FY2023 Project for Ministry of the Environment Japan

FY2023
City-to-City Collaboration Programme for Zero-Carbon Society

Project to Promote 2050 Zero Carbon City in Riau Province Region through Cooperation with Pekanbaru City

Report

March 2024

Nippon Koei Co., Ltd.
Kawasaki City

FY2023
City-to-City Collaboration Programme for Zero-Carbon Society

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Report

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Abbreviations

BAPPENAS	Badan Perencanaan Pembangunan Nasional
BAU	Business-as-Usual
CAPEX	Capital Expenditure
CNG	Compressed Natural Gas
COVID-19	Coronavirus Disease 2019
CRIC	Climate Resilient and Inclusive Cities
DISHUB	Dinas Perhubungan
EFB	Empty Fruit Bunch
EMS	Energy Management System
FAME	Fatty Acid Methyl Ester
FFB	Fresh Fruit Bunch
F/S	Feasibility Study
GHG	Green House Gas
GIC	Kawasaki Green Innovation Cluster
IGES	Institute for Global Environmental Strategies
IPB	Institut Pertanian Bogor
ITB	Institut Teknologi Bandun
JCM	Joint Crediting Mechanism
JCM Demo-Project	Demonstration Project for Application of New Decarbonizing Technology
LED	Light Emitting Diode
LOI	Letter of Intent
MF	Mesocarp Fiber
MOU	Memorandum of Understanding
NDC	Nationally Determined Contribution
OPEX	Operating Expenditure
PAO	Palm Acid Oil
PKS	Palm Kernel Shell
PLN	PT Perusahaan Listrik Negara /Persero (National Electricity Company)
POME	Palm Oil Mill Effluent
PTPN	PT. Perkebunan NusantaraⅣ-RegionalⅢ
PT.SPP	PT. Sarana Pembangunan Pekanbaru
PUPR	Dinas Pekerjaan Umum dan Perumahan Rakyat
PV	Photovoltaic
RAD-GRK	Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca (Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca)
RAN-GRK	Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca (Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca)
RSPO	Roundtable on Sustainable Palm Oil
RUEN	Grand National Energy Plan 2015-2050 (Rencana Umum Energi Nasional)
SDGs	Sustainable Development Goals
TMP	Transmetro Pekanbaru
UNIDO	United Nations Industrial Development Organization
UNRI	Universitas Riau

CHAPTER 1 BACKGROUND AND OBJECTIVE

1.1. Background of the project

The Paris Agreement which entered into force in November 2016 and began implementation stage from 2020, mentions that not only central governments but non-governmental actors including local governments and cities need to accelerate their countermeasures to climate change. Also, in "Ministerial meeting of the "Online Platform" on a Sustainable and Resilient Recovery from COVID-19" held in September 2020, necessity of zero-carbon policies of local governments that lead communities directly and importance of development approach by initiatives of local communities were confirmed. In Japan, the Government declared that Japan is aiming to become a zero-carbon society by achieving zero emission of overall greenhouse gas (GHG) by 2050, and more than 300 local governments will declare net zero emissions.

Roles of cities and local governments are becoming more important to consider and implement climate change countermeasures and projects in each region. Toward realization of zero-carbon society in the entire globe, it is necessary to accelerate movements to sustainable and zero-carbon society especially in Asia where economic growth is remarkable. Thus, international supports for city's activities have been enforced for realization of zero/low-carbon society with supporting activities for development of society and economy.

Also, cities are required to re-coordinate and consider new policies to achieve sustainable development while tackling issues induced by the COVID-19 pandemic. From this perspective, it is important to develop new measures and improve collaboration between cities.

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 a priority countermeasure. Also, Indonesian Government has promised to reduce 29% of GHG emission compared to Business-as-Usual (BaU), and in case international assistance such as JCM is introduced, their target is 41% in Nationally Determined Contribution (NDC) submitted in 2016, then the NDC was updated with the provision aiming to achieve carbon neutrality by 2060. Following that, DKI-Jakarta developed Governor's regulation 2021/No.90 with the target of achievement of carbon neutrality by 2050. The movement for zero-carbon society in Indonesia is currently quite active.

This project is being implemented between Kawasaki City and Pekanbaru City. municipalities in Riau Province (Pekanbaru City and Rokan Hulu Regency). Pekanbaru City is the capital of Riau Province, which is located in the center of Sumatra Island of Indonesia and its core industry is oil palm. Palm oil is one of 10 key products decided by the Ministry of Trade of Indonesia. The percentage of palm oil in export in 2017 was 12% which was larger than any other product. Production amount of palm oil in Indonesia is the largest producer in the world and 83% of palm oil in the world is produced in Indonesia and Malaysia (Palm Oil Explorer, USDA, 2022). Riau Province produces the biggest amount of palm oil in Indonesia, which composes 27% of total (same).

While oil palm sector is the core industry in Riau Province, management of waste generated from production of palm oil is one of the environmental issues there. On the other hand, In Pekanbaru City with rapid economic growth, environmental issues are arising from industrialization and urbanization.

1.2. Objectives of the project

"The City-to-City Collaboration Programme for Zero-Carbon Society" aims to support foreign cities for activities, the introduction of equipment, and the realization of decarbonization domino for the development of zero-carbon society in cooperation with Japanese cities with the experiences and know-how.

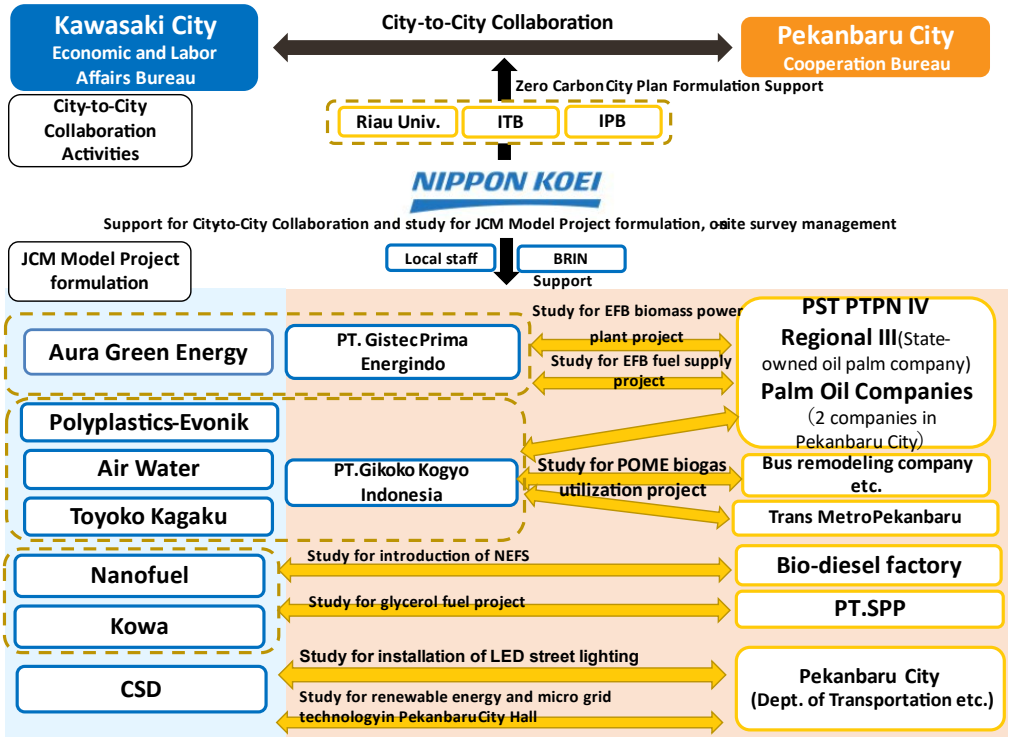
1.3. Implementation structure

Implementation structure of FY2023 is illustrated in Figure 1.1. Kawasaki City and Pekanbaru City carried out discussion of development of Zero Carbon City and of circular socio-economy.

Also, under the City-to-City Collaboration, 1-1) Empty Fruit Bunch (EFB) biomass utilization project as well as EFB biomass power plant project, 1-2) Project for Palm Oil Mill Effluent (POME) biogas utilization and 1-3) Nano-emulsion technology utilization project were studied and implemented as projects contributing to formulation of circular socio-economy. Regarding 1) EFB biomass utilization project, we approached and gathered information from manufacturers of EFB fuel conversion equipment, feedstock and fuel (pellet) suppliers, and potential off-takers, with the aim of establishing a framework to commercialize it. Meanwhile, Polyplastics-Evonik Ltd., Air Water Inc., Toyoko Kagaku, and a local company, PT. Gikoko Kogyo Indonesia implemented study with palm oil mills owned by PT.PN4 Regional3 (PTPN) to considerate to formulate the biogas utilization project, discussed with Transmetro Pekanbaru (TMP) and implemented Pre-F/S. the Department of Transportation of Pekanbaru City (Dinas Perhubungan: DISHUB) for 1-2). Moreover, for 1-3), NanoFuel and Kowa Company surveyed where NanoFuel's nanoemulsion technology could be used to apply for "Demonstration Project for Application of New Decarbonizing Technology" (hereinafter JCM Demo-Project).

In addition, as JCM projects contributing to development of zero carbon city, 1-4) the introduction of renewable energy and energy management in public buildings, and 1-5) Project for installation of LED street lightings were studied. Based on information provided by Department of Public Works and Public Housing (Dinas Pekerjaan Umum dan Perumahan Rakyat: PUPR) and DISHUB of Pekanbaru City, CSD Co., Ltd. considered to apply the JCM Model project.

Nippon Koei Co., Ltd. entirely supported the city-to-city collaboration and JCM Model project as the representative operator. This project was implemented with three trips to Riau Province. Information collection, studies, and discussions were implemented in cooperation with two local companies above and three local experts.



Source: Prepared by Nippon Koei

Figure 1-1 Implementation structure

1.4. Project schedule

Project period was from June 22nd, 2023 to March 8th, 2024. The schedule of this project is shown below.

#	Study Contents	2023						2024		
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. City-to-City Collaboration Activities										
1	Support for development of 2050 Zero Carbon City Roadmap	→	→	→	→	→	→	→	→	
2	Disscussion with local stakeholder		▼		▼			▼		
3	Support for realization of decarbonization domino effect in Riau Province region		▼							
4	Exchange of ideas with other supporting scheme (CRIC, JICA etc.)		▼		▼					
2. JCM Project Formulation										
1	Disscussion and support with counterpart for formulation the projects	→	▼ Visit	→	→	→	→			
2	Online meeting with companies and desk review	→	→	→	→	→	→	→	→	
3	Information collection	→	▼ Visit	→	▼ Visit	→	→	▼ Visit	→	
4	Business matching					▼	Business matching in Kawasaki International Eco-Tech Fair			
3. Report, Presentation etc.										
1	Monthly report		▼	▼	▼	▼	▼	▼	▼	▼
2	Reporting meeting with MOE	▼ Kick-off			▼	Progress			Wrap-up	▼
3	Workshop			▼						
4	Presentation									
5	Kawasaki International Eco-Tech Fair				→	▼	→			
6	Final Report						→	→	→	

Source: Prepared by Nippon Koei

Figure 1-2 Project schedule

CHAPTER 2 OVERVIEW AND ENVIRONMENTAL ACTIONS OF PARTICIPATING CITIES

2.1. Kawasaki City

2.1.1. OVERVIEW OF KAWASAKI CITY

Kawasaki City is a government ordinance city located in the northeast part of Kanagawa Prefecture, next to Tokyo across the Tama River.

The city underpins Japan's economic growth as the core city of waterfront Keihin Industrial Zone. Kawasaki, with a history and experience on solving environmental pollution with citizens, business operators and public services, has attracted many companies with competitive environmental technologies. In addition, the western part of the city boasts large areas of greenery including Ikuta Ryokuchi Park.

Source: Kawasaki City

Figure 2-1 Location of Kawasaki City

Table 2-1 Statistical data of Kawasaki City

#	Item	Statistical data
1	Area	144.35km^2
2	Population	1,545,711 (as of January 1, 2024)
3	Number of households	773,052 (as of January 1, 2024)
4	Gross city product (nominal)	6,381.6 billion yen (2020)

Source: Kawasaki City

In addition to activities for environmental improvement and preservation, recently Kawasaki City was appointed to be the ambassador of "RE 100 Declaration RE Action", a new framework for small and medium-scale companies, municipalities, and educational and medical institutions who do not meet the standard for joining RE100[1] (the standard of RE100 is over 10 GWh energy consumption a year) to commit to 100% renewable energy. Through the activities such as the ambassador, the city is expanding renewable energy initiatives across Japan. In July 2019, as a result of experience of solving various issues together with citizens and business operators and initiatives for sustainable society were highly evaluated, Kawasaki City was selected by the Regional Revitalization Promotion Office of Cabinet

1 RE100 is international business initiative to promote 100% renewable energy consumption by companies, operated by The Climate Group and CDP. RE100 visualizes 100% renewable energy use by companies and aims at promotion of renewable energy. Influential large companies in the world are participating in RE100. (RE100 Platform)

Office as a "SDGs Future City [2]". Through such activities and awards, Kawasaki City has been actively promoting climate change countermeasures and SDGs.

2.1.2. KAWASAKI CITY BASIC PLAN TO PROMOTE GLOBAL WARMING COUNTERMEASURES

Kawasaki City has been implementing global warming countermeasures based on the Kawasaki City Basic Plan to Promote Global Warming Countermeasures formulated in 2010 (revised in 2018), and in November 2020, the city formulated the Kawasaki Carbon Zero Challenge 2050 (see below), a strategy to realize a decarbonized society by 2050, and has been promoting decarbonization efforts. In November 2020, the company formulated the Kawasaki Carbon Zero Challenge 2050 (see below), a strategy to realize a decarbonized society by 2050. The following table summarizes the outline of the 2022 Plan.

Source: Kawasaki City

Figure 2-2 The Kawasaki City Basic Plan to Promote Global Warming Countermeasures

Table 2-2 Kawasaki City Basic Plan for the Promotion of Global Warming Countermeasures (Plan 2022)

Item	Proposed Plan for 2022
Duration	FY2022 - FY2030 period
Future Vision	Aim for Net-Zero GHG emissions in the city area by 2050
Basic Concept	"Creating a Zero-Carbon city where future generations can live peacefully" and "Creating a sustainable and powerful industry through a virtuous cycle between the environment and the economy"
Basic direction	A city where citizens, businesses, and other entities work toward decarbonization A city that contributes to decarbonization of the world through green innovation A city that optimizes energy by maximizing the use of renewable energy A city with earth-friendly transportation environment A city where the municipal office takes the initiative to achieve decarbonization A city that works on resource recycling aiming at decarbonization A city where people can adapt to climate change and lead safe and healthy lives A city where citizens are connected through diverse forms of greenery
GHG reduction targets	Target for city area: Net-Zero GHG emissions in the city area in 2050 50% reduction by FY 2030 (11.8 million tCO2 reduction compared to FY 2013)

[2] SDGs Future City cities and regions with high potential to achieve sustainable development and create new values, especially economic, social and environmental values are chosen from cities and regions promoting the basic and comprehensive activities based on SDGs philosophy, these. In 2019, 31 cities were newly selected (total 60 cities).

Item	Proposed Plan for 2022
	Consumer targets (consumer households and consumer businesses): 45% or more reduction by FY 2030 (1.7 million tCO2 reduction compared to FY 2013) Industrial targets (industries, energy conversion, industrial processes): 50% or more reduction by FY 2030 (9.52 million tCO2 reduction compared to FY 2013) Municipal office targets (all public facilities in the city): 50% or more reduction by FY 2030 (210,000 tCO2 reduction compared to FY 2013)
Renewable energy introduction target for FY 2030	Introduction of 330,000 kW or more by FY 2030 (200,000 kW of renewable energy was introduced in the entire city area in FY 2020)

Source: Prepared by Nippon Koei based on the Kawasaki City Basic Plan to Promote Global Warming Countermeasures

2.1.3. ZERO CARBON STRATEGY “KAWASAKI CARBON ZERO CHALLENGE 2050”

On February 17, 2020, the Mayor of Kawasaki City Norihiko Fukuda announced 2050 Zero Carbon City, stating that by the end of the year, the city will show a future image and a strategy toward zero carbon city. In November, “Kawasaki Carbon Zero Challenge 2050” was released as a starting point for zero carbon initiatives, which illustrates 2030 milestones (medium-term targets), basic concept, and leading activities to reduce 100% of net CO2 emission by 2050.

2030 milestone was calculated by back casting the figures required to achieve zero carbon by 2050. It includes targets from the Basic Plan (reduction of about 2.5 million tCO2 by FY2030 (26% reduction compared with FY2013) and 80% of the emissions by FY2050 compared with FY2013) and aims to reduce additional one million tCO2 in the 10 years to FY 2030.

Source: Kawasaki City

Figure 2-3 Kawasaki Carbon Zero Challenge 2050

2.1.4. KAWASAKI GREEN INNOVATION CLUSTER (GIC)

In 2014, Kawasaki City released its Promotion Policy on Kawasaki Green Innovation (to be integrated into the Kawasaki Basic Plan for the Promotion of Global Warming Countermeasures in 2022). It describes basic policies and practices on how to create sustainable cities by taking advantage of environmental technologies and industries and to develop and extend Green Innovation initiatives more. The four pillars for Green Innovation are:

I. To revitalize local economy by creating and supporting environmental technologies and industries
II. To apply competitive environmental technologies and industries to city life
III. To collaborate with diverse parties to utilize environmental technologies and industries

IV. To contribute to international communities with Kawasaki's environmental technologies and industries

The Kawasaki Green Innovation Cluster (GIC) was established in 2015 as a network to promote Pillars I and IV of the four pillars, aiming to create a new society by working on environmental improvement through collaboration among industry, academia, government, and the private sector, and by promoting industrial development and international contributions. GIC has been positioned as a "consultation service for utilizing the policies of Kawasaki City and supporting organizations," "promotion, publicity, and provision of information," and "business creation utilizing environmental technologies, administrative expertise, and know-how," among the measures in the Kawasaki Basic Plan for the Promotion of Climate Change Countermeasures. GIC is working to create innovations in the environmental field through functions such as "consultation services to take advantage of the policies of Kawasaki City and support organizations," "promotion, publicity, and information provision," and "support for business creation utilizing environmental technologies, administrative knowledge, and know-how.

