FY2021 Project for Ministry of the Environment Japan

FY2021
City-to-City Collaboration Programme for Zero-Carbon Society

Project to Promote Development of Circular Economy and 2050 Zero Carbon City in Riau Province Region

Report

March 2022

Nippon Koei Co., Ltd.
Kawasaki City

FY2021
City-to-City Collaboration Programme for Zero-Carbon Society

Project to Promote Development of Circular Economy
and 2050 Zero Carbon City in Riau Province Region

Report

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Abbreviations

BAU	Business-as-Usual
BtoB	Business to Business
CAPEX	Capital Expenditure
CNG	Compressed Natural Gas
COVID-19	Coronavirus Disease 2019
DKI-JKT	Special Capital Region of Jakarta (Daerah Khusus Ibukota Jakarta)
DPRD	Regional People's Representative Council (Dewan Perwakilan Rakyat Daerah)
EFB	Empty Fruit Bunch
EMS	Energy Management System
FFB	Fresh Fruit Bunch
F/S	Feasibility Study
FY	Fiscal Year
IMF	International Monetary Fund
GHG	Green House Gas
GIC	Kawasaki Green Innovation Cluster
JCM	Joint Crediting Mechanism
JST	Japan Standard Time
KSDLL	Regional Cooperation with Overseas Organizations (Kerja Sama Daerah Dengan Lembaga Di Luar Negeri)
KSDPL	Regional Cooperation with Overseas Local Governments (Kerja Sama Daerah Dengan Pemerintah Daerah Di Luar Negeri)
LED	Light Emitting Diode
LOI	Letter of Intent
MF	Mesocarp Fiber
MOE	Ministry of the Environment, Japan
MOU	Memorandum of Understanding
NDC	Nationally Determined Contribution
OM	Operations and Maintenance
OPEX	Operating Expenditure
PKS	Palm Kernel Shell
PLN	PT Perusahaan Listrik Negara /Persero (National Electricity Company)
POME	Palm Oil Mill Effluent
PSA	Pressure Swing Adsorption
PT.PN	PT. Perkebunan Nusantara
PT.PN5	PT. Perkebunan Nusantara V (PERSERO)
PT.SPP	PT. Sarana Pembangunan Pekanbaru
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)
RPRKD	Climate Resistant Regional Low Carbon Development Plans (Rencana Pembangunan Rendah Karbon Daerah)

RSPO	Roundtable on Sustainable Palm Oil
RUEN	Grand National Energy Plan 2015-2050 (Rencana Umum Energi Nasional)
SDGs	Sustainable Development Goals
WWF	World-Wide Fund for Nature
ZEB	Net Zero Energy Building
ZEH	Net Zero Energy House
ZEV	Zero Emission Vehicle

CHAPTER 1 BACKGROUND AND OBJECTIVE

1.1 Background of the project

Paris Agreement which entered into force in November 2016 and to 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 leading communities directly and importance of development approach by initiatives of local communities were confirmed. In Japan, the Government declared that Japan in aiming to become a zero-carbon society by achieving zero emission of overall greenhouse gas (GHG) by 2050 and more than 300 local governments declared 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, under current situation of COVID-19 pandemic, while tackling issues related to the pandemic, cities are required to re-coordinate and consider new policies to achieve sustainable development. From this perspective, it is important to develop new measures and cities by 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 priority countermeasures. 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 implemented between Kawasaki City and municipalities in Riau Province (Pekanbaru City and Rokan Hulu Regency). Riau Province is located in the center of Sumatra Island of Indonesia and core industry there 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 of 2017 was 12% which was larger than any other product. Production amount of palm oil in Indonesia is the largest in the world and 85% of palm oil in the world is produced in Indonesia and

Malaysia. (WWF 2017). Also, both production (7.72 million ton) and cultivation area (2.26 million ha) in Riau Province are the largest in Indonesia (Statistik Kelapa Sawit Indonesia 2017).

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 on activities towards low-/zero-carbon society, introduction of equipment to contribute to development of low-/zero-carbon society and realization of decarbonization domino by cooperating with Japanese cities with experiences and knowhow for development of low/zero-carbon society.

This project contributes to promotion of circular economy for oil palm industry in Riau Province Region by utilizing Kawasaki City's experience of promotion of Zero-emission Concept and technologies of companies related to Kawasaki. Also, support for development of 2050 Zero Carbon City in Pekanbaru City is carried out.

1.3 Implementation structure

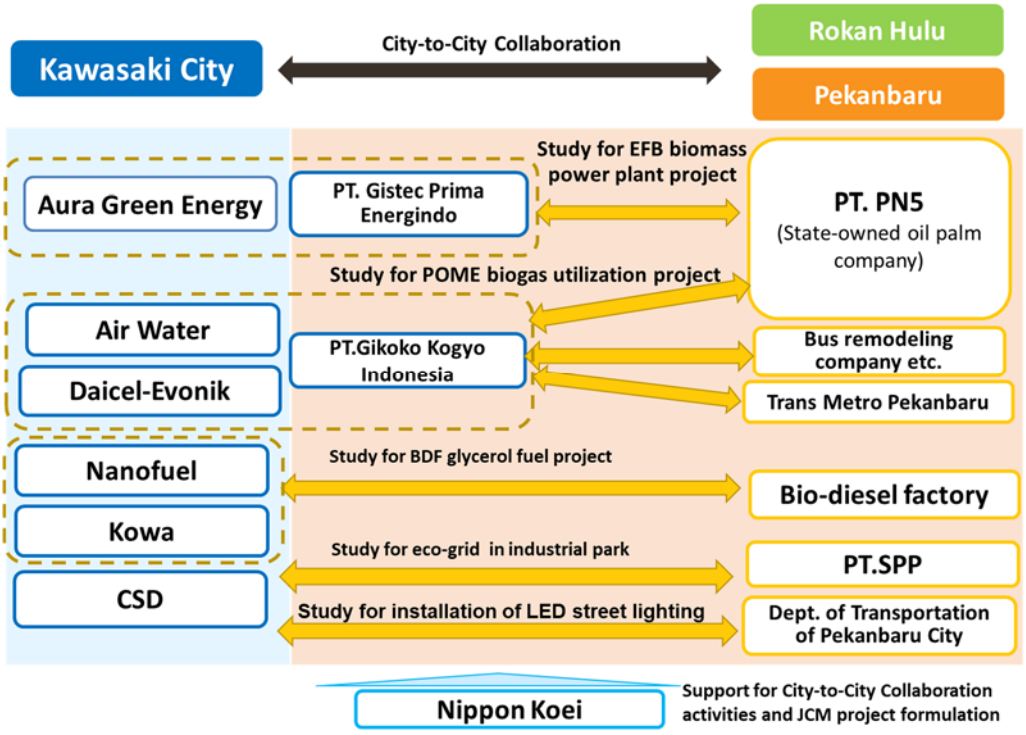
Implementation structure of FY2021 is illustrated in Figure 1.1. Kawasaki City carried out discussion of circular economy for oil palm industry and of development of 2050 Zero Carbon City with Pekanbaru City and Rokan Hulu Regency.

Also, under the City-to-City Collaboration, 1-1) Empty Fruit Bunch (EFB) biomass power plant project, 1-2) Project for Palm Oil Mill Effluent (POME) biogas utilization and 1-3) BDF glycerol fuel project were implemented as projects contributing to formulation of circular economy in palm oil sector. Regarding 1-1), Aura Green Energy Co., Ltd. and its local partner, PT. Gistec Prima Energindo, implemented feasibility study on target palm oil mills owned by National Oil Palm Company, PT. Perkebunan Nusantara V (PT.PN5), whereas Daicel-Evonik Ltd., Air Water Inc. and PT. Gikoko Kogyo Indonesia implemented study with palm oil mills owned by PT.PN5 for consideration of design of bio-CNG plant and interviewed to public bus company, Trans Metro Pekanbaru for data collection for 1-2). About 1-3) Study on BDF factories and glycerol market were implemented by Nanofuel Co., Ltd. and Kowa Company.

In addition, as JCM projects contributing to development of zero carbon city, 2-1) Project for Eco-grid in an industrial park and 2-2) Project for installation of LED street lightings were studied. Based on information provided by operating company of Tenayan Industrial Park, PT Sarana Pembangunan Pekanbaru (PT.SPP), and Department of Transportation of Pekanbaru

City, CSD Co., Ltd. considered specification of technologies and impact on GHG emission reduction.

This project was implemented without a trip to Riau Province considering COVID-19 pandemic in the world. Thus, information collection, studies and discussions were implemented under cooperation with two local companies above and two local experts.



Source: Prepared by Nippon Koei

Figure 1.1 Implementation structure

1.4 Project schedule

Project period was from September 13th, 2021 to March 10, 2022. Schedule of this project is shown below.

#	Study contents	Sep	Oct	Nov	Dec	Jan	Feb	Mar
City to City Collaboration Activities								
1	Discussion on circular economy	→	→	→	→	→	→	
2	Discussion on 2050 Zero-Carbon City	→	→	→	→	→	→	
3	Information collection regarding oil palm sector		→	→	→	→	→	
4	Procedure for LoI conclusion	→	→	→	→	→	→	→
Workshop, Seminar etc.								
1	Workshop and business matching seminar				▼		▼	
2	Kawasaki Eco-Tech Fair			▼				
Field study, preparation of report etc.								
1	Field study and information sharing	→	→	→	→	→	→	
2	Monthly report		▼	▼	▼	▼	▼	▼
3	Reporting meeting with MOE	▼				▼	▼	
4	Meetings (Kawasaki City, partner companies)	▼	▼	▼	▼	▼	▼	
5	Preparation of final report					→	→	
JCM project formulation study EFB biomass plant project (1-1)								
1	Study on biomass fuel		→	→	→	→	→	
JCM project formulation study: POME biogas utilization project (1-2)								
1	Design of bio-CNG plant	→	→	→	→	→	→	
2	Estimation of CAPEX and OPEX of bio-CNG plant	→	→	→	→	→	→	
3	Selection of company for retrofit of buses	→	→	→	→	→	→	
4	Project plan development and economic evaluation			→	→	→	→	
JCM project formulation study: BDF glycerol fuel project (1-3)								
1	Contact to BDF factories and collection of bi-glycerol sample	→	→	→	→	→	→	
2	Study on glycerol market			→	→	→	→	
3	Consideration of project plan			→	→	→	→	
JCM project formulation study: Project contributing to zero-carbon city (2-1, 2-2)								
1	Information collection from local stakeholders	→	→	→	→	→		
2	Technical proposal and discussion			→	→	→	→	
3	Consideration of specification of installed technologies			→	→	→	→	
4	Project plan development and economic evaluation			→	→	→	→	
5	Consideration of project structure			→	→	→	→	

Source: Prepared by Nippon Koei

Figure 1.2 Project schedule

CHAPTER 2 OVERVIEW AND ENVIRONMENTAL ACTIONS OF KAWASAKI CITY AND RIAU PROVINCE REGION

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 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 Map of Kawasaki City

Table 2.1 Statistical data of Kawasaki City

#	Item	Statistical data
1	Area	144.35km2
2	Population	1,538,825 (as of January 1, 2022)
3	Number of households	754,576 (as of January 1, 2022)
4	Gross city product (nominal)	6,381.6 billion yen (2016)

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

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)

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).

2.1.2 Kawasaki City Basic Plan to Promote Global Warming Countermeasures

In 2010, based on Kawasaki City Ordinance for Promotion of Global Warming Countermeasures released in 2009, Kawasaki City enacted the Basic Plan to Promote Global Warming Countermeasures (hereafter "Plan 2010") to drive actions against global warming in a comprehensive and systematic manner, and to set reduction target for FY2020. Plan 2010 was revised in 2018 (hereafter "Plan 2018") to set new reduction target for FY2030, and to illustrate plans to achieve the target.

