAPPEDA, DPMPTSP, the Embassy of Japan in Indonesia, and several Semarang companies.
60th Anniversary of Indonesia and Japan Diplomatic Relations (Tokyo)	29 July 2018	The 60th Anniversary of Indonesia and Japan Diplomatic Relations Ceremony was conducted in Tokyo. Mr. Megawati Ex-president of Indonesia, Mr. Arifin Tasrif Ambassador of the Embassy of the Republic of Indonesia in Japan, Ms. Puan Maharani, Coordinating Minister of Human Development and Culture, and other dignitaries attended this ceremony. The relevant persons from Toyama city and Semarang city also joined as well.
Business matching (Toyama)	30 July 2018	7 delegates from Semarang city were invited to Toyama city to join the business matching between Toyama companies for JCM model formulation in Semarang City. 6 Toyama companies which have environmental technologies introduced their own products to the delegates.
Site visit in Toyama (Toyama)	31 July 2018	7 delegates from Semarang city were invited to Toyama city for the business matching, and they also visited Toyama City Eco Town to see the technologies related to solid waste management of 3 Toyama companies (Eco-mind Co., Ltd., Toyama Green Food Recycle Co., Ltd., Izak Co., Ltd.)
1st Reporting to MOEJ (Tokyo)	28 August 2018	Progress and the current issues of the Study after the kick-off meeting with MOEJ were reported.
The 2nd Field Survey (Semarang)	3 - 8 September 2018	The purpose of this field survey was arrangement of business matching in October, arrangement of JCM seminar in Japan in October, the 1st JCM seminar for Semarang companies,

Content	Schedule	Description
		implementation of feasibility study for JCM model project formulation. During this survey in Semarang, several meetings with BAPPEDA, DPMPTSP, an owner company of BSB Industrial Park, an owner company of Tanjung Emas Industrial Estate Industrial Park, KADIN etc. were conducted
Letter of Appreciation from the Government of Indonesia	18 September 2018	The contribution of Toyama city to Indonesia has been highly evaluated an and a Letter of Application was presented from the Government of Indonesia. Toyama city is the first Japanese local government to receive the same.
The 3rd Field Survey (Semarang)	14 - 20 October 2018	The purpose of this field survey was discussion with BAPPEDA, factory visit to find a potential company for JCM model project formulation, Semarang Business Forum. Several Toyama companies also joined this field survey.
Semarang Business Forum (SemBiz) (Semarang)	17 October 2018	Semarang Business Forum (SemBiz) is held in Semarang city every year. In this year, business matching session between Toyama companies and Semarang companies was included in this forum. Total approx. 300 people inclusive of Semarang city Mayor & Vice Mayor, Head of KADIN, Head of DPMPTSP, Toyama companies and Semarang companies were attended.
JCM seminar and courtesy call (Yokohama/ Toyama)	24 - 30 October 2018	5 delegates from Semarang city was invited to JCM seminar on city-to-city collaboration held in Yokohama, and they gave a presentation about on-going activities related to the City-to-City Collaboration. Also, they visited Toyama city to pay a courtesy call to Director General of Environment Dept. in Toyama city
2nd Reporting to MOEJ (Tokyo)	6 November 2018	Progress and the current issues of the Study after 1st reporting to MOEJ were reported.
The 4th Field Survey (Semarang)	2 - 8 December 2018	The purpose of this field survey was discussion with Semarang city for wrap-up meeting in January, arrangement of a completion ceremony of Trans Semarang, discussion on the theme for next fiscal year's activities between Toyama city and Semarang city, implementation of feasibility survey for JCM model project formulation. To realize this purpose, the meetings with BAPPEDA, DPMPTDP of Semarang city, KADIN, Semarang companies, and industrial parks in Semarang city were conducted.
The 5th Field Survey (Semarang)	7 - 15 January 2019	The purpose of this field survey was participation in the completion ceremony of Trans Semarang, organization of 2nd JCM seminar with KADIN, wrap-up meeting with Semarang city, discussion on the theme of next fiscal year's activities, feasibility survey for JCM model project formulation, the meetings with Semarang companies.
Completion ceremony of Trans Semarang (Semarang)	8 - 9 January 2019	The completion ceremony of the JCM model project which was selected in FY2018 on Trans Semarang's CNG buses was held in Semarang city. Total approx. 350 people attended including Toyama city Mayor, Central Java Governor, Semarang city Mayor.
Wrap-up meeting (Semarang)	14 January 2019	The activities of the Study in FY2018 and Semarang City Low Carbon Action Plan were explained. Then, the candidates of JCM model project in FY2019 based on the study of JCM model project formulation were introduced as

Content	Schedule	Description
		well. Both Toyama city and Semarang city agreed to continue city-to-city collaboration for low carbon society in FY2019, and discussed theme of the future activities.

Source: Prepared by NK

2.3 BUSINESS MATCHIING AND SITE VISIT IN TOYAMA CITY

Business matching for Toyama companies and Semarang companies were conducted on 30 July 2018 at Toyama city. Seven (7) delegates from Semarang city and Six (6) companies in Toyama city attended the business matching, and Toyama companies introduced their own technologies or products to the attendees from Semarang city.

The outline of this business matching is described hereunder.

Date/Time: 30 July 2018 (Mon.) 13:30～17:00
Place: Oarks Canal Park Hotel Toyama
Attendees: Semarang city (7 people), Toyama city (10 people), IGES (2 people), Private companies in Toyama (6 companies, total 11 people), Nippon Koei (3 people), Total 33 people
Agenda: See the following table

Table 2.3 Agenda of Business Matching in Toyama city

No.	Content	Presenter
1	Opening Remarks	Director General of Environment Dept. of Toyama city Head of DPMPTSP, Semarang city
2	Introduction of Semarang City	Head of the Chamber of Commerce Industry in Semarang city
3	Introduction of Industrial policy of Toyama City	Assistant Manager of Industrial policy Dept. of Toyama city
4	Explanation of JCM scheme	Nippon Koei Co., Ltd. Manager of Environmental Science & Engineering Dept.
5	Introduction of Toyama city's private companies	Toyama Hokuryo Co., Ltd. (Air conditioning system, PV system) Suiki Kogyo Co., Ltd. (Micro hydro) Hokusan Co., Ltd. (Gas supply) Nihonkucho Hokuriku (Boiler, Air conditioning system) Ishibashi Co., Ltd. (Waste treatment) Taiwa Seiki Co., Ltd. (Rice milling machine)
6	Q&A, Discussion session	---

Source: Prepared by NK

On 31 July 2018, delegates from Semarang city visited Toyama City Eco Town, and inspected three (3) Toyama companies (Eco-Mind Co., Ltd., Toyama Green Food recycle Co., Ltd., Izak Co., Ltd.) which have technologies related to waste treatment.

The overview of the business matching and site visit are shown in the photos below.

Opening Remarks by Director General of Environment Dept. of Toyama city

Opening Remarks by Head of DPMPTSP, Semarang city

Discussion session in business matching

Venue of business matching

Site visit in Toyama City Eco Town

Site visit at Eco-Mind Co., Ltd.

2.4 60TH ANNIVERSARY OF INDONESIA-JAPAN DIPLOMATIC RELATIONS

On 29 July 2018, the 60th Anniversary of Indonesia and Japan Diplomatic Relations Ceremony was conducted in Tokyo. Mr. Megawati Ex-president of Indonesia, Mr. Arifin Tasrif Ambassador of the Embassy of the Republic of Indonesia in Japan, Ms. Puan Maharani, Coordinating Minister of Human Development and Culture, and other dignitaries attended this ceremony. Relevant persons from Toyama city and Semarang city also joined as well.

2.5 SEMARANG BUSINESS FORUM (SEMBIZ)

Semarang Business Forum (SEMBIZ) is a big business forum which is held in Semarang city every year, and it was held on 17 October in 2018. In this forum, the Study Team introduced the activities of the City-to-City Collaboration between Toyama city and Semarang city and the JCM scheme. Semarang city Mayor & Vice Mayor, Head of KADIN, Head of DPMPTSP, private companies, management companies of industrial parks in Semarang, and total approximately 300 people attended.

To formulate JCM model projects under the Study, a business matching session among private companies in Toyama city and Semarang city was provided at a booth in this forum. Private companies in Toyama city (Nihonkucho Hokuriku Co., Ltd., Izak Co., Ltd., Suiki Kogyo Co., Ltd.) introduced their own business, and Toyama city explained their advanced actions for low carbon society. Particularly, the technical cooperation agreement between Toyama and Semarang for low-carbon society and the environmental technologies of Toyama city's companies were emphasized in the forum.

The overview of SEMBIZ is shown in the photos below.

Semarang city Mayor & Vice Mayor, Toyama city

Presentation by Toyama city

Venue of Business Forum

Booth of Toyama city

2.6 JCM SEMINAR IN YOKOHAMA AND COURTESY CALL IN TOYAMA

5 delegates from Semarang city were invited to the JCM Seminar organized by the Ministry of Environment, Japan, and held in October 2018 at Yokohama. At the seminar, participants from Semarang presented city's environmental policies and on-going activities related to the City-to-City Collaboration.

"Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" was selected as FY2018 JCM model project under the Study is the first JCM model project with tender. Much attention from the attendees was about the tender procedures.

The delegates from Semarang city also went to Toyama city the next week of JCM seminar, paid a courtesy call to Director General of Environment Dept. in Toyama city. During the courtesy call, they exchanged their opinions each other about the City-to-City Collaboration and JCM scheme.

The following photos show the overview of JCM seminar and courtesy call.

Presentation by Semarang city at JCM seminar in Yokohama

Courtesy Call to Director General of Environment Dept. in Toyama

2.7 SUPPORT OF ONGOING JCM MODEL PROJECT

Hokusan Co., Ltd., which is located at Toyama city, conducted a survey under "FY2017 City-to-City Collaboration Programme for Low-Carbon Society between Toyama city and Semarang city", and they confirmed that there was a potential of GHG emission reduction by fuel switching of public bus in Semarang. Then, the company submitted a proposal for "Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" and it was selected as one of the FY2018 JCM model projects.

This JCM model project aims to reduce GHG emissions through fuel switch from diesel to CNG. In this project, 72 diesel bases owned by Trans Semarang, including 25 large-sized buses (mileage: approx. 2.08 km/L) and 47 mid-sized buses (mileage: approx. 3.53 km/L), are retrofitted from diesel engine to Dual Diesel Fuel (DDF) with CNG system. Amount of GHG emission reduction of this project will be calculated.

Toyama city concluded a technical cooperation agreement with Semarang city to realize low carbon society under the city-to-city collaboration. Based on the agreement, Toyama city and

Semarang city have continued support for the above JCM model project in order to realize low carbon society and also implement the city-to-city collaboration activities in FY2018 smoothly.

On 9 January 2019, the completion ceremony of the above JCM model project organized by Trans Semarang was held in Semarang city (see photos below). The ceremony was attended by Mr. Masashi Mori of Toyama city Mayor, Mr. Ganjar Pranowo of Central Java Governor, Mr. Hendrar Prihadi of Semarang city Mayor, the Director of Planning and Development of the Ministry of Energy and Mineral Resources of Oil and Gas Infrastructure, Acting Development Director of the Ministry of Home Affairs, Assistant Deputy of Multilateral Economic Cooperation and Financing of the Coordinating Ministry for Economic Affairs, VP of Strategic Planning & Development of PT Pertamina (Persero), VP of Commercial Java PT Pertagas Niaga, President of Hokusan, Co., Ltd, in total approx. 350 people attended. The ceremony made the headlines by Indonesian Media as a good case of fuel switch in the transportation sector.

A panel discussion session with the Central Java Governor, Tabanan Province, Ministry of Home Affairs, Ministry of Transportation, Ministry of Energy and Mineral Resources was conducted, and they exchanged their opinions about the issues of transportation sector or fuel switching. They also discussed how to promote fuel switch in transportation sector in Indonesia. Through this ceremony, Indonesian government officials recognized that fuel switch to CNG at transportation sector is effectiveness for developing low carbon society. For the future, Toyama city is expected to collaborate with not only Semarang city but also other Indonesian cities and Ministry of Transportation, etc. to expand project of fuel switch in Indonesia such as the above JCM model project.

Venue of Trans Semarang Ceremony

Group Photo of Trans Semarang Ceremony

Speech from Toyama City Mayor

Introduction of CNG-DDF buses

2.8 THE WRAP-UP MEETING IN SEMARANG

On 14 January 2019, wrap-up meeting with Semarang city was conducted at BAPPEDA office. The main contents of this meeting were reporting of the result of the Study FY2018, explanation of "Low Carbon Action Plan for Semarang City" which is supported to create by IGES, and introduction of candidate projects for FY2019 JCM model project. In addition, Toyama city and Semarang city discussed the theme of continuous city-to-city collaboration for low carbon society in the next year.

The Project "Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" was adopted as FY2018 JCM Model Project. It drew a lot of attention as the first project of fuel switch in transportation sector in Indonesia, and the project is regarded as a milestone achievement of the city-to-city collaboration. Cross development of the fuel switch in the transportation sector in Indonesia is expected together with cooperation from Toyama city and Toyama companies. From the result of the study for JCM Model Project formulation in FY2018, it was clear that the fuel switch is effective for realization of low carbon society. There is potential for CO2 emission reduction by the introduction of CNG-Diesel hybrid system not only in the transportation sector but also in the public and private sectors that apply diesel oil engine at present.

Accordingly, low carbon society by the promotion of fuel switch in Semarang is proposed as the theme of the city-to-city collaboration in FY2019. Projects to be a policy model for the promotion of fuel switch in public sector and private sector are planned to be formulated. The details of proposed study for FY2019 City-to-city Collaboration are described in section 5.2.4.

CHAPTER 3 FORMULATION OF JCM MODEL PROJECT

3.1 SELECTION OF TARGET FACTORY

Industrial Parks (IPs) in and surrounding Semarang City mainly consist of light industry such as textile, food, and assembly factories. In Semarang Industrial Park (IP), project formulation studies were conducted for JCM Model Project with energy saving and CO2 emission reduction by equipment such as (i) high-efficiency once-through boiler and fuel switch and (ii) high-efficiency chiller.