2.1.5. LEADING DECARBONIZATION REGIONS

The "Leading Decarbonization Regions" are regions that achieve virtually zero CO2 emissions from electricity consumption in the consumer sector (households, businesses, and other sectors) toward carbon neutrality in 2050. They are expected to achieve reductions in other greenhouse gas emissions, including transportation and heat use, consistent with Japan's 2030 target for the entire country. The region will be a model for the "Decarbonization Domino in Action".

Leading decarbonization regions are established in the "Regional Decarbonization Roadmap" compiled by the National and Regional Decarbonization Conferences in 2021. Led by local governments, local businesses, and financial institutions with active support from the national government, especially from the Ministry of the Environment, Japan, at least 100 regions will establish a path toward decarbonization by FY2025, with implementation by FY2030. This will show a direction toward decarbonization in a variety of regions, including rural areas, remote islands, and urban areas while solving regional issues and improving the quality of residents' lives.

Mizonokuchi area, home to "Decarbonization Action Mizonokuchi," was nominated as a leading decarbonization region from Kawasaki City. This is because of its efforts since 2020 to achieve its 2030 CO2 emissions reduction target through the concerted efforts of citizens and businesses.
Examples for actions of Decarbonization Action Mizonokuchi are shown below.

Table 2-3 Examples for "Decarbonization Actions" of Decarbonization Action Mizonokuchi

Areas of actions	Examples
Renewable energy	Joint purchase of electricity for households, introduction of the energy to public and commercial facilities
Resource recycling	My bottle, reusable tableware and reusable bottles, recycling systems
Sharing economy	Shared bicycles, car sharing, umbrella sharing
Electric and fuel cell vehicles	Hydrogen stations, introduction into official and company vehicles
Reduction of food loss	Development and dissemination of eco-friendly recipes, food sharing

Source: prepared by Nippon Koei based on Decarbonization Action Mizonokuchi, Kawasaki City

The "Decarbonization Action Mizonokuchi" Promotion Council brings together various businesses and organizations active in the Mizonokuchi area, including energy-related companies, local businesses, and community groups, to collaborate on the development of decarbonization initiatives and publicity.

Table 2-4 The activity contents of Decarbonization Action Mizonokuchi Promotion Council

Promotion of "Decarbonization Action Mizonokuchi"	Dissemination of information on the initiatives of each member organization	Creating connections among members
● Information sharing on initiatives of each member organization ● Discussion on the future direction of the council	● Organize events and seminars for citizens ● Create videos, leaflets, etc. to introduce the initiatives of businesses ● Publicity using public relations tools	● Business matching ● Organizing seminars and other events for businesses

Source: prepared by Nippon Koei based on Decarbonization Action Mizonokuchi HP, Kawasaki City

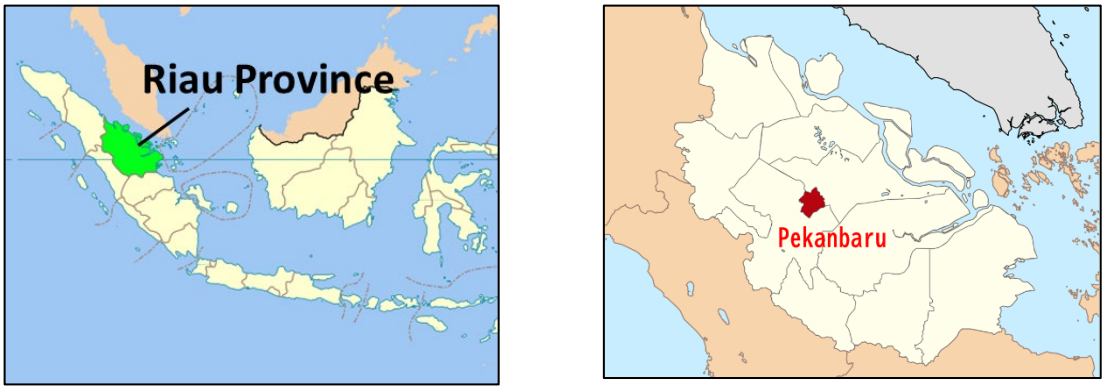
2.2. Pekanbaru City

2.2.1. OVERVIEW OF PEKANBARU CITY

Pekanbaru City, the capital city of Riau Province which is in the center of Sumatra Island of Indonesia, has been developing its economy and industry rapidly over the years. With a population of more than one million, they have been promoting various policies and projects such as the development of an industrial park, the development of a new city center, and the introduction of a new transportation system, etc. Forming a smart city is one of the city's priority policies.

The core industry in the province is palm oil. P which is one of 10 key products decided by the Ministry of Trade of Indonesia. Production amount of palm oil in Indonesia is the largest in the world, and 83% of palm oil in the world is produced in Indonesia and Malaysia (Palm Oil Explorer, USDA, 2022). Riau Province produces the biggest amount of palm oil in Indonesia, which composes 27% of total (same).

The location of Pekanbaru City and the overview are shown below.



Source: Prepared by Nippon Koei

Figure 2-4 Location of Pekanbaru City

Table 2-5 Overview of Pekanbaru City

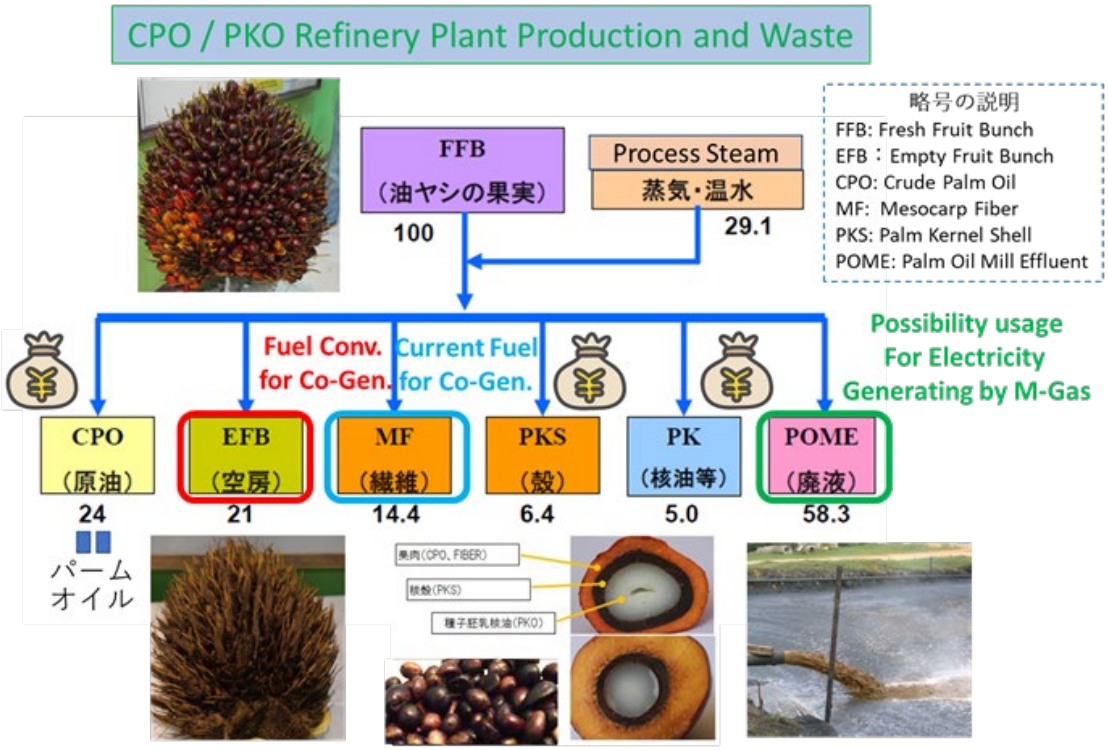
Content	Data
Population（2022）	1,303,000
Area（km2）	632
Density （person/km2）（2022）	2,062
Gross Regional Product (USD million) (2021)	8,845

Source: Prepared by Nippon Koei based on reports of Statistics of Pekanbaru City

2.2.2. RESIDUES GENERATED FROM PALM OIL PRODUCTION

Production of palm oil from Fresh Fruit Bunch (FFB) generates multiple residues in processes. While Palm Kernel Shell (PKS) and Palm Kernel Oil (PKO) are utilized as biomass fuels and chemical materials, EFB is left in plantation and putrefied, which frequently causes environmental issues such as soil and ground groundwater pollution, emission of methane and forest fires. Also, POME is only treated by open lagoon method, which emits much methane to the air and possibly leads to river pollution.

Thus, management of residues from oil palm sector is a serious problem in production area such as Rokan Hulu and management measures and technologies for utilization of the residues are required in this area.



Source: Project for conversion of POME to fuel in Indonesia

Figure 2-5 Residues generated from palm oil production

2.2.3. DEVELOPMENT OF 2050 ZERO CARON CITY

Pekanbaru City is promoting formulation of smart city as one of prioritized policies. When activities of Kawasaki City for decarbonization of Kawasaki City were introduced in the City-to-City Collaboration

Conference between Pekanbaru City and Kawasaki City held in February 2020, representatives of Pekanbaru City showed their interests in development of 2050 Zero Carbon City. In addition, Mayor of Pekanbaru City also agreed with promoting 2050 Zero Carbon City in this City-to-City Collaboration project and as a result, 2050 Zero Carbon City was set as the theme of both Letter of Intent between Pekanbaru City and Kawasaki City, between Pekanbaru City and Nippon Koei.

2.2.4. CRIC PROJECT

The CRIC (Climate Resilient and Inclusive Cities) project is a five-year EU-funded tripartite partnership between Southeast Asia (Indonesia, Malaysia, Philippines, Thailand), South Asia (India, Nepal, Bangladesh), and Europe. Under this project, 10 pilot cities in Indonesia are working on climate change initiatives under the management of the United Cities and Local Governments Asia Pacific (UCLG ASPAC). Pekanbaru has been selected as a pilot city and its focus sector is the waste sector. The pilot cities and their sectors of focus are summarized in the table below.

Table 2-6 The locations of CRIC project in Indonesia and the focus sectors

Location	Focus sector
● Pangkal Pinang ● Bandar Lampung	Early flood warning system
● Ternate	Early coastal warning system
● Pekanbaru ● Cirebon ● Samarinda ● Mataram	Waste management
● Banjarmasin ● Kupang	Water management
● Gorontalo	Water and sanitation

Source: Prepared by Nippon Koei based on "Climate Resilient and Inclusive Cities" (originally in Indonesian)

According to the results of the analysis in the CRIC project published in 2020, Pekanbaru City faces disaster risks from floods, forest fires, and smog. Priority issues included waste management, sustainable urbanization, and disaster prevention as well as reduction of air pollution. Based on the results, Pekanbaru City is currently focusing on waste management in the CRIC project.

Pekanbaru City has established a Climate Change Working Group (WG; POKJA) and plans to issue a mayoral decree promoting climate change mitigation and adaptation measures and waste management initiatives.

2.2.5. DEVELOPMENT OF TENAYAN INDUSTRIAL PARK

Pekanbaru City is currently developing Tenayan Industrial Park (total developed land area: 2.66 km^2), which has been designated by the Indonesian government as a priority industrial park (one of four nationwide) under a national strategic project. The project is supported by the Ministry of National Development Planning (Badan Perencanaan Pembangunan Nasional: BAPPENAS) and plans to start the operation of the park in 2024. The industrial park is along the Siak River and will be nearby new

city center being developed with relocation of City Councils, which shows that the area is very strategic in terms of business development.

Pekanbaru City has a plan to develop the industrial park as "Eco Industrial Park" and has an interest in the experiences of Kawasaki City that has been promoting eco town concept. Also, Pekanbaru City tries to invite foreign companies including Japanese to set up their business base in the industrial park and has an interest in installation of Japanese energy-saving and renewable energy technologies as infrastructures in the park.

Source: Pekanbaru City

Figure 2-6 Tenayan Industrial Park

CHAPTER 3 CITY-TO-CITY COLLBAOLATION ACTIVITIES FOR ZERO CARBON SOCIETY

3.1. City-to-City Collaboration activities from FY2019 to FY2022

City-to-City Collaboration project between Kawasaki City and Riau Province Region was selected as "FY2019 City-to-City Collaboration Program for Low-Carbon Society" and officially started in 2019. Discussion between municipalities and JCM model project formulation for development of circular economy and 2050 zero-carbon city in Riau Province region has been carried out.

The main activities in FY2019 and FY2020 are as follows.

Table 3-1 City-to-City Collaboration activities in FY2019 and 2020

Year/Month	Activity (Location)	Overview
April 2019	Selection as FY2019 City-to-City Collaboration Program for Low-Carbon Society	"City-to-City Collaboration Project Between Rokan Hulu Regency and Kawasaki City (Project to Promote Circular Economy for Palm Industry in Riau Province Region)" was selected as "FY2019 City-to-City Collaboration Program for Low-Carbon Society" and the project started officially in July.
August 2019	Kick-off meeting with Rokan Hulu Regency (Rokan Hulu)	In the seminar, theme of collaboration between Rokan Hulu Regency and Kawasaki City was discussed and have reached basic agreement to decide circular economy for oil palm industry as one theme.
August 2019	Mini seminar targeting staff of Rokan Hulu Gov. and companies related to oil palm industry (Rokan Hulu)	Staff of Rokan Hulu Gov and 22 companies of oil palm industry in Rokan Hulu participated in the mini seminar. Kawasaki City officer presented about overview of their city and activities for development of circular economy of Kawasaki whereas company based in Kawasaki City explained about their EFB biomass power generation technology.
August 2019	Courtesy visit to Pekanbaru City Mayor (Pekanbaru)	Kawasaki City officer implemented courtesy visit to Pekanbaru City Mayor and explained about overview of Kawasaki and city-to-city collaboration. The mayor showed his interest in collaboration with Kawasaki city.
January 2020	Japan Visit and City-to-City Collaboration Seminar (Kawasaki and Tokyo)	Mayor and 6 city officers of Pekanbaru visited Japan and implemented site tour in Kawasaki and discussion about potential of city-to-city collaboration with Kawasaki City. Then, the Pekanbaru delegation participated in "Seminar on City-to-City Collaboration for Zero-Carbon Society".
February 2020	City-to-city Collaboration Conference between Pekanbaru City and Kawasaki City (Pekanbaru)	City-to-City Collaboration Conference between Pekanbaru City and Kawasaki City was held. From Pekanbaru side, represented by Ms. Shabrina, Assistant II of the city government, 25 staffs attended the seminar from Cooperation Office, DISHUB, Department of Development and Planning (BAPPEDA), PUPR, PT SPP (Public company to manage the industrial park) etc. From each department in charge, following presentations on potential collaboration topics were made, namely, smart city, industrial park development, transport and wastewater treatment. From Kawasaki side, the general information and city-to-city collaboration of Kawasaki City (with DKI-Jakarta and Yangon City), and zero-emission industrial park were presented. During the conference, Pekanbaru City chows their interest in 2050 Zero Carbon City and it was agreed to make it theme of

Year/Month	Activity (Location)	Overview
		City-to-City Collaboration after the event
August 2020	Conclusion of LOI between Pekanbaru City and Nippon Koei	Pekanbaru City and Nippon Koei concluded LOI about 2050 Zero Carbon City on August 24, 2020.
September 2020	Selection as FY2020 City-to-City Collaboration Program for Zero-Carbon Society (2nd call)	"Project to Promote Development of Circular Economy for Oil Palm Industry and 2050 Zero Carbon City in Riau Province Region" was selected and started in December 2020.
January 2021	Online business seminar between GIC members and Pekanbaru City (Online)	An online business seminar was held between GIC member companies and Pekanbaru City during the Kawasaki International Eco-Tech Fair (January 21-February 5). Four GIC companies introduced their technologies and products and discuss possibility of installation with Pekanbaru City.
January-February 2021	Kawasaki International Eco-Tech Fair (Online)	"Introduction of Tenayan Industrial Park", "Current status of Siak River and technical needs for rehabilitation", and "Support for circular economy in oil palm sector" were exhibited in online booth of Kawasaki International Eco-Tech Fair.
February, 2021	City-to-City Collaboration Seminar held by MOE (Online)	"Seminar on City-to-City Collaboration for Creating a Zero-carbon Society" was held online by MOE. A total of over 100 representatives attended the meeting from Japanese and overseas cities carrying out City-to-City Collaboration Programme, and its representative entities and partner companies. Presentations on City-to-City Collaboration Programme and JCM Model Project trends and a panel discussion on how to execute projects in the COVID-19 pandemic.
March, 2021	City-to-City Collaboration Webinar between Peanbaru City and Kawasaki City (Online)	City-to-City Collaboration Webinar between Pekanbaru City and Kawasaki City was implemented. In the webinar, reporting of activities' result in FY2020 and discussion for plan in FY2021 was carried out.
April, 2021	Selection as FY2021 City-to-City Collaboration Program for Zero-Carbon Society	"Project to Promote Development of Circular Economy for Oil Palm Industry and 2050 Zero Carbon City in Riau Province Region" was selected and started in September 2021.
November,2021	Kawasaki International Eco-Tech Fair (Online)	Online booth of this project was prepared in Kawasaki International Eco-Tech Fair. In addition to overview of this project, "Development of Tenayan Industrial Park", "Siak River Rehabilitation", "Fuel-Switching of Buses in Pekanbaru" and "Installation of LED street lightings", provided by Pekanbaru City were exhibited.
December, 2021	Online business seminar between GIC members and Pekanbaru City/ DKI-JKT	Online business seminar between GIC members and Pekanbaru City/ DKI-JKT was organized together with GIC Secretariat and four member companies presented their business and products.
February, 2022	City-to-City Collaboration Workshop	City-to-City Collaboration Workshop between Pekanbaru City and Kawasaki City with theme of 2050 Zero -Carbon City was held. Pekanbaru City mentioned that they positively proceed for LOI conclusion with Kawasaki City and zero-carbon declaration in their opening and closing remarks.
April, 2022	Selection as FY2022 City-to-City Collaboration Program for Zero-Carbon Society	The " Project to Promote 2050 Zero Carbon City in Riau Province Region through Cooperation with Pekanbaru City " was adopted, and activities started in June 2023.
November, 2022	Kawasaki International Eco-Tech Fair	A booth was exhibited as the project at the Kawasaki International Eco-Tech Fair. In addition to poster outlining the

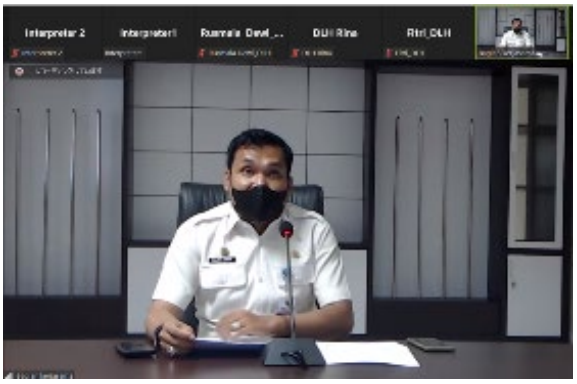
Year/Month	Activity (Location)	Overview
		project, poster on the development of Tenayan Industrial Park, the purification of the Siak River, and the introduction of LED street lighting, which were provided by the City of Pekanbaru, were displayed. In addition, matching sessions with companies in Kawasaki, booth tours, and exchanges of opinions were conducted.
February, 2023	City-to-City Collaboration Workshop	LOI signing ceremony, explanation of Kawasaki City's efforts to decarbonize the city centered on the "Kawasaki City Basic Plan for the Promotion of Global Warming Countermeasures" from the Environment Bureau of Kawasaki City, and other events were held.