The overview of Plan 2010 and Plan 2018 is shown in Table 2.2. Plan 2018 is currently being revised in line with the declaration of 2050 Zero Carbon City and release of Kawasaki Carbon Zero Challenge 2050.

Source: Kawasaki City

Figure 2.2 Basic Plan to Promote Global Warming Countermeasures

Table 2.2 Overview of Plan to Promote Global Warming Countermeasures (Plan 2010 and Plan 2018)

Item	2010 Plan	2018 Plan
Period	FY2011-2020	FY 2018-2030
Basic concept	To develop a sustainable low-carbon society based on harmonization and positive cycle of the environment and economy and to preserve positive environment for the next generations.	To develop a low-carbon society with multi-benefit measures against global warming.
Basic policy	(1) To develop a social and economic system leading to reduction of GHG emissions effectively. (2) To use locally available energy resources such as renewable and unutilized energy efficiently and effectively. (3) To reduce GHG emissions by business operators, citizens and the city in their respective capacity. (4) To encourage joint activities. (5) To contribute to reduction of GHG emissions worldwide. (6) To contribute to countermeasures to heat island phenomenon.	(1) To proceed reduction of GHG emissions. (2) To implement of introduction of renewable energy and optimization of energy consumption. (3) To promote adaptation measures for climate change. (4) To contribute with environmental technologies and industries. (5) To encourage collaboration among citizens, business operators and public sector.
Reduction target	To aim at 25% reduction of GHG emissions compared with FY1990, by FY2020.	To aim at 30% reduction of GHG emissions by FY2030, compared with FY1990 (or 20% compared with FY2013).

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

This plan is currently being revised in accordance with the formulation of the 2050 Zero Carbon City Declaration and the "Kawasaki Carbon Zero Challenge 2050" decarbonization strategy, as described below. The following table summarizes the draft of the Kawasaki City Basic Plan for the Promotion of Global Warming Countermeasures (hereinafter referred to as the "2022 Draft Plan"), which was released in December 2021.

Table 2.3 Kawasaki City Basic Plan for the Promotion of Global Warming Countermeasures (Plan 2022)

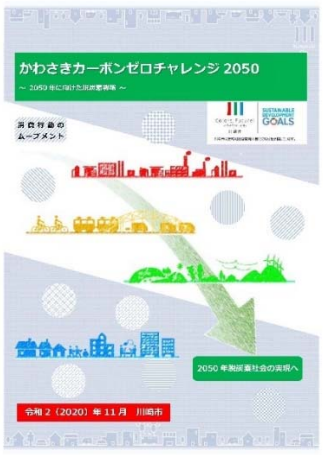
Item	Proposed Plan for 2022
Duration	FY2022 - FY2030 period
Future Vision	Aim for Net-Zero GHG emissions in the city area by 2050
Basic Concept	"Creating a Zero-Carbon city where future generations can live peacefully" and "Creating a sustainable and powerful industry through a virtuous cycle between 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) 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 (210,000 tCO2 reduction compared to FY 2013) Municipal office targets (all public facilities in the city): 50% or more reduction by FY 2030 (9.52 million 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 2019)

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

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

The strategy lists of images of achievements of zero carbon society in Kawasaki as shown below.

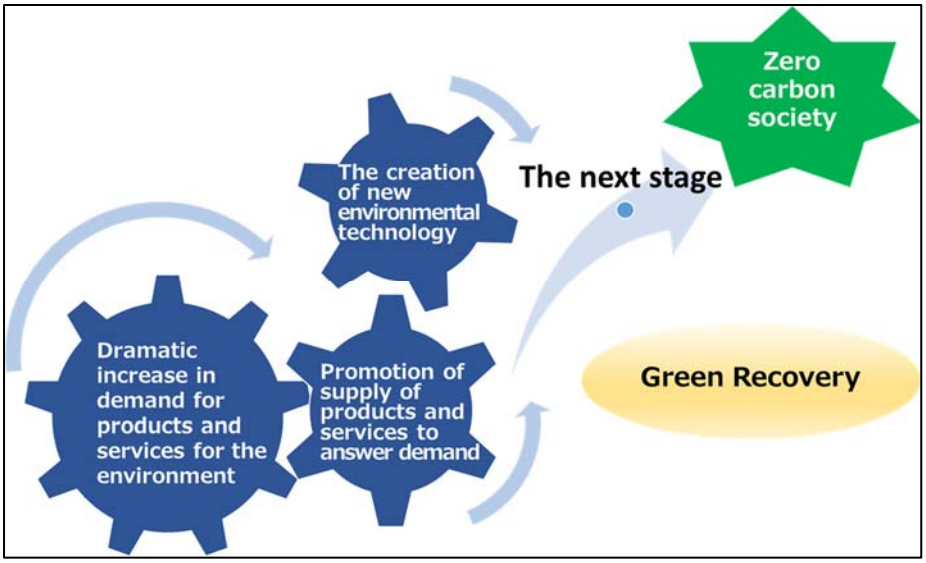
Table 2.4 Images of zero carbon society in Kawasaki in 2050

Sector	Images
Private sector (households and business operations)	(1) Zero-energy buildings (shifting to Net Zero Energy Building (ZEB) and Net Zero Energy House (ZEH)) become general. (2) Power sources based on renewables are widespread, as well as local power supply and consumption by utilizing the potential of the region. (3) Realization of compact city, decarbonization of buildings and realization of urban forest by generalizing wooden buildings. (4) 100% renewable energy utilization for the city’s activities and minimization of energy consumption in public facilities.
Transportation	(1) Replacement of vehicles including cars, buses, taxis and trucks with Zero Emission Vehicle (ZEV). (2) Replacement of all official cars with ZEV.
Waste	(1) Transformation of lifestyle such as to stop using single-use plastics, transformation to biomass materials, generalization of behaviors for food loss by generalizing environmentally friendly manners of citizens and companies.
Industry	(1) More companies in Kawasaki turn to decarbonization voluntarily. (2) Innovation and business model of environmental and energy sectors generated in Kawasaki lead industries inside and outside the city. (3) Promotion of renewable energy as main energy. (4) Realization of technological innovation and industrialization to contribute to zero carbon and contributions to zero-carbon lifestyle of citizens by collaborating with companies in Kawasaki. (5) Development of society based on hydrogen energy networks. (6) Generalization of sustainable finance to contribute to decarbonization.

Source: Prepared by Nippon Koei based on Kawasaki Carbon Zero Challenge 2050

The basic approach of Kawasaki City for realization of zero-carbon society is "to realize zero-carbon society by having consumer activity movement influences on the society. This is based on the role of municipality, "to encourage citizens and companies to act in environmentally friendly manner as a familiar sight in the community" and characteristics and advantages of Kawasaki City "accumulation of environmental technologies, industries and research institutes and existence of a lot of citizens and companies with high awareness on the environment".

"Consumer activity movements" means that consumers select environmentally friendly products and services and dramatically boost their needs (demand). Also, "Influencing society" means to accelerate supply of products and services for zero carbon and to develop new innovations. Furthermore, the city has set three pillars as drivers of these three cogwheels to achieve zero-carbon society by 2050.



Source: Kawasaki Carbon Zero Challenge 2050

Figure 2.4 Image of the approach to zero-carbon society

Table 2.5 Three activity pillars and unique activities

Activity pillars	Initiatives led by the city (unique activities)
Pillar I (Participation and collaboration of various stakeholders)	Establishment of zero-carbon model district (as a familiar zero-carbon model
Pillar II (Kawasaki City takes initiative)	Introduction of renewable energy to public facilities, thoroughness of energy saving and change of awareness of officers. - To reduce 10% energy consumption in city halls by 2030, by thoroughness of energy saving. - To achieve RE100 in main public facilities such as city halls and ward offices by local generation of renewable energy and procurement of renewable energy.
Pillar III (Promotion of green innovations from Kawasaki)	To consider evaluation supports and evaluation measures for companies implementing activities for decarbonization.

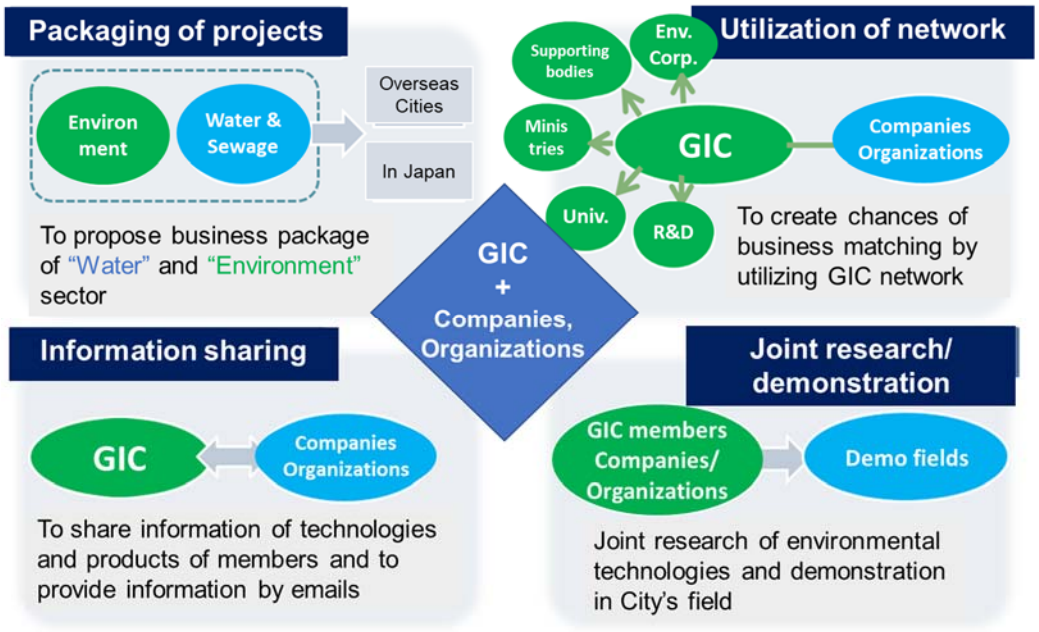
Source: Prepared by Nippon Koei based on Kawasaki Carbon Zero Challenge 2050

2.1.4 Kawasaki Green Innovation Cluster (GIC)

In 2014, Kawasaki City released its Promotion Policy on Kawasaki Green Innovation. 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

In 2014, Kawasaki Green Innovation Cluster (GIC) was established as a structure to promote these four pillars. It is a network for collaboration among industries, academia, and private and public sectors to improve the environment and to promote industrial development and international contributions. GIC functions to provide "access to utilization of schemes of Kawasaki City and supporting organizations", "promotion and information sharing opportunities" and "support of business development by utilizing environmental technologies, and know-how of public services".



Source: Kawasaki City

Figure 2.5 Image of activities utilizing GIC

2.1.5 Kawasaki Eco-Town

Kawasaki City positions "Zero-Emission Concept" as the basic concept for creating a local circular economy and recognize it as the basis for revitalizing the local community. In 1997, the city developed "the Kawasaki Eco-Town Plan" targeting the entire coastal area of Kawasaki (about 2,800 ha) and received approval from the government as the first eco-town in Japan. The target areas are working on resource circulation activities, with companies circulating and reusing resources and waste emitted in the city among themselves by taking an advantage of the high concentration of companies and environmental technologies in the coastal area. Also, resource circulation activities are carried out not only in the city, but in wider in Japan and overseas.

Shown below are the four pillars and concrete measures based on the Kawasaki Eco-Town Concept.