The Study aims to select a model factory to promote introduction of high-efficiency energy-saving equipment and fuel switch in IPs in Semarang. The candidates are mainly private factories. The selection for candidate of JCM Model Project was conducted as follows:

1) Explanation of JCM scheme to the management company of IPs and factories which was introduced from IP management company
2) Holding seminars about JCM explanation with support of chamber of commerce of Semarang city (KADIN)
3) Visit to factories of which needs for new or replacement of boilers and chillers were confirmed in the seminar item 2)

The JCM seminars in the above 2) were conducted in two times: (i) for IPs and factories in Semarang on September 5, 2018 and (ii) for factories and commercial facilities on January 8, 2019. In the seminar, the factories and facilities who were interested in introduction of high-efficiency equipment such as once-through boilers and centrifugal chillers were interviewed for selection.

There are nine (9) IPs in Semarang city. Some IPs consist of storage and assemble factory only, and it was considered there is no needs for chillers and boilers for such IP. Except for those IPs, we visited six (6) IPs which were considered to have energy saving and fuel switch potential, as shown in the table below.

Table 3.1 IPs visited and its Outline

Industrial Park	Foundation	Area	Tenant	Gas supplied	Remarks
Kawasan Industri Park Bukit Semarang Baru (BSB)	N/A	215 ha	N/A	by Lorry	- Potential of GHG emission reduction in this park is low.
Kawasan Industri Tugu Wijaya Kusuma (KITW)	1988	250 ha	77	Gas pipeline	- 4 out of 77 are Japanese companies
Kawasan Industri Terboyo Park	1990	300 ha	100	by Lorry	- Almost all of the tenant are used for warehouse
Kawasan Industri Candi	1999	500 ha	600	by Lorry	- F/S for installing gas pipeline conducted. - 75% are warehouse
Kawasan Industri Berikat Lamicitra	1993	30 ha	9	by Lorry	- The oldest industrial park in Semarang - Special export zone
Kendal Industri Park	2016	2,200 ha (under construction)	6 (46 companies already decided to move in.)	by Lorry	- Integrated industrial park inclusive of shopping mall, residential area, and industrial area

Source: Prepared by NK

Of the IPs, independent gas pipeline system is installed in Kawasan Industri Wijaya Kusuma (KIW), and it is considered that there is potential for fuel switch from coal/oil to gas for equipment such as boiler is expected in KIW. Accordingly, explanation about JCM scheme was held for KIW first. Then, we visited and explained about JCM scheme to IPs such as Bukit Semarang Baru (BSB), Terboyo Park which has operated for 30 years, Tanjung Emas Industrial Park which is a special export zone, Kundal industrial Park operated by a Singapore developer. Factory information was collected to identify CO2 emission reduction potential.

In Indonesia, two high-efficiency once-through boiler projects and three high-efficiency centrifugal chiller projects have already been implemented as JCM Model Project. Equipment such as boilers and chillers are in large demand in industry and widely applied in Indonesia. According to industrial growth, the number of installed equipment is increasing. It has large potential of cross development and CO2 emission reduction compared to other sectors. Especially, fuel switch is effective for CO2 emission reduction.

We visited the following IPs and factories to find and select possible project owners with scales more than 1,000 tCO2/year.

Table 3.2 Visited Industrial Parks and Factories

IP	Location	Date	Outline
Kawasan Industri Wijaya Kusuma (KIW)	Management company	2018/6/8	・77 tenant companies, of which 44 are Japanese investment ・Garment, textile, furniture, food, etc.
	Food production company	2018/9/6	・Bread maker, No.1 share in Indonesia ・Gas boiler is installed. Energy saving for chiller and compressor is done.
	Garment factory	2018/9/6 2018/10/18	・Cloths and trousers are produced. ・2 units of coal boilers (4t/hx2) are installed. Replacement to gas boilers are considered
Bukit Semarang Baru (BSB)	Management company	2018/9/4	・Small heat demand in IP. No factory consumes large amount of fuel for boilers.
	Garment factory	2018/9/4	・It produces suits and cloths. Japanese investment. ・3 nos of diesel oil boiler (1th/x3) were installed in 2013 and 2016.
Tanjung Emas Industrial Estate	Management company	2018/9/7	・The eldest IP in Semarang (since 1993). 9 companies with 72 buildings. ・Port area, export special zone.
	Sports gear factory	2018/9/7	・Cloth production for apparel. ・LPG oiler (1t/h) is installed. ・New boiler already ordered.
	Garment factory	2018/9/7	・Sports gears are produced ・Diesel oil boilers 800kg/h x 2 are installed 5 years ago, and no replacement plan so far.
Candi Industrial Park	Management company	2018/12/6	・Largest IP with 500 ha. 600 tenant companies. 75% are storage and 25% are production. ・F/S for gas pipeline installation is conducted.
Kendal Park	Management company	2018/12/7	・New IP in Semarang. Singapore investment. 1000 ha development in Phase1 with international port. 6 companies are in operation, assembly of furniture and motor bile, food, storage, etc.
Terboyo Park	Management company	2019/1/15	・Established in 1990. About 100 tenant companies are located, including assembling cell phone. It plans to build grass factory. Demand of gas supply is high.
-	Fiber factory	2018/10/18 2018/12/5	・Polyester fiber about 20% in Indonesia is produced. ・Replacement of centrifugal chiller and compressor are considered.
-	Grain factory	2019/1/16	・Rice, corn, beans are collected and dried. ・Gas boiler is considered as heat source for dryer.

Source: Prepared by NK

3.2 INTRODUCTION OF BOILER IN GARMENT FACTORY

3.2.1 Factory to install Gas Once-Through Boiler

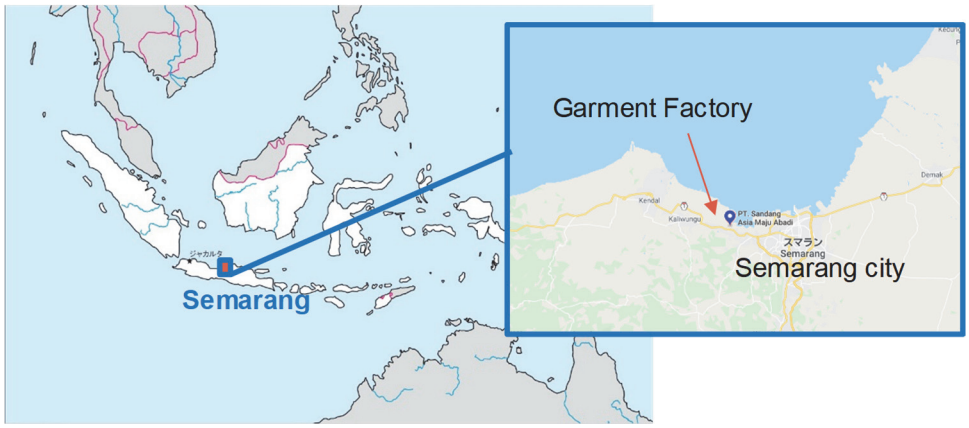
A garment factory in KIW Industrial Park was selected as the candidate JCM Model Project

for installation of gas once-through boiler. The garment factory produces clothes and trousers for domestic supply and to export to USA and Europe. At present, the garment factory installs two units of 4 t/h coal boiler for heat demand of dryer, dyeing, and ironing. Meanwhile, the coal boiler has disadvantages in operation such as (i) treatment of ash waste produced from coal boiler is necessary, and (ii) 24-hour continuous operation is needed so as not to cool down the boiler. Thus, the garment factory has been considering the replacement of the existing coal boilers with gas boilers. Accordingly, the JCM Model Project plan was formulated to install high-efficiency once-through boilers using gas.

Source: Photo taken by NK

Figure 3.1 Present Coal Boiler and Driers

The location of the target factory is shown below.



Source: Prepared by NK using maps of https://www.abysse.co.jp/world/map/country/asia/indonesia.html and Google Map

Figure 3.2 Target Site of Once-through Boiler Introduction

3.2.2 Applied Technology (High-efficiency Once-through Boiler)

The high-efficiency once-through boiler inputs all feed-in water from one side, and steam is produced without circulation. The once-through boiler has advantages of (i) fast starting, (ii) small space, (iii) small noise, and (iv) low emission of NOx and CO. The characteristics are as summarized in the following table.

Table 3.3 Advanced Technology of High-efficiency Once-through Boiler

Advantage	Description
High performance in starting, response to load variation, and advanced control	Different from water tube boiler, once-through boiler produces steam in a pile. By this, starting and response to load variation is fast. High-level control for stable steam production amount and temperature control is conducted.
Small space	Only 60% of space is necessary compared with other boilers.
High efficiency is kept at low load range	It controls in response to load variation. High efficiency operation is possible in broad range of load.
Recovery of exhaust gas by economizer	High-efficiency is enabled by an economizer that recovers remaining heat in exhaust gas and pre-heating the water pressurized by feed-in pump.
Low air pollutant emission	Emission of NOx and CO is low, which was enabled by lowering combustion temperature and arrangement of nozzle location.

Source: Prepared by NK

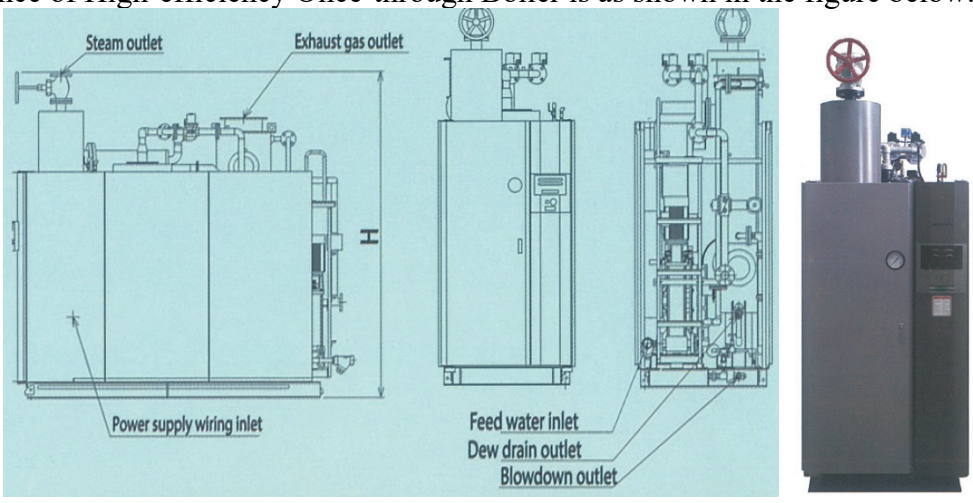
The specification of the high-efficiency once-through boiler is as shown in the table below.

Table 3.4 Specification of High-efficiency Once-through Boiler

Item	unit	Value	Remark
Pressure	MPa	0.49-0.88	
Equivalent output	kg/h	2000	
Actual output	kg/h	1680	
Heat output	MW	1.25	
Boiler efficiency	%	98	
Water content	L	138	
Fuel consumption	Nm3/h	113.5	LHV 40.6 MJ/Nm3
Rated power consumption	kW	10.4	AC380V, 3ϕ, 50Hz
Weight	kg	2360	
Size	mm	W990, D2835, H2635	

Source：Miura SI2000GVS

Appearance of High-efficiency Once-through Boiler is as shown in the figure below.



Source: Brochure of Miura SI2000GVS

Figure 3.3 Size and Appearance of High-efficiency Once-through Boiler

Source: Photo taken by NK, Catalogue of Miura

Figure 3.4 Replacement from Coal Boiler to Gas Once-through Boiler

Compared with coal boiler, the once-through gas boiler has the following advantages.

- Switch-off is easy in once-through gas boiler, while coal boiler needs long lead time for operation start and end.
- Processing fee for ash waste from coal boiler can be saved
- NOx, CO, and soot in exhaust gas is much reduced

If the once-through boiler is applied as JCM project, it needs to consider the following eligibility criteria in Indonesia:

- Damage to boiler may happen when pre-treatment of feed-in water is inadequate. Thus, the methodology requires installation of water purification treatment unit such as reverse osmosis (RO). Initial investment cost will be increased due to RO.

3.2.3 Estimation of CO2 Emission Reduction

The JCM methodology in Indonesia ID_AM015" Energy Saving by Introduction of High Efficiency Once-through Boiler" has been approved in July 2018. CO2 emission reduction amount is estimated with this methodology.
The reference emission is calculated with the following formula.

$$RE_p = \sum_i \sum_j \left(FC_{p,i,j,PJ} \times NCV_{i,j,PJ} \times EF_{RE} \times \frac{\eta_{i,PJ}}{\eta_{RE}} \times \frac{100 - BF_{PJ}}{100 - BF_{RE}} \right)$$

RE_p : Reference emissions during the period *p* [tCO_2/p]
$FC_{p,i,PJ}$: The amount of fuel consumption of project boiler *i* for the fuel type *j* during the period p = 645,043 [Nm^3/year]
$NCV_{i,j,PJ}$: Net calorific value of fuel used by project boiler *i* for the fuel type *j* = 0.0406 [GJ/Nm^3]
EF_{RE} : CO_2 emission factor of fuel used by reference boiler [tCO_2/GJ] = 0.0895 [tCO_2/GJ] (Sub-bituminous coal)
$\eta_{i,PJ}$: Efficiency of project boiler *i* [dimensionless] = 98%

η_{RE} : Efficiency of reference boiler [dimensionless] = 89%
BF_{PJ} : Blow flow rate setting of project boiler [%] = 5%
BF_{RE} : Blow flow rate setting of reference boiler [%] = 5%

From the above, reference emission was calculated to be REp= 2,581 tCO2/year.

The blow rate in the above formula is set by boiler manufacturer for boilers with water softener and water purification unit such as RO respectively, which will be determined at the time of boiler installation. Here, the values of BF_{pj} and BF_{RE} is assumed to be the same for conservative estimation.