Source: Prepared by Nippon Koei

Courtesy visit to Pekanbaru City Mayor (August 2019)

Japan Visit (January 2020)

Online business seminar between GIC members and Pekanbaru City (January 2021)



Opening remarks of City-to-City Collaboration Webinar (February 2022)

LOI singing (February 2023)

City-to-City Collaboration Workshop (February 2023)

3.2. City-to-City Collaboration in FY2023

Themes of FY2021 City-to-City Collaboration project are: 1) Support for development of circular economy and green recovery and 2) Support for development of 2050 Zero Carbon City. City-to-city collaboration activities considering know-how and experiences of Kawasaki City and environmental needs found in Riau Province Region were carried out.

Overview of the activities are shown in the table below.

Table 3-2 Themes and overview of city-to-city collaboration activities

#	Theme	Overview
1	Support for development of 2050 Zero Carbon City	・ With the support of Institut Teknologi Bandung (ITB), Institut Pertanian Bogor (IPB), and the Institute for Global Environmental Strategies (IGES), a capacity building project was conducted for Pekanbaru City officials and Universitas Riau (UNRI) on the preparation of the 2050 Zero-Carbon City Roadmap for Pekanbaru City. The team also worked closely with the CRIC projects (UCLG, IPB, and POKJA) and actively collaborated with them, understanding the different roles of both. (3.3.1) ・ City-to-City Collaboration workshop was held to share information on Zero-Carbon Plan in Riau Province, etc. (3.3.2) ・ Exhibited at the 16th Kawasaki International Eco-Tech Fair, introduced environmental issues in Pekanbaru City, and exchanged opinions with interested companies in Kawasaki City and others. In addition, we invited Pekanbaru City official to meet with companies in the city and supported their presentations at the "Southeast Asia City-to-City Collaboration Forum" hosted by Kawasaki City. (3.3.3) ・ Discussions were held between Kawasaki City and Pekanbaru City on continued cooperation after the expiration of the LOI on the theme of Zero-Carbon in 2050. (3.3.4) ・ Supported the invitation of Pekanbaru City official to the City-to-City Collaboration Seminar organized by the MOE, and additionally invited the Head of the Transportation Department of Pekanbaru City. In addition, after this event, a visit was made to Air Water's resource recycling model development facility. (3.3.5)
2	Support for the formation of a decarbonization dominoes in Riau Province	Information sharing on Zero-Carbon Plan in Riau Province at the City-to-City Collaboration workshop. (3.3.2)

Source: Prepared by Nippon Koei

3.3. Results of city-to-city collaboration activities

3.3.1. ACTIVITIES IN FY2023

Activities in FY2023 are summarized in the table below.

Table 3-3 City-to-city collaboration activities in FY2023

Activities	Date	Overview
Kick-off meeting with MOE	July, 13, 2023	Kick-off meeting among MOE, Kawasaki City and Nippon Koei was carried out. Project overview and schedule in FY2023 was confirmed.
1st field survey	July 31 to August 6	Meetings were held with the Indonesian JCM Secretariat, the Pekanbaru City Government, the Embassy of Japan in Indonesia, and

Activities	Date	Overview
	2023	others to confirm this year's activity schedule, and in particular to discuss the LED street light project with the aim of applying for a JCM project. In addition, a city-to-city workshop was held to share Riau's decarbonization plan and to explain the implementation of the LED street lighting project.
Meeting with JICA	August 10, 2023	A web meeting was held with JICA Indonesia to explain the outline of the project and discuss the possibility of collaboration with this project. Although no possible collaboration with JICA Indonesia was identified at this point, it was confirmed that information sharing will continue.
Discussions to develop the 2050 Zero Carbon City Roadmap	September 4, 2023	In Pekanbaru, local staff (ITB and IGES) took the lead in developing the 2050 Zero Carbon City Roadmap with Pekanbaru City officials and Riau University.
2nd field survey	September 30 to October 6, 2023	Face-to-face meetings were held with the Pekanbaru City government and biogas operators, etc., mainly for the formation of POME biogas utilization project applications for the next fiscal year.
Progress Meeting with MOE	October 13, 2023	A progress meeting was held to MOE to report on the progress of the activities and to confirm the future schedule.
Invitation to and participation in the Kawasaki International Eco-Tech Fair	November 15 to 17, 2023	The company exhibited a booth at the 16th Kawasaki International Eco-Tech Fair, where it conducted matchmaking with companies in Kawasaki, toured booths, and exchanged opinions with them. In addition, Pekanbaru city official were invited to this event to deepen understanding of companies with environment-related technologies through meetings with four GIC member companies and presentations at the "Southeast Asia City-to-City Collaboration Forum" hosted by Kawasaki City.
3rd field survey	January 14 to 20, 2024	Meetings were held with the Pekanbaru City government and local companies to gather information, especially for the realization of the POME biogas utilization project, and discussions were held for the continuation of the project in the next fiscal year.
City-to-City Collaboration Seminar	February 26 to 28, 2024	Supported invitation of two Pekanbaru city officials, including the Head of the Transportation Department to the City-to-City Collaboration Seminar organized by MOE. In addition, a tour of Air Water's demonstration facility was conducted.
Wrap-up Meeting with MOE	March 6, 2024	Wrap-up meeting was held to MOE to report the results of this fiscal year's activities.

Source: Prepared by Nippon Koei

3.3.2. CITY-TO-CITY COLLABORATION WORKSHOP BETWEEN PEKANBARU CITY AND KAWASAKI CITY

On August 2, 2023, a City-to-City Collaboration workshop was held between Pukanbaru City and Kawasaki City. In this workshop, the Riau Provincial BAPPEDA presented the process and contents of Riau's 2060 Zero Carbon Roadmap for the preparation of the 2050 Zero Carbon City Roadmap for Pekanbaru City. In addition, Kawasaki City gave a presentation on the 16th Kawasaki International Eco-Tech Fair to be held in November. On the other hand, CSD, candidates for the JCM Model project, and Nippon Koei provided an overview of the project and information on the JCM Model project.

See Appendix 1 for the presentation materials.

<Overview of the workshop>

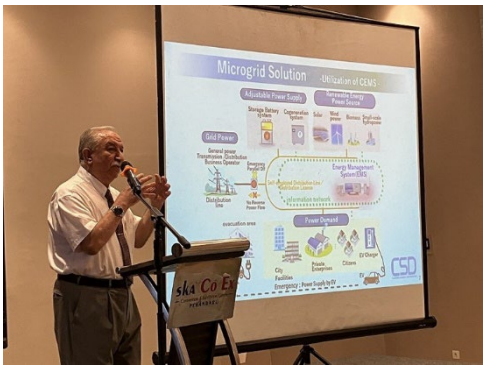
Date: Wednesday, August 2, 2023 10:30-13:00 (JST)
Place: SKA Co Ex Pekanbaru- Convention & Exhibition Centre –
(Offline/Online Hybrid system)
Participants Pekanbaru City (Cooperation Bureau, DISHUB, BAPPEDA etc.), Kawasaki City (Economic and Labor Bureau), Riau Province (BAPPEDA etc.), CSD, IPB, ITB, UNRI, Lancang Kuning University, PTPN, Companies in Pekanbaru, Nippon Koei, Interpreter (Bahasa Indonesia ⇔Japanese) ; Total 65 people

Table 3-4 Agenda for City-to-City Collaboration workshop in Pekanbaru

#	Program	Speaker
1	Introduction	Nippon Koei
2	Opening remarks	Pekanbaru City and Kawasaki City
3	Chronology and overview of City-to-City Collaboration Project	Nippon Koei
4	Introduction for the 16th Kawasaki International Eco-Tech Fair	Kawasaki City
5	Introduction for 2060 Zero Carbon roadmap in Riau Province	Riau Province
6	Introduction for LED street lighting project in Pekanbaru City	CSD and Nippon Koei
7	Q&A and discussion	-
8	Closing remarks	Pekanbaru City

Source: Nippon Koei

BAPPEDA, Riau Province



CSD

Q&A session

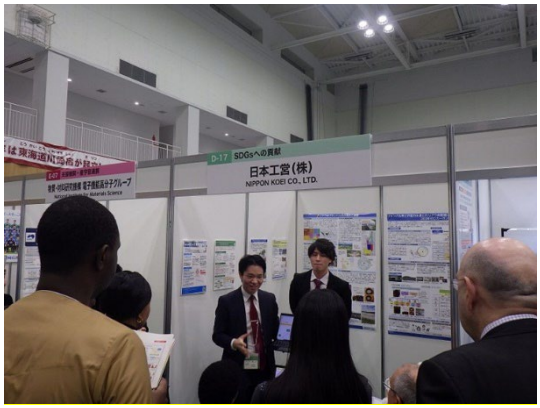
Group photo

3.3.3. KAWASAKI INTERNATIONAL ECO-TECH FAIR

The 16th Kawasaki International Eco-Tech Fair was held on November 15 and 16, 2023, with the aim of providing a venue for business matching between exhibiting companies and organizations and companies from Japan and abroad, and to disseminate information from Kawasaki to the rest of the world by exhibiting a wide range of environmental technologies from those that respond immediately to environmental problems in Japan and abroad to cutting-edge environmental technologies that solve global environmental problems. We exhibited a booth in the category of "Contribution to SDGs" with

the main purpose of introducing our project, and created and displayed a poster explaining the outline of our project and the current situation and issues in Pekanbaru. In addition to companies and related organizations in Kawasaki, embassy officials from various countries visited the booth and exchanged opinions directly with visitors on a tour organized by the United Nations Industrial Development Organization (UNIDO).

The Exhibition



Briefing for Embassy officials

Poster for the booth 1

Poster for the booth 2

Also the project team invited Mr. Hafiz Munanda, Head of the International Cooperation Subsector of the Cooperation Bureau of Pekanbaru, to visit the booths, meet with four companies related to this project, and introduce the needs of Pekanbaru City at the "Southeast Asia City-to-City Collaboration Forum" hosted by Kawasaki City. At the request of Kawasaki City, Nippon Koei served as a moderator and assisted in the operation of the forum. On November 17 (Fri.), the day after the exhibition, the Pekanbaru City official joined a tour of Kawasaki City organized by Kawasaki City to deepen their understanding of the city's advanced environmental technologies.

See Appendix 2 for the presentation materials.

Table 3-5 Agenda for Southeast Asia City-to-City Collaboration Forum

#	Time	Program	Speaker
1	14:00	Opening	Moderator: NIPPON KOEI
2	14:00 - 14:05	Opening	Bureau of Economy and Labor, City of Kawasaki
3	14:05 - 15:05	Part 1 Introduction of local needs from Southeast Asian countries (15 minutes each)	Cooperation Bureau, Pekanbaru City
4			Yachiyo Engineering
5			Ministry of Environment, Forest and Climate Change, Bangladesh
6			Department of Technology and Innovation, Ministry of Science and Technology, Vietnam
7	15:05 - 15:15	Q&A session	-
8	15:15 - 15:20	Short break	-
9	15:20 – 15:50	Part 2 Introduction of seeds from exhibitors	Hinode Sangyo
10			Count Zero
11			WOTA
12	15:50 - 16:00	Q&A session	-
13	16:00 - 16:05	Closing	UNIDO Tokyo Office

<Overview of the tour >

Date: Friday, November 17, 2023 9:30-17:00

Visit Place: KING SKYFRONT Management Center
→Shimadzu Tokyo Innovation Plaza
→Ukishima Waste Treatment Center
→Iriezaki Wastewater Treatment Center

Participants: Pekanbaru City-to-City Collaboration project Team (Mr. Hafiz, Cooperation Bureau of Pekanbaru City, 2 staffs from Nippon Koei), Southeast Asian Countries Technical Officer Team (Mr. Hossein, Ministry of Environment, Forest and Climate Change, Bangladesh, Mr. Phi, Department of Technology Innovation, Ministry of Science and Technology, Vietnam, UNIDO Tokyo Office staff)

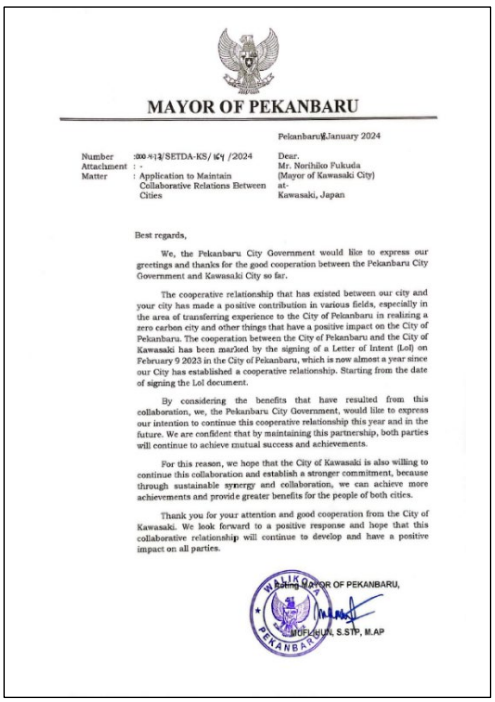
Presentation by Mr. Hafiz, Pekanbaru City

Tour in Kawasaki City

3.3.4. DISCUSSIONS ON CONTINUED THIRE COOPERATION BETWEEN THE TWO CITIES

Kawasaki City and Pekanbaru City held the LOI signing ceremony on February 9, 2023, and the two cities cooperate in four areas: “Zero Carbon City 2050”, “Development of sustainable and environmentally friendly means of transportation”, “Development of renewable energy sources”, and “Energy optimization”.

Since the LOI mentioned above is valid for one year, the letters were exchanged between the two mayors stating that the two cities will continue to cooperate on the LOI items. This confirms that the two cities will continue to cooperate mainly in the area of decarbonization.



MAYOR OF PEKANBARU

Pekanbaru, January 2024

Number : 200.4.1.2/SETDA-KS/ 154 /2024
Attachment : -
Matter : Application to Maintain Collaborative Relations Between Cities

Dear,
Mr. Norihiko Fukuda
(Mayor of Kawasaki City)
at-
Kawasaki, Japan

Best regards,

We, the Pekanbaru City Government would like to express our greetings and thanks for the good cooperation between the Pekanbaru City Government and Kawasaki City so far.

The cooperative relationship that has existed between our city and your city has made a positive contribution in various fields, especially in the area of transferring experience to the City of Pekanbaru in realizing a zero carbon city and other things that have a positive impact on the City of Pekanbaru. The cooperation between the City of Pekanbaru and the City of Kawasaki has been marked by the signing of a Letter of Intent (LoI) on February 9 2023 in the City of Pekanbaru, which is now almost a year since our City has established a cooperative relationship. Starting from the date of signing the LoI document.

By considering the benefits that have resulted from this collaboration, we, the Pekanbaru City Government, would like to express our intention to continue this cooperative relationship this year and in the future. We are confident that by maintaining this partnership, both parties will continue to achieve mutual success and achievements.

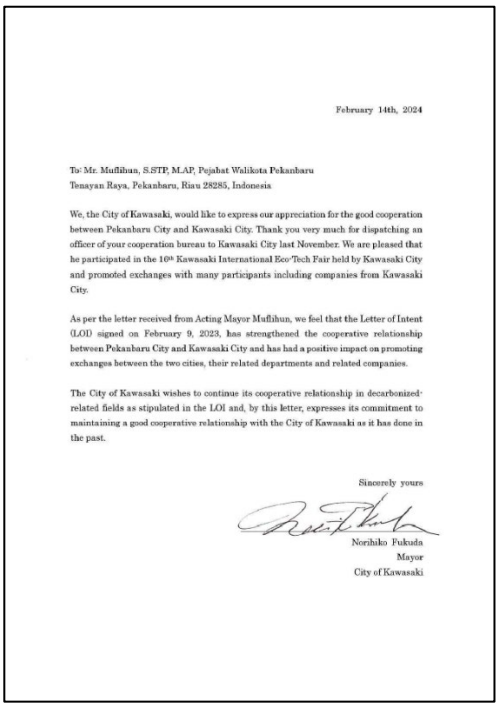
For this reason, we hope that the City of Kawasaki is also willing to continue this collaboration and establish a stronger commitment, because through sustainable synergy and collaboration, we can achieve more achievements and provide greater benefits for the people of both cities.

Thank you for your attention and good cooperation from the City of Kawasaki. We look forward to a positive response and hope that this collaborative relationship will continue to develop and have a positive impact on all parties.

Acting MAYOR OF PEKANBARU,

MUFLIHUN, S.STP, M.AP

Request Letter from Pekanbaru City



February 14th, 2024

To: Mr. Muflihun, S.STP, M.AP, Pejabat Walikota Pekanbaru
Tenayan Raya, Pekanbaru, Riau 28285, Indonesia

We, the City of Kawasaki, would like to express our appreciation for the good cooperation between Pekanbaru City and Kawasaki City. Thank you very much for dispatching an officer of your cooperation bureau to Kawasaki City last November. We are pleased that he participated in the 16th Kawasaki International Eco-Tech Fair held by Kawasaki City and promoted exchanges with many participants including companies from Kawasaki City.