Table 2.6 The four pillars and concrete measures based on the Kawasaki Eco-Town concept

Pillars of the activities	Measures
Promoting eco-friendly measures by each company	- To organize advanced recycling facilities - To encourage resource circulation based on characteristics and strengths of companies - To realize zero-emission of industrial waste and wastewater
Promoting eco-friendly measures with other companies	- To develop Kawasaki Zero-Emission Industrial Park - To implement joint recycling in the district
Undertaking researches for environment-based, sustainably	- To research on effective energy usage - To research on advancing Eco-Town initiatives

Pillars of the activities	Measures
developing districts	- To vitalize the research and development industry
Documenting the achievements of the companies and districts and contributing to developing countries	- To provide study tours - To hold Kawasaki International Eco-Tech Fair

Source: Prepared by Nippon Koei based on Kawasaki City website

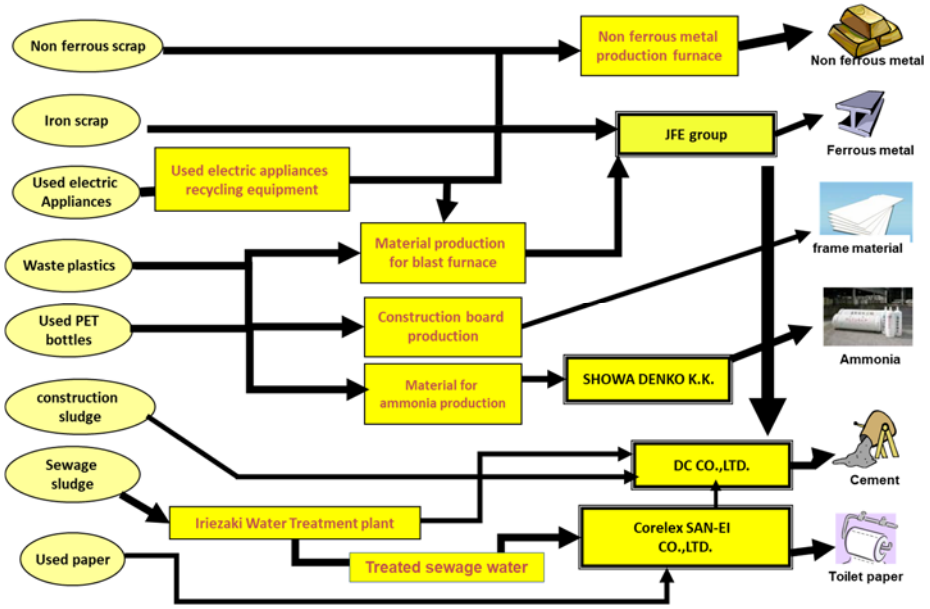
In 2002, in Kawasaki Eco-Town target areas, Kawasaki Zero-Emission Industrial Park started operation as a model facility of the Kawasaki Eco-Town Concept. It saves waste from business activities and aims to minimize environmental burden by reusing and recycling resources and utilizing circulated energy.

The concept and concrete measures of the Zero-Emission Industrial Park are as follows.

Table 2.7 The concept and concrete measures of Zero-Emission Industrial Park

Concept	Measures
- To set own basic environmental policies by each company. - To set a higher goal (zero-emission) than the emission criteria. - To work together with other companies in the industrial park to make the activities more efficient. - To integrate factors of environmental burden into processes by cooperation among companies. - To realize total zero emission by linking things, difficult to be made zero emission in the industrial park, - with surrounding circulation function	- They set waste reduction targets for and actively save internally generated waste - The industrial park's union collects all paper waste from the companies to be recycled - To reuse waste heat energy from incineration plants - To reuse highly treated water from Kawasaki Iriezaki Water Treatment Center in the industrial park, as well as water treated in the plants - To recycle as much water as possible and reduce the work of waste treatment facilities - To reuse incineration fly ash as a raw material for cement - To compost organic waste from the companies and use as a fertilizer for communal green area in the industrial park - To use rainwater as fire protection water and irrigation water - To share each self-generated power among companies

Source: Prepared by Nippon Koei based on Kawasaki City website



Source: Kawasaki City

Figure 2.6 Resources circulation in Kawasaki Eco-Town including Zero Emission Industrial Park

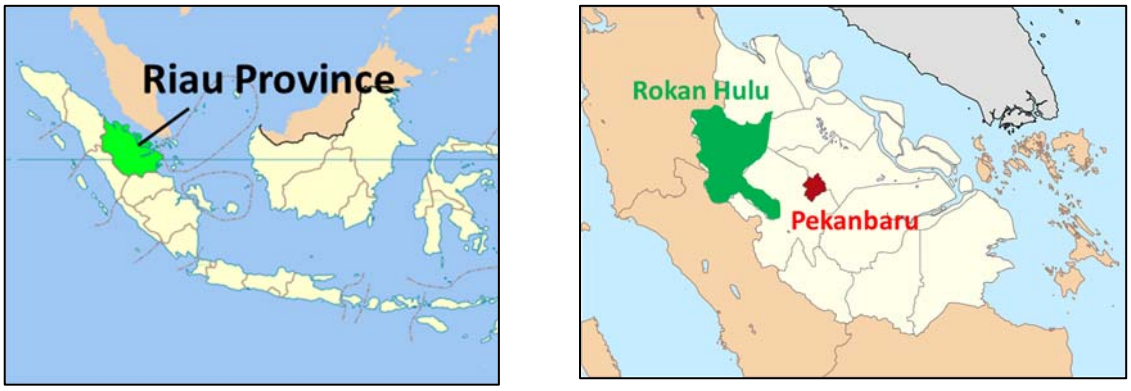
2.2 Riau Province Region

2.2.1 Overview of Riau Province Region

Riau Province is located in the center of Sumatra Island of Indonesia and core industry in the area is oil palm sector. Palm oil is one of 10 key products decided by the Ministry of Trade of Indonesia. The percentage of palm oil in export of 2017 was 12% which was larger than any other product. Both production (7.72 million ton) and cultivation area (2.26 million ha) in Riau Province are the largest in Indonesia (Statistik Kelapa Sawit Indonesia 2017). Also, production and cultivation area in Rokan Hulu are the biggest in Riau Province, 1.49 million ton and 0.41 million ha, respectively.

On the other hand, Pekanbaru City, the capital city of Riau Province, has been developing its economy and industry rapidly with the population of more than one million and been promoting various policies and projects such as development of an industrial park, development of new city center and introduction of new transportation system etc.

Locations of Riau Province, Pekanbaru City and Rokan Hule Regency and overview of them are as shown below.



Source: Prepared by Nippon Koei

Figure 2.7 Locations of Riau Province, Pekanbaru City and Rokan Hulu Regency

Table 2.8 Overview of Riau Province Region

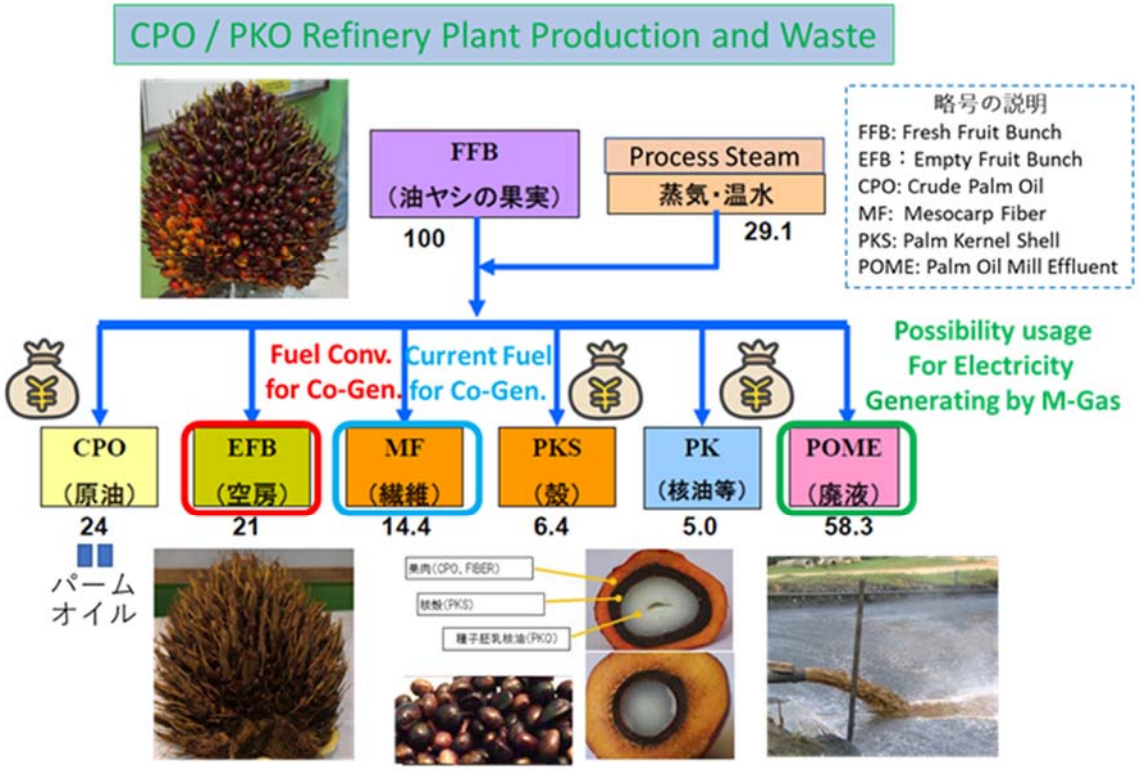
Items	Riau Prov.	Pekanbaru	Rokan Hulu
Population (2019)	6,454,751	1,045,039	560,355
Area (km2) (2019)	87,023	632	7,588
Density (person/km2) (2019)	74	1,555	74
Gross Regional Product (USD million) (2020)	54,120	8,430	---

Source: Prepared by Nippon Koei based on reports of Statistics Indonesia

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 2.8 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 Letter of Intent between Pekanbaru City and Nippon Koei.

2.2.4 Development of Tenayan Industrial Park

Pekanbaru City is currently developing Tenayan Industrial Park (Total development area: 2,66 km2) which was designated as a prioritized industrial park by the Indonesian Government. The industrial park is along with 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 experiences of Kawasaki City who 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 2.9 Tenayan Industrial Park

2.2.5 Siak River Rehabilitation

Siak river flows from the center of Sumatra Island to the Strait of Malacca through Pekanbaru and is 370 km long. The river is famous as the deepest river in Indonesia and tankers and container ships can access to Pekanbaru. For this reason, there are many factories such as palm oil mills, paper and pulp, wood processing and rubber processing factories along the river.

Source: Pekanbaru City

Figure 2.10 Siak River

While Siak River supports the economy of Riau Province, pollution of the river by industrialization of urban areas is one of the largest issues. Considering this situation, Pekanbaru City has a strong interest in experiences of Kawasaki City on rehabilitation of Tama River and Citarum River purification through cooperation with Bandung City and in technologies of companies in Kawasaki for purification of water environment.

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

3.1 City-to-city collaboration activities in FY2019 and FY2020

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, Department of Transportation, BAPPEDA, Department of Public Works and Housing, 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

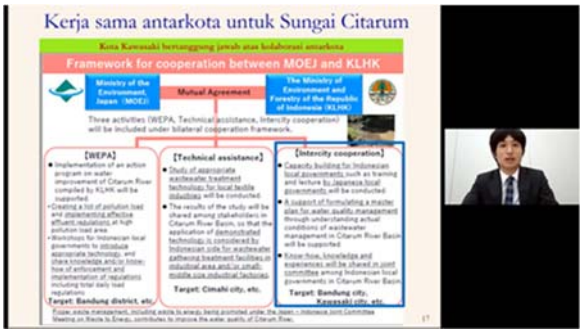
Year/Month	Activity (Location)	Overview
		collaboration of Kawasaki City (with DKI-Jakarta and Yangon City), and zero-emission industrial park were presented. During the conference, Pekanbaru City chows their interest in 2050 Zero Carbon City and it was agreed to make it theme of City-to-City Collaboration 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.