The project emission is calculated with the following formula.

$$PE_p = \sum_i \sum_j \left(FC_{p,i,j,PJ} \times NCV_{i,j,PJ} \times EF_{i,j,PJ} \right)$$

PE_p : Project emissions during the period *p* [tCO_2/p]
$FC_{p,i,PJ}$: The amount of fuel consumption of project boiler *i* for the fuel type *j* during the period *p* = 6645,043 [Nm^3/year]
$NCV_{i,j,PJ}$: Net calorific value of fuel used by project boiler *i* for the fuel type *j* = 0.0406 [GJ/Nm^3]
$EF_{i,j,PJ}$: CO_2 emission factor of fuel used by project boiler *i* for the fuel type *j* [tCO_2/GJ] = 0.0543 [tCO_2/GJ] (natural gas)

From the above, PEp = 1,422 tCO2/year.

The emission reduction calculation is conducted with the following formula.

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

= 2,581 – 1,422 = 1,159 [tCO_2/year]

The result is as shown in the table below.

Table 3.5 CO2 Emission Reduction by High-efficiency Once-through Boiler

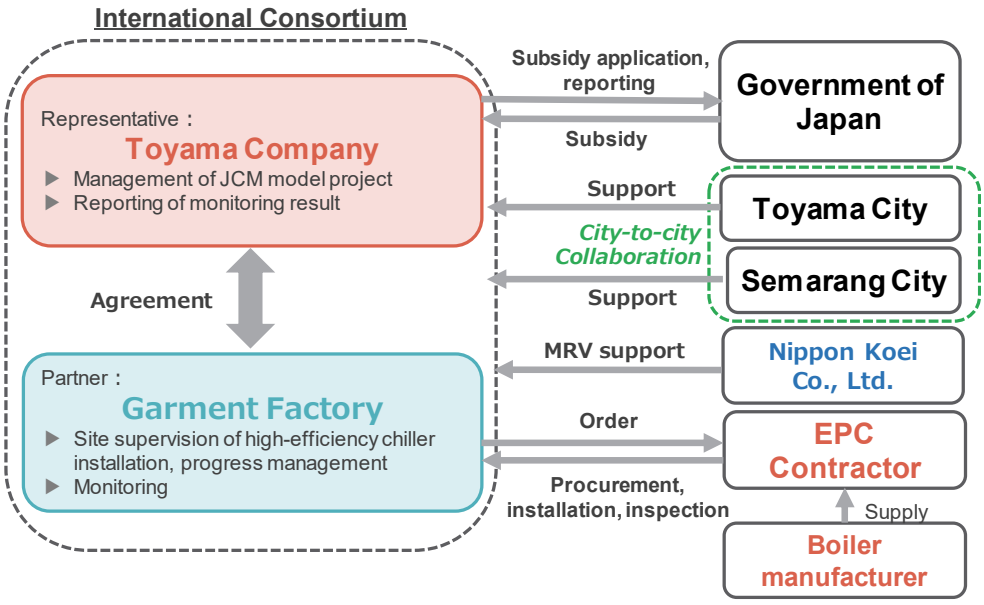
Item	Value	Unit	Remark
Boiler capacity	6.00	t/h	2t/h x 3 nos
Annual operation hours	2,368	hrs	8 hr/d
Annual gas consumption	645,043	Nm3	LHV 40.6 MJ/m3
Reference boiler efficiency	89%		
Project boiler efficiency	98%		
Emission factor of coal	0.0895	tCO2/GJ	Sub-bitumenous
Emission factor of gas	0.0543	tCO2/GJ	
CO2 emission reduction	1,159	tCO2/yr	
Legal life	7	yr	
Assumed subsidy%	30%		
JCM Cost performance	1,750	JPY/tCO2	

Source: Prepared by NK

From the above, the CO2 emission reduction will be 1,150 tCO2/year. Since the fuel switch from coal to gas is planned in the project, the cost performance for JCM Model Project is 2,170 JPY/tCO2, which is considerably high.

3.2.4 International Consortium for Application of JCM Model Project

International Consortium for the application of JCM Model Project is proposed as shown in the figure below. A Toyama engineering company who has technical expertise of air conditioning and boiler technology will be the representative company, which conduct project management and confirmation and reporting about monitoring result. A Japanese boiler manufacturer will supply once-through boilers to local EPC contractor and installs boilers in the garment factory. Toyama city and Semarang city provides supports and coordination for MoEJ, government of Indonesia, etc. Nippon Koei will support JCM procedure such as PDD preparation, validation, project registration, preparation of monitoring report, verification, and CO2 credit issue.



Source: Prepared by NK

Figure 3.5 International Consortium for Once-through Boiler Installation

3.2.5 Confirmation about Environmental License and SDIP

In Indonesia, Sustainable Development Implementation Plan (SDIP) needs to be submitted and approved together with Project Design Document (PDD) at the time of JCM project registration. SDIP items were confirmed at the target garment factory according to JCM form.

The result about confirmation of SDIP items is as shown in the table below.

Table 3.6 SDIP Items for the Target Textile Factory

No.	Items	Questions	Yes /No	If answer is Yes, please describe the action plans.
1	EIA	Does the proposed project require official/legal process of EIA?	No	
2	Pollution Control (No need to answer if EIA is required)	Does the proposed project emit air pollutants?	Yes	Emission from chimney of the boiler is checked in accordance with "PERATURAN MENTERI NEGARA LINGKUNGAN HIDUP NOMOR 07 TAHUN 2007 TENTANG BAKU MUTU EMISI SUMBER TIDAK BERGERAK BAGI KETEL UAP"
3		Does the proposed project discharge water pollutants or substances which influence BOD, COD or pH, etc.?	Yes	Waste water from boiler blow will be collected and processed in the treatment pond.
.4		Does the proposed project generate waste?	Yes	Small quantity of packaging waste is generated for delivery of the equipment and spare parts and consumable. The waste will be internally treated.
5		Does the proposed project increase noise and/or vibration from the current level?	No	
6		Does the proposed project cause ground subsidence?	No	
7		Does the proposed project cause odor?	No	
8	Safety and health	Does the proposed project create dangerous condition for local communities as well as individuals involved in the project, during either its construction or its operation?	Yes	The contractor will provide safety training in operation. The company implements the inspection every timing of maintenance in accordance with their standard.
9	Natural Environment and biodiversity	Is the proposed project site located in protected areas designated by national laws or international treaties and conventions?	No	
10		Does the proposed project change land use of the community and protected habitats for endangered species designated by national laws or international treaties and conventions?	No	
11		Does the proposed project bring foreign species?	No	
12		Does the proposed project include construction activities considered to affect natural environment and biodiversity (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	No	
13		Does the proposed project use surface water, ground water and/or deep ground water?	Yes	The project already uses the water for coal boiler operation. Since efficiency is improved, the water usage will be reduced. The same water source will be used and no additional effect on ground/surface water.
14	Economy	Does the proposed project have negative impact on local workforce capacity?	No	
15		Does the proposed project have negative	No	

No.	Items	Questions	Yes /No	If answer is Yes, please describe the action plans.
		impact on local community's welfare?		
16	Social Environment and Community Participation	Does the proposed project cause any resettlement or other types of conflict?	No	
17		Does the proposed project fail to involve activities to respond to, and follow up, comments and complaints that have been received from local communities, particularly from the public consultation?	No	
18		Do the project participants violate any laws and/or ordinances associated with the working conditions of local communities which the project participants should observe in the project?	No	
19	Technology	Does the proposed project fail to involve activities to build capacity of human resources through technology transfer and technical assistance?	No	
20		Does the proposed project fail to describe information of technology specification that consists of manual book and ways to overcome the problems that may occur when being operated on the site, at least in English and in Bahasa Indonesia as applicable?	No	

Source: Prepared by NK according to JCM Sustainable Development Implementation Plan Form

It is considered that additional environment procedure such as AMDAL is not necessary since the project replaces existing coal boiler to gas boiler with smaller capacity than existing boiler.

Currently, the target garment factory generates waste water for dyeing. The waste water is processed in a water purifier tank and the waste water is recycled. The industrial water is supplied from KIW IP. This aspect needs to be mentioned in SDIP.

3.2.6 Issues for Application of JCM Model Project

The fuel cost will be increased in gas boiler about 2.2 times from coal boiler even considering boiler efficiency difference. When maintenance cost difference between coal boiler and gas boiler is considered in addition to fuel cost difference, the annual cost with be 1.7 times for gas boiler than coal boiler. The factory owner is assessing if they can accept the cost increase. If they conclude the will accept the project, the application for JCM Model Project will be prepared.

3.3 CHILLER AND COMPRESSOR INTRODUCTION IN A FIBER FACTORY

3.3.1 Factory Selection of High-efficiency Chiller and Compressor Introduction

A fiber company located in the suburb of Semarang City was established in 1984, and produces about 20% of the polyester fiber of Indonesia and 3-4% of Asia. The factory is the largest electricity consumer in Central Jawa province. The fiber factory conducted energy audit, and considers energy saving from (i) replacement of old equipment such as chillers and compressors, (ii) re-engineering of piping, insulation, line coolers, etc, and (iii) replacement of transformers and cooling towers. In addition, the factory has conducted feasibility study for roof-top PV system.

The total refrigeration demand of the chillers is 5,000 USRt in the whole factory. Of this, replacement of in total 2,400 USRt is considered due to chiller aging. In addition, 10 units of gas compressor are also aged, and replacement is being considered. Currently, the factory installed one 5 t/h boiler in 2015, and there are no needs for boiler replacement.

Accordingly, formulation of JCM Model Project was studied for CO2 emission reduction by replacement of chillers and compressors and new installation of PV system in this fiber factory.

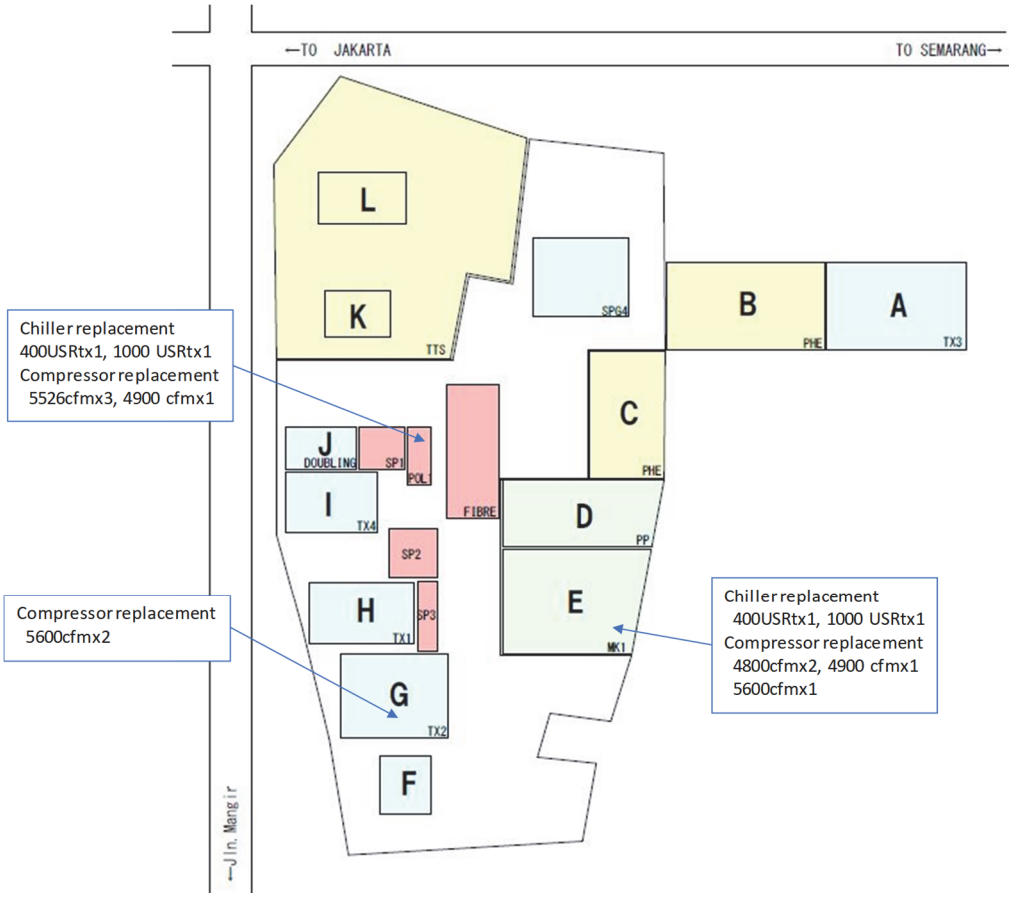
Source: Prepared by NK using maps of https://www.abysse.co.jp/world/map/country/asia/indonesia.html and Google Map

Figure 3.6 Target Site of High Efficiency Chiller Installation

Source: Photo provided by fiber factory and taken by NK

Figure 3.7 Target Fiber Factory and Chillers under Operation

The layout of the fiber factory is shown in the figure below. The existing chillers and compressors to be replaced are currently installed in the buildings of MKI, POL, and TX2.



Source: Prepared by Nippon Air Conditioning Hokuriku, and revised by NK

Figure 3.8 Layout of the Fiber Factory

3.3.2 Applied Technology (Centrifugal Chiller)

High-efficiency centrifugal chillers have advantages in energy saving by application of economizer and small compressor. Especially, high-efficiency compressor enables compact size. Automatic extraction function prevents leakage of refrigerant which has high global warming coefficient. High COP (Coefficient of Performance) is achieved in high efficiency centrifugal chiller.

High Efficiency Centrifugal Chiller

The specification of proposed centrifugal chiller is shown in the figure below.