As per the letter received from Acting Mayor Muflihun, we feel that the Letter of Intent (LOI) signed on February 9, 2023, has strengthened the cooperative relationship between Pekanbaru City and Kawasaki City and has had a positive impact on promoting exchanges between the two cities, their related departments and related companies.

The City of Kawasaki wishes to continue its cooperative relationship in decarbonized-related fields as stipulated in the LOI and, by this letter, expresses its commitment to maintaining a good cooperative relationship with the City of Kawasaki as it has done in the past.

Sincerely yours

Norihiko Fukuda
Mayor
City of Kawasaki

Response Letter from Kawasaki City

3.3.5. SEMINAR ON CITY-TO-CITY COLLABORATION FOR ZERO CARBON SOCIETY

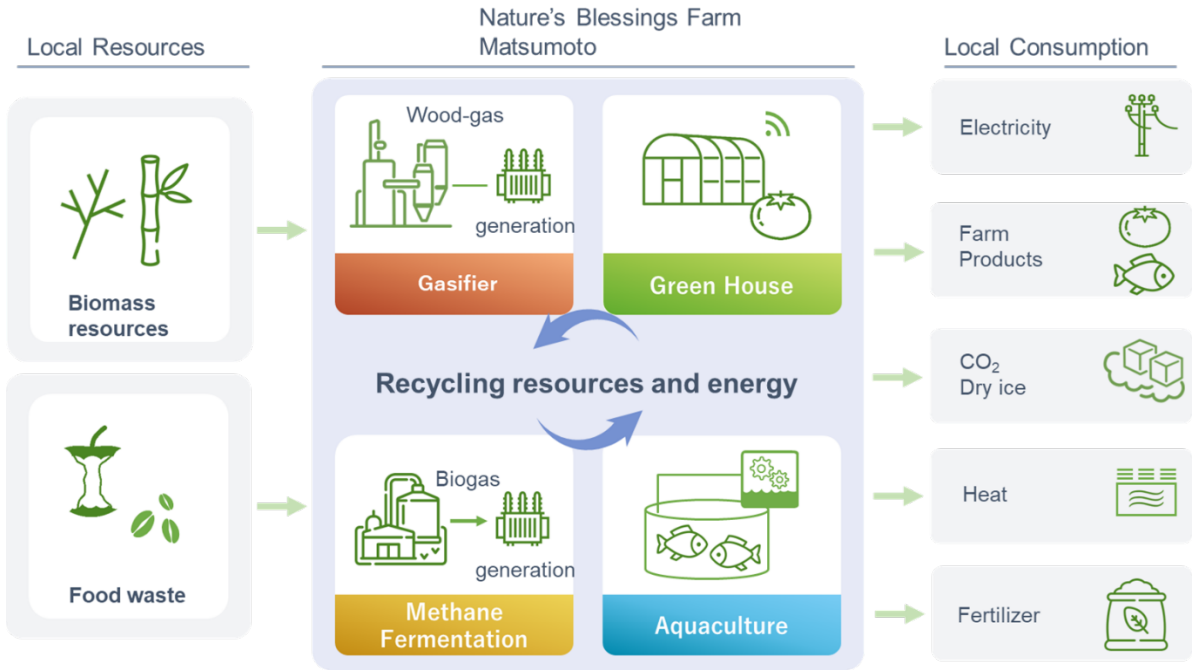
One official from a local municipality involved in City-to-City Collaboration was invited to hold a " Seminar on City-to-City Collaboration for Zero Carbon Society" on February 26 and 27, 2024, as part of the " Climate Change and Zero Carbon City Week" organized by MOE. In conjunction with this, the Head of DISHUB were invited from Pekanbaru City. In addition to participating in the above seminar, on Wednesday February 28th, the participants visited the "Nature's blessing farm in Matsumoto," a development facility for a resource circulation model based on locally produced and consumed energy by Air Water Inc.

Table 3-6 Overview of events related to the Seminar on City-to-City Collaboration for Zero Carbon Society

Date	Summary
Monday, February 26 @ Iino Hall & Conference Center	
10:00 - 11:30	Seminar on City-to-City Collaboration Program (High-level session) Participants: People involved in City-to-City Collaboration Programme (high-level), general applicants Contents: Presentations from MOE and domestic and international local governments on the overview and results of their projects
13:30 – 17:00	Mutual learning on local decarbonization initiatives (Closed) Participants: C3P participants & JCM Global Partnership Meeting participants (9 government officials from Chile, Mongolia, Philippines, Thailand and Vietnam) Overview: Group discussions will be held on specific topics, following the presentations by MOEJ and JICA.
17:30 – 19:00	Reception
Tuesday, February 27 @ Yokohama City (For Cooperation Dept.) @Kawasaki City (For Head of DISHUB)	

8:00 - 13:00	Visits to decarbonization leading area (excursions) Participants: Invitees from overseas municipalities Description: Visits to leading decarbonization regions in Japan to observe specific initiatives
9:30 – 11:00	Meeting with Kawasaki City, site tour at Kawasaki City office
Wednesday, February 28 @ Matsumoto City	
9:00 - 12:00	Inspection of Nature's blessings farm in Matsumoto
13:00 - 15:00	Inspection of Methane Fermentation Facility

Source: Prepared by NIPPON KOEI



Source: Air Water

Figure 3-1 Resource circulation model using locally produced and locally consumed energy at "Nature's blessings farm in Matsumoto"

Meeting with Kawasaki City

Inspection of Nature's blessings farm in Matsumoto

CHAPTER 4 JCM PROJECT FORMULATION STUDY

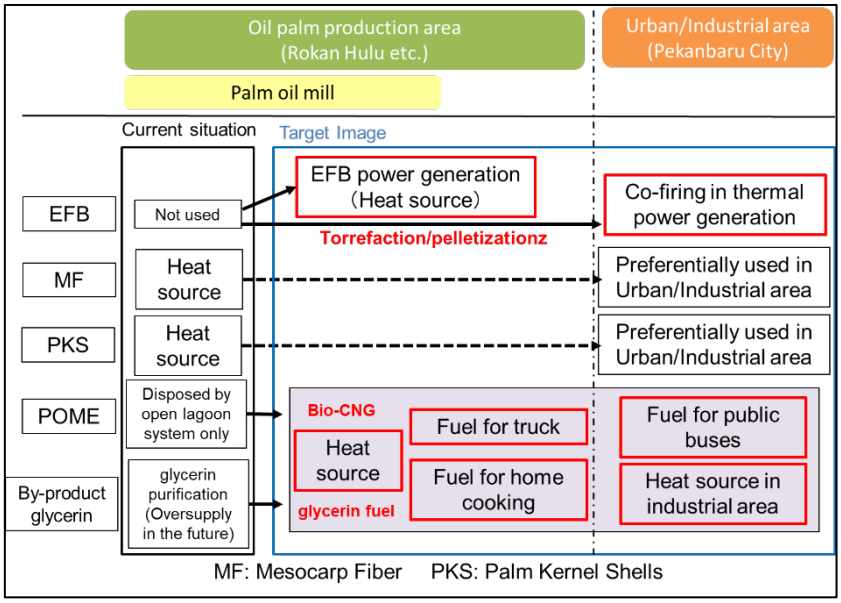
JCM project formulation studies for 1) development of circular economy, and 2) development of 2050 Zero-Carbon City were carried out.

4.1. Studies of JCM projects for development of circular economy

As JCM model projects for development of circular economy in oil palm sector, EFB biomass utilization project (Section 4.1.1) continued from last fiscal year, which utilize EFB as biomass fuel, and POME biogas utilization project (Section 4.1.2), which purifies biogas emitted from POME and produces bio compressed natural gas (bio-CNG), were studied with targeting palm oil mills owned by PTPN continuously from last fiscal year. In addition, Nano-emulsion technology utilization project (Section 4.1.3) aimed to produce new fuels using Nano-emulsion technology.

EFB biomass utilization project enables utilization of EFB for electricity consumed in a palm oil mill, which was generated by PKS and MF to date. Also, PKS and MS can be combusted in thermal power plant in Pekanbaru or in new biomass plant, which lead to effective utilization of energy source of residues generated by palm oil production in the region and GHG emission reduction in urban area as well. In addition, the pelleting and semi-carbonization of EFB, which was difficult to use in urban areas, solves the problems of transportation and utilization, and the use of EFB together with PKS, MF, POME, and bio-CNG, which are easy to handle, is expected to lead to resource recycling in the entire Riau Province Region.

In addition, to utilize the by-product glycerol, which is predicted to be much more emitted in the future corresponding to the drastic increase of BDF production in Indonesia, as nano-glycerol fuel utilizing Nano-emulsion technology, which can contribute to circular economy and decarbonization of the region.



Source: Prepared by Nippon Koei

Figure 4-1 Circular economy in oil palm sector in Riau Province Region

4.1.1. EFB UTILIZATION PROJECT

Aura Green Energy (hereinafter, Aura) is implementing JCM model project "12MW Biomass Power Plant Project in Aceh Province, Sumatra" with local company, PT. Gistec Prima Energindo (hereinafter, Gistec).

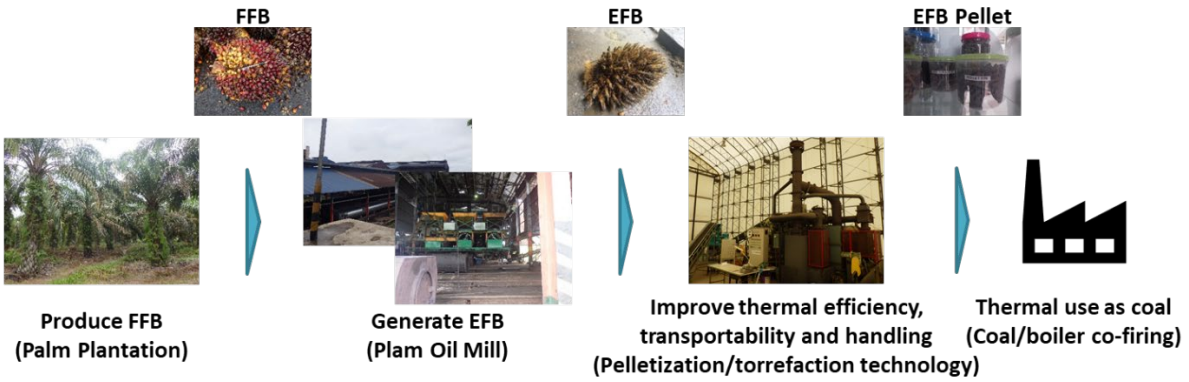
As a rollout project of the project in Ache Province, feasibility study for EFB biomass power plant project, which utilizes EFB generated in palm oil mills owned by PT. PN5 in Rokan Hulu,

had been conducted. However, since it was found that the distance from the grit within Riau District was too far to expect profitability, we concluded that it would be difficult to implement EFB biomass power generation project in Riau District at this situation.

On the other hand, due to its size and weight, and the fact that it is generated far from urban areas, EFB has not been used as a heat source in urban areas. From last fiscal year, we have started to study the EFB biomass fuel conversion project, because pelleting or half-carbonizing EFB can reduce transportation costs and make it possible to use EFB for co-firing at thermal power plants and other facilities located in urban areas.

(1) EFB biomass fuel conversion project

As part of the EFB fuel conversion project, we have studied technologies to convert EFB into fuel that can be used in urban areas by improving the calorific value, transportation efficiency, and ease of handling of EFB through the EFB pelletizing and half-carbonization technologies possessed by Japanese companies. This technology will enable energy use over a wide area and contribute to GHG reduction.



Source: Prepared by Nippon Koei

Figure 4-2 Overall Process of EFB Fuel Conversion Project

1) Study progress until FY2022 (EFB biomass power plant project)

Study progress until FY2022 is summarised in Table 4-1.

Table 4-1 Study progress until FY2022 (EFB biomass power plant project)

#	Contents	Overview/Results
1	Selection of target palm oil mills	The research was conducted at two oil mills, Sei Galuh and KOTA GARO, located in Riau Province, to collect information on FFB generation, sales price, and status of RSPO acquisition. (Table 4 6)
2	Information gathering and comparative study of EFB fuel conversion equipment manufacturers	Through meetings with four Japanese companies that have EFB fuel conversion technology and plant inspection (one company), collected information on fuel conversion technology and estimated production costs. (Table 4 7)
3	Collection of information on biomass fuels in Indonesia	Information on biomass fuels in Indonesia was shared through meetings with EFB fuel suppliers and a company responsible for the EPC of an EFB fuel plant.
4	Estimate GHG reduction	Estimated GHG emission reductions based on the assumption that EFB fuel is co-fired with coal.

Source: Prepared by Nippon Koei

Table 4-2 Results of information collection for palm oil mills

Items	Sei Galuh	KOTA GARO
Amount of FFB processing capacity	243,000 (ton/year) (planned value) 45 (ton/h) (planned value) 174,862(ton/year) (FY2022) ※Currently, processing volume is about 2/3 due to equipment repair	164,000 (ton/year) 22.7 (ton/h) ※Estimated from the amount of CPO
Amount of generated EFB	48,600 (ton/year) (5400h: FY2022) 9 (ton/h)	32,775 (ton/year) 4.55 (ton/h) ※Estimated from the amount of CPO
EFB shape	As it is →Incinerated and sold as fertilizer	1.As it is 2.Cut & compressed(like fiber) (1 inch=2.54 cm) (moisture rate≒40%)
EFB cost	10 IDR/kg →No demand and almost no price	1. 12 IDR/kg 2. 80 IDR/kg
Implementation	1.BOT (Building Operation Transfer) →transfer the facility in 10 years 2.JO (Joint Operation) →investment ×financial, ○land, ○human resources, ○material support	Supplier Business owner
RSPO	Acquired	In progress (may take time)

Source: Prepared by Nippon Koei

Table 4-3 Collected information about biomass fuels in Indonesia

#	Contents	Overview
1	Carbonization equipment operation in Indonesia	[redacted]
2	Land area required for facilities to convert to EFB fuel	
3	Possibility of supplying EFB fuel to PLN	
4	Biomass fuel prices	
5	Ideal production volume	

Source: Prepared by Nippon Koei

Estimated GHG reductions from EFB fuel conversion

#	Item	Figure	Unit	Remarks
a	FFB amount	45	ton/h	Design throughput (some machines are currently out of order but will be repaired in the future)
b	The amount of generated EFB	9	ton/h	Approximately 21% of the FFB volume is EFB
c	EFB fuel production	1.4	ton/h	Mass loss due to drying of water content in EFB
d	Annual operating time	5,400	h/year	Actual results
e	Annual EFB fuel production	7,560	ton/year	=c x d
f	EFB Fuel Unit Calorific Value	4,000	kcal/kg	Assumed amount
g	EFB Fuel Unit Calorific Value	16.7	GJ/ton	1 kcal=4.184kJ
h	General coal unit calorific value	26.08	GJ/ton	Source: Agency for Natural Resources and Energy List of Standard Calorific Value and Carbon Emission Coefficient by Energy Source
i	CO2 emissions per unit of general coal	2.409	kg-CO2/kg	
j	Fuel switch potential	64.2	%	=g / h x 100
k	GHG reduction potential	11,687	t-CO2eq/year	=e x i x j

Source: Prepared by Nippon Koei

2) Information gathering and comparative study of EFB fuel conversion equipment manufacturers

Based on the study until FY2022, we have continued to collect and compare information on EFB fuel conversion equipment manufacturers this year, and held meetings with four Japanese companies that have EFB fuel conversion technologies. Two EFB fuel conversion technologies were identified. One is a pelletizing technology that makes it easier to handle EFB as biomass fuel. The other is a half-carbonization technology that improves crushability and calorific value by carbonizing the pelletized EFB.

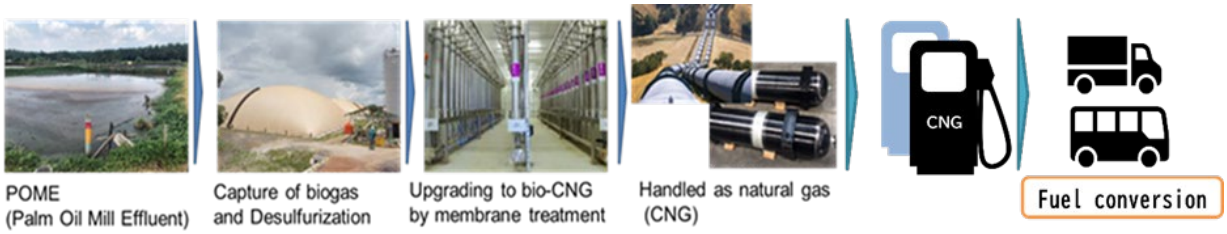
Table 4-4 EFB fuel conversion technologies gathered from four Japanese companies

company	A	B	C	D
Technology	Black pellet Half-carbonization	Black pellet Half-carbonization	White pellet pelletization	White pellet pelletization
Co-firing rate				
Calorific value(kcal/kg)				
Na, K, Cl Reduction technology	—	◎ Patented tech	○	○
Business achievement	○	○	◎	○
Cost	△	○	○	○
Crushability	-	◎	△	-
Water resistant	-	◎	△	△

Pelletizing technology is relatively inexpensive to produce because the process is less than half-carbonization, and demand is already anticipated in Indonesia as an alternative to fossil fuels. On the other hand, low crushability is an issue because EFB fibers remain during mixing and firing.
Half-carbonization technology increases the carbon content by thermal decomposition in an oxygen-deprived environment, resulting in a higher calorific value compared to wood pellets. Half-carbonization improves crushability, water resistance, spontaneous combustion resistance, and biodegradability, enabling high co-firing rates, improved stability for outdoor storage, improved storage safety, and long-term storage. On the other hand, the issue is that the process is more complicated and the production cost is higher than with pelletizing technology.
A common issue is to reduce the concentration of chlorine, potassium, etc. in order to use EFB as a fuel. Hydrochloric acid gas (Cl2) and hydrogen chloride gas (HCl) are known to cause severe corrosion of steel. The higher potassium (K) content also increases the potential for fouling and slagging ash adhesion and deposition disturbances in coal-fired pulverized coal boiler co-firing. Therefore, these reduction techniques are needed.
In selecting EFB fuel conversion technologies, it is necessary to take into account the quality standards of fuel acceptable to off-takers and the unit price.