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)



City-to-City Collaboration Webinar (March 2021)

3.2 City-to-city collaboration in FY2021

Themes of FY2021 City-to-City Collaboration project were 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 circular economy and green recovery	Through Kawasaki International Eco-Tech Fair (Section 3.3.3), and Online business seminar of GIC members with Pekanbaru City and DKI-JKT (Section 3.3.4), information transmission of environmental needs of Pekanbaru City, and technology introduction from GIC members and network formulation for circular economy and green recovery was carried out.
2	Support for development of 2050 Zero Carbon City	Discussion for conclusion of LOI between Kawasaki City and Pekanbaru City about 2050 Zero-Carbon City was implemented (Section 3.3.2). In the City-to-City Collaboration Workshop, progress of zero-carbon strategy "Kawasaki Carbon Zero Challenge 2050" developed in November 2020 by Kawasaki City and activities for zero-carbon city by DKI-JKT, who published zero-carbon plan "RPRKD" in October 2021, were shared with Pekanbaru City. (Section 3.3.5)

Source: Prepared by Nippon Koei

3.3 Results of city-to-city collaboration activities

3.3.1 Activities in FY2021

Activities in FY2021 are summarized in the table below.

Table 3.3 City-to-city collaboration activities in FY2021

Activities	Date	Overview
Presentation in GIC member meeting	September 13, 2021	Nippon Koei participated in GIC member meeting and introduced this project to member companies whereas implementing individual meetings with some member companies.

Activities	Date	Overview
Kick-off meeting with MOE	September 21, 2021	Kick-off meeting among MOE, Kawasaki City and Nippon Koei was carried out. Project overview and schedule in FY2021 was confirmed.
Meeting with the Indonesian Embassy in Japan	October 4, October 13, 2021	Kawasaki City and Nippon Koei visited Indonesian Embassy in Japan and explained about this project to Head of Forestry Department. It was agreed to implement information sharing of progress including LOI conclusion and to cooperate each other when necessary.
Meeting with Cooperation Division of Pekanbaru City	November 5, 2021	Meeting with Cooperation Division of Pekanbaru City was carried out. It was confirmed that Pekanbaru City requires to explain about LOI with Kawasaki City and MOU with Nippon Koei to Ministry of Home Affairs thus, signing on the documents will be later than January 2021.
Kawasaki International Eco-Tech Fair	November 16-26, 2021	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.
Online business seminar between GIC members and Pekanbaru City/ DKI-JKT	December 23, 2021	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.
Interim reporting meeting with MOE	January 5, 2022	Interim reporting meeting with MOE was implemented. Progress and schedule of this project were confirmed.
Meeting with Cooperation Division of Pekanbaru City	January 25, 2022	Meeting with Cooperation Division of Pekanbaru City was carried out. It was confirmed that officials of Pekanbaru City visit to Ministry of Home Affairs in February for explanation about LOI with Kawasaki City and MOU with Nippon Koei. Also, coordination and cooperation for City-to-City Collaboration Workshop in February was requested.
City-to-City Collaboration Workshop between Pekanbaru City and Kawasaki City	February 16, 2022	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.
Final reporting meeting with MOE	February 24, 2022	This fiscal year’s activities and plans for the next fiscal year’s activities were reported to MOE

Source: Prepared by Nippon Koei

3.3.2 LOI between Kawasaki City and Pekanbaru City

Kawasaki City and Pekanbaru City are preparing for conclusion of LOI about 2050 Zero-Carbon City under agreement of both cities,

In Indonesia, the “Government Regulation on Regional Cooperation (PP No. 28/2018)” was enacted in 2018, and more detailed procedures are stipulated in the “Ministry of Home Affairs Regulation on Procedures for Regional Cooperation with Overseas Local Governments and

Overseas Organizations (Permendagri No. 25/2020)". The outline of each regulation and main points related to the signing of the LOI are summarized below.

Table 3.4 Summary of Provisions on Regional Cooperation

Item	Contents
Outline (Government Regulation Clause 1; Ministry of Home Affairs Regulation Clause 1)	Regional cooperation refers to the cooperation between local governments in Indonesia, between local governments in Indonesia and overseas local governments, or between local governments in Indonesia and overseas organizations for the effective and efficient provision of public services and mutual benefits. Regional cooperation with overseas local governments is referred to as KSDPL, while regional cooperation with overseas organizations is referred to as KSDLL.
Areas covered by KSDPL (Government Regulation Clause 23, Ministry of Home Affairs Regulation Clause 4)	1. Development of science and technology 2. Cultural exchange 3. Improvement of technical capabilities and management capabilities of the government 4. Promotion of regional potential 5. Others that do not violate legal provisions
Requirements for KSDPL (Clause 27, Ministry of Home Affairs Regulation Clause 5)	1. There must be a diplomatic relationship. 2. The cooperation activities must be carried out by local governments. 3. The local governments must not open representative offices overseas. 4. The overseas local governments must not interfere with the government of the country. 5. The activities must be in line with national and local policies and plans. 6. Administrative status/territorial equality must be maintained. 7. The two cities must complement each other. 6. h. The cooperation must strengthen the relationship between communities.
Stages of KSDPL implementation (Government Regulation Clauses 24, 26 and 28, Ministry of Home Affairs Regulation Clause 9)	1. Assessment of regional cooperation **2. Declaration of the intent to cooperate (Signing of LOI)** 3. Preparing cooperation plan 4. Approval by DPRD (Regional People's Representative Council) 5. Verification 6. Preparing draft MOU 7. Discussion on MOU 8. Approval by Minister 9. Signing of MOU 10. Implementation
Required Items and Procedures for LOI (Ministry of Home Affairs Regulation Clauses 13 and 14)	Required items: a) Title, b) Areas covered under cooperation, c) Objectives and goals, d) Scope of cooperation e) Period of validity (within one year after signature) f) Place and date of signature Procedure for signing the LOI: 1. The Mayor must coordinate and consult with the Ministers of Home and External Affairs prior to signing the LOI. Coordination and consultation shall be conducted by submitting a written request for response to the Ministers. 2. After receiving the request, the Ministers shall submit a written response. 3. The Mayor shall sign the LOI. The same LOI as submitted to the Home Minister shall be signed.

Source: Prepared by Nippon Koei based on the "Government Regulation on Regional Cooperation (PP No. 28/2018)" and the "Ministry of Home Affairs Regulation on Procedures for Regional Cooperation with Overseas Local Governments and Overseas Organizations (Permendagri No. 25/2020)"

Through discussions in this fiscal year, contents of LOI were agreed by both Pekanbaru City and Kawasaki City. In City-to-City Collaboration Workshop, it was confirmed that Pekanbaru City is currently communicating with Ministry of Home Affairs for final coordination and that mayors of both cities will sign the document after confirmation by the ministry.

3.3.3 Kawasaki International Eco-Tech Fair

Online booth of this project was prepared in 14th Kawasaki International Eco-Tech Fair held during the period from November 16 to 26, 2021. By cooperating with Pekanbaru City, “Over view of this project”, “Development of Tenayan Industrial Park”, “Siak River Rehabilitation”, “Fuel-Switching of Buses in Pekanbaru” and “Installation of LED street lightings” were exhibited. Exhibited materials are attached as Attachment 1.

Source: Kawasaki International Eco-Tech Fair

Figure 3.1 Online booth (Screen of booth entrance)

Source: Kawasaki International Eco-Tech Fair

Figure 3.2 Online booth (Screen of activity introduction)

3.3.4 Online business seminar between GIC members and Pekanbaru City/DKI-JKT

Online business seminar between GIC members and Pekanbaru City/DKI-JKT was held on December 23, 2021.

In this business seminar, the International Economic Affairs Office in Kawasaki City introduced GIC and the Kawasaki International Eco-Tech Fair, and explained how to participate in the fair. The participants from Pekanbaru City and DKI-JKT were encouraged to visit the archived pages of the fair. Soushow Co., Ltd., Kujo Kigyo Company, Asian Gateway Corporation, and one other company participated in the event as GIC member companies and introduced their respective technologies and products, and held a Q&A session with the participants from Pekanbaru City and DKI-JKT to discuss the possibility of using the introduced technologies locally. The contents of the Q&A session are shown in Table 3.6, and the presentation materials of each company are shown in Appendix 2.

[Overview]

Date: December 23, 2021 (Thu), 13:00-14:30 (Jakarta Time)
Location: Online meeting
Participants: Pekanbaru City (Cooperation Bureau, Transportation Bureau, and others)
DKI-JKT (BAPPEDA, Environment Agency, Transportation Bureau, Department of Manpower, Transmigration and Energy, SDGs Secretariat, and others)
Kawasaki City (International Economic Affairs Office, Economic and Labour Affairs Bureau)
GIC member companies (Soushow Co., Ltd., Kujo Kigyo, Asian Gateway Corporation, and one other company)
PT.SPP
Tepia Corporation Japan Co., Ltd. (GIC Secretariat)
Nippon Koei
2 interpreters (Japanese ↔ Indonesian) Total of about 60 participants

Table 3.5 Agenda of online business seminar between GIC members and Pekanbaru City/ DKI-JKT

#	Time (JST)	Program	Speaker
1	15:00-15:05	Introduction	International Economic Affairs Office, Kawasaki City
2	15:05-15:10	Green Innovation Initiatives in Kawasaki City	International Economic Affairs Office, Kawasaki City
3	15:10-16:10	Introduction of private companies in Kawasaki city (GIC member) that contribute to the needs of DKI-JKT and Pekanbaru City	Kawasaki GIC member companies
4	16:10-16:25	Q&A	All participants
5	16:25-16:30	Closing remarks	Manager of International Economic Affairs Office, Kawasaki City

Source: Prepared by Nippon Koei

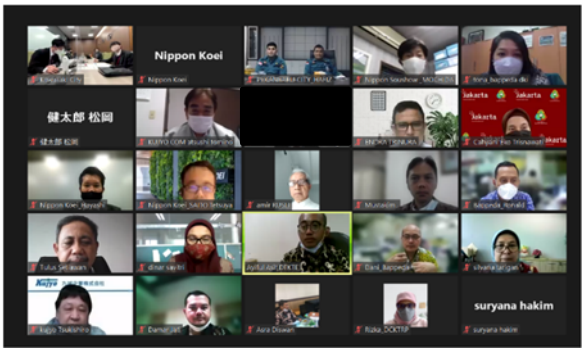
Table 3.6 Q&A in the online business seminar between GIC members and Pekanbaru City/ DKI-JKT