Table 3.7 Specifications of Centrifugal Chiller

Item			Description	Description
Capacity			1000 USRt	400 USRt
Location			INDOOR / NON HAZARDOUS	INDOOR / NON HAZARDOUS
Applied Standard			GB, EBARA'S STANDARD	GB, EBARA'S STANDARD
Capacity		kW	3517 (1000 USRT)	1406 (400 USRT)
Control Range		%	100 ～ 20	100 ～ 20
Chilled Water	Type		Fresh water	Fresh water
	Entering/Leaving	℃	12.0 → 7.0	12.0 → 7.0
	Flow rate	m3/h	603.6	241.3
	Pass		2	2
	Pressure Drop	kPa	60	42
	Scaling Factor	m2K/kW	0.086	0.086
	Max. Pressure	MPa	1.0	1.0
	Water Box Nozzle Flange Rating	Inch	GB/T9119-2010,HGT2059 (1.0 MPa) (WITH COMPANION FLANGE)	GB/T9119-2010,HGT2059 (1.0 MPa) (WITH COMPANION FLANGE)
Cooling Water	Type		Fresh water	Fresh water
	Entering/Leaving	℃	32.0 → 37.0	32.0 → 37.0
	Flow rate	m3/h	698.9	283.3
	Pass		2	2
	Pressure Drop	kPa	79	63
	Scaling Factor	m2K/kW	0.086	0.086
	Max. Pressure	MPa	1.0	1.0
	Water Box Nozzle Flange Rating	Inch	GB/T9119-2010,HGT2059 (1.0 MPa) (WITH COMPANION FLANGE)	GB/T9119-2010,HGT2059 (1.0 MPa) (WITH COMPANION FLANGE)
Main Motor	Input Power	kW	517 x 1	230 x 1
	Voltage x Freq.	V x Hz	10kV x 50	380V x 50
	Start Pattern		Direct Line start	Direct Line start
Refrigerant/Lubricant			R245fa	R245fa
Chiller Dimension （L)		mm	5550 approx.	3970 approx.
Chiller Dimension （W）		mm	3420 approx.	2485 approx.
Chiller Dimension （H)		mm	3440 approx.	2430 approx.
Approx. Dry Rigging Weight		t	19.9	8.3
Approx. Running Weight		t	23.4	10.6

Source: Ebara Refrigeration Equipment and Systems

3.3.3 Calculation of CO2 Emission Reduction

(1) High Efficiency Centrifugal Chiller

CO2 emission reduction amount was estimated with approved methodology “ID AM002 Energy Saving by Introduction of High Efficiency Centrifugal Chiller”, as follows.

The target chillers are 2 units of 400 USRt and 2 units of 1000 USRt.

The reference emission reduction is calculated as follows.

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

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]
=9,758 MWh
$COP_{PJ,tc,i}$: COP of project chiller *i* calculated under the standardizing temperature conditions
400 USRt: 6.11 [-], 1000 USRt: 6.80 [-] (Catalogue specification)
$COP_{RE,i}$: COP of reference chiller *i* under the standardizing temperature conditions [-]
400 USRt: 4.66 [-], 1000 USRt: 5.89 [-] (Methodology ID AM002)
EF_{elec} : CO_2 emission factor for consumed electricity 0.877 [tCO_2/MWh]

The grid emission factor EF_{elec} is 0.877 [tCO_2/MWh], which is the value issued by JCM Secretariat for Jamali (Jawa-Madura-Bali) grid.

The project emission amount is calculated as follows.

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

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* =8,517 [MWh/year]
EF_{elec} : CO_2 emission factor for consumed electricity = 0.877 [tCO_2/MWh]
The emission reduction amount is calculated as follows.

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

= 9,7585 x 0.877 – 8,517 x 0.877 = 1,088 [tCO_2/year]

The result of CO2 emission reduction estimation by high-efficiency centrifugal chillers are shown in the table below.

Table 3.8 CO2 Emission Reduction by High-efficiency Centrifugal Chillers

Unit	USRt	Motor input kW	Current COP	Reference COP_RE,i	Project COP_PJ,tc,i	Average operation hr/yr	Project Energy consump-tion MWh	Reference energy consump-tion MWh	Emission reduction tCO2
Chiller-1	400	302	4.66	5.33	6.11	4260	1,287	1,476	165.76
Chiller-2	400	302	4.66	5.33	6.11	4260	1,287	1,476	165.76
Chiller-4	1000	598	5.89	5.94	6.80	4970	2,972	3,404	378.56
Chiller-6	1000	598	5.89	5.94	6.80	4970	2,972	3,404	378.56
TOTAL							**8,517**	**9,758**	**1,088.64**

Source: Prepared by NK

Table 3.9 JCM Project Summary of High-efficiency Centrifugal Chiller Installation

Item	Value	Unit
Project Chiller COP (1000 USRt)	6.80	
Reference Chiller COP (1000 USRt)	5.94	
Project ChillerCOP (400 USRt)	6.11	
Reference ChillerCOP (400 USRt)	5.33	
Energy saving compared with Refernece Case	1,241	MWh/yr
Grid Emission Factor(Jawa-Bali)	0.877	
CO2 Emission Reduction	1,088.6	tCO2/yr
Legal Life	7	years
Project CO2 Emission Reduction	7,620.45	
Subsidy Percentage	30%	
Cost Performance	3,949	JPY/tCO2

Source: Prepared by NK

（2）High-efficiency Centrifugal Compressor

The centrifugal compressor is a type of compressor that converts kinetic energy to pressure at deceleration flow path with adding the kinetic energy by centrifugal force of impeller to gas. High-efficiency centrifugal compressor applies the motor to compress air efficiently and saves energy.

Centrifugal Compressor planned to replace

The fiber factory has needs of replacement of 10 old air compressors at the capacity 4,800-5,600 cfm, which was installed around 1998.

There is no approved methodology for air compressor at this scale in Indonesia. Accordingly, the following method was proposed to estimate emission reduction amount tentatively.

The reference emission amount is estimated as follows.

$$\mathbf{RE_p} = \sum_{\mathbf{i}} \left\{ \mathbf{EC_{PJ,i,p}} \times \left(\frac{\mathbf{CE_{PJ,i}}}{\mathbf{CE_{RE,i}}} \right) \times \mathbf{EF_{elec}} \right\}$$

RE_p : Reference emission during the project period p = 70,051 tCO2/year
$EC_{PJ,i,p}$: Electricity consumption of the project compressor i during the project period p = 74,017 [MWh/year]
$CE_{PJ,i}$: Capacity efficiency of the project compressor i = 6.67 [cfm/kW]
$CE_{RE,i}$: Capacity efficiency of the reference compressor i = 5.93～6.44 [cfm/kW]

$$\mathbf{CE_p} = \frac{\mathbf{VC_{PJ,i}}}{\mathbf{MP_{PJ,i}}} \ , \ \mathbf{CE_{RE,i}} = \frac{\mathbf{VC_{PJ,i}}}{\mathbf{MP_{RE,i}}}$$

$VC_{PJ,i}$: Capacity of the project compressor *i* [cfm]
$MP_{PJ,i}$: Motor input of the project compressor *i* [kW]
$MP_{RE,i}$: Motor input of the reference compressor *i* [kW]

EF_{elec} : Grid emission factor = 0.877 [tCO_2/MWh]

The grid emission factor EF_{elec} is 0.877 [tCO_2/MWh], which is the value issued by JCM Secretariat for Jamali (Jawa-Madura-Bali) grid.

The project emission is calculated as follows.

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

PE_p : Project emission during the project period *p* = 64,913 [tCO_2/year]
$EC_{PJ,i,p}$: Electricity consumption of the project compressor *i* during project period *p* = 74,017 [MWh/year]
EF_{elec} : Gird CO_2 emission factor = 0.877 [tCO_2/MWh]

The emission reduction is calculated as follows.

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

= 70,051 – 64,913 = 5,139 [tCO_2/year]

The equipment data used for the estimation above is shown in the table below.

Table 3.10 CO2 Emission Reduction Potential by High-efficiency Compressor

No.	Capacity CFM	Capacity m3/min	Motor input kW (Assumption)	Ref. CFM/kW	New compressor CFM/kW	Average operation hr/yr	Current energy comsumption MWh/yr	Saving potential MWh	Reference emission tCO2/yr	Project emission tCO2/yr	Emission Reduction tCO2/yr
LP-1	5526	156.5	932.0	5.93	6.67	8,520	7,941	882	7,834	6,964	870
LP-5	4800	135.9	745.7	6.44	6.67	8,520	6,353	222	5,774	5,572	202
HP-5	4900	138.8	761.2	6.44	6.67	8,520	6,486	227	5,894	5,688	206
LP-16	5600	158.6	887.4	6.31	6.67	8,520	7,561	407	7,008	6,631	378
LP-2	5526	156.5	932.0	5.93	6.67	8,520	7,941	882	7,834	6,964	870
LP-6	5600	158.6	932.0	6.01	6.67	8,520	7,941	787	7,731	6,964	767
LP-4	4800	135.9	745.7	6.44	6.67	8,520	6,353	222	5,774	5,572	202
LP-3	5526	156.5	932.0	5.93	6.67	8,520	7,941	882	7,834	6,964	870
LP-17	5600	158.6	887.4	6.31	6.67	8,520	7,561	407	7,008	6,631	378
Elliot-1	5526	156.5	932.0	6.31	6.67	8,520	7,941	429	7,361	6,964	397
TOTAL							74,017	5,347	70,051	64,913	5,139

Source: Prepared by NK based on data from the fiber factory

In the above estimation, the annual CO2 reduction is estimated to be 5,139 tCO2/yr. Lower $CE_{PJ,i}$ value was estimated to be conservative. The method for conservative calculation needs to be investigated in the methodology for detailed emission reduction calculation. The value

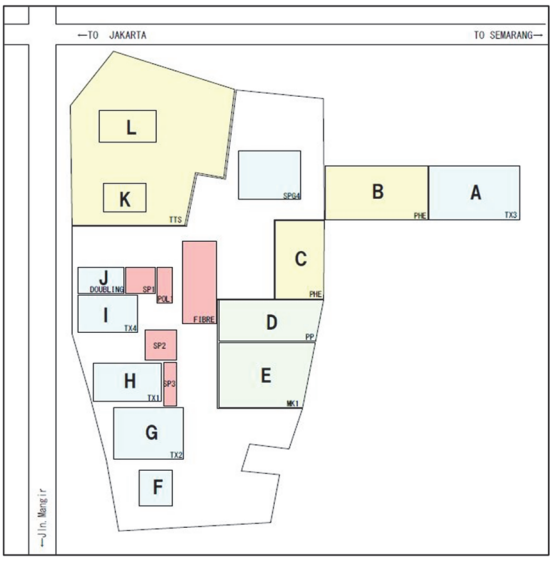
will also be varied according to actual operation condition. Even considering the uncertainty, since the power consumption by the compressors are large, sufficient CO2 reduction amount is expected for JCM model project by the replacement to high-efficient equipment.

Meanwhile, in addition to replacement to high-efficiency equipment from the existing one, engineering arrangement is necessary such as application of insulation, review of piping, duct size and layout, confirmation of valve loss, prevention of air leakage, and so forth. It is difficult to cope with such arrangement by lease, and financing arrangement is challenging. Thus, the compressor replacement will not be included as the component of JCM model project at this time. When financial arrangement is confirmed, preparation to apply JCM model project will be started.

(3) Rooftop Solar PV System

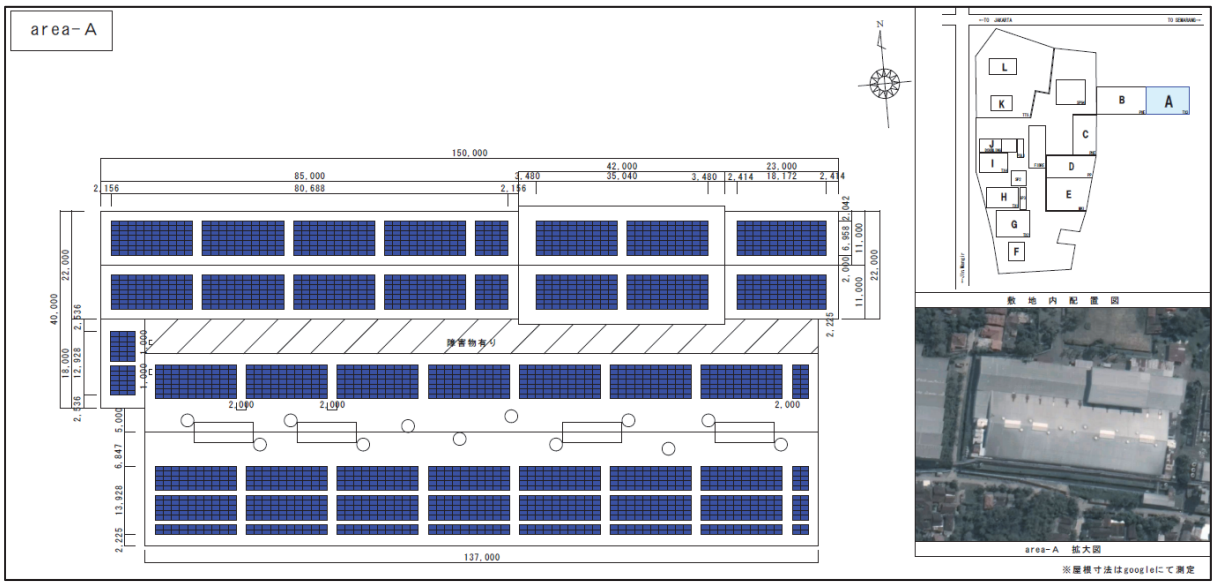
As the rooftop PV system on the buildings of the fiber factory, 5.8 MW solar PV system is possible to install considering available areas. The layout of the PV system and arrangement of PV modules are shown in the figure below.

Building	PV Module Output (kW)
A	884.74
B	646.66
C	446.40
D	280.24
E	153.45
F	334.80
G	1,008.74
H	460.66
I	425.01
J	443.92
K	219.48
L	535.68
TOTAL	5839.78



Source: Prepared by Nippon Air Conditioning Hokuriku

Figure 3.9 5.8 MW Roof-top PV System on Factory Buildings



Source: Prepared by Nippon Air Conditioning Hokuriku

Figure 3.10 Example of a Layout of Roof-top PV System on Factory Buildings

The generated energy and CO2 emission reduction amount by 5.8 MW roof-top PV system for the fiber factory is as shown in the table below. The solar irradiation and generated energy amount is calculated as rough value using ESMAP Global Solar Atlas. All the generated energy is assumed to be used in the factory since the energy demand is much larger than the PV system output.