4.1.2. POME BIOGAS UTILIZATION PROJECT

As POME biogas utilization project, installation of technologies to purify POME biogas and to produce highly purified methane gas, namely bio-CNG were studied. Separation membrane of Polyplastics-Evonik can produce biogas with more than 90% methane and the purified gas can be used the same as normal CNG. Thus, bio-CNG can be used for not only power generation by gas engine, but vehicle fuel and household use. Furthermore, it will be available to discharge bio-CNG to pipeline which will be installed in the target area in the near future.



Source: Prepared by Nippon Koei

Figure 4-3 Overall image of project for POME biogas utilization

In East Kalimantan Province, similar bio-CNG purification plant was constructed and started operation in 2020 and biogas separation membrane of Polyplastics-Evonik, SEPURAN® Green was installed to the plant.

Source: Polyplastics-Evonik

Figure 4-4 SEPURAN® Green

Source: PT.Gikoko Kogyo Indonesia

Figure 4-5 SEPURAN® Green installed in East Kalimantan Project

(1) Study progress until FY2022 (POME biogas utilization project)

Study progress until FY2022 is summarised in Table 4-5.

Table 4-5 Study progress until FY2021 (POME biogas utilization project)

#	Study contents	Overview
1	Selection of study target palm oil mills	Considering information of palm oil mills owned by PT.PN5 collected by local consultant, target mills were decided. In consideration of FFB processing amount and transport of bio-CNG, two mills the nearest from Pekanbaru City, Sei Galuh Mill (Approx. 30 km away, FFB processing capacity 60ton/h), and Sei Buatan (Approx. 80 km away, FFB processing capacity 60 ton/h) were decided to be study target.
2	Consideration on Biogas generation potential and fuel switch potential	Considering components of POME emitted from Sei Buatan Mill and Sei Galuh Mill, potentials of biogas generation were estimated. Also, from the estimation of the potentials and data of public buses in Pekanabru City, preliminary calculation of fuel switch potential of the buses (diesel to bio-CNG) was carried out. In case of Sei Buatan mill, 58.8 % of annual diesel consumption of public buses can be switched to bio-CNG and in case of Sei Galuh, 38.2%.
3	Consideration on Preliminary design of bio-CNG purification plant	Based on the data and calculation results from #1, #2, preliminary design of bio-CNG plant was implemented.
4	Information collection of companies capable of retrofitting buses for fuel switch	Information collection of companies capable of retrofitting from diesel to CNG buses for fuel switch was carried out by cooperation with PT. Gikoko Kogyo Indonesia.
5	Information collection of POME biogas utilization project in East Kalimantan Province	Information collection of POME biogas utilization project operated in East Kalimantan Province and installing biogas separation membrane of Polyplastics-Evonik was carried out by cooperation with PT. Gikoko Kogyo Indonesia.
6	Bio-CNG plant design	Bio-CNG plant design for a palm oil mill (Sei Buatan mill) owned by PT. PN5.
7	Rough CAPEX, OPEX estimate	Roughly calculated CAPEX and OPEX for the bio-CNG plant using the information obtained in #6.
8	Examination of fuel conversion potential and GHG reductions	Fuel conversion potential and GHG reductions for buses in Pekanbaru were studied.
9	Selection of target palm oil mills	Conducted site visits to two oil mills in Riau Province, Sei Galuh and KOTA GARO, to collect information on POME generation, sales price, and status of RSPO acquisition. Sei Galuh was chosen as a future study target due to its distance from Pekanbaru city, the amount of generated POME, and status of RSPO acquisition.
10	Information gathering of target palm oil mill	Various information necessary for the construction of a bio-CNG plant was collected at the Sei Galuh (PT.PN5).
11	Initial design of biogas purification plant	Bio-CNG plant design for a palm oil mill (Sei Galuh mill) owned by PT. PN5.
12	Rough CAPEX, OPEX estimate	Roughly calculated CAPEX and OPEX for the bio-CNG plant using #3 information.
13	Examination of fuel conversion potential and GHG reductions	Calculated fuel conversion potential and GHG reductions for buses in Pekanbaru.
14	Information sharing with DISHUB	Shared information with DISHUB, which is considering bio-CNG user, on the status and future policies.

Source: Prepared by Nippon Koei

Based on the study until FY2022, a simple Pre-feasibility study was conducted, and a survey was conducted to establish a business implementation system. The studies below were carried out in FY2023.

Table 4-6 Summary of Pre-F/S this year (POME Biogas Utilization Project)

#	Items	Overview
1	Information gathering of target palm oil mill (Sei Galuh)	Collected various necessary information for Pre-feasibility study at the candidate site (Sei Galuh).
2	Meeting with related companies and request for rough quotations	Provided the necessary information to companies that expressed interest in the POME biogas utilization project and asked them to prepare rough quotations to compile the information.
3	Information sharing with DISHUB and TMP	Shared information with DISHUB and TMP, which is considering bio-CNG user, on the status and future policies.
4	Examination of GHG reductions and cost-effectiveness calculations	Calculated the GHG reductions and cost-effectiveness.

Source: Prepared by Nippon Koei

(2) Information gathering of target palm oil mill (Sei Galuh)

FFB processing amount, process flow diagram, and other information required for rough quotations was collected from PT.PN. The collected information is summarized below.
POME component analysis was also conducted during the site visit.

Table 4-7 information about Sei Galuh

No		Data Required	UoM	2020	2021	2022	until Nov 2023
1	a	FFB processed	ton FFB/year				
			ton FFB/month				
			ton FFB/hour				
	b	Working Hours	Hours				
2	a	FFB Supply					
		- Core Plantation	ton FFB/year				
		- Eksternal	ton FFB/year				
		- Total	ton FFB/year				
		- Average	ton FFB/month				
	b	Area					
		- Core Plantation	Ha				
		- Eksternal	Ha				
	c	Planting year	-				
3		POME Production	ton POME/year				
			ton POME/month				
4		PFD of POM Production	-				
5		PFD of WWTP	-				
6		Specification and Photo of WWTP	-				
7		COD at WWTP inlet	ppm				
8		Map of existing WWTP location	-				
9		Map of electricity network	-				
10		PKS Coordinate Point	-				
11		Soil test result	-				
12		Regarding future plans for PKS and FFB processing, should be raised to 60 ton/h	-				

Source: Prepared by PT.PN

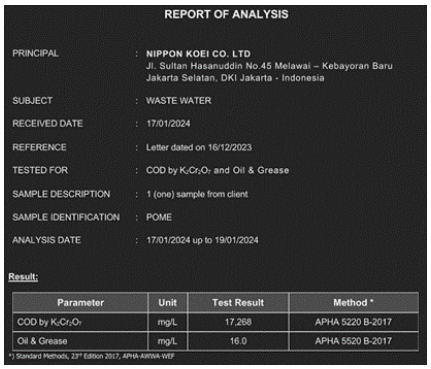
Gambar 24 Lay Out PKS Sei Galuh

Figure 4-6 Process flow design (Waste Water Treatment Plant)

Source: Prepared by PT.PN

Figure 4-7 Process flow design (POME)

Source: Prepared by PT.PN



REPORT OF ANALYSIS

PRINCIPAL	:	NIPPON KOEI CO. LTD Jl. Sultan Hasanuddin No.45 Melawai – Kebayoran Baru Jakarta Selatan, DKI Jakarta - Indonesia
SUBJECT	:	WASTE WATER
RECEIVED DATE	:	17/01/2024
REFERENCE	:	Letter dated on 16/12/2023
TESTED FOR	:	COD by $K_2Cr_2O_7$ and Oil & Grease
SAMPLE DESCRIPTION	:	1 (one) sample from client
SAMPLE IDENTIFICATION	:	POME
ANALYSIS DATE	:	17/01/2024 up to 19/01/2024

Result:

Parameter	Unit	Test Result	Method *
COD by $K_2Cr_2O_7$	mg/L	17,268	APHA 5220 B-2017
Oil & Grease	mg/L	16.0	APHA 5520 B-2017

*) Standard Methods, 23rd Edition 2017, APHA-AWWA-WEF

Results of POME Analysis

POME sampling

Source: Prepared by Nippon Koei

(3) Meeting with related companies and request for rough quotations

The information collected in (2) was provided to companies with biogas collection technology, and rough quotations were required and compiled. Based on the information collected, the Pre-feasibility of the project was evaluated. TMP, an off-taker candidate, purchases bus fuel diesel at a government subsidized price. Therefore, the evaluation of economic feasibility was conducted in two patterns: (1) when the diesel is sold at an amount equivalent to the subsidized diesel price and heat value, and (2) when the diesel is sold at an amount equivalent to the market diesel price and heat value without the subsidy. The result is shown below.

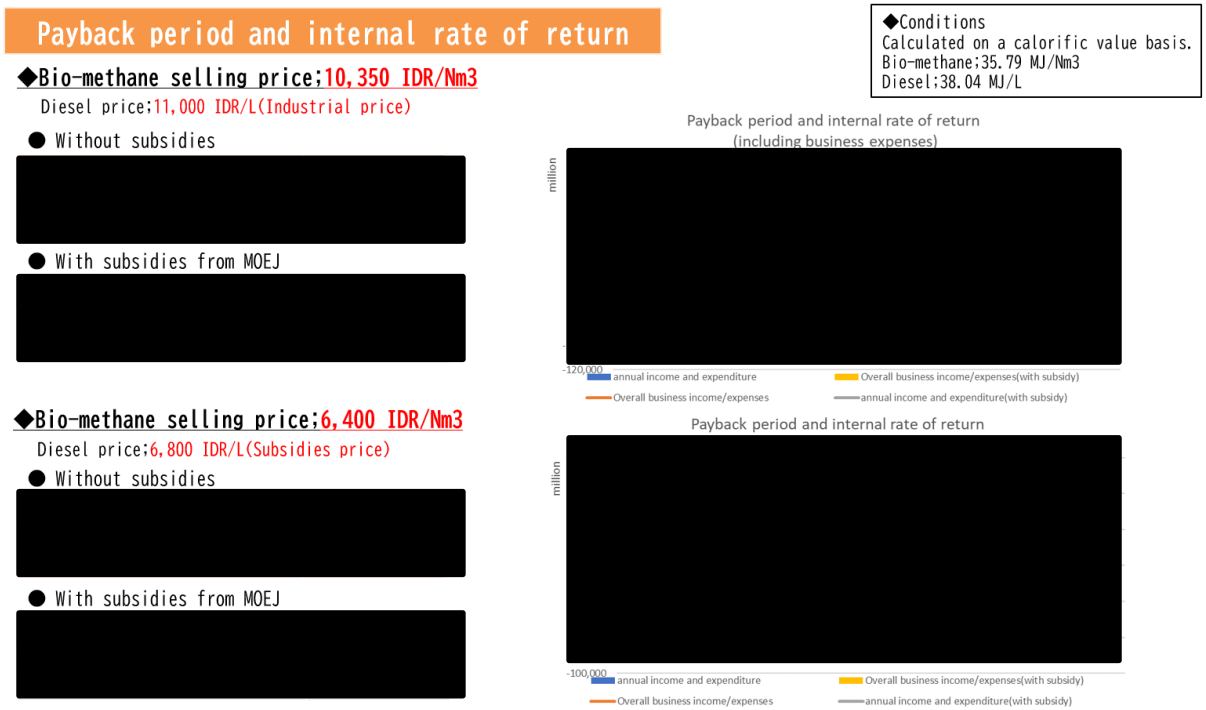


Figure 4-8 The evaluation of economic feasibility

Source: Prepared by Nippon Koei

(4) Information sharing with DISHUB and TMP

Information was shared with DISHUB and TMP, which are considering bio-CNG supply sources.

The Indonesian central government has set a national policy of clean bus fuel by 2045, and it was found that it is possible to provide EV and CNG buses in accordance with the wishes of local governments.

In order for TMP to agree to purchase bio-CNG derived from the POME biogas utilization project, the approval of the Mayor or Sekda (City Secretary General, the No. 2 position in the city) is required, but since the mayoral election is scheduled for October 22, 2024 and the current acting mayor's term of office ends on May 22, it turned out to be difficult to participate in POME biogas utilization project until next November.

Regarding the status of TMP's operations, the company owns a total of 90 buses, 40 small buses and 50 large buses, but due to COVID 19, it currently operates with a total of 46 buses, including 14 small buses, 24 large buses, and 8 spare buses, which significantly reduces diesel consumption, and the estimated bio-CNG generation is expected to exceed the diesel consumption. Therefore, it is necessary to consider private companies such as transportation companies as bio-CNG off takers.

(5) Examination of GHG reductions and cost-effectiveness calculations

Based on the above studies, the GHG reductions and cost-effectiveness estimates of utilizing the biogas obtained were examined. In this examination, the estimation was made based on the assumption of fuel conversion to bio-CNG for TMP and private transport companies in Pekanbaru. Based on the results of the estimation, the annual GHG reduction is estimated to be 57,324 tCO2-eq/year.

Table 4-8 CH4 emissions from POME (open lagoon method)

#	Items	Value	Unit	Remarks
a	FFB processing volume	200,000	t/year	assumption
b	POME ratio	0.65	m3 POME/t-FFB	assumption
c	Annual POME discharge	130,000	m3 POME/year	=a×b
d	COD concentration	62,000	mg COD/L	USAID & Winrock International, "POME-to-Biogas"(2015)
e	COD mass	8,060,000	kg COD/year	=f×g/1000
f	COD ⇒ methane ratio	0.35	Nm3 CH4/kg COD removed	USAID & Winrock International, "POME-to-Biogas"(2015)
g	COD removal efficiency	90	%	assumption
h	Annual methane emissions (volume)	2,538,900	Nm3 CH4/year	=e×f×g
i	Methane density	0.717	kg/m3	
j	Annual methane emissions (mass)	1,820	tCH4/year	=h×i/1000
k	Global warming potential of methane	27.9	tCO2/tCH4	IPCC AR6
l	Annual methane emissions	50,789	tCO2-eq/year	=j×k

Source: Prepared by Nippon Koei

Table 4-9 CO2 emissions from diesel buses/trucks

#	Items	Value	Unit	Remarks
m	Bus annual fuel consumption	1,151,600	L/year	Information form DISHUB（2023）
n	Truck annual fuel consumption	1,500,000	L/year	Assumption
o	Annual diesel consumption	2,651,600	L/year	=m+n
p	Emission Factor	2.62	tCO2/kl	Diesel : List of Calculation Methods and Emission Factors in the Calculation, Reporting and Publication System (updated December 12, 2023), Ministry of the Environment, Japan
q	Annual CO2 emissions	6,947	tCO2/year	= o × p /10^3

Source: Prepared by Nippon Koei

Table 4-10 Project CO2 Emissions

#	Items	Value	Unit	Remarks
r	Annual methane emissions (mass)	1,820	tCH4/year	= j
s	Percentage of methane in bio-CNG	95	%	assumption
t	Annual bio-CNG production	1,916	ton/year	=r × s
u	Annual bio-CNG calorific value	45	TJ/ton	assumption
v	Annual bio-CNG production calorific value	86,229	TJ/year	=t × u
w	Annual diesel consumption	2,651,600	l/year	=o
x	Density	835	kg/l	
y	Calorific value	41.4	TJ/Gg	IPCC2006
z	Annual Diesel Consumption Heat Value	91,663	TJ/year	=w × x × y /10^6
A	Fuel Conversion Potential	94.1	%	= v / z × 100, 100% upper limit
B	Annual diesel emissions	157,196	l/year	= w × A
C	Emission Factor	2.62	tCO2/kl	Diesel : List of Calculation Methods and Emission Factors in the Calculation, Reporting and Publication System (updated December 12, 2023), Ministry of the Environment, Japan
D	Annual GHG emissions	412	tCO2/year	= B × C/10^3

Source: Prepared by Nippon Koei

Table 4-11 GHG reductions and cost-effectiveness calculations

#	Items	Value	Unit	Remarks
E	Annual GHG Reduction	57,324	tCO2-eq/year	= l + q – D
F	Annual GHG reduction (energy origin)	6,535	tCO2/year	
G	Anticipated Subsidy Application Amount	250,000,000	Yen	assumption (Manufacturing and refining only)
H	Project period	10	Year	Gas industry facilities Manufacturing facilities
I	Total GHG emission reductions	573,243	tCO2-eq	
J	Total GHG emission reductions (energy origin)	65,353	tCO2	
K	Cost-effectiveness	436	Yen/tCO2	
L	Cost-effectiveness (energy origin)	3,825	Yen/tCO2	

Source: Prepared by Nippon Koei

4.1.3. NANO-EMULSION TECHNOLOGY UTILIZATION PROJECT

In addition to the development of nano-glycerol fuel produced by mixing by-product glycerol with diesel with nano-emulsion technology of Nanofuel (based in Kawasaki City and GIC member) and formulation of BDF nano-glycerol fuel project with Kowa, we also continued to study the development of demonstration project for nano-emulsion of liquid fossil fuels utilizing proprietary nano-technology.

(1) Nano-Emulsion Fuel System "NEFS"

Nano-Emulsion Fuel System "NFES" of Nanofuel is a system to produce nano-emulsion fuel by adding water to liquid fuel by original nano technology. By making diesel and heavy oil nano-emulsion, combustibility and fuel efficiency can be improved, which leads to CO2 emission reduction.
This equipment awarded grand prize of "Low CO2 Kawasaki Brand" which Kawasaki City certifies products and technologies to reduce CO2 in whole lifecycle from material procurement to disposal/recycling in comparison with ordinary ones.