1. Soushow: Introduction of Heat reflecting film	
Question	*Answer*
What are the technical differences between your film and the films normally used in Indonesia? Also, are there similar products in Indonesia? (BAPPEDA, DKI-JKT)	The film sold by Soushow is called "DTEC", and I think "V-KOOL" is used in Indonesia, but it is difficult to answer this question since we don't have any information on films used in Indonesia. We don't have presence in Indonesia yet. (Soushow)
In tropical regions such as Indonesia, the air conditioner is constantly in use for ventilation when riding a car. Can power consumption be reduced in such a case? (BAPPEDA, DKI-JKT)	It is difficult to answer the question about equipment used inside vehicles, such as air conditioners, because it is the domain of other companies, but it seems to me that energy consumption can be reduced by raising the temperature of the air conditioner. (Soushow)
Are you considering using the film in buildings that are more spacious than vehicles, and what would be the effects? (Department of Housing and Settlement Areas, Pekanbaru)	The film is very effective for buildings as well, and in general, the higher the degree of sealing and the larger the number of windows, the greater the energy-saving effect. (Soushow)
2. KUJYO Company: Introduction of energy saving device (LORENTZ MG)	
Question	*Answer*
Is there any price difference between customers in the industrial and residential sectors? For example, even if the residential sector saves 10% energy, it may be very difficult to achieve the target return on investment (ROI). (BAPPEDA, DKI-JKT)	The return on investment varies depending on the electrical load factor. Generally, the more the amount of electricity used, the faster the return. This is the area that cannot be determined by price alone. (Kujo Kigyo)
Is the working principle same as that of the capacitor bank? (Manpower, Transmigration and Energy Agency, DKI-JKT)	The function is totally different from that of a capacitor bank. While the capacitor bank improves the lagging power factor, the Lorentz MG uses the reactance of the coil and reduces the current value without generating a loss. A leading power factor can also be brought closer to 1 by connecting Lorentz MG in series with the capacitor bank (improving the energy saving effect). (Kujo Kigyo)
Are there certain maintenance costs associated with the introduction of Lorentz MG? Is it possible to provide fast-moving parts to Indonesia? (Department of Housing and Settlement Areas, Pekanbaru)	Maintenance is free for seven years. When you say fast-moving parts, you are probably referring to moving parts of an automatic voltage regulator, which are not there in Lorentz MG. There are no mechanical parts in the device. (Kujo Kigyo)
Can areas with high electrical strain affect the life of the equipment? (Department of Housing and Settlement Areas, Pekanbaru)	There is no problem even in areas of high harmonics. The iron core absorbs the harmonics. (Kujo Kigyo)
How effective can we expect Lorentz MG to be in industries that use very noisy engines and motors? (Pekanbaru City)	It depends on the type of motor; however, if there is no fixed torque, then Lorentz MG is effective in reducing the rotation speed, thereby reducing the noise. (Kujo Kigyo)

3. Asian Gateway: Introduction of sharing mobility project	
Question	*Answer*
What is the biggest advantage of using this service in Indonesia, where most of the people who have a license have a personal motorcycle? Wouldn't a privately owned motorcycle be more cost effective? (BAPPEDA, DKI-JKT)	A motorcycle can be privately owned or rented. Of course, the first priority is to reduce costs. Fuel costs can be reduced to about 1/6th, and operating costs can be dramatically reduced. In addition, the incentives provided by connected bikes, is an advantage. (Asian Gateway)

Source: Prepared by Nippon Koei

Presentation by Kawasaki City



Participants of the online workshop

3.3.5 City-to-City Collaboration Workshop between Pekanbaru City and Kawasaki City

City-to-City Collaboration Workshop between Pekanbaru City and Kawasaki City was held on February 16 in 2022. This workshop was implemented under the theme of 2050 Zero-Carbon City and Nippon Koei presented progress of this project and proposal for development of zero-carbon city at first. Then, progress of zero-carbon strategy "Kawasaki Carbon Zero Challenge 2050" developed in November 2020 by Kawasaki City and activities for zero-carbon city by DKI-JKT, who published zero-carbon plan "RPRKD" in October 2021, were shared with Pekanbaru City.

Also, Pekanbaru City mentioned that they positively proceed for conclusion of LOI with Kawasaki City about 2050 Zero-Carbon City and zero-carbon declaration in their opening and closing remarks.

Presentation material of the event is attached as Attachment 3.

[Overview]

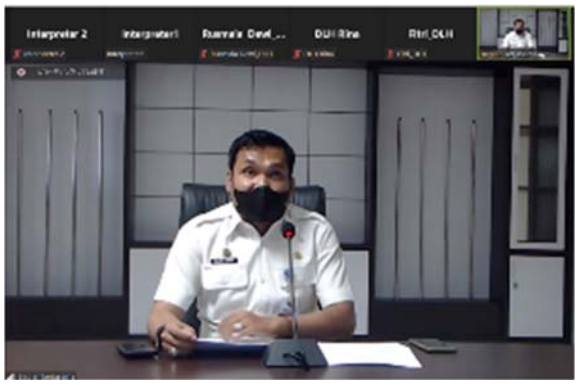
Date:	February 16, 2021 (Wed), 15:30-17:30 (JST)
Location:	Online meeting
Participants:	Pekanbaru City (Cooperation Bureau, Department of the Environment) DKI-JKT (Environmental Agency) Kawasaki City (International Economic Affairs Office- Economic and Labour Affairs Bureau, Environmental Department) Nippon Koei 2 interpreters (Japanese ↔ Indonesian)

Table 3.7 Agenda of City-to-City Collaboration Workshop between Pekanbaru City and Kawasaki City

#	Time (JST)	Program	Speaker
1	15:30-15:35	Introduction	Nippon Koei
2	15:35-15:45	Opening remarks	Kawasaki City/ Pekanbaru City
3	15:45-16:00	Progress of City-to-City Collaboration Project -Towards 2050 Zero Carbon City-	Nippon Koei
4	16:00-16:15	Zero-carbon strategy "Kawasaki Carbon Zero Challenge 2050"	Kawasaki City
5	16:15-16:40	Background and development of zero carbon plan of DKI-Jakarta	DKI-Jakarta
7	16:40-17:00	Q & A and Discussion	---
8	17:00-17:10	Closing remarks	Kawasaki City/ Pekanbaru City

Source: Prepared by Nippon Koei

Workshop (Japan side)



Opening remarks of Pekanbaru City

CHAPTER 4 JCM PROJECT FORMULATION STUDY

The same as city-to-city collaboration activities, JCM project formulation studies for 1) development of circular economy and green recovery and 2) development of 2050 Zero-Carbon City were carried out.

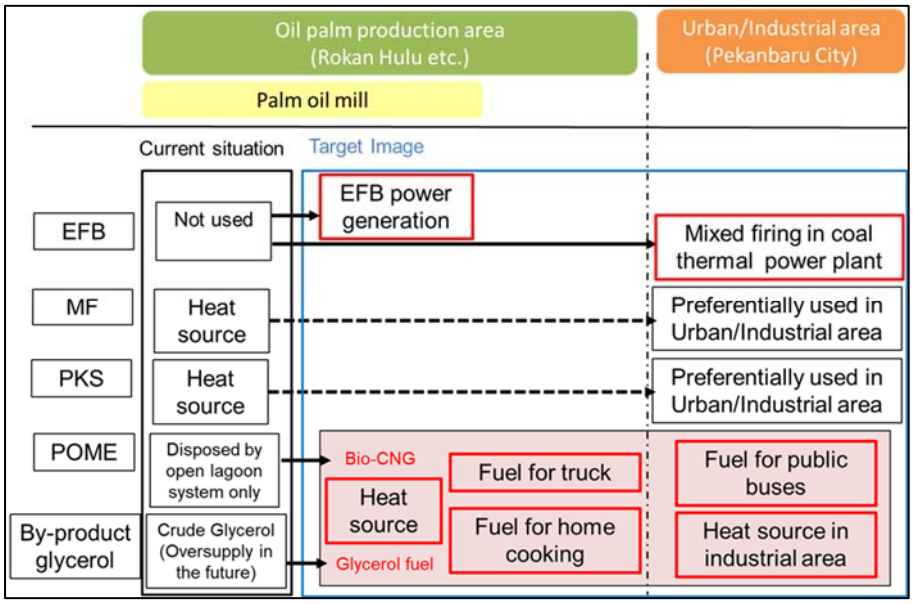
4.1 Studies of JCM projects for development of circular economy

As JCM model projects for development of circular economy in oil palm sector, EFB biomass power plant project (Section 4.1.1), 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 PT.PN5 continuously from last fiscal year. Also, BDF glycerol fuel project (Section 4.1.3), which utilizes by-product glycerol generated from production of BDF, was newly considered.

The three potential projects can contribute to realization of circular economy in oil palm sector as illustrated in Figure 4.1.

EFB biomass power plant 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. Although it is difficult to use EFB in urban areas due to difficulty of transportation and utilization, PKS, MF and bio-CNG is easy to be transported and utilized. Thus, those projects are expected to contribute to circulation of resources in whole 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, 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 biomass power plant 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, was implemented continuously from the previous year.

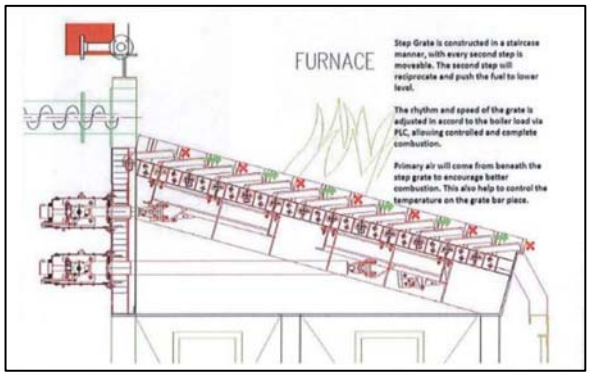
(1) Overview of "12MW Biomass Power Plant Project in Aceh Province, Sumatra"

Aura and Gistec are implemented JCM model project "12MW Biomass Power Plant Project in Aceh Province, Sumatra" adopted in FY2018 and will start operation of the plant in 2021. The plant is assumed to generate 73,500MWh and will lead to GHG reduction of 31,322 tCO2 annually.

EFB has characteristics such as (1) difficulty of processing due to size and hardness, (2) low calory, (3) High moisture rate, (4) easiness to formulate clinker, (5) Low melting point and the amount of ashes and (6) sedimentation of soot, and is difficult to utilize as fuels. Because of those characteristics, heat utilization of EFB has not been proceeded to date. However, the boiler installed to the plant in Ache has movable staircase stoker with automatic ash removal function and optimization controlling system for internal temperature of the furnace, which reduce generation of clinker and enable to stable and complete combustion by equally combusting EFB with rotating EFB continuously.

Source: Aura Green Energy

Figure 4.2 Image of biomass power plant in Aceh Province



Source: Aura Green Energy

Figure 4.3 Movable staircase stoker with automatic ash removal function

(2) Study progress until FY2020

Study progress until FY2021 is summarized in Table 4-1. Also, GHG emission reduction by the EFB biomass power plant project is shown in Table 4-2. GHG emission reduction of EFB biomass power plant project was calculated based on the formula below of methodology, ID_AM027 "Electricity generation by a biomass power plant" which was approved by Indonesia JCM secretariat on February 17, 2021.

Table 4.1 Study progress until FY2020 (EFB biomass power plant project)

#	Contents	Overview/results
1	Study on generation amount of biomass fuel	The amount of biomass fuels generated from three palm oil mills in Rokan Hulu Regency (Sei Rokan, Sei Intan, Sei Tapung) was studied. Total amount of EFB from the three mills was 144,829 ton. As a result of consideration of such data and transport cost, project site was decided to be near Sei Intan and power generation capacity was to be 7.5MW.
2	Confirmation of status of electricity access and study on grid connection	By collecting information of power plant in Riau Province and data of recent electricity supply and demand and by interviewing to PLN, grid connection point was selected. It is assumed to connect to the nearest grid from Sei Intan (Approx. 3 km).
3	Consideration of installed technologies and project cost	Potential to install Japanese technologies and technologies of companies based in Kawasaki City was considered. Also, project cost and economic evaluation was carried out.
4	Confirmation of permits	Confirmation of required permits and schedule for obtaining them were implemented.