Table 3.11 Generated Energy by 5.8 MW PV System and CO2 Emission Reduction

Item	Value	Unit	Remark
Average solar irradiation	5.249	kWh/m2/day	ESMAP
PV output	5,839.78	kW	
Azimuth	0	degree	
Inclination	15	degree	
Daily PV generation	22,420	kWh/day	
Annual PV generation	7,959	MWh/yr	
Emission Factor	0.533	tCO2/MWh	
CO2 emission reduction	4,242	tCO2/yr	
Project year	7	yr	Legal life for textile factory
Project CO2 emission reduction	29,695	tCO2	
Subsidy	30%		
CO2 ER cost performance	9,086	JPY/tCO2	

Source: Prepared by NK

As shown in the table above, the legal life will be 7 years for textile factory since all the generated energy from PV system will be used for internal supply. Accordingly, the total emission reduction amount during project period is not as much as grid-connected system for which legal year is 17 years. Accordingly, the emission reduction cost performance will be

more than 9,000 JPY/tCO2. If they intend to apply to JCM Model Project, the subsidy percentage has to be decreased to about 13%, which is not attractive for the private sector.

In case the PV system is connected to the grid and all the power is sold to the grid, the subsidy percentage could be up to 30%; however, power purchase agreement with PLN is necessary, which is quite challenging.

Accordingly, the component of roof-top PV system plan for the fiber factory will not be included in the application to JCM Model Project so far.

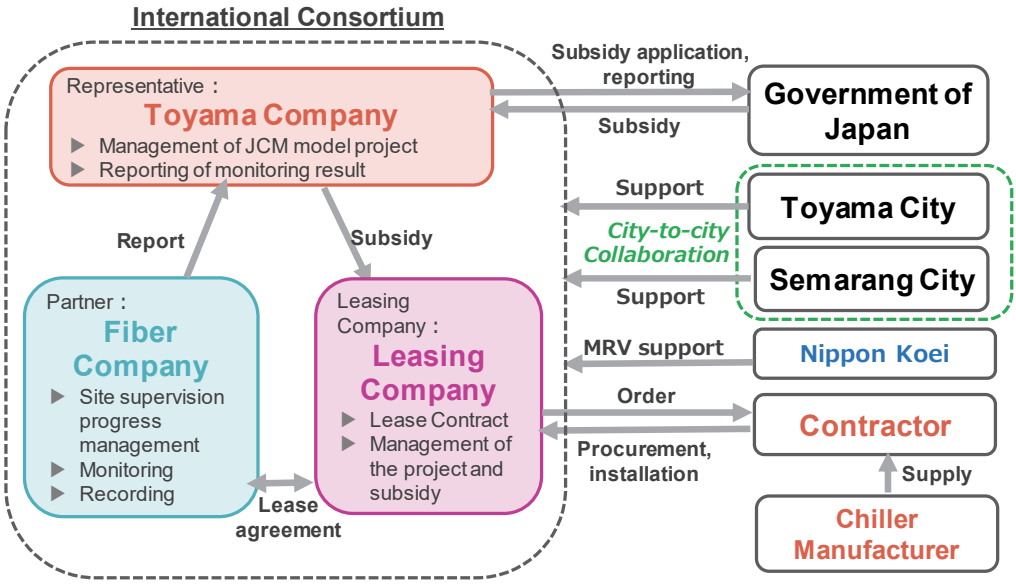
3.3.4 International Consortium for JCM Model Project

Currently, there is no issue in financial conditions for the factory. However, there is an issue in bank loan, and it will consider the application of the lease scheme in the JCM Model Project.

An engineering company in Toyama will be the representative company in the International Consortium. Both the fiber company and leasing company will be the partners in the international consortium. The leasing company will purchase equipment and lent the equipment to the factory. The leasing fee will be set considering the subsidy amount from JCM Model Project.

Toyama city and Semarang city will support the JCM Model Project implementation and coordinate with MoEJ and Government of Indonesia. Nippon Koei Co., Ltd. will support the preparation of Project Design Document (PDD), validation, project registration, preparation of the monitoring report, and verification.

The proposed international consortium and implementation structure is shown in the figure below.



Source: Prepared by NK

Figure 3.11 International Consortium for Introduction of High-Efficiency Equipment in Fiber Factory

3.3.5 Confirmation of Environmental License and SDIP

Additional AMDAL or environmental license procedure will not be necessary for the proposed JCM Model Project since the project is to replace existing aged equipment with new equipment.

The fiber factory received award from Government of Central Java, Indonesia for its contribution to the sustainable community development, as shown in the figure in the right.

Items for Sustainable Development Implementation Plan (SDIP) was confirmed in the target factory, as summarized in the table below.

Award about Environment from Government of Central Java

Table 3.12 Confirmation of SDIP Items at the Fiber Factory

No.	Items	Questions	Yes /No	If answer is Yes, please describe the action plans.
1	EIA	Does the proposed project require official/legal process of EIA?	No	
2	Pollution Control (No need to answer if EIA is required)	Does the proposed project emit air pollutants?	No	
3		Does the proposed project discharge water pollutants or substances which influence BOD, COD or pH, etc.?	No	
4		Does the proposed project generate waste?	Yes	Small quantity of packaging waste is generated for delivery of the equipment and spare parts and consumable. The waste will be internally treated.
5		Does the proposed project increase noise and/or vibration from the current level?	No	
6		Does the proposed project cause ground subsidence?	No	
7		Does the proposed project cause odor?	No	
8	Safety and health	Does the proposed project create dangerous condition for local communities as well as individuals involved in the project, during either its construction or its operation?	Yes	The contractor will provide safety training in operation. The company implements the inspection every timing of maintenance in accordance with their standard.
9	Natural Environment and biodiversity	Is the proposed project site located in protected areas designated by national laws or international treaties and conventions?	No	
10		Does the proposed project change land use of the community and protected habitats for endangered species designated by national laws or international treaties and conventions?	No	

No.	Items	Questions	Yes /No	If answer is Yes, please describe the action plans.
11		Does the proposed project bring foreign species?	No	
12		Does the proposed project include construction activities considered to affect natural environment and biodiversity (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	No	
13		Does the proposed project use surface water, ground water and/or deep ground water?	Yes	The project already uses the water for chiller operation. The same water source will be used and no additional effect on ground/surface water.
14	Economy	Does the proposed project have negative impact on local workforce capacity?	No	
15		Does the proposed project have negative impact on local community's welfare?	No	
16	Social Environment and Community Participation	Does the proposed project cause any resettlement or other types of conflict?	No	
17		Does the proposed project fail to involve activities to respond to, and follow up, comments and complaints that have been received from local communities, particularly from the public consultation?	No	
18		Do the project participants violate any laws and/or ordinances associated with the working conditions of local communities which the project participants should observe in the project?	No	
19	Technology	Does the proposed project fail to involve activities to build capacity of human resources through technology transfer and technical assistance?	No	
20		Does the proposed project fail to describe information of technology specification that consists of manual book and ways to overcome the problems that may occur when being operated on the site, at least in English and in Bahasa Indonesia as applicable?	No	

Source: Prepared by NK based on JCM Sustainable Development Implementation Plan Form

3.3.6 Issues for JCM Model Project Application

Although there are no apparent issues in financial status for the fiber factory, the credit is not obtained from the Japanese leasing company. At present, local lease company is being considered. When the leasing company credit is obtained, preparation for the JCM Model Project application will be started.

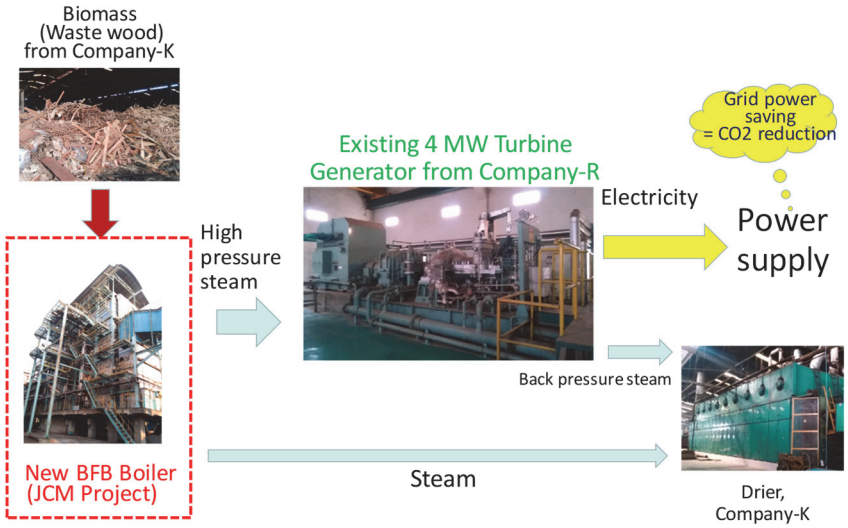
3.4 OTHER CANDIDATE JCM MODEL PROJECTS

3.4.1 Biomass Generation Plan in Timber Factory

Company R produces particle boards for furniture and musical instrument, and they installed 4 MW biomass boiler and turbine generation system for stable internal power supply. However, malfunction of biomass boiler and price hike of biomass material were the issues in its operation. Since the power supply from PLN became stable, the company stopped the operation of the biomass generation system.

Meanwhile, Company K who produces plyboards is located at about 4 km from Company R. Company K produces plenty of wood waste as biomass. Company K had installed biomass boilers in 1980s. Those biomass boilers are aged, and they are planning to replace the boilers, with introduction of biomass generation system.

To utilize the existing biomass generation system in Company R, there was an idea to install new fluidized bed biomass boiler, and then utilize the steam from the boiler for both steam demand in Company K and an existing biomass generator currently installed in Company R. The biomass boiler is assumed to be the target of JCM Model Project.



Source: Prepared by NK

Figure 3.12 Concept of Biomass Generation Project by Installation of Biomass Boiler

The CO2 emission reduction amount by the biomass generation system is summarized in the table below. It was estimated at 8,116 tCO2/year.

Table 3.13 Estimate CO2 Emission Reduction by the Biomass Generation System

Item	Value	Unit
Emission Factor (Jamali)	0.613	tCO2/MWh
Generation output	4	MW
Utilization factor	0.52	
Annual operation hours	6,400	hours/yr
Annual generated energy	13,240	MWh/yr
Annual emission reduction	8,116	tonCO2/yr
Legal life	8	yrs
Project emission reduction	64,929	ton

Source: Prepared by NK

However, there are issues to materialize the project: (i) it is necessary to obtain approval from PLN about power purchase and sales agreement between respective private company, and (ii) utilization of back-pressure from the generation turbine is not possible.

3.4.2 Introduction of Gas Boiler for a Drier in a Grain Factory

A grain factory is located in Godong, 45 km west to Semarang. The factory collects and dries rice, wheat, beans, and corn, and exports grains and feedstock.

The factory plans to install drier for drying corn with a drying capacity of 120 ton, 5 hours per a batch, 3-4 batches per a day.

The grain company once installed a diesel oil drier. Then, the factory tested using rice husks in the furnace, but since soot is mixed to the product, they will stop to use rice husks. Thus, introduction of gas once-through boiler for dryer is now considered.

Since the heat demand for the boiler is large, it is expected to be able to apply to JCM model project with fuel switch from diesel oil to gas.

Source: Photo taken by NK

Figure 3.13 Existing Furnace for Drier and Silo for Corn

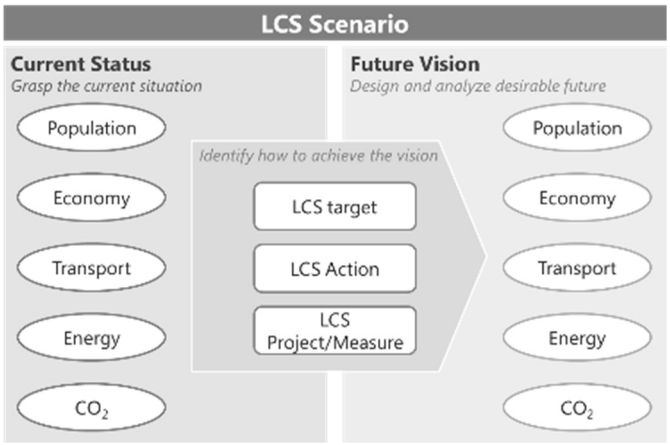
CHAPTER 4 STUDY TO ESTABLISH LOW CARBON SOCIETY