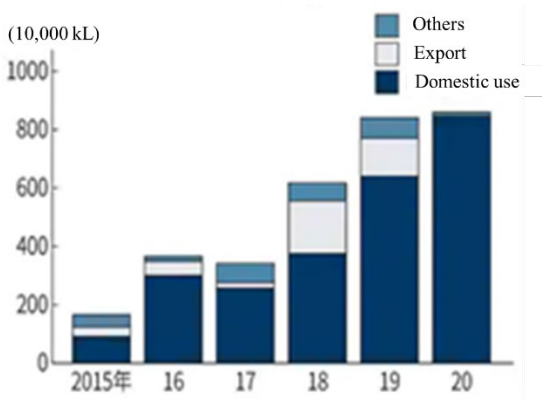
Source: Nanofuel

Figure 4-9 Nano-emulsion fuel system "NEFS"

(2) BDF GLYCEROL FUEL PROJECT

1) Background

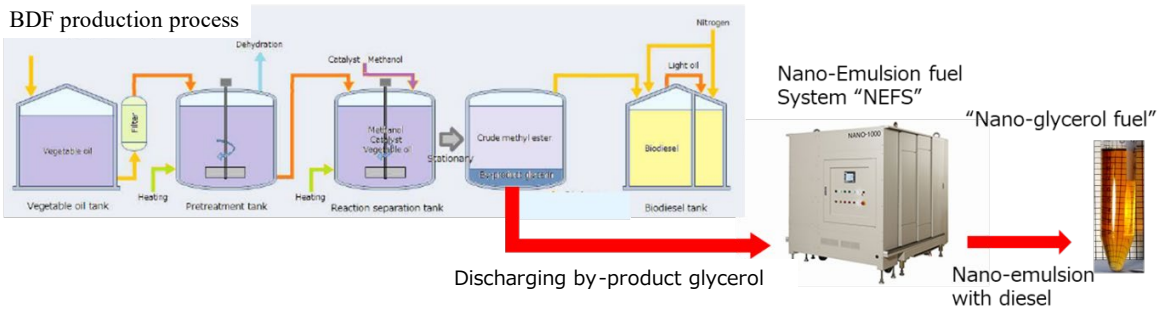
In Indonesia, since National Energy Policy was published as President Law No.5 in 2006, conversion from fossil fuel to bio-fuel generated from palm oil has been proceeding. BDF is mainly produced by mixing fatty acid methyl ester (FAME) with diesel. Corresponding to the increase of BDF production and mixture rate of FAME, production of FAME has also been increasing drastically. In addition, as national oil company, Pertamina has a plan to increase BDF production by 15%, production of FAME is predicted to increase further.



Source: Indonesia Biofuel Producer Association

Figure 4-10 FAME production in Indonesia

On the other hand, when producing FAME, by-product glycerol with low concentration is generated. Most BDF factory purify by-product glycerol and sell purified glycerol at present. However, it cannot be predicted that while BDF production is rising rapidly, demand of glycerol is increasing at the same rate. Therefore, glycerol will be over-supplied and be difficult to be sold in the future, which means that measures for utilization of by-product glycerol would be necessary.



Source: Prepared by Nippon Koei based on document of Nanofuel

Figure 4-11 Production process of nano-glycerol fuel

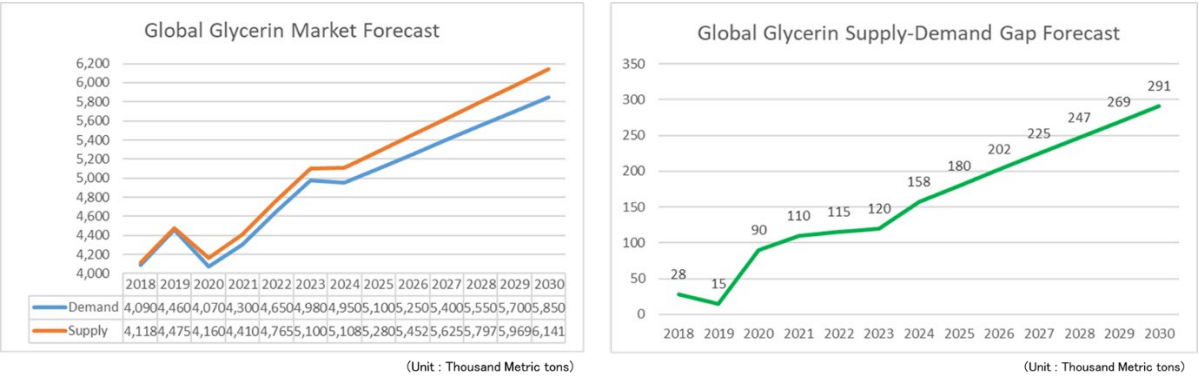
2) Overview of glycerol market

Glycerol is utilized as food additives such as sweeteners, preservatives, moisturizers, thickening stabilizers and used as moisturizers and lubricants of pharmaceuticals, cosmetics, etc.

Glycerol can be divided into natural glycerol produced by purifying vegetable oil such as palm oil and soy, and synthetic glycerol produced by hydrolysis of epichlorohydrin. Production rate of them is 93:7 and the rate of natural glycerol is much larger than that of synthetic glycerol. Also, two-thirds of all glycerol production consists of glycerol from BDF production, which means BDF production amount has a large impact on production of glycerol.

Figure 4-12 shows the prediction of supply and demand in the world. It is anticipated that the glycerol production will be increasing corresponding to drastic increase of BDF globally. Because of the increase of world population, demand of glycerol can also increase. However, the gap of supply and demand will be larger and will reach 290,000 tons in 2030.

Therefore, it is important to consider new uses of glycerol and it is valuable to explain and propose nano-glycerol fuel as one of the uses, to BDF suppliers.



Source: Prepared by Kowa based on "Status and prospect of biochemical / de-petrochemical market 2020" (Fuji Chimera Research Institute)

Figure 4-12 Prediction of glycerol supply and demand in the world

3) Collection of by-product glycerol from BDF factories

As the first step of the implementation of BDF nano-glycerol fuel project, it is necessary to confirm production technology of the nano-glycerol fuel using by-product glycerol generated in Indonesia. For this purpose, request for collection of by-product glycerol sample was carried out.

There are 22 BDF factories in Indonesia and 8 of them are located in Riau Province. Location of each factory in the Province are as shown below.

Table 4-12 BDF factories in Riau Province

#	Name of supplier	Factory location
1	PT Wilmar Bioenergi Indonesia	Dumai
2	PT Bayas Biofuels	Indragiri Hilir
3	PT Cemerlang Energi Perkasa	Dumai
4	PT Intibenua Perkasatama	Dumai,
5	PT Dabi Biofuels	Dumai
6	PT Ciliandra Perkasa	Dumai
7	PT Pelita Agung Agrindustri	Bengkalis

Source: Prepared by Nippon Koei based on Ministry of Energy and Mineral Resources Law No. 252.K/10/MEM/2020

Requests for by-product glycerol were sent mainly to factories in Riau Province. It was found that all contacted factories sell glycerol purified from by-product glycerol generated by BDF production.

The results of the component analysis of the samples obtained last year are as follows.

- There were no oils or fats present. This is assumed to be because the water and fats and oils were separated in the tank and were collected from the bottom of the tank.
- The glycerin content was less than 50%, which is within the range expected by Nanofuel.
- The methanol content was higher than expected. This may be due to the fact that methanol is mixed in during the BDF preparation process.

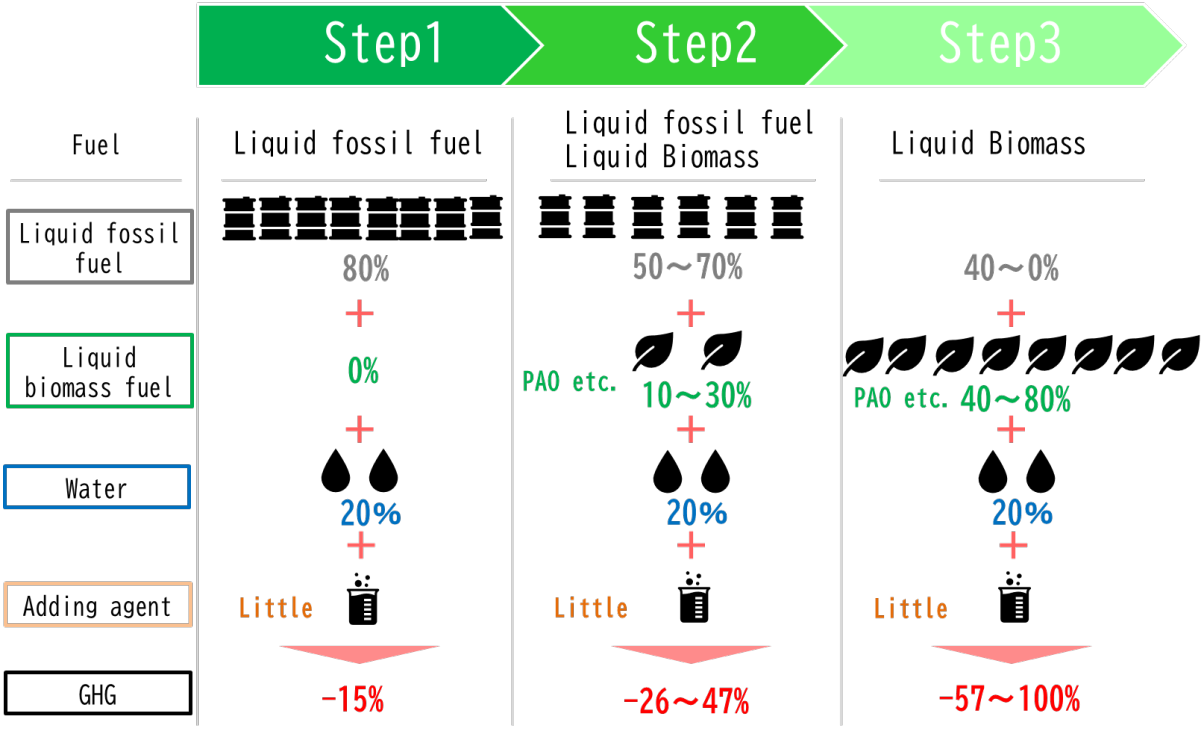
When sampling in the future, it will be necessary to collect from multiple tanks to ensure uniform quality.

Source: Nippon Koei

Figure 4-13 Sample of by-glycerol

(2) Nano-emulsion technology utilization project

Nanofuel has been considering partner companies from factories in Indonesia that use liquid fossil fuels in order to conduct a demonstration project to produce nano-emulsion fuels that reduce the use of liquid fossil fuels (ex.) heavy oil, diesel, etc.) by utilizing Nanofuel's nano-emulsion technology. Starting with this demonstration, Nanofuel aims to produce cleaner fuels by mixing liquid biomass fuels such as PAO (Palm Acid Oil) in the future. This year, PT. Kowa Emori Indonesia, a local partner of Nanofuel, and PT. BOT Finance, which we interviewed during the previous year's survey, introduced Nanofuel to several local companies, but they were unable to realize the demonstration project. On the other hand, we consulted with the Global Environment Centre Foundation (GEC) and the Indonesian JCM Secretariat in advance of applying for the project to be included in the JCM Demo-Project with the aim of establishing the project. Although we received comments from both parties regarding the challenges to formulation, their responses were generally positive.



Source：Nippon Koei

Figure 4-14　Image of liquid fossil fuel conversion by Nanofuel

(3)　Estimation of GHG emission reduction

1) BDF GLYCEROL FUEL PROJECT

GHG emission reduction by BDF nano-glycerol fuel project was calculated with assumption of production capacity 3,000L/h. The result of the calculation is shown below.

Table 4-13　Estimation of GHG emission reduction (BDF nano-glycerol fuel project)

#	Item	Figure	Unit	Remarks
a	Production capacity of nano-glycerol fuel	3,000	L/h	Assumption
b	Annual production of nano-glycerol fuel	21,024,000	L/yr	Assumption
c	NCV of nano-glycerol fuel	31.40	MJ/L	Assumption
d	Annual production of nano-glycerol fuel	660,056,364	MJ/year	= b x c
e	NCV of diesel	38.04	MJ/L	Petroleum Association of Japan
f	Potential of switch from diesel	17,351,639	L/year	= d / e
g	Emission Factor (Diesel)	0.0726	tCO2/GJ	IPCC2006
h	Annual reference CO2 emission	47,920	tCO2/year	= d x g /1,000
i	Rate of glycerol mixture	50%		Assumption
j	Annual diesel mixture amount	10,512,000	L/year	= b x i
k	Annual project CO2 emission	29031	tCO2/year	=e x g x i / 1,000
i	Annual CO2 emission reduction	18,889	tCO2/year	= h－k
m	Project period	7	year	Legal lifetime
n	Total CO2 emission reduction	132,223	tCO2	= i x m

Source: Prepared by Nippon Koei

2) Demonstration project for utilizing Nano-emulsion technology

GHG reduction effects of the liquid fossil fuel nano-emulsion demonstration project were estimated assuming an annual diesel consumption of 30,000,000 liters. The results of the trial calculation are as follows.

Table 4-14 Estimation of GHG emission reduction (Demonstration project for utilizing Nano-emulsion technology)

#	Items	Values	Unit	Remarks
a	Annual diesel consumption	30,000,000	l/year	Assumption
b	Emission factor (diesel)	2.62	tCO2/kl	MOE, Japan
c	Annual Reference GHG Emissions	78,600	tCO2/year	=a×b
d	Water blending ratio	20	%	Nanofuel's plan
e	Diesel blending in nano-emulsion fuel	24,000,000	l/year	=a*(1-d)
f	Annual project GHG emissions	62,880	tCO2/year	=b×e
g	Annual GHG reductions	15,720	tCO2/year	=c-f
h	Anticipated Subsidy Application Amount	200,000,000	Yen	Assumption
i	Project period	7	Years	Petroleum or coal product manufacturing facilities
j	Total GHG emission reductions	110,040	tCO2-eq	
k	Cost-effectiveness	1,818	Yen/tCO2	

Source: Nippon Koei

4.2. Studies of JCM projects for zero carbon city

In this project, introduction of renewable energy and energy management in public buildings and the project to introduce LED street lightings were considered as projects that contribute to the formation of zero-carbon city.

The effects of the implementation of these projects combining renewable energy and energy-saving technologies with IoT technology are the followings.

- Reduction of CO2 emissions through the use of renewable energy (reduction of environmental impact)
- Local production for local consumption of energy and utilization of local resources
- Lower energy costs
- Vitalization of local industry and virtuous circulation of local funds
- Improvement of energy supply reliability
- Strengthening resilience (enhancing energy security during disasters)
- Attracting companies which are member of RE100

In addition, it is possible not only to induce private companies and others in the region to take zero carbon initiatives but also to expand similar projects to other regions, promoting these projects as model projects to promote the formation of zero-carbon city in Pekanbaru City in collaboration with Kawasaki City.

4.2.1. INTRODUCTION OF RENEWABLE ENERGY AND ENERGY MANAGEMENT IN PUBLIC BUILDINGS

(1) Study on introduction of EMS technology in the new city hall of Pekanbaru City

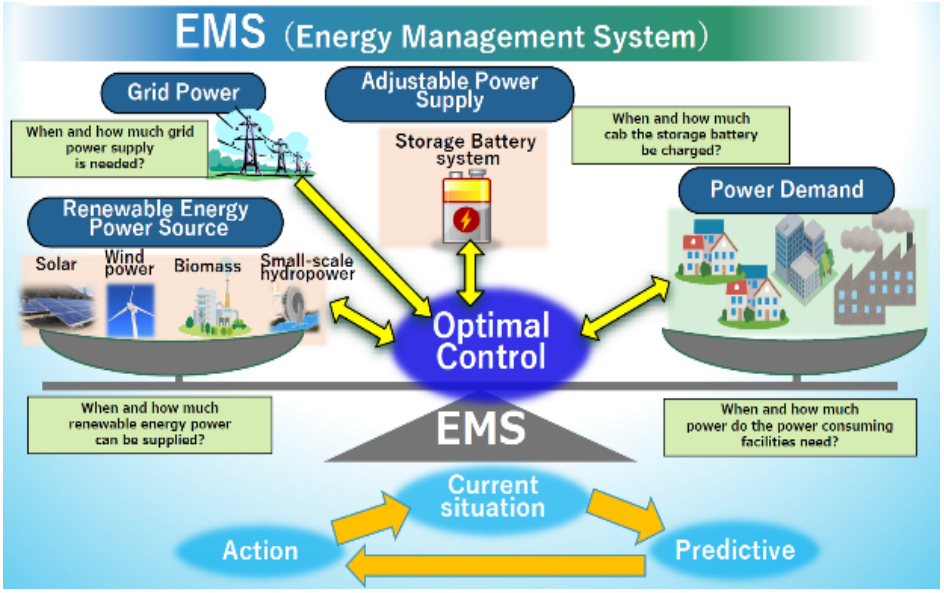
Continuing from last year, the possibility of introducing CSD's EMS technology in the new city hall of Pekanbaru City was studied.

EMS is a system that optimally controls the entire energy system by assessing the current status of when and to what extent grid power is needed, renewable energy sources can be supplied, storage batteries can be charged and discharged, and how much power is needed by power-consuming facilities.

CSD is mainly engaged in the development of environmentally and safety-conscious systems using EMS technology.

Source: Pekanbaru City

Figure 4-15 New City Hall area of Pekanbaru City



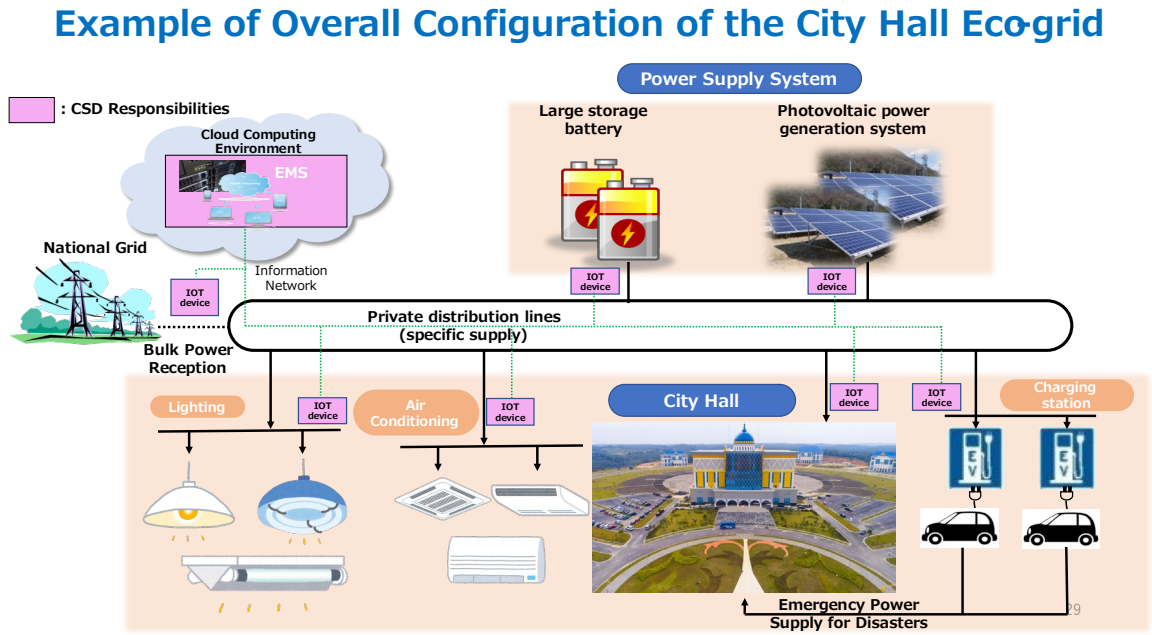
Source: Presentation material provided by CSD

Figure 4-16 Image of EMS technology

The measures and results of this fiscal year's study are as follows.