Source: Prepared by Nippon Koei

Table 4.2 Calculation of GHG emission reduction

#	Item	Figure	Unit	Remarks
a	Net capacity	5.65	MW	Result of the study
b	Operation hour	7920	h/year	Result of the study
c	Annual electricity generation	44,748	MWh/year	=a x b
d	Emission Factor (National Grid)	0.458	tCO2/MWh	ID_AM027 (Sumatra)
e	Reference emission (RE_p)	20,494	tCO2/year	=c x d
f	Fossil fuel consumption	150,000	L/year	Diesel
g	Density	0.844	kg/L	IEA
h	Net calorific value	41.4	GJ/t	IPCC2006
i	Emission Factor (Diesel)	0.0726	tCO2/GJ	IPCC2006
j	Project emission (Fossil fuel) ($PE_{ONSITE,p}$)	381	tCO2/year	=f x g x h x i / 1,000
k	Transported EFB amount	144,829	ton/year	Assumed amount
l	Transportation distance	47	km	Assumed distance
m	Emission Factor (Transportation)	0.000129	tCO2/ton-km	ID_AM027, Heavy vehicle
n	Project emission (Transportation) ($PE_{TRANS,p}$)	878	tCO2/year	=l x m x n
o	Annual GHG emission reduction	19,235	tCO2/year	=e – (j + n)

Source: Prepared by Nippon Koei

(3) Study in FY2021

Almost all studied required for business development was completed by the end of FY2020. However, before the start of FY2021 project, it was confirmed that PLN published that they aim at carbon neutrality by 2050 and PT.PN group pends all activities related to EFB utilization to consider cooperation with PLN. As a result, consideration of EFB biomass power plant project under the city-to-city collaboration project was also put on hold. Thus, a wider range of biomass fuel study was carried out in FY2021. Study contents and overviews are shown in Table 4-3.

Table 4.3 Study overview in FY2021 (EFB biomass power plant project)

#	Study contents	Overview
1	Biomass fuel generation and characteristics study.	The amounts of EFB, EF and PKS emitted from palm oil mills in Riau Province and their characteristics (moisture rate, net calorific value, chemical contents etc.) were studied. (Table 4.4)
2	Transport cost study	Transport costs of biomass fuels from palm oil mill to main ports and within the region were studied. ()
3	Study on technologies for biomass fuel processing	Difficulties on EFB utilization and processing methods and technologies for them were organized.
5	Supply chain verification	RSPO certificate status of palm oil mills in Riau Province was confirmed.
6	Consideration on countermeasures to environmental impact by biomass power generation	Standards of emission of exhaust gases and fly ash from biomass power plant was confirmed and countermeasures were considered.
7	Review of reporting system of utilization of palm oil residues	Reporting system of palm oil residue utilization regulated in Ache Province was reviewed.

Source: Prepared by Nippon Koei

Table 4.4 Result of biomass fuel analysis of palm oil residues

Parameter	Unit	EFB	Fibre	Shell 1	Shell 2	Methods
Total Moisture	%, ar	48.80	31.30	14.10	15.60	ASTM D.3302-10
Proximate Analysis						
Moisture in Analysis	%, adb	7.20	9.50	9.80	14.30	ASTM D.3173-08
Ash Content	%, adb	5.60	5.10	2.50	2.60	ASTM D.3174-04
Volatile Matter	%, adb	71.90	68.20	69.80	66.70	ISO 562-2010
Fixed Carbon	%, adb	15.30	17.20	17.90	16.40	ASTM D.3172-07
Total Sulphure	%, adb	0.27	0.22	0.08	0.02	ASTM D.4239-10
Gross Calorific Value	kcal/kg, adb	4,822.00	4,485.00	4,728.00	4,322.00	ASTM D.5865-10
Gross Calorific Value	**kcal/kg, ar**	**2,660.00**	**3,405.00**	**4,503.00**	**4,256.00**	ASTM D.5865-10
Ultimate Analysis						
Carbon (C)	%	53.75	52.36	53.15	50.13	ASTM D.3178-02
Nitrogen (N)	%	0.63	0.40	0.35	0.32	ASTM D.3179-02
Hydrogen (H)	%	7.95	6.34	6.71	6.43	ASTM D.3178-02
Oxygen (O)	%	31.80	35.58	37.21	40.50	ASTM D.3176-02
Chemical Analysis of Ash						
Silicone Dioxide (SiO2)	%	40.28	60.89	74.69	74.60	ASTM D.6349-09
Aluminium Trioxide (Al2O3)	%	2.14	1.11	1.12	6.34	ASTM D.6349-09
Iron Trioxide (Fe2O3)	%	3.59	2.02	0.93	2.32	ASTM D.6349-09
Titanium Dioxide (TiO2)	%	0.10	0.07	0.06	0.32	ASTM D.6349-09
Calcium Oxide (CaO)	%	6.01	6.72	2.24	1.20	ASTM D.6349-09
Magnesium Oxide (MgO)	%	6.93	5.37	4.13	1.81	ASTM D.6349-09
Pottasium Oxide (K2O)	%	29.33	10.39	9.68	5.06	ASTM D.6349-09
Sodium Oxide (Na2O)	%	2.11	0.92	0.30	0.22	ASTM D.6349-09
Phosphorus Pentaoxide (P2O5)	%	3.30	4.56	4.98	2.24	ASTM D.6349-09
Sulphur Trioxide (SO3)	%	5.55	7.55	1.58	5.30	ASTM D.1757-03
Manganese Dioxide (MnO2)	%	0.21	0.12	0.12	0.13	ASTM D.6349-09
Chlorine (Cl)	%	0.27	0.18	0.10	0.02	ASTM D.3682-01

ar = sample as received

adb = sample as determined base

Source: PT.Gistec Prima Energindo

Table 4.5 Transport costs of biomass fuels from mills to main ports in Riau Province

No.	Name of POM	Dumai	Tanjung Buton Siak	Teluk Bayur
		Distance/Cost	Distance/Cost	Distance/Cost
1	PT. Rohul Sawit Industri			
2	PT. Padasa Utama 6 (1)			
3	PT. Padasa Utama 6 (2)			
4	PT. Padasa Utama 6 (3)			
5	PTPN V Sei Garo			
6	PTPN V Sei Galuh			
7	PTPN V Sei Rokan			
8	PTPN V Lubuk Dalam			
9	PTPN V Sei Pagar			
10	PTPN V Sei Tapung			
11	PTPN V Air Molek			
12	PTPN V Sei Buatan			
13	PT. Permata Berlian Indah			
14	PT. Guna Setia Pratama Pasir Putih			
15	PT. Bina Sawit Nusantara			
16	PT. Sawit Mas Nusantara Langga			
17	PT. INECDA			
18	PT. Nikmat Halona Reksa			
19	PT. Jalur Pusaka Sakti Kumala			
20	PT. Peputra Supra Jaya			

Source: PT.Gistec Prima Energindo

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 Daicel-Evonik can produce biogas with more than 90% methane and the purified gas can be used 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.

In FY2020, selection of target palm oil mills, consideration of potential of biogas generation from POME, initial design of biogas purification plant was caried out. Also, the potential of fuel swich in case utilizing bio-CNG for fuel in buses owned by Trans Metro Pekanbaru, who operates city bus services in Pekanbaru, was calculated.

Source: Prepared by Nippon Koei

Figure 4.4 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 Daicel-Evonik, SEPURAN® Green was installed to the plant.

Source: Daicel-Evonik

Figure 4.5 SEPURAN® Green

Source: PT.Gikoko Kogyo Indonesia

Figure 4.6 SEPURAN® Green installed in East Kalimantan Project

Study progress until FY2020 is summarised in Table 4.6.

Table 4.6 Study progress until FY2020 (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 Daicel-Evonik was carried out by cooperation with PT. Gikoko Kogyo Indonesia.

Source: Prepared by Nippon Koei

Based on the study until FY2020, the studies below were carried out in FY2021.

(1) Design of bio-CNG plant

Design of bio-CNG plant targeting a palm oil mill owned by PT.PN5 (Sei Buatan Mill) was carried out.

1) Preconditions

Conditions of raw material gas and purified gas are shown in Table 4.7 and Table 4.8 respectively. Conditions of raw material gas was set based on the chemical composition data of POME biogas from Terantam Mill while purified gas was decided in accordance with standard of CNG in Indonesia.

This consideration was carried out under the concept to unitize the plant in Japan and to install it outside Sei Buatan Mill.

Table 4.7 Condition of raw material gas

Contents	Conditions	
Flow rate (Nm3/h)		520
Pressure (MPaG)		0.001
Temperature (degree C)		32
Composition	Methane (CH4)	:60.00%
	Carbon dioxide (CO2)	:34.72%
	Nitrogen (N2)	:1.10%
	Hydrogen (H2)	:1.00%
	Carbon monoxide (CO)	:0.62%
	Hydrogen sulfide (H2S)	:0.16%
	Water (H2O)	:2.40%

Source: Prepared by Air Water

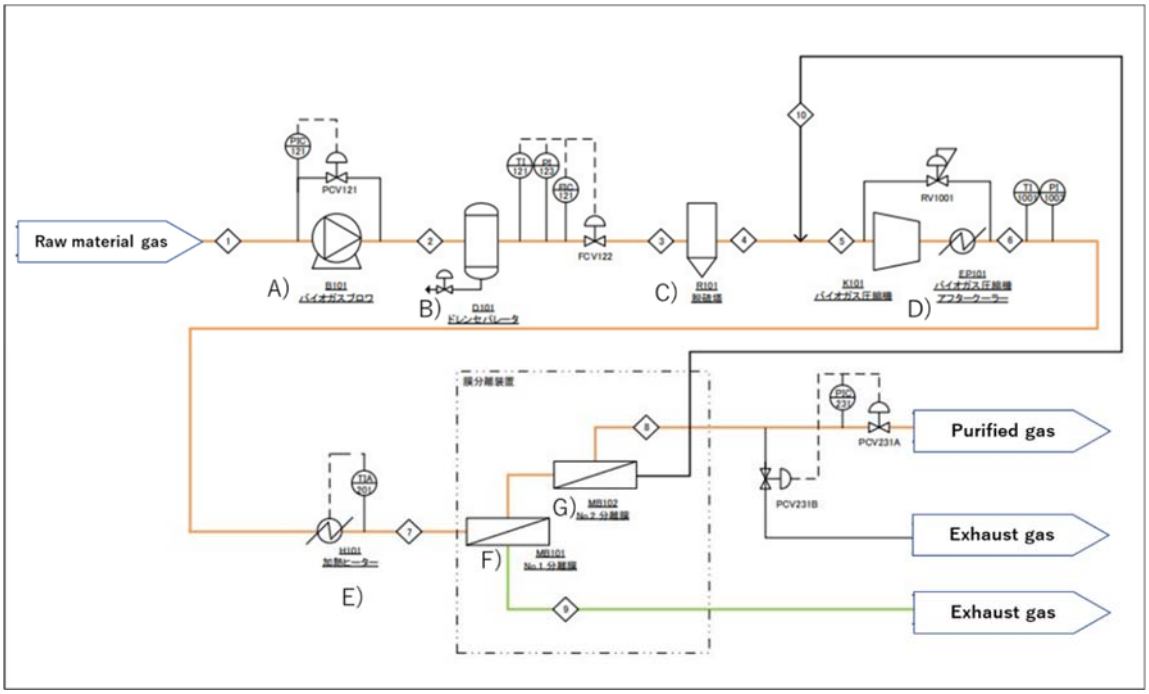
Table 4.8 Condition of purified gas

Contents	Conditions	
Composition	Methane (CH4)	: over 89.00%
	Carbon dioxide (CO2)	: less than 5.00%
	Nitrogen (N2)	: less than 3.00%
	Hydrogen sulfide (H2S)	: less than 0.63%
	Water (H2O)	: less than 3.00%

Source: Prepared by Air Water

2) Process flow

The results of consideration on process flow under the preconditions above were described in Figure 4.7 and Table 4.9. Also, each process flow is explained in Table 4.10.