4.1 LOW CARBON SOCIETY ACTION PLAN IN SEMARANG

4.1.1 Low Carbon Scenario and AIM Model

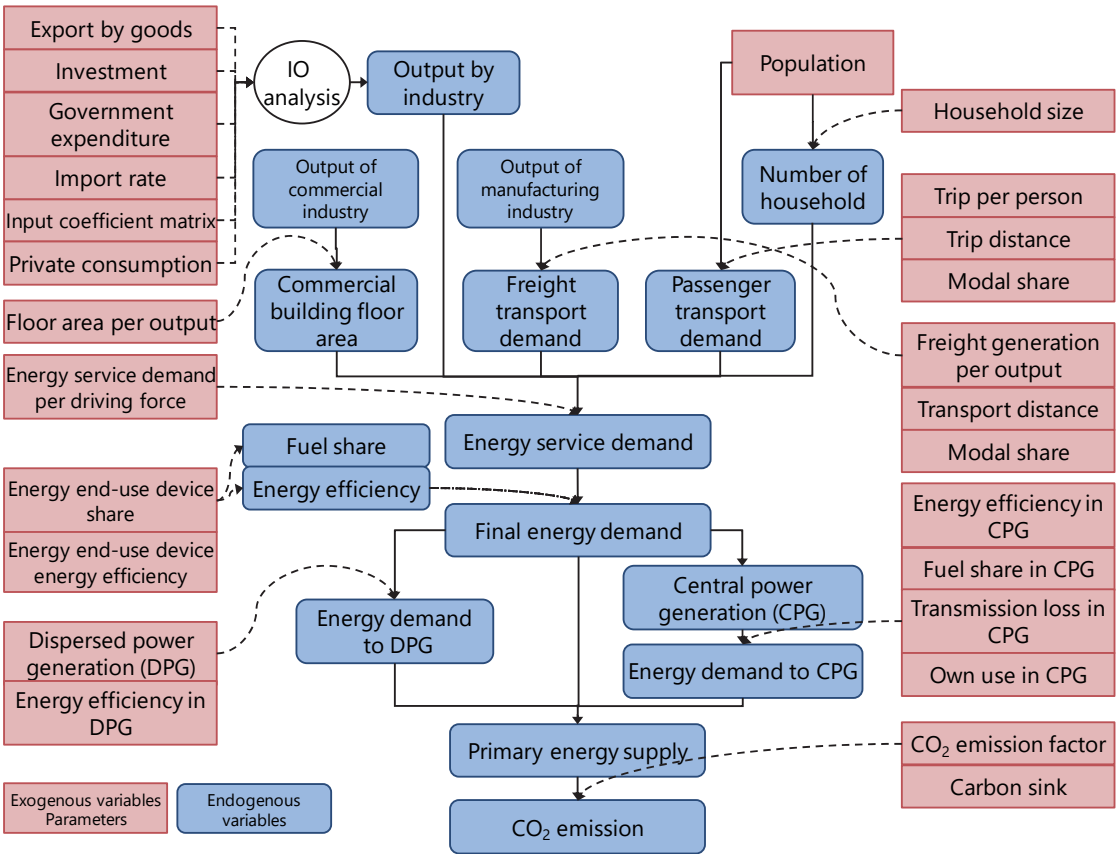
Following up Presidential Regulation 61/2011 and 71/2011, Semarang City as one of the cities in Indonesia has a liability for GHG reduction activities. The research on low carbon society (LCS) scenario for Semarang City aims to contribute on promoting climate change actions and policies at the city level. Low Carbon Society (LCS) Scenario is a kind of guide to realize or achieve low or even zero emissions of greenhouse gases considering the future vision of society (Figure1). It is one of the outcomes of collaboration among Semarang Municipality, Diponegoro University and Asia-Pacific Integrated Model (AIM) team in Japan. The Asia-Pacific Integrated Model (AIM) is a family of analytical models which were developed by research institutes in Japan. The research began with gathering data and information related to socio-economic parameters and energy consumption. It used domestic and international sources to estimate both current and future status of Semarang City such as the national economic vision, "Masterplan for Acceleration and Expansion of Indonesia's Economic Development 2011- 2025". The entire data are processed with tool namely Asia-Pacific Integrated Model Extended Snapshot (ExSS) (Figure2). The tool was applying and focuses on energy-related CO2 emission.

Two kinds of data are required: first data on the existing condition (as of 2015) and second data about the future vision. The data of existing conditions such as population, number of households, economic accounts, input-output tables, transport volume, energy balance tables and GHG emission were collected. In some cases, if data was not available in the city level, it was assumed and estimate based on available data at province level or national/ country level.



Source: AIM Team

Figure 4.1 Conceptual Framework of LCS Scenario



Source: AIM Team

Figure 4.2 Structure of AIM EXSS model

4.1.2 Baseline Socio-Economic Activities in Semarang City and Its Future Development

Total population of city is 1,595,267 persons and 471,327 households (as of 2015) (BPS, 2016) and gross regional domestic product (GRDP) per capita at 6,461.5 USD (1USD=13,000 IDR) (BPS, 2016). The largest contributor to GRDP is the secondary sector such as manufacturing food, beverage and tobacco, chemical and pharmaceuticals, and other industry such as textile and transport equipment (Table 1). Semarang City's total CO_2 emission estimated to be 5,282 $ktCO_2e$ or 3.3 tCO_2e/person in 2015. The industry sector is the largest CO_2 emitter in Semarang City (IGES, 2017).

Based on available data of Semarang City in 2015 and other information such as the national economic vision, "Masterplan for Acceleration and Expansion of Indonesia's Economic Development 2011-2025", we made projection of socioeconomic indicators in 2030. The population will increase about 1.29 times or additional 464,733 people from 2015 to 2030. The number of households is estimated to increase around 1.6 times compare to the number of household in 2015. The macro-economic condition indicator (GRDP) will rise about 6 times or 834,197 billion rupiah in Semarang city. Manufacturing of food, textile and transport equipment and Information and communication technology (ICT) industry will lead the economic growth of this city which is also written in the master plan. In 2030, the largest

contributor to GRDP in Semarang City is the secondary sector especially construction industry. The tertiary sector is in the second place and primary sector is the lowest contributor (Table 2). However, based on our prediction, the highest growth rate is estimated at around 6.55 times in the tertiary sector. It is slightly higher than secondary sector (6.01 times), while primary sector increase of about 2.61 times. These will lead to increased transport demand especially passenger transport and freight transport to support the manufacturing outputs.

Table 4.1 Socio Economic Indicator of Semarang City in 2015 and 2030

Indicators	Unit	2015	2030	Ratio 2030/2015
Population	persons	1,595,267	2,060,000	1.29
No of Households	households	471,327	686,667	1.46
GRDP per capita	million rupiah	84	405	4.81
GRDP	Billion rupiah	134,207	834,197	6.22
(a) Primary Industry		1,373	3,590	2.61
(b) Secondary Industry		73,340	440,906	6.01
(c) Tertiary Industry		59.493	389.701	6.55
Final Consumption	Billion rupiah	79,822	486,134	6.09
Gross Capital Formation	Billion rupiah	99,697	607,179	6.09
Export	Billion rupiah	37,563	228,772	6.09
Import	Billion rupiah	114,672	690,811	6.02
Commercial Floor Area	Thousand m^2	50,252	330,043	6.57
Transport Demand				
Passenger Transport	Million pass-km	18,342	28,422	1.55
Freight Transport	Million ton-km	3,391	20,307	5.99

Source: IGES, 2017

Table 4.2 Gross Regional Domestic Product by Sector in Semarang City (in bil. IDR)

Sector	2015	2030	2030/2015
(1) Primary	1,373	3,590	2.61
(2) Secondary	73,340	440,906	6.01
(a) Mining and quarrying	261	1,414	5.41
(b) Foods, beverage & tobacco	17,885	110,507	6.18
(c) Paper, paper products & printing	408	2,165	5.30
(d) Chemicals & pharmaceuticals	6,785	35,783	5.27
(e) Non-metal mineral products	459	1,490	3.24
(f) Basic metals	2,840	17,264	6.08
(g) Metal products, machinery & equipment	2,804	17,162	6.12
(h) Other manufacturing	5,695	32,959	5.79
(i) Construction	36,201	222,162	6.14
(3) Tertiary	59,493	389,701	6.55
(j) (a) Electricity, gas, water & waste	250	1,658	6.62
(k) (b) Wholesale & retail trade	18,966	124,395	6.56

Sector	2015	2030	2030/2015
(l) (c) Transport & Communications	14,669	99,352	6.77
(m) Financial, real estate & company services	10,452	67,700	6.48
(n) Other services	15,157	96,597	6.37
Total	**134,207**	**834,197**	**6.22**

Source: IGES, 2017

4.1.3 Low Carbon Society Scenario for Semarang City

Increasing population and its income will also increase consumption expenditure especially in the tertiary sector such as transport and communication, utility services, wholesale and retail trade, and financial sector include real estate and company services. Those above factors will automatically increase final energy consumption (Table 3) and CO_2 emissions (Table 4) in 2030. Two kinds of scenarios, namely Business as Usual (BaU) scenario and Countermeasure (CM) scenario were prepared to analyze reduction potential of CO_2 emission in future. The BaU scenario assumed that there is no policy or technology intervention to reduce carbon emission, while countermeasure scenario (CM) aims to reduce carbon emission. Under BaU scenario, final energy consumption will increase around 2.22 times from 2015 to 2030. The total amount of energy consumption will also rise-up from 866.4 ktoe (2015) to 1,920.3 ktoe (2030). The passenger transport sector will still be the highest energy consumer in 2030. It is, however, without significant growth of energy consumption in this sector. The highest growth will occur in the commercial sector around 7.08 times compared to the consumption in 2015. In contrast, energy consumption in CM scenario is 24% lower than in BaU scenario as the results of the implementation of Low Carbon Society projects. Energy consumption will reduce significantly from passenger transport sector around 35% compared to BaU scenario.

In BaU scenario, total CO_2 emission will increase 2.56 times from 2015 or equivalent to 7.214 $ktCO_2e$ in 2030. While CM scenario will decrease CO_2 emission up to 5.152 $ktCO_2e$, or equal to 29% reduction compare to BaU scenario. In both BaU and CM scenario, the commercial sector will increase CO_2 emission at the highest rate compared to other sectors or equal to 7.08 times of data in 2015. It will be followed by freight transport sector (5.99 times) and the industry sector (5.71 times). CM on low carbon scenario projects will reduce 37% compared to BAU of CO2 emission of commercial sector and 34% of passenger transport sector.

Table 4.3 Final Energy Consumption by Sector in Semarang City (ktoe)

Sector	2015	2030 BAU	2030 CM	BAU/2015	CM/BAU
Industry	731.6	4,139.9	3,483.6	5.66	0.84
Commercial	71.7	507.6	442.5	7.08	0.87
Residential	392.2	615.8	605.1	1.57	0.98
Passenger Transport	457.7	709.2	421.0	1.55	0.59
Freight transport	29.6	177.2	138.8	5.99	0.78
Total	**1,682.8**	**6,149.6**	**5,091.0**	**3,65**	**0.83**

Source: IGES, 2017

Table 4.4 CO2 emission by sector and fuel in Semarang City (kt CO_2e)

Year	Sector	Coal	Oil	Gas	Electricity	Total
2015	Industry	497.0	492.5	586.8	948.2	**2524.5**
	Commercial	0.0	45.3	5.7	520.0	**571.0**
	Residential	0.0	173.5	0.3	574.2	**748.0**
	Passenger Transport	0.0	1,350.7	0.0	0.0	**1,350.7**
	Freight transport	0.0	87.3	0.0	0.0	**87.3**
	Total	**497.0**	**2,149.3**	**592.7**	**2,042.5**	**5,281.5**
2030 BAU	Industry	2,738.9	2,820.5	3,322.9	5,694.5	**14,576.9**
	Commercial	0.0	320.8	40.3	3,680.7	**4,041.7**
	Residential	0.0	272.4	0.4	588.8	**861.7**
	Passenger Transport	0.0	1,093.0	0.0	0.0	**2,093.0**
	Freight transport	0.0	522.8	0.0	0.0	**522.8**
	Total	**2,738.9**	**5,029.5**	**3,363.7**	**9,964.0**	**22,096.1**
2030 CM	Industry	1,905.1	2,140.8	3,137.6	3,642.7	**10,826.3**
	Commercial	0.0	208.9	105.7	2,350.8	**2,665.3**
	Residential	0.0	272.4	0.4	588.8	**861.7**
	Passenger Transport	0.0	1,182.6	40.6	23.2	**1,246.3**
	Freight transport	0.0	409.7	0.0	0.0	**409.7**
	Total	**1,905.2**	**4,214.4**	**3,284.3**	**6,605.5**	**16,009.4**

Source: IGES, 2017

4.1.4 Action Plans/Projects

To reduce CO_2 emission, a variety of low carbon society (LCS) projects as countermeasures are proposed to implement in Semarang city. These projects are categorized into five LCS actions from the perspective of fields and similarities which are “Green Industry”, “Smart Building”, “Smart Device”, Sustainable Transport” and “Green Energy”. These actions can help to reduce CO_2 emission by 4,220.4 ktCO_2e. The additional emission reduction around 2,179.1 ktCO_2e are expected from the improvement of emission factor as the impact of national policy on promoting renewable energy to replace or reduce the contribution of coal power energy (Table 5).

Action 1 on Green Industry covers LCS projects for reducing energy consumption or CO_2 emission especially factories in industries areas. The CO_2 emission reduction by the project around 2,552.0 ktCO_2e which come from energy saving support scheme such as energy service company (ESCO) projects as the main projects in this group of action. This project on energy saving will contribute to reduce 964.6 ktCO_2e of CO_2 emission (Table 5).

Action 2 on Smart Building LCS projects related to housing and building. The reduction of CO_2 emission about 248.4 ktCO_2e due to the development of infrastructure for natural gas and solar water heater and energy saving technology such as insulated materials for the buildings. For instance, Introduction of solar water heater to houses and buildings can reduce CO_2 emission by 52.3 ktCO_2e (Table 5).

Action 3 on Smart Device promote energy efficient devices and equipment used in houses and offices. Total GHG emission reduction by projects is 434.1 $ktCO_2e$. Projects on the commercial sector gives the largest potential to reduce around 354.4 $ktCO_2e$ of CO_2 emission (Table 5).

Action 4 on Sustainable Transport, the projects could reduce 950.1 $ktCO_2e$ because the passenger transport sector is the largest CO_2 emitter compared to other sectors. The modal shift from private vehicles to public transportation as well as promotion of high efficiency of vehicles are examples of the actions. Deployment of high fuel efficiency of cars gives the largest CO_2 emission reduction around 452.3 $ktCO_2e$. The introduction of fuel efficiency of motorbike come in the second place (Table 5). The conversion from Diesel to Natural Gas for the public bus (Trans Semarang) in all 12 corridors could potentially reduce around 6.1 $ktCO_2e$ per year. Semarang city just launched the project on CNG bus conversion program under Joint Crediting Mechanisms of the city-to-city cooperation between Toyama City and Semarang City. The JCM model project FY 2018 on fuel switch for about 72 buses of Trans Semarang Corridor 1,2,5 & 6 are expected to reduce GHG emission around 9.348 tCO_2e for 5 years or 1.87 $ktCO_2e$ per year or equal to 30% of the target on the low carbon society scenario for Semarang 2030. The expansion of the project to the other corridors within the city could help to achieve the target in the low carbon society scenario for Semarang 2030.

Action 5 on Green Energy focuses on promoting renewable energy for electric power generation. The introduction photovoltaic power generation systems and small-scale hydropower generation facilities could reduce 35.7 $ktCO_2e$ in Semarang City (Table 5).