<Main measures>

1. Energy savings and CO2 reduction effects when solar power generation is used as electricity.
2. Furthermore, the energy saving and CO2 reduction effects of incorporating EMS-based lighting control and air conditioning control in the new city hall.
3. Emergency power supply by EVs in the event of a disaster



Source: CSD

Figure 4-17 Overview of the project

In addition, the following were confirmed through last fiscal year's interview survey;

1. When installing PV, confirmation with the PLN (National electric power company) is required, and the PV capacity that can be installed is less than (or equal to) 15% of the electricity consumed.
2. Ground-mounted PV is considered an IPP (Independent Power Producer), which makes it difficult to obtain approval from PLN.
3. The roof of the City Hall is a traditional design with a steep slope, making it difficult to install PV.

(2) Results

In order to study the possibility of applying EMS technology to the new city hall in Pekanbaru City, we calculated the GHG reduction. Each value was calculated by referring to local information from Pekanbaru City through on-site investigation, and using hypothetical data for information that was not available.

The results of the calculations are shown in the table below and the figure below. When discussing the effect of EMS, it is common to include the effect of adopting solar power generation in the evaluation, and the effect of only EMS in this case is;

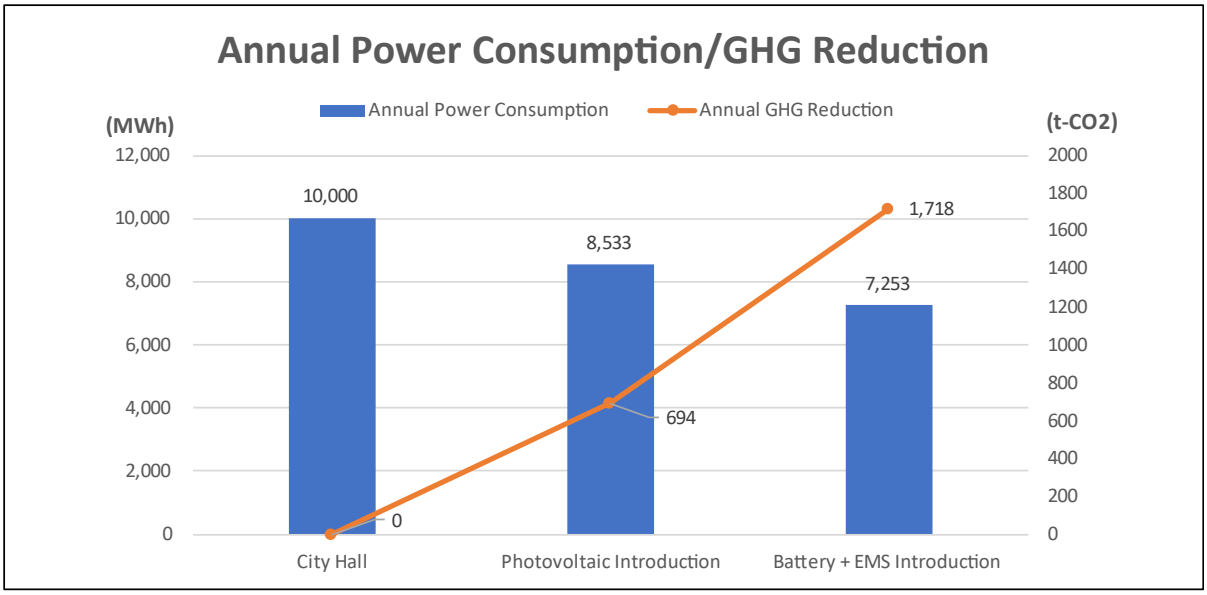
- Reduction of purchased electricity by storage batteries: 3-6% (depending on the size of the storage batteries)
- Reduction in electricity consumption by control: approx. 10% (varies depending on control target and content)
- The overall effect was assumed to be 15% in this study

The annual GHG emissions reductions when a 1.1 MW solar power system is installed for an EV bus system are 694 t-CO2 shown in . In addition, the annual GHG emission reductions when EMS and storage batteries besides on the above solar power system are installed is 224 t-CO2, assuming a 15% reduction effect, indicating the reduction effect of EMS.

Table 4-15 Results of the study of EMS technology introduction in the new city hall in Pekanbaru City

#	Items	Values	Unit	Remarks
a	Annual power consumption on the city hall	10,000	MWh/Year	Solar power capacity: 1.1 MW
b	Annual power generation	1,467	MWh/Year	Source: Global Solar Atlas
c	(PV system)	0.473	t-CO2/MWh	JCM model project (Renewable Energy, Sumatra)
d	Emission Factor	694	t-CO2/Year	= b×c
e	Annual GHG reduction	15	%	Storage batteries capacity: 2 MWh
f	(PV system)	0.8	t-CO2/MWh	Hypothesis data
g	Reduction effects	2,747	MWh/Year	EMS= PV optimum control + lighting control + air conditioning control
h	(Storage batteries + EMS)	1,718	t-CO2/Year	JCM model project (Energy saving, Sumatra)

Source: Prepared by Nippon Koei from materials provided by CSD



Source: provided by CSD

Figure 4-18 Results of the study of EMS technology introduction in the new city hall in Pekanbaru City

(3) Next steps

Although we have continued to study the feasibility of the JCM Model project, it turned out to be difficult to realize this project, which assumes that the equipment holder is PUPR of Pekanbaru City, because it was found difficult to include Pekanbaru City within the implementation structure in the survey described in 4.2.2. On the other hand, progress has been made regarding the 15% PLN rule, and the following changes are expected to be made in the future as a result of the President's approval on February 7, 2024 of an amendment to the Department of Energy and Mineral Resources (ESDM)

Decree "Permen ESDM No. 26 Tahun 2021".

Items	Current ESDM Decree	Current PLN support	Proposed changes
Maximum installed capacity	Up to 100% of existing capacity	Limited to 15% of existing capacity due to PLN internal regulations	No maximum capacity limit
Surplus power transmission to PLN	Surplus power is purchased by PLN at a price equivalent to the price of electricity	Does not purchase excess power. Does not provide meters for transmission.	No purchase of excess electricity (no transmission)
Application Period for Solar Installation	Possible at any time	Limit application availability by region.	Twice a year application system; quotas set up for possible applications

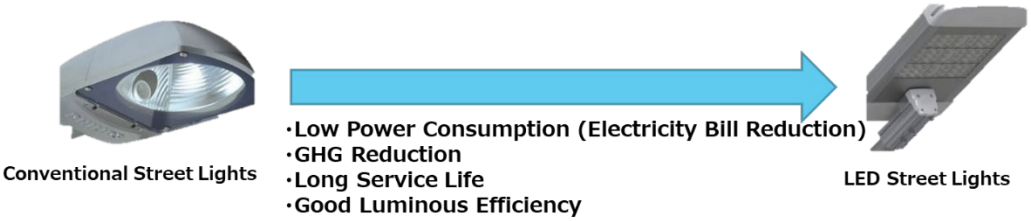
Source: Nippon Koei

This change will require effective use of surplus electricity, which may increase the demand for storage batteries + EMS, so we will first develop and introduce the above study idea to private companies in Pekanbaru City or Riau Province.

4.2.2. LED STREET LIGHTING PROJECT

(1) Project overview

DISHUB of Pekanbaru City is currently promoting the installation of LED streetlights in the city. As of 2017, there were approximately 40,000 street lights installed in Pekanbaru City, but 30,000 of them were not metered, resulting in higher-than-usual electricity rates. To solve this issue, we considered installing LED streetlights.



Source: CSD

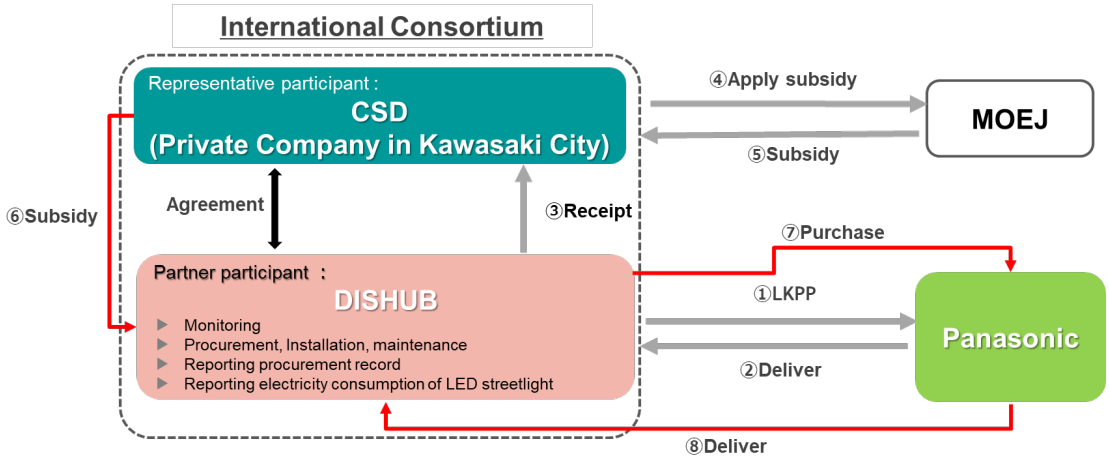
Figure 4-19 Image of introduction of LED streetlights

(2) Results

A study was conducted to introduce LED streetlights to Pekanbaru City using the JCM Model project for this fiscal year. In this project, it is envisioned to introduce more LED streetlights within the determined city budget by introducing additional LED streetlights by utilizing the subsidy for purchased LED streetlights.

1) Implementation Structure

The proposed implementation structure is shown in Figure 4-20. In this project, CSD, a company in Kawasaki City, was assumed as the representative company, the partner participant was assumed to be DISHUB, and the LED streetlights were assumed to be manufactured by PT. Panasonic Gobel Life Solutions Sales Indonesia (PGLSSID), a local subsidiary of Panasonic. The company's products are listed in the LKPP (Government Procurement Agency) E-Catalog and have a track record of installation in municipalities such as Jakarta Special Province.

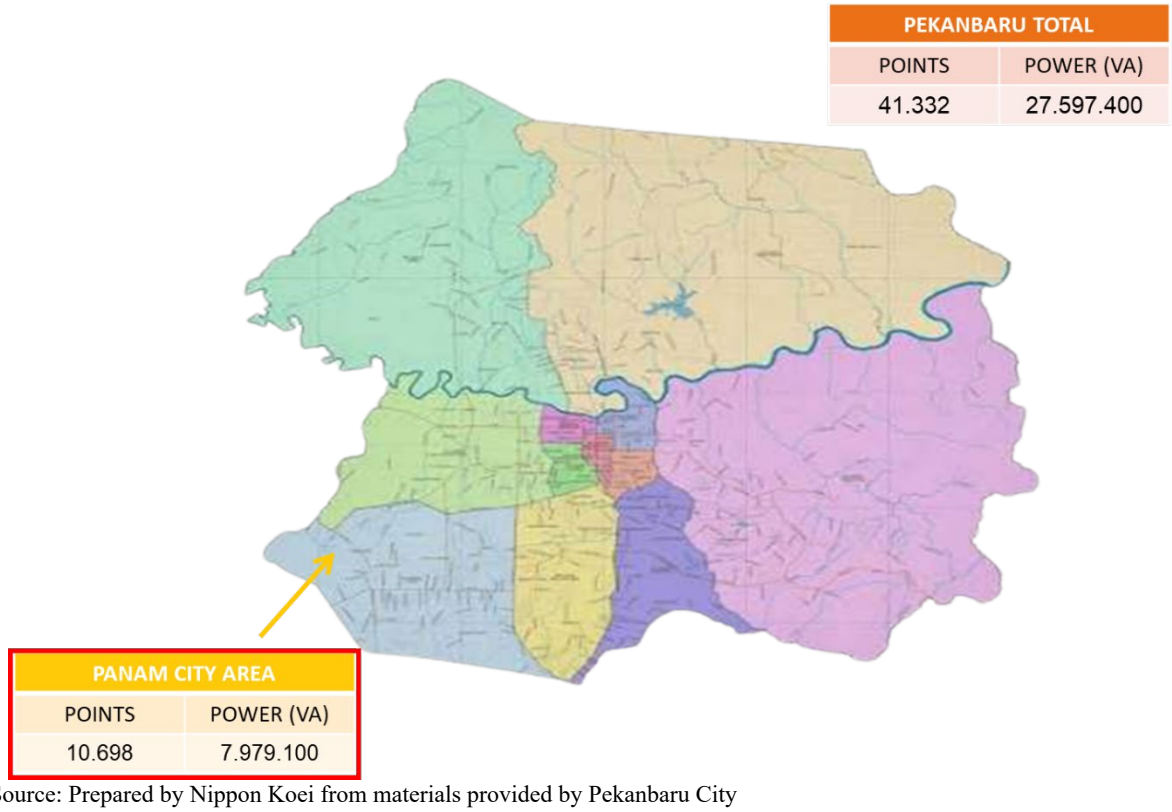


Source: Nippon Koei

Figure 4-20 Proposed Implementation structure for LED street lighting installation project

2) Project Site

In response to a request from Pekanbaru City, this project will consider installation in Panam city area of the city. As shown in Figure 4-21, Panam city area is an area where UNRI, a national university are located, and approximately 10,000 streetlights, or about a quarter of the total number of streetlights in Pekanbaru, have been installed.



Source: Prepared by Nippon Koei from materials provided by Pekanbaru City

Figure 4-21 Project Area for LED street lighting installation project

3) Estimation of GHG emission reduction

The existing methodology (JCM_ID_AM018_ver01.0) was used to estimate GHG emission reductions. The results of the estimation are shown in.

#	Items	Values	Unit	Remarks
a	Power Consumption of Project LEDs	90	W	Assumption based on data from DISHUB
b	Number of project LEDs installed	10,000	Points	Assumption (Panam City area)
c	Lighting hours of project LEDs	4,380	h/year	Assumption (12 hours x 365 days)
d	Annual energy consumption of project LEDs	3,942	MWh/year	Assumption
e	Luminous efficacy of project LEDs	160	lm/W	Assumption
f	Luminous efficacy of reference lighting	115	lm/W	See ID_AM018
g	Emission factor	0.94	tCO2/MWh	FY2023 JCM Equipment Subsidy Project Application Guidelines (Sumatra)
h	Annual reference GHG emissions	5,155	tCO2/year	=a×(b/c)×d
i	Annual project GHG emissions	3,705	tCO2/year	=a×d
j	Annual GHG reduction	1,450	tCO2/year	=e-f
k	Anticipated subsidy application amount	25,000,000	Yen	Assumption
l	Project Period	10	Year	JCM ID025
m	Total GHG emission reductions	14,500	tCO2-eq	
n	Cost-effectiveness	1,724	Year/tCO2	

Source: Nippon Koei

4) Challenges for application

we have been preparing for the project application as described in items 1) to 3) above but faced the following three issues in the preparation stage of the application documents.

1. Difficulty in obtaining documents requiring signatures from Pekanbaru City due to lack of precedent
2. Difficulty in obtaining necessary data and information due to delay in receiving them from Pekanbaru City
3. Pekanbaru City's budget is smaller than we assumed and is considering introducing other manufacturers.

With regard to No.1 above, DISHUB will be the owner of the LED streetlights, which are the installed equipments, and therefore was included in the International Consortium. However, it was found difficult to sign the International Consortium Agreement, which is a necessary document for application, as there are no examples. Regarding No.2, we were unable to obtain the information necessary for equipment selection (e.g., spacing and height of existing lighting) from the person in charge in Pekanbaru City. Regarding No.3, the budget for the next year for the purchase of LED streetlights in Pekanbaru City was only enough for approximately 140 lights, and the city was considering other manufacturers due to price. Particularly with regard to the latter, the project could not be realized because CSD., a candidate for the project representative, had no experience in the JCM Model project, and the condition was to use PGLSSID's products, which are reliable in terms of performance, technology, and communication.

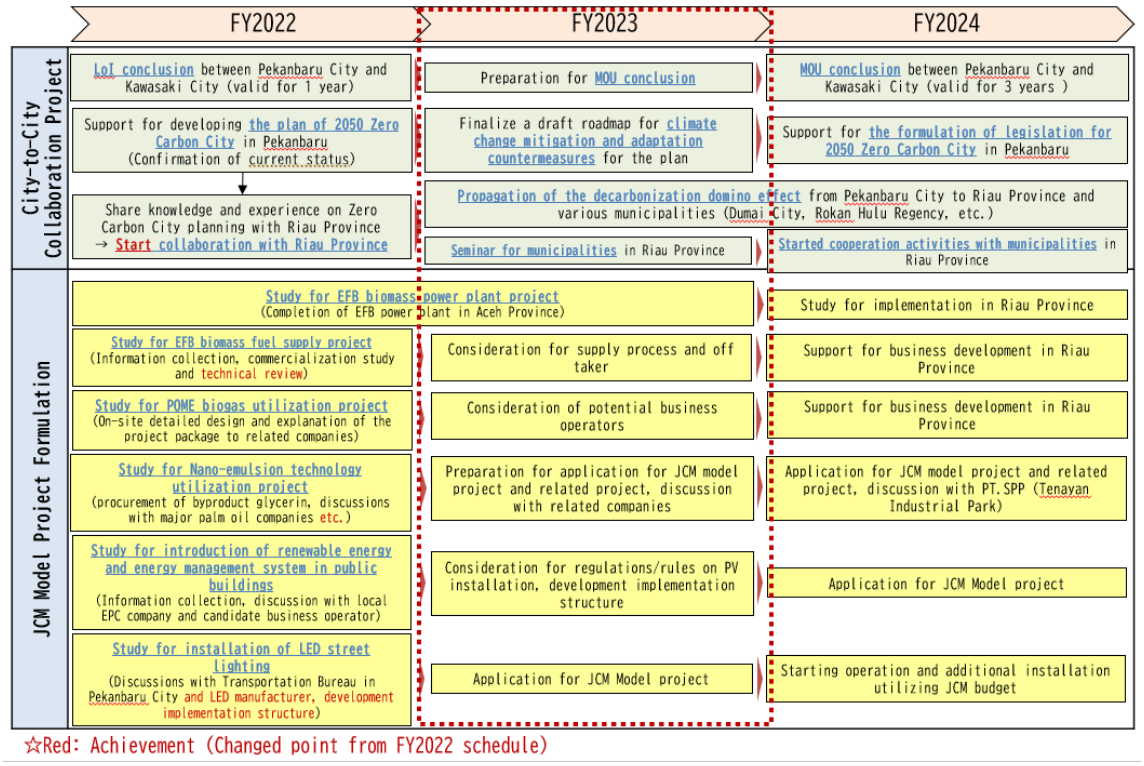
(3) Next steps

Based on the above, we found it difficult to establish a project with Pekanbaru City, so we will conduct a study in the next fiscal year with the aim of introducing the system to private companies in factories, buildings, shopping malls, etc. and industrial parks.