Source: Prepared by Air Water

Figure 4.7 Process flow diagram

Table 4.9 Material balance

Number		1	2	3	4	5	6	7	8	9	10
Flow	Nm3/h	520.0	520.0	519.9	519.1	708.6	696.9	696.9	314.7	192.7	189.4
Pressure	MPaG	0.001	0.030	0.027	0.026	0.026	0.800	0.779	0.761	0.730	0.030
Temp.	℃	32.3	40.0	40.0	40.0	36.3	10.0	30.0	25.8	28.1	28.7
Composition	CH4	60.00	60.00	60.01	60.11	53.60	54.50	54.50	95.50	6.66	35.90
	CO2	34.72	34.72	34.73	34.78	41.90	42.55	42.55	2.27	89.93	61.27
	N2	1.10	1.10	1.10	1.10	1.08	1.10	1.10	1.69	0.20	1.04
	H2S	0.16	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CO	0.62	0.62	0.62	0.62	0.77	0.78	0.78	0.88	0.22	1.17
	H2O	2.40	2.40	2.38	2.39	1.80	0.15	0.15	0.00	0.44	0.08
	H2	1.00	1.00	1.00	1.00	0.87	0.89	0.89	0.09	2.53	0.51

Source: Prepared by Air Water

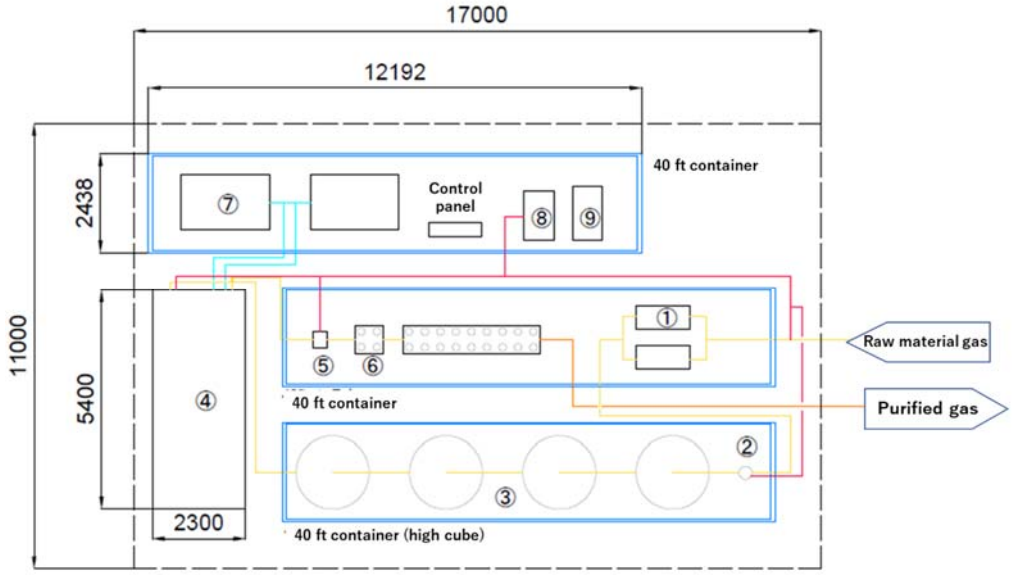
Table 4.10 Explanation of each flow

Flow	Overview
A) Blower	The pressure of raw material biogas is raised from 0.001 MPaG to 0.03 MpaG. By raising the pressure, the gas is transported to next stage.
B) Drain separator	Droplet in the biogas is removed.
C) Desulfurization equipment	H2S in raw material biogas is removed by iron-based catalyst. The desulfurization equipment was designed so that H2S becomes less than 1 ppm at the outlet. If raw material gas includes H2S, compressor and membrane are easily damaged. Thus, Desulfurization tower was set before them.
D) Compressor	The pressure of raw material biogas is raised to about 0.8 MPa. Although high-pressure gas safety law in Japan was taken into account and the pressure was set to be 0.8 MPa in this designing, it is necessary to confirm Indonesian law. After chilling the compressed biogas to 10 degree C by chilling water, condensed water is removed because if water is condensed in membranes, function of membrane deteriorates.
E) Heater	Biogas chilled on the previous stage is heated from 10 degree C to 30 degree C to improve function of membrane.
F) Stage 1 membrane module	To aim at 95% of CH4 concentration in purified gas, membrane process has two stages. Stage 1 has four membranes. CH4 does not permeate while CO2 permeates the membrane wall to outside the system. Stage 1 is rough purification and as a result of simulation, approx. 90 % of permeated gas is CO2 and Approx. 6.6% is CH4.
G) Stage 2 membrane module	Second stage has 18 membranes. Since CH4 concentration of permeated gas is approx. 60%, it is recycled to before compressor. By doing this, collection rate of CH4 can improve. Purified gas is collected in non-permeated side and as a result of simulation, gas flow is 315 Nm3/h, concentration of CH4 is 96%, CO2 is 2.3% and N2 is 1.7%.

Source: Prepared by Air Water

3) Layout

Layout of the bio-CNG plant is illustrated in Figure 4.8. Size of each equipment is shown in Table 4.11. Since it is assumed that the plant is installed outside, the design is basically done to be stored in 40 ft containers. As a result of consideration, main equipment other than compressor are placed in two 40 ft containers and one 40 ft high cube container while compressor is set outside individually. Required area is 17m x 11m. Container of chiller, N2 PSA and power control panel is non-explosion-proof while containers of others are explosion-proof.



Source: Prepared by Air Water

Figure 4.8 Layout

Table 4.11 List of equipment

#	Name	Size [mm]	Spec	Capacity [kW]	Num
(1)	Blower	(W) 574 ×(L) 1,332×(H) 756	Explosion-proof	7.5 (per equipment)	2
(2)	Drain separate	(Diameter) 268/ (Length) 1,440	-	-	1
(3)	Desulfurization tower	(Diameter) 1,800 / (Length) 1,829	-	-	4
(4)	Compressor (Wing type)	(W) 2,300 × (L) 5,400 × (H) 2,200	Explosion-proof	106	1
(5)	Heater	(W) 395 × (L) 345 × (H) 1,430	Non-explosion-proof	6.7	1
(6)	Membrane	(Diameter) 184 / (Length) 1,450	-	-	22
(7)	Chiller	(W) 2,190 × (L) 1,340 × (H) 2,150	Non-explosion-proof	74.4 (per equipment)	2
(8)	N2 PSA	(W) 1,200×(L) 750 × (H) 1,800	Non-explosion-proof	-	1
(9)	Compressor	(W) 1,320 × (L) 700 × (H) 1,200	Non-explosion-proof	11	1

Source: Prepared by Air Water

(2) Rough calculation of CAPEX and OPEX

1) Rough calculation of CAPEX

The result of CAPEX calculation of the bio-CNG plant is shown in Table 4.12. Main equipment includes blower, compressor, heater, chillers, membranes and N2 PSA (for instrumentation /purge) and catalyst for desulfurization towers. Foundation work excludes piling cost because data of soil is insufficient.

Table 4.12 Rough calculation of CAPEX

#	Contents	Price [1,000 JPY]
1	Main equipment	[redacted]
2	Valves and meters	[redacted]
3	Production cost	[redacted]
4	Power control panel	[redacted]
5	Design cost	[redacted]
6	Transport cost	[redacted]
7	Installation cost	[redacted]
8	Foundation work	[redacted]
9	Contingency	[redacted]
Total		[redacted]

Source: Prepared by Air Water

2) Rough calculation of OPEX

The result of CAPEX calculation of the bio-CNG plant is shown in Table 4.13. Required amount of utility was calculated based on the data in Indonesia in 2017. Regarding chilling water, since supply condition was not clear, required amount was calculated under assumption that chilling water of 32 degree C is supplied. By setting cooling tower in the site, required amount of cooling water can be decreased.

It is necessary to develop local maintenance structure. Maintenance cost of main equipment is reference value calculated by assuming implementation in Japan although maintenance of equipment other than compressor and heater can be carried out in Indonesia.

Table 4.13 Rough calculation of OPEX

Contents		Consumption	Price [1,000 JPY/year]
Utility	Chilling water	30 m3/h	[redacted]
	Electricity	250 kW	
Maintenance	Main equipment	---	
	Filler of desulfurization tower	---	
	Others	---	
Total			[redacted]

Source: Prepared by Air Water

(3) Fuel switch potential and GHG emission reduction

Fuel switch potential of buses in Pekanbaru City by utilization of bio-CNG was re-calculated based on the consideration result above. Annual diesel consumption of buses was estimated based on actual amount in January 2020, before COVD-19 pandemic.

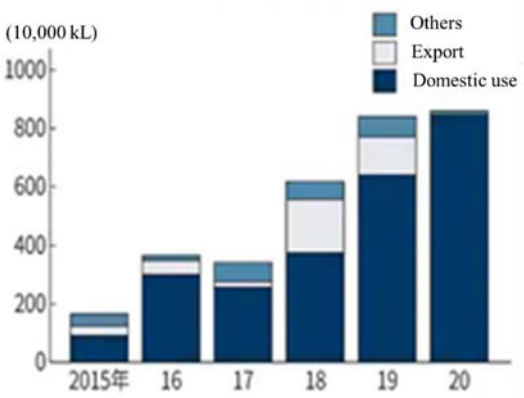
Table 4.14 Fuel switch potential and GHG emission reduction

#	Item	Figure	Unit	Remarks
a	Production Capacity of bio CNG	314.5	Nm3/h	Simulation result
b	Operation hour	3,600	h/year	Assumption
c	Annual production of bio CNG	1,132,200	Nm3/year	=a x b
d	Annual production of bio CNG	756.3	ton	
e	Net calorific value of bio-CNG	45	TJ/ton	Assumption
f	Annual production of bio CNG	34,034	TJ/year	=d x e
g	Annual diesel consumption by buses	1,942,594	L/year	Dept. Transport of Pekanbaru City
h	Density	835	kg/L	
i	Net calorific value of diesel	41.4	TJ/Gg	IPCC2006
j	Annual diesel consumption by buses	67,154	TJ/year	=g x h x i /10^6
k	Fuel switch potential	50.6	%	= j / g
l	Annual reduction of diesel	959,641	L/year	= g (1-k)
m	Emission Factor	0.0726	tCO2/TJ	IPCC2006
n	GHG reduction potential	2,408	tCO2/year	= i x j x k x m /10^6

Source: Prepared by Nippon Koei

4.1.3 BDF glycerol fuel project

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.

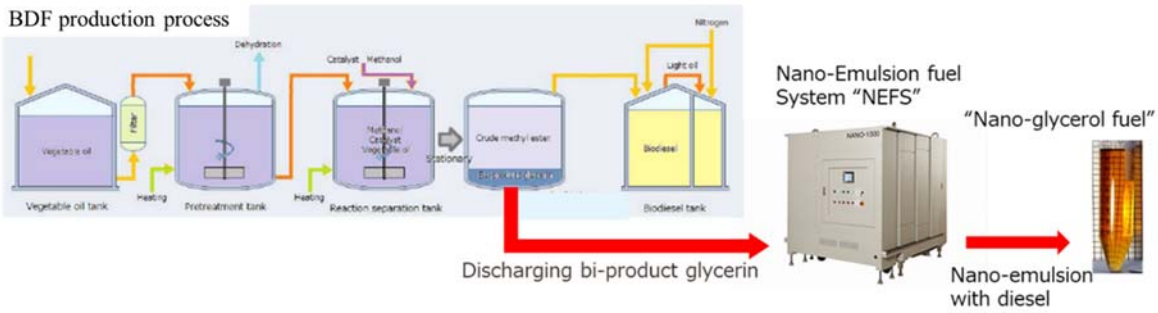


Source: Indonesia Biofuel Producer Association

Figure 4.9 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.