Table 4.5 Low Carbon Projects and Its Impact on CO_2 reduction

Action	Project	Sector	Emission Reduction ($ktCO_2e$)
1. Green Industry	1-01 Energy saving support scheme such as ESCO (Energy Saving Company) project for industries	Industry	964.6
	1-02 Installation high energy efficiency facilities	Industry	346.6
	1-03 Regional energy supply system	Industry	487.7
	1-04 Improvement of kiln and furnace technology	Industry	692.3
	1-05 Promotion of fuel shift of furnaces and boilers from Coal to Natural Gas	Industry	58.8
	Total		**2,550.0**

Action	Project	Sector	Emission Reduction ($ktCO_2e$)
2. Smart Building	2-01 Installation of insulated glasses to commercial buildings	Commercial	84.1
	2-02 Installation of insulated glasses to houses	Residential	12.2
	2-03 Introduction of incentive to low energy buildings	Commercial	15.9
	2-04 Introduction of insulating material to houses	Residential	7.0
	2-05 Energy efficiency technology applied to buildings	Commercial	35.8
	2-06 Shift to natural gas in buildings	Commercial	17.1
	2-07 Introduction of solar water heater to commercial buildings	Commercial	52.3
	2-09 Introduction of solar water heater to households	Residential	23.9
	Total		**248.3**
3. Smart Device	3-01 Energy saving support scheme such as ESCO (Energy Saving Company) project for commercial buildings	Commercial	150.6
	3-02 High efficiency lighting in commercial buildings	Commercial	66.5
	3-03 High efficiency lighting in households	Residential	22.8
	3-04 High efficiency air conditioners (such as air conditioners with inverter controllers) in commercial buildings	Commercial	137.3
	3-05 High efficiency air conditioners (such as air conditioners with inverter controllers) in households	Residential	33.7
	3-06 Promotion of energy-efficient appliances	Residential	23.1
	Total		**434.0**
4. Sustainable Transport	4-01 Promotion of eco-driving with digital tachographs	Transport	7.2
	4-02 Wide-range traffic control	Transport	28.8
	4-03 Expansion of frequencies and routes of bus and BRT	Transport	96.2
	4-04 Development of public transportation like railway and MRT	Transport	98.6
	4-05 Shift to CNG bus	Transport	6.1
	4-06 Introduction of electric motorbikes	Transport	61.5
	4-07 Promotion of energy-efficient vehicles (cars for passenger)	Transport	452.3
	4-08 Promotion of energy-efficient vehicles (motorbikes)	Transport	86.7

Action	Project	Sector	Emission Reduction ($ktCO_2e$)
	4-09 Promotion of energy-efficient vehicles (trucks)	Transport	112.8
	Total		**950.2**
5. Green Energy	5-01 Introduction of photovoltaic power generation to commercial buildings	Commercial	24.3
	5-02 Introduction of photovoltaic power generation to households	Residential	9.7
	5-03 Introduction of small-scale hydropower generation (at water distribution stations)	Commercial	1.7
	Total		**35.7**
Improvement of CO_2 emission factor of electricity			**2,179.1**
Total			**6,397.3**

Source: Prepared by IGES

References

1) Badan Pusat Statistik (BPS), Kota Semarang (2016): Kota Semarang dalam Angka Tahun 2016.

2) Badan Pusat Statistik (BPS), Kota Semarang (Website): [2010 Version] GRDP At Current Market Prices by Industrial Origin Per Sector-Sub Sector in Semarang Municipality, 2008 - 2016.

3) Badan Pusat Statistik (BPS), Kota Semarang (Website): [2010 Version] GRDP of Semarang Municipality at Current Market Prices [2010] by Type of Expenditure (Million Rupiahs), 2010 - 2016.

4) Low Carbon Society Scenario Semarang 2030, Institute for Global Environmental Strategies (IGES), 2017.

4.2 INCENTIVES FOR FUEL SWITCH

4.2.1 Financial Benefit from Fuel Switch and Efficient Equipment

For the formulation of JCM Model Project, fuel switch of boiler makes larger CO2 emission reduction than efficiency improvement. CO2 emission factors per unit heat value of fuels, coal, diesel oil, and natural gas as an example, are as shown in the table below. Fuel switch from coal to gas and from oil to gas contributes to CO2 emission reduction.

Table 4.6 CO2 Emission Factor for Coal, Diesel Oil, and Gas

Fuel	CO2 Emission Factor per Heat Value	Source
Coal	0.0873 - 0.0909 tCO2/GJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Diesel Oil	0.0726 tCO2/GJ	
Natural Gas	0.0543 tCO2/GJ	

Source: Prepared by NK

According to a boiler manufacturer with local office located in Indonesia, the rough figure of boiler fuel in Semarang is 90% coal, 5% is oil, and 5% is gas. Thus, the fuel switch potential seems to be high.

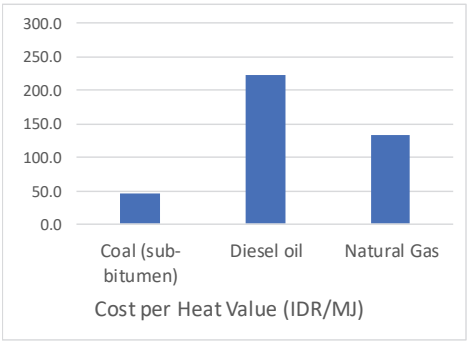
Meanwhile, fuel switch is effective for CO2 emission reduction, but running cost increase is a hurdle for private companies.

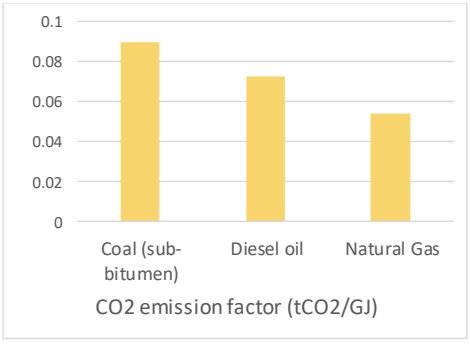
According the Study result, the unit prices per heat value of coal, diesel oil, and gas are shown in the table below.

Table 4.7 Fuel Price in Indonesia

Fuel	Unit Price (USD/MJ)	Source
Coal	0.00317	From ESDM HBA 2017 price, 75.66 USD/ton and 23,850 MJ/ton, 0.00317 USD/MJ
Diesel Oil	0.0153	From Pertamina, diesel oil price is 8,448 IDR/L and 38.04 MJ/L（Agency of Natural Resource and Energy, METI and currency rate 14,522 IDR/USD (Dec 2018), 0.0153 USD/MJ.
Natural Gas	0.0081	From Pertagas, 8.54 USD/mmBTU, and 1054 MJ/mmBTU(TEPCO), 0.0081 USD/MJ

Source: Prepared by NK





Item	Coal	Diesel Oil	Natural Gas
Price	75.66 USD/ton	8448 IDR/Litter	8.54 USD/mmbtu
Source	HBA2017	Pertamina	Pertagas
Cost per Heat Value	44.7 IDR/MJ	223 IDR/MJ	133.7 IDR/MJ

Source: Prepared by NK

Figure 4.3 Price Per Heat Value and CO2 Emission Amount for Fuels

The assumed boiler efficiency by boiler fuel type is summarized in the table blow.

Table 4.8 Boiler Efficiency by Fuel Type

Fuel Type	Boiler efficiency (%)	Source
Coal Boiler	80	CDM Tool09 Determining the baseline efficiency of thermal or electric energy generation systems
Oil Boiler	89	JCM Methodology (ID_AM007 Additional Information)
Gas Boiler	98	Specification of Miura Gas Once-through Boiler

Source: Prepared by NK

From above tables, the fuel price comparison for boiler operation is as follows.

Table 4.9 Fuel Price Comparison for Boiler Operation

Fuel	Fuel Price (USD/MJ)	Fuel price ratio, gas boiler as 1.0
Coal Boiler	0.00396	0.48
Oil Boiler	0.0172	2.08
Gas Boiler	0.00827	1

Source: Prepared by NK

From the above table, in case the fuel switch from coal boiler to gas boiler, the fuel price will be as much as twice, so there is no financial incentive. Meanwhile, the fuel switch from diesel oil to gas reduces fuel cost almost half, and so the incentive for oil to gas fuel switch is strong.

4.2.2 Incentive for Fuel Switch in Industry Sector

As shown in Table 4.6, CO2 emission factor of diesel oil is 1.3 times than gas, and coal is 1.6 times than gas for the same heat value. Promotion of fuel switch will reduce CO2 emission and contribute to establishment of low carbon society in Indonesia. Fuel switch from oil to gas will be progressed since it has financial benefit. Meanwhile, as shown in Section 4.2.1, the fuel switch from coal to gas increases fuel cost almost double. There is no financial incentive for the private sector in Semarang for fuel switch from coal to gas, which is challenging. Policy program for fuel switch promotion is necessary.

Policy formulation for fuel and energy saving in the industrial sector in Indonesia is managed in central government by Kementerian Energi dan Sumber Daya Mineral Republik Indonesia (Ministry of Energy and Mineral Resources, ESDM). Thus, it is necessary to work with ESDM for policy formulation of promoting incentives for fuel switch.

The following are the possible ways to promote fuel switch:

1) Introduction of carbon tax
2) Review of emission standard of pollutant
3) Setting monitoring obligation

Review of emission standard of air pollutant from factories would be one of the method to promote fuel switch. The guideline setting for measurement method and penalty setting for business owners who emitted excessing level of pollutant would also be possible method. In addition, exemption or mitigation of monitoring obligation for boilers with 100% gas as fuel would be effective.

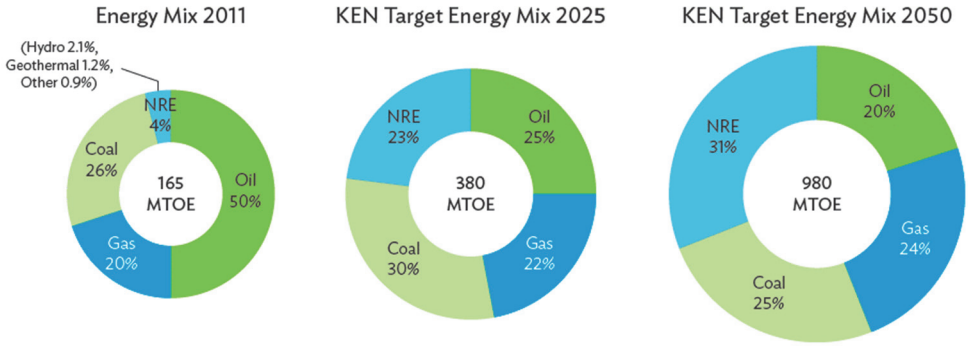
If expense for related cost of coal utilization such as dust collection and ash treatment becomes higher, fuel switch to gas will be considered to be promoted.

Meanwhile, coal usage for equipment such as boiler has been prohibited in 2017 in China. This results in confusion in social life due to insufficient heating equipment and shortage of natural gas as an alternative fuel. Radical fuel switch is not recommended, and it is preferable to take realistic step-by-step approach for fuel switch considering actual possible fuel supply amount.

The fuel switch policy requires the re-orientation of the national policy, and it is desirable to conduct technical cooperation at the national level.

4.3 NATURAL GAS INTRODUCTION TO INDUSTRIAL PARK

Primary energy consumption in Indoneshia in 2011 FY was 164 million TOE, consists of oil for 50%, gas for 20%, and coal for 25%. According to National Energy Policy (KEN: Kebijakan Energi Nasional), they are planning to reduce the oil dependence and increase the use of coal, gas and renewable energy (i.e., oil reduced to 25% , gas increased to 22%, coal to 30%, and renewable energy to 23% in 2025).



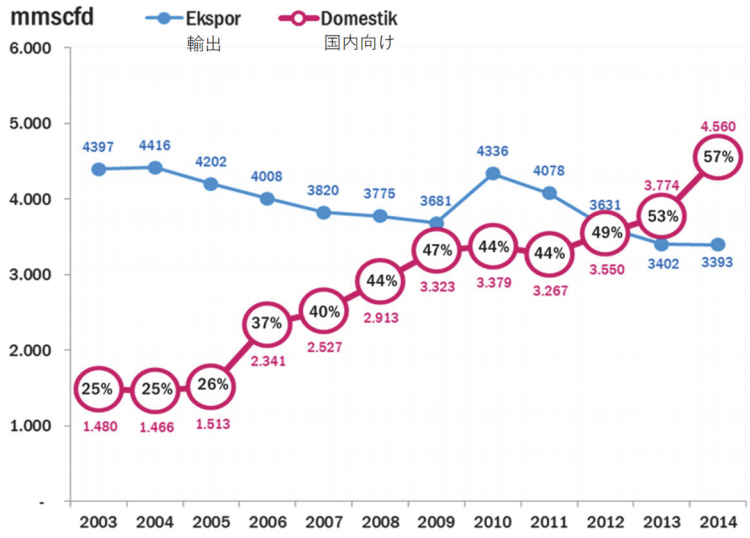
Source: ADB Energy Sector Assessment, Strategy, and Road Map

KEN: KebijakanEnergiNasional (national energy policy)

Figure 4.4 National Energy Policy in Indonesia

According to BP Statistics issued in 2018, proved natural gas reserve in Indonesia as of end 2017 was 102.9 TCF. Most of the reserves are located in Offshore area. The gas production in 2017 was 2.4 TCF and domestic consumption was 1.4 TCF in Indonesia. According to IEA, Indonesian domestic gas consumption will be increased to 4.1 TCF by 2025 and become the largest gas consumer in South East Asia. Major gas user will be power, fertilizer, industry and transportation sectors.