CHAPTER 5 PROGRESS AND OUTCOMES OF FY 2023

City-to-City Collaboration Project of Kawasaki City in Riau Province Region launched in 2019. This fiscal year was the second year of project Phase 2.

The figure below shows the three-year plan as of the time of the current year's proposal.



Source: Prepared by Nippon Koei

Figure 5-1 3-year plan (at the beginning of FY 2023 project)

Progress and outcomes of the plan are summarized in Table 5-1.

Table 5-1 Progress and outcomes of FY 2023

Sector	Progress and outcomes
(1) City-to-city collaboration activities	
Preparation for MOU Conclusion between Pekanbaru City and Kawasaki City	Through discussions between the two cities, it was confirmed that an MOU is not necessary at this time. On the other hand, since both cities were willing to continue the cooperative relationship, request letter and response letter were exchanged by the mayors of both cities to continue the cooperation.
Support for Pekanbaru City 2050 Zero Carbon City Plan Formulation	Capacity building by ITB/IPB/IGES to Pekanbaru City and UNRI was conducted to build capacity on the part of Pekanbaru City for the development of the Zero Carbon City Roadmap. In addition, an MOU between Nippon Koei and UNRI was signed to enable formal participation in the project. In the Mid-term Development Plan, which is being revised in 2023-2024, the project requested to include the strategy toward zero-carbon city and the circular economy concept of local biomass resources which have been promoted by this project.

Sector	Progress and outcomes
Propagation of the Decarbonization Domino in the Riau Region	Presentation of the 2060 Zero Carbon Roadmap by the Riau Province at the City-to-City Collaboration Workshop.
(2) JCM project formulation studies	
Studies of projects for development of circular economy	- EFB biomass utilization project Conducted interviews and surveys with EFB suppliers and several companies with fuel conversion technologies to establish a system and gather information for commercialization. - POME Biogas Utilization Project Pre-F/S was conducted to establish a business structure centered on the representative company, and to ascertain business profitability, etc. In addition, we signed NDAs with each company and actively collected information. - Nano-emulsion technology utilization project Analysis was conducted upon the by-product glycerin samples obtained through field surveys at local BDF plants. In addition, meetings were held with various companies to realize a demonstration project for Nano-emulsion technology by introducing NEFS in Indonesia.
Studies of projects for development of zero-carbon city	- Project for introducing renewable energy and energy management to public buildings Through a number of discussions with local EPC candidate companies and the city of Pekanbaru, we examined Indonesian laws and regulations and the implementation structure. Consultations were held with companies with experience in implementing solar JCM Model projects in Indonesia. - Project for the introduction of LED streetlights After repeated discussions with Pekanbaru City and LED manufacturers, as well as a field trip by a potential representative company, preparations were made to apply for the JCM Model project for LED streetlights. In the end, it was concluded that it would be difficult for Pekanbaru City to sign the international consortium agreement (direct contracting with an overseas corporation would require lengthy coordination), and the project was not realized.

Source: Prepared by Nippon Koei

CHAPTER 6 FUTURE PLANS

6.1. City-to-city collaboration activities

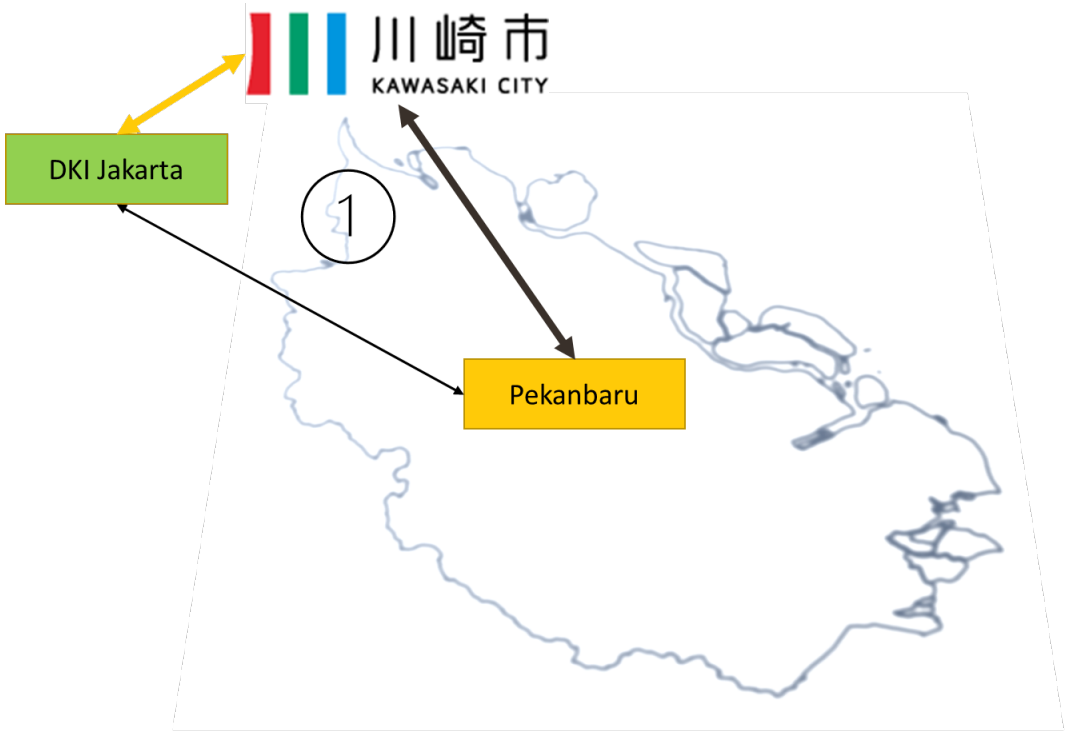
Realization of a decarbonization domino from Pekanbaru City

In FY2022, DKI Jakarta, Kawasaki's city-to-city collaboration partner, participated in a seminar in Pekanbaru and introduced their efforts and laws and regulations for decarbonization. Questions were actively raised among the Indonesian local governments, and it was confirmed that the coordination of city-to-city collaboration project by Kawasaki was effective.

In Phase 2, the approach will be to first support Pekanbaru City in developing a decarbonization roadmap by introducing the knowledge and experience of Kawasaki City and DKI Jakarta, and then to spread that knowledge within Riau Province. In doing so, the approach is to establish a partnership with Riau Province as Step 2, and in Step 3, Pekanbaru City will take the lead in spreading decarbonization to Riau Province and each local government (city and regency). Rather than Kawasaki working directly with many local governments, the approach is to support key organizations that will serve as the starting point of spreading decarbonization. As support for Pekanbaru City, Kawasaki will provide planning support in FY2022 and FY2023, while promoting the implementation of JCM projects in FY2023 and FY2024 that will lead to actual GHG reductions.

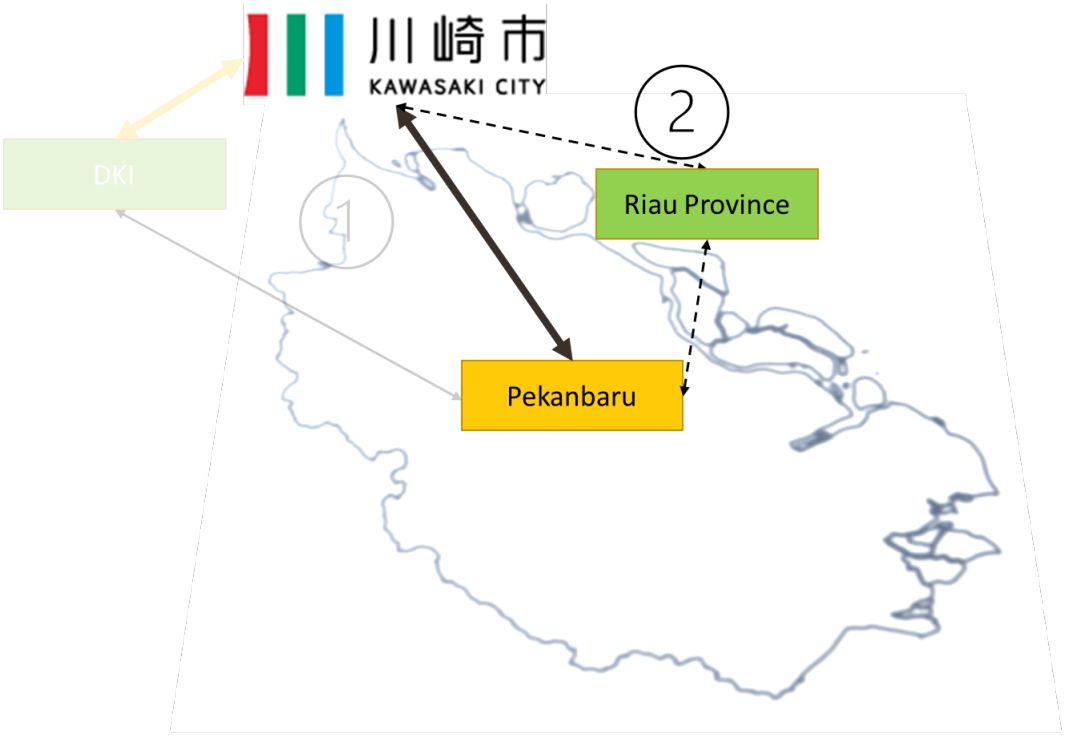
In particular, as for the possibility of utilizing the technology under consideration in this project, in addition to Pekanbaru City, there is high potential in other central palm oil production areas in Riau Province, such as Dumai City, where many palm oil-related industries are located in the coastal area, and Rokan Hulu Regency and other regencies which have large palm plantation areas.

The following is an image of the decarbonization workflow in Riau Province Region with the city of Pukanbaru at its core.



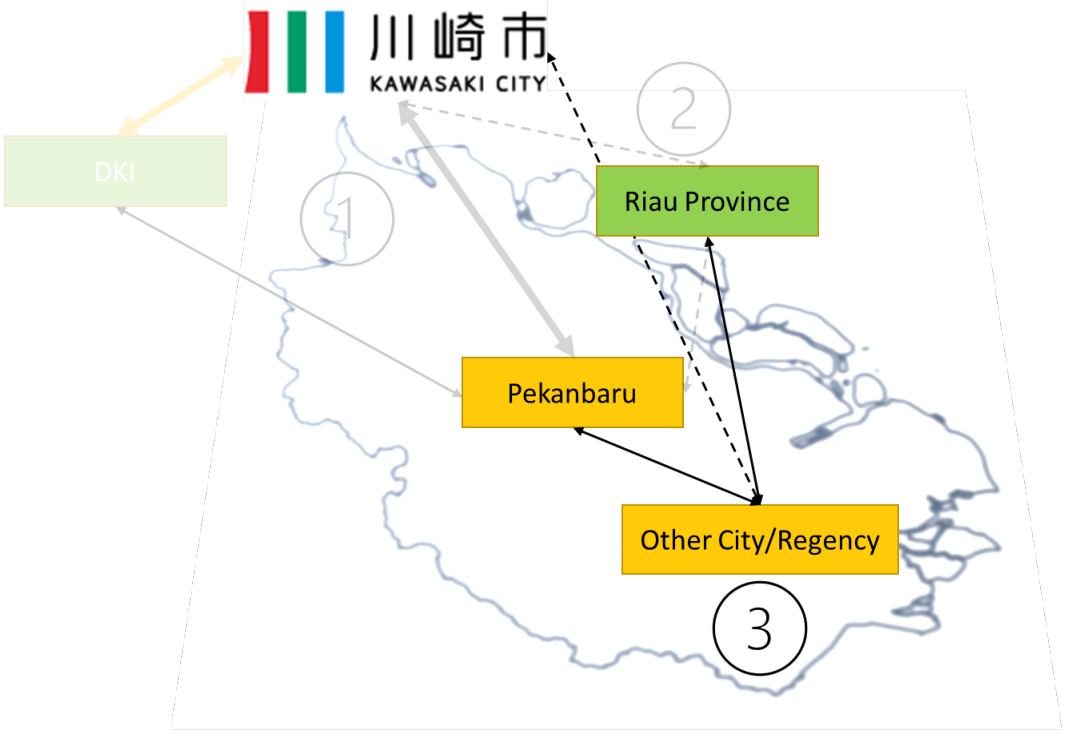
Source: Nippon Koei

Figure 6-1 Step 1: Develop a zero-carbon city roadmap for Pekanbaru in collaboration with Kawasaki City and the DKI Jakarta



Source: Nippon Koei

Figure 6-2 Step 2: Collaboration with Riau Province for development of zero-carbon city roadmap of Pekanbaru City supported by Kawasaki City



Source: Nippon Koei

Figure 6-3 Step 3 Decarbonization spread to cities and regencies in Riau, with Pekanbaru City as the core

In order to ensure the implementation of the project, the experts from ITB and IPB, who had assisted

DKI Jakarta in planning, joined the project implementation structure from FY2023 and started supporting Pekanbaru City. In addition, UNRI has joined the project as a core organization to store experience and knowledge in the province of Riau. We believe that an implementation support system has been established with these universities as the core, and we will continue to share the knowledge of ITB and IPB with UNRI, Pekanbaru City, and Riau Province in the next fiscal year as we support the creation of a concrete roadmap for the project.

6.2. JCM feasibility study

Based on the results of this fiscal year's study, the following candidate decarbonization projects will be considered in the Pekanbaru zero-carbon city roadmap as potential JCM model projects and other support programs.

6.2.1. EFB BIOMASS FUEL CONVERSION PROJECT

Regarding the EFB biomass power generation project, it was found that the completion of the plant in Aceh Province has been delayed and that the distance from the grid within Riau Province is too far to be profitable. On the other hand, with regard to the investigation of the EFB fuel conversion project, it was learned that the construction of the demonstration plant of Company A, a candidate fuel conversion manufacturer, has started, and the progress of the project will be updated. Another candidate manufacturer, Company B, is considering the use of EFB and other palm waste in Indonesia to demonstrate its technology, which has been demonstrated in a different country and with a different resource, and is currently preparing to sign a contract for the sale of the fuel. There is a high possibility of making this project a reality by taking advantage of the field research conducted in this project and the cooperative relationship with PTPN, thus the submission of a proposal for JCM-Demo project will be promoted in the next fiscal year.

6.2.2. POME BIOGAS UTILIZATION PROJECT

A Pre-F/S was conducted with the aim of establishing an implementation structure in this fiscal year, and the main candidate companies for the project value chain were identified and estimated costs were calculated.
Based on the results of this year's study, next year we will select construction companies, identify biogas users, and conduct a sensitivity analysis of biogas sales prices to confirm business feasibility. In addition, a geological survey and POME laboratory analysis are necessary to calculate more accurate construction costs and biogas production, and will be proposed to be included in next year's activities. Furthermore, in order to obtain agreement on the use of biogas in city buses, discussions with the new mayor of Pekanbaru City and DISHUB will be held pending the results of the mayoral election to be held in the next fiscal year. The plan is to submit a proposal for a project to JCM Demo-project (or its successor scheme) in the next fiscal year, or in FY 2025.

6.2.3. NANO-EMULSION TECHNOLOGY UTILIZATION PROJECT

The company had tried to apply for the JCM Demo-project this fiscal year, but was unable to do so due to the time required to make final adjustments with the factory where the fuel will be used. In the next fiscal year, with the support of a local partner company, they will proceed with the identification and coordination of the plant where the fuel will be used, which was difficult this year, and aim to apply for the project within the next fiscal year.

6.2.4. PROJECT FOR INTRODUCTION OF RENEWABLE ENERGY AND ENERGY MANAGEMENT SYSTEM

The transfer of carbon credit rights to PLN , the state-owned electric power company, is required for all

project to introduce renwable energy in Indonesia, and this will continue to be a major challenge for the formation of JCM projects, however, with the president's approval of the removal of restrictions on the amount of capacity to be installed, we will consider the introduction of a combination of storage batteries and EMS in the next fiscal year in particular. On the other hand, since the survey conducted this year revealed that it is difficult to form JCM projects for facilities owned by Pekanbaru City, approaching industrial parks in Dumai City and campus of UNRI will be further studied. Continuous to follow the development status of Tenayan Industrial Park, which is planned in Pekanbaru City, but since the timeline does not fit the current situation, we will consider expanding the project after its introduction to other industrial parks in the province.
Even if it is difficult to develop JCM project, consideration will be started in the next fiscal year so that this kind of project through financial contribution by private companies, etc., can be realized in order to further introduce renewable energy in Riau province region.

6.2.5. LED LIGHTING PROJECT

Through three discussions with DISHUB through this fiscal year's field trip, it was confirmed that it would be difficult for Pekanbaru City to be included within the international consortium. On the other hand, through multiple discussions with LED manufacturers within the Special Province of Jakarta, strong interest was expressed in introducing their products using the JCM subsidy. Therefore, in the next fiscal year, formulation of a JCM Model project through discussions with industrial parks, buildings, shopping malls, etc. within Riau Province will be promoted.

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