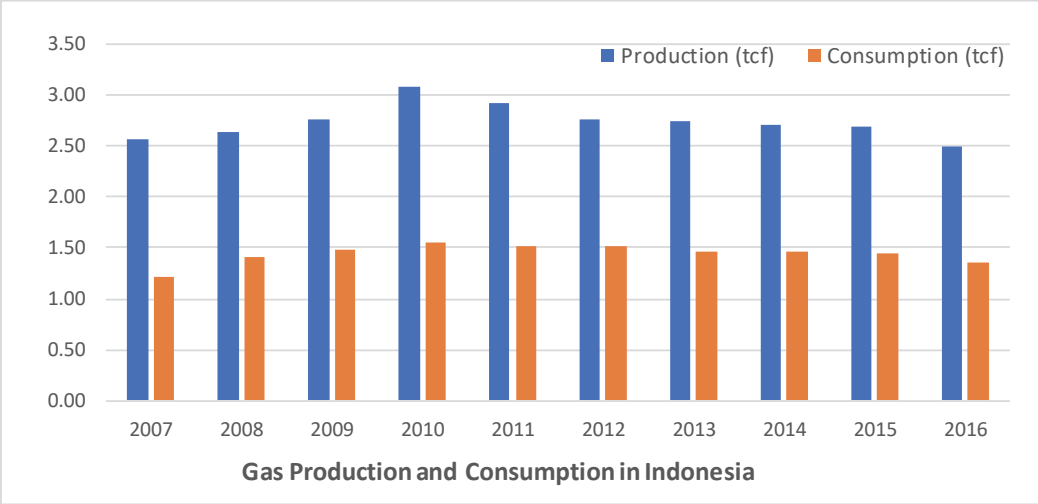
Indonesia is the fourth largest LNG exporter in the world, following Qatar, Malaysia, and Australia. Under the Product Sharing Agreement with contractors, contractors are obligated to supply 25% of the shared product to the local market at a local price. Gas demand is increasing and proportion against the total production is increasing year by year. Gas export in 2014 is 3,393 mmscfd, while domestic consumption is 4,560 mmscfd, accounting for 57% of the total production.



Source: https://www.esdm.go.id/assets/media/content/Renstra_KESDM.pdf

Figure 4.5 Gas Export and Domestic Consumption Ratio

Indonesian gas production in 2017 was 2.4 TCF and domestic consumption was 1.4 TCF. Production peaked in 2010 and started to decline.



Source: BP Statistics

Figure 4.6 Gas Production and Domestic Consumption in Indonesia

Gas domestic consumption declined in 2015 and 2016 due to an economic recession and also a gas priority allocation to export. Geographically, gas production site is distant from the gas demand centers and gas transmission and distribution infrastructures has not been developed. This is considered as one of the major constraints for gas supply to local cities like Semarang City.

Indonesian natural gas supply was initiated by MEMR, SKK MIGAS and PT Pertamina. Major oil companies such as Total, Conoco Phillips, ExxonMobil take part in gas production and

refining, and Pertamina and PT Perusahaan Gas Negara (PGN) take part in gas transmission and distribution with some other local companies.

To support economic growth of the Nation, the government has introduced discounted gas price for domestic industries. The gas price for fertilizer industry was set at 7 USD/mmBTU in Oct 2015, and similar price discount were introduced for ceramics, detergent, steel, glass, petrochemicals in May 2016 by Presidential Ordinance. However, price of gas has been increasing as of 2018.

Natural gas supply to Semarang City is conducted by Pertagas, a part of Pertamina, and PGN. Gas is provided in a form of Compressed Natural Gas (CNG) and transported by lorries from Cirebon and/or Surabaya

CNG introduced by PGN is distributed via independent mini-gas distribution network installed in part of the Industrial Park, such as KIW. Amount of gas supply in a form of CNG is limited and shortfall of supply to cover potential demand exists in the Semarang District
Gresik-Semarang Pipeline from Surabaya to Tambakrejo Onshore Receiving Facility (ORF) is under construction and scheduled to be completed in 2019. Gas field development in offshore West Jawa are also underway by Sampang PSC and Kangean PSC, however, it will take longer time, and physical supply will be starting a few years after the completion of the pipeline.

According to press, another pipeline from Cirebon to Semarang is scheduled to complete in 2018; however, exact status is not known. Pertamina once planned to install Floating Storage Regasification Unit (FSRU) off the coast of Semarang; however, the plan was cancelled due to a plan to install a pipeline. For the time being, CNG supply via lorry will continue for the next few years in Semarang.

Source: Prtagas

Figure 4.7 Gas Pipeline Plan to Semarang

CHAPTER 5 ISSUES AND FUTURE PLAN

5.1 ISSUES

5.1.1 CO2 Emission Reduction Amount in Energy Efficiency Improvement

Factory types around Semarang city are mainly light industry such as food, textile, garment, and assembling. Power and heat demand of respective project owners is not large.

According to existing methodology for chillers ID_AM002, the reference COP is set 4.02-5.94, and this value of reference chillers are set much higher than BAU. On the installation of new equipment, energy saving enough to justify financial benefit could be expected in comparison with BAU; however, CO2 emission reduction amount will be much smaller than expected when it is calculated and compared with reference COP in the methodology.

When emission reduction at the level of 1000 tCO2/year is necessary to achieve, large facility, more than 2,000 USRt demand for example, will be necessary. (The amount of CO2 reduction depends on factory operation hours.) Also, the refrigeration demand in most of the factories and commercial facilities would be less than 300 USRt in Semarang. Thus, even where there are demand, it is challenging to formulate JCM Model Project directly.

Boiler has the same challenges. In the methodology ID_AM015, the reference boiler efficiency is set as 90%, while the efficiency of BAU is 80-85% or even less in many cases. Although boiler replacement has financial merit when it is compared with BAU case, large amount of heat demand will be necessary to formulate JCM Model Project when simple efficiency improvement is applied for CO2 reduction calculation.

Also, the emission reduction performance is higher in fuel switch than in efficiency improvement for boiler. However, in case of switch from coal to gas, fuel cost will be increased, and it is difficult for local business owner to decide fuel switch to gas as a management judgement. On the other hand, fuel switch from diesel oil to gas has financial benefit.

It is possible for boilers to increase emission reduction amount with the combination of efficiency improvement and fuel switch. However, in the methodology ID_AM015, fuel switch can only be considered in case (i) replacement of existing boiler to new boiler with fuel switching and (ii) business plan of coal or new oil boiler is once officially approved and to be changed to gas boiler if JCM is applied. Accordingly, it should be noted that if new gas boiler is newly installed from the start, it cannot be considered as fuel switch project in the current methodology.

From the above, it would be necessary to combine several projects for application of JCM Model Project with sufficient emission reduction amount for smaller projects.

5.1.2 Simplification of required Document for Project Combination

For establishment of low carbon city, there are few business owners who have large power and heat demand in the private sector. Accordingly, combination of several projects might be necessary for application to JCM Model Project.

It is preferable for subsidy amount of JCM model project to be more than 50 million JPY. Assuming JCM subsidy is 40% of equipment cost, the project scale will be more than 125 million JPY. There are few private factories that can decide to make the investment for energy saving equipment at this scale. Project combination will be necessary in this term too.

Also, when the project combination is assumed, work load on the Representative Company of JCM Model Project will be quite heavy, since coordination and document preparation are required for application, such as international consortium agreement, material for financial status, business and fund procurement plan, document for intention of project participation, etc. Especially, it is difficult to obtain audited financial statement from local companies. It is desirable to ease and simplify the document requirement, when investment of a participant company is small, for example.

To promote formulation of JCM Model Projects with project combination and cross development in city-to-city collaboration, it is preferable to simplify the document requirement in JCM Model Project application.

5.1.3 Lease Scheme and Credit

When lease is planned in JCM Model Project by local project owner, it is difficult for Japanese lease company to obtain credit for leasing. In some cases, lease credit might be possible by local lease company or lease company in third company. At this case, flexible formation of the International Consortium need to be approved in JCM Model Project.

5.1.4 Bidding and JCM Model Project

In case of the public sector, there is possibility for energy saving to be large-scale as required in JCM Model Project such as transportation and water. However, most public sector projects requires bidding for equipment procurement. In case bidding is conducted in JCM Model Project, coordination with stakeholders and schedule management is necessary considering specific requirements of JCM.

It is highly possible that the project with equipment in terms of environment infrastructure export concept cannot avoid bidding. To promote JCM project formulation through city-to-city collaboration, the framework design and operation considering bidding requirement is desirable, such as accepting applications throughout the year.

5.1.5 JCM Project without JCM Model Project Subsidy

There are many energy saving projects that have potential to provide emission reduction credit even if the project is not applicable to JCM Model Project due to insufficient cost performance not less than 4000 JPY/tCO2 or annual emission reduction is less than 1000 tCO2. However, there is no merit for the private sector project owner to register as JCM project since it requires expense for PDD preparation, validation, registration, monitoring, and verification. It is desirable to provide incentive to the private sector to register as JCM project even if no subsidy is provided as JCM Model Project.

5.2 WAY FORWARD

5.2.1 Application of JCM Model Project

As described in Chapter 3, factories were selected as the target of JCM Model Project application in the survey. As the result, "JCM Model Project for Installation of Gas Once-through Boilers in Garment Factory" and "JCM Model Project for Installation of Centrifugal Chiller in Fiber Factory" were formulated and considered for application in FY2019.

5.2.2 Challenges for Application of JCM Model Project for Installation of Gas Once-through Boilers in Garment Factory

The project plans to replace 2 units of 4 t/h coal boilers to provide steam for dyeing, drying, and ironing in a garment company. The garment company is willing to replace from the coal boiler to gas boiler since (i) disposal of waste ash from coal is costly and (ii) the coal boilers cannot be switched off and needs to be operated continuously 24 hours/day. The estimated emission reduction is 1,150 tCO2/yr. The cost performance is estimated to be 2,170 JPY/tCO2, which is quite effective since coal to gas fuel switch is included.

The annual fuel cost of gas will be about twice as much as coal. Thus, it is challenging for project owner to accept the running cost increase. At present, the garment company owner is considering. When the conclusion for project implementation is obtained, they will prepare application of FY2019 JCM Model Project.

5.2.3 Challenges for Application of JCM Model Project for Installation of Centrifugal Chiller in Fiber Factory

The Project is planned to replace four centrifugal chillers (2 units of 400 USRt and 2 units of 1,000USRt) in a fiber factory. The estimated CO2 emission reduction with chiller is 1,089 tCO2/year. Introduction of chillers are the component of JCM Model Project.

In addition, at first, 10 units of aged centrifugal compressors (4,800-5,600cfm) are also planned to be replaced. However, in addition to equipment replacement, it needs plant engineering such as application of insulation, review of piping and duct layout, confirmation of pressure loss of

valves, and improvement of air leakage. Lease arrangement is difficult to cope with such arrangement and there is an issue of finance procurement. Thus, preparation for application of JCM Model Project will be started if financing is secured for the compressor component.

In this project, lease company will be a project participant in the International Consortium. The lease company will lease the equipment to the fiber company. Since credit for leasing have not been obtained from Japanese leasing company, participation of local leasing company is also considered. When credit for leasing is obtained, application will be prepared for JCM Model Project.

5.2.4 Proposed Study for FY2019 City-to-city Collaboration

Both Toyama city and Semarang city agreed to continue city-to-city collaboration for low carbon society in FY2019 in the wrap-up meeting in January 2019. BAPPEDA of Semarang city are going to issue Letter of Interest for FY2019 study.

As the theme of continuous city-to-city collaboration for low carbon society in the next year, "Low Carbon City with Fuel Switch in Semarang" is proposed.

The Project "Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" was adapted as FY2018 JCM Model. It highly drew attentions as the first project of fuel switch in transportation sector in Indonesia, and the Project is regarded as a milestone achievement of city-to-city collaboration. In the completion ceremony of Trans Semarang held in January 2019, the effectiveness of CNG fuel switch in the transportation sector was shared among national government officers. Cross development of the fuel switch in the transportation sector in Indonesia is expected together with cooperation from Toyama city and Toyama companies. In addition, additional JCM project is requested for installing remaining buses in Trans Semarang where CNG-Diesel hybrid equipment have not been installed yet.

From the result the Study for JCM Model Project formulation in FY2018, it was clear that the fuel switch is effective for realization of low carbon society. There are potentials of CO2 emission reduction by the introduction of CNG-Diesel hybrid system not only in the transportation sector but also in the public and private sectors that use diesel oil engine at present.

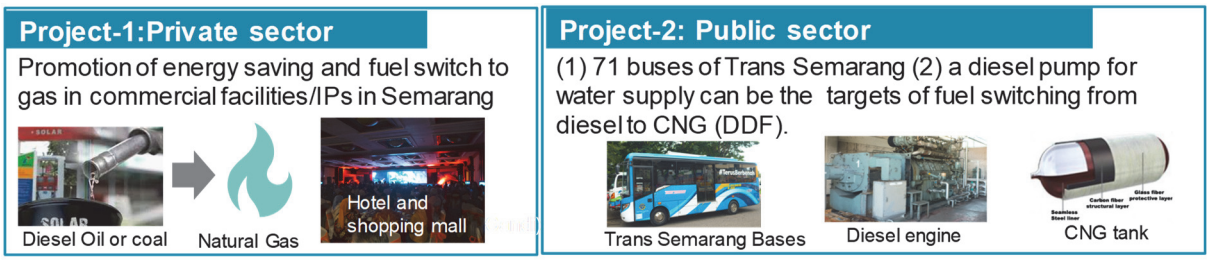
When pipeline operation to be connected to Semarang is commenced, the utilization of natural gas and CNG will be accelerated in Semarang.

Accordingly, low carbon society by the promotion of fuel switch in Semarang is proposed as the theme of the city-to-city collaboration in FY2019. Projects to be a policy model for the promotion of fuel switch in public sector and private sector are planned to be formulated as shown in the table below.

Table 5.1 Candidate JCM Theme for City-to-city Collaboration in FY2019

Sector	Target	Project Component
Private	Commercial and industry	Energy saving by high-efficiency equipment and fuel switch to CNG in factories and hotels and shopping centers
Public	Public transportation	Fuel switch to CNG by DDF application for 71 bases owned by three private companies and operated by Trans Semarang
	Water facility	Introduction of CNG-diesel hybrid system to existing engine for pumps for water supply in Perusahaan Daerah Air Minum (DPAM) of Semarang to reduce CO2 emission.

Source: Prepared by NK



Source: Prepared by NK

Figure 5.1 JCM Theme for City-to-city Collaboration in FY2019