In this context, technology 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 were supported in the city-to-city collaboration project.



Source: Prepared by Nippon Koei based on document of Nanofuel

Figure 4.10 Production process of nano-glycerol fuel

(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 4.11 Nano-emulsion fuel system "NEFS"

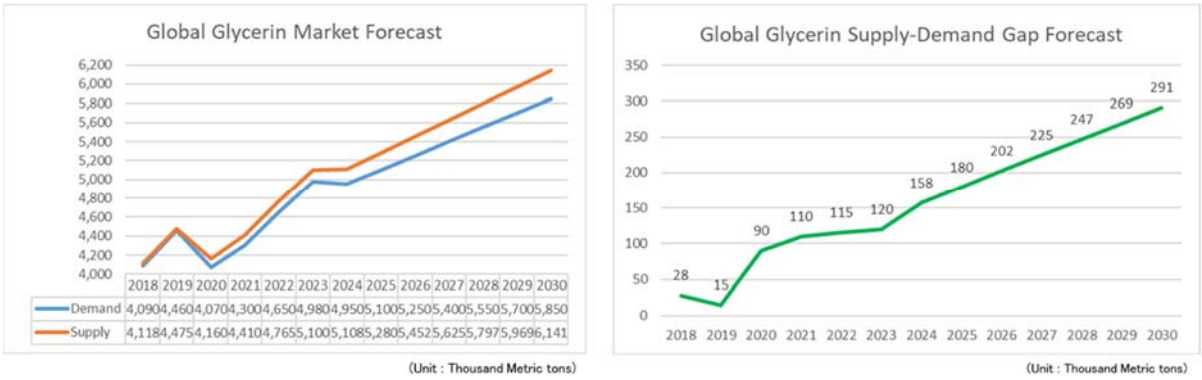
(2) Overview of glycerol market

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

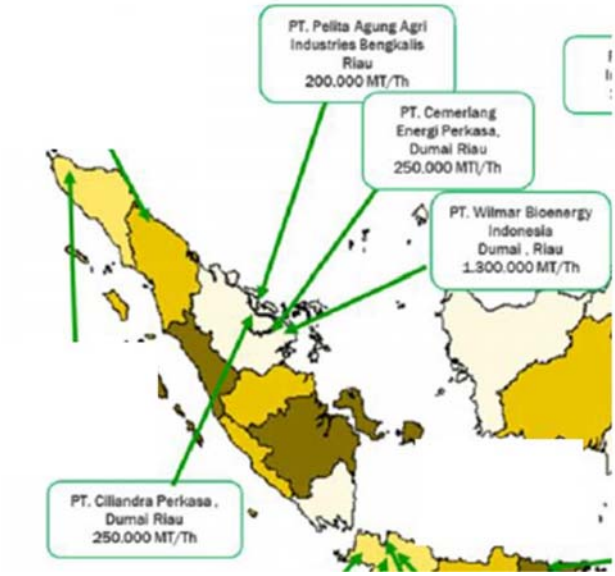
As the first step of the implementation of BDF nano-glycerol fuel project, it is necessary to confirm production technology of the nano-glycerol fuel using by-product glycerol generated in Indonesia. For this purpose, request for collection of by-product glycerol sample was carried out.

There are twenty BDF factories in Indonesia and seven of them are located in Riau Province. Location and FAME production of each factory in the Province are as shown below.

Table 4.15 BDF factories in Riau Province

#	Name of supplier	Factory location	FAME production capacity (kL/year)
1	PT Wilmar Bioenergi Indonesia	Dumai	1,395,000
2	PT Bayas Biofuels	Indragiri Hilir	750,000
3	PT Cemerlang Energi Perkasa	Dumai	600,000
4	PT Intibenua Perkasatama	Dumai,	385,000
5	PT Dabi Biofuels	Dumai	360,000
6	PT Ciliandra Perkasa	Dumai	250,000
7	PT Pelita Agung Agrindustri	Bengkalis	200,000

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



Source: BPPT

Figure 4.13 Location of main BDF factories in Riau Province

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.

On the other hand, no factory provided sample of by-product glycerol by the end of this project. The main reasons are 1) prospect of glycerol market has not been understood well, and 2) by-product glycerol cannot be discharged because the generated by-product glycerol is flown directly to purification process in the factories. For 1) it is necessary to show information such as future trend of supply and demand of glycerol shown above to promote understanding of BDF suppliers. Also, for both items 1) and 2), it is effective to show economic benefit of transformation from purified glycerol sales to sales of nano-glycerol fuel (or sales of by-product glycerol).

(4) Consideration on cooperation potential with oil palm industry development in Tenayan Industrial Park

Through an interview with PT.SPP, operation company of Tenayan Industrial Park in Pekanbaru, it was confirmed that oil palm industry area including a BDF factory is planned to be developed in the industrial park. For the purpose to consider cooperation potential with Public Company D, the developer of the area, discussion with PT.SPP, consultant of the Ministry of National Development Planning for development of the industrial park has started.

As written above, although generated by-product glycerol is flown directly to purification process in existing factories, it is possible to consider designing new factory for discharging by-product glycerol. Thus, business development in the new factory can be more effective than in an existing factory.

Tahun Ini Pabrik Pengolahan Sawit Dibangun di Kawasan Industri Tenayan

Rabu 24 Februari 2021, 14:04 WIB

Walikota Pekanbaru, Firdaus

Pekanbaru, berazamcom - Pekanbaru bertransformasi dari kawasan agraria menjadi kawasan industri. Tahun ini pabrik pengolahan sawit akan dibangun di Kawasan Industri Tenayan (KIT) tahun ini.

Walikota Pekanbaru, Firdaus di Kompleks Perkantoran Tenayan Raya, Selasa (23/2) mengatakan, industri hilir Crude Palm Oil (CPO) direncanakan dibangun di Kawasan Industri Tenayan. Produksi 2 juta ton per tahun.

"Pembangunan fisiknya akan dimulai tahun ini. Mereka akan membutuhkan 155.000 pekerja," ungkapnya.

Pabrik sawit ini akan memberikan kontribusi kepada daerah Rp14,5 triliun per tahun. Makanya, Pemko Pekanbaru bekerja sama dengan semua Politeknik di Provinsi Riau.

"Sebanyak 32 perguruan tinggi di Provinsi Riau dengan lulusan per tahun hanya sekian ribu. Jumlah ini belum dapat memenuhi 155.000 tenaga kerja yang dibutuhkan pabrik sawit tersebut," ucap Firdaus.

Anak-anak di Riau jangan jadi penonton. Anak-anak di Riau jangan menjadi tamu di rumah sendiri.

"Artinya, kalau mereka tak disiapkan dengan keterampilan, mereka tak bisa diterima. Itu bukan kesalahan mereka," sebut Firdaus."

Pekanbaru has transformed from an agrarian area to an industrial area. This year the palm oil processing plant will be built in the Tenayan Industrial Estate (KIT) this year.
Pekanbaru Mayor, Firdaus at the Tenayan Raya Office Complex, Tuesday (23/2) said that the downstream Crude Palm Oil (CPO) industry is planned to be built in the Tenayan Industrial Estate. Production of 2 million tons per year.

Source: https://www.berazam.com/read-126815-2021-02-24-tahun-ini-pabrik-pengolahan-sawit-dibangun-di-kawasan-industri-tenayan.html#sthash.ZpCUQ3aE.fZsmg0yr.dpbs (Accessed on 2022/03/06)

Figure 4.14 Article regarding oil palm industry development in Tenayan Industrial Park

(5) Trial calculation of GHG emission reduction

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 4.16 Trial calculation 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	石油連盟
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	47,920.1	tCO2/year	= e x f 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	29031.0	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

4.2 Studies of JCM projects for zero carbon city

In this project, the Eco-grid project in an industrial park 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.

1) Reduction of CO2 emissions through the use of renewable energy (reduction of environmental impact)
2) Local production for local consumption of energy and utilization of local resources
3) Lower energy costs
4) Vitalization of local industry and virtuous circulation of local funds
5) Improvement of energy supply reliability
6) Strengthening resilience (enhancing energy security during disasters)
7) 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 Eco-grid project

(1) Study on eco-grid project in Tenayan Industrial Park

As described in the previous section, Pekanbaru City intends to develop Tenayan Industrial Park as an eco-industrial park, based on the information provided by PT.SPP, which is an operating public corporation, the feasibility study of introducing energy management system (EMS) technology was examined.

Source: Pekanbaru City

Figure 4.15 Image of the completed Tenayan Industrial Park

CSD Co., Ltd. (hereinafter referred to as "CSD"), a GIC member and a company in Kawasaki City, conducted this study to examine the possibility to introduce their EMS technology.

However, when we discussed with PT. SPP through a local staff, we could not receive sufficient information to consider the introduction of EMS due to the delay in the progress of the construction of the industrial park. Therefore, we decided to switch to the study described in the next section.

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

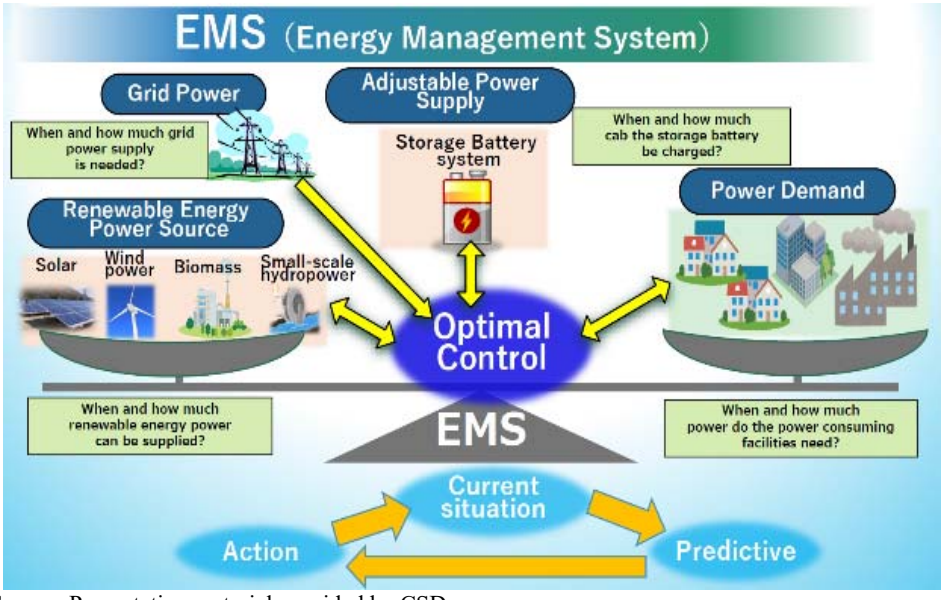
Based on the above situation, the possibility of introducing CSD's EMS technology in the new city hall of Pekanbaru City was studied.

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 4.16 New City Hall area of Pekanbaru City



Source: Presentation material provided by CSD

Figure 4.17 Image of EMS technology

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

<Main measures>

I. Energy savings and CO2 reduction effects when solar power generation is used as electricity.

II. Furthermore, the energy saving and CO2 reduction effects of incorporating EMS-based lighting control and air conditioning control in the new city hall.

<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, 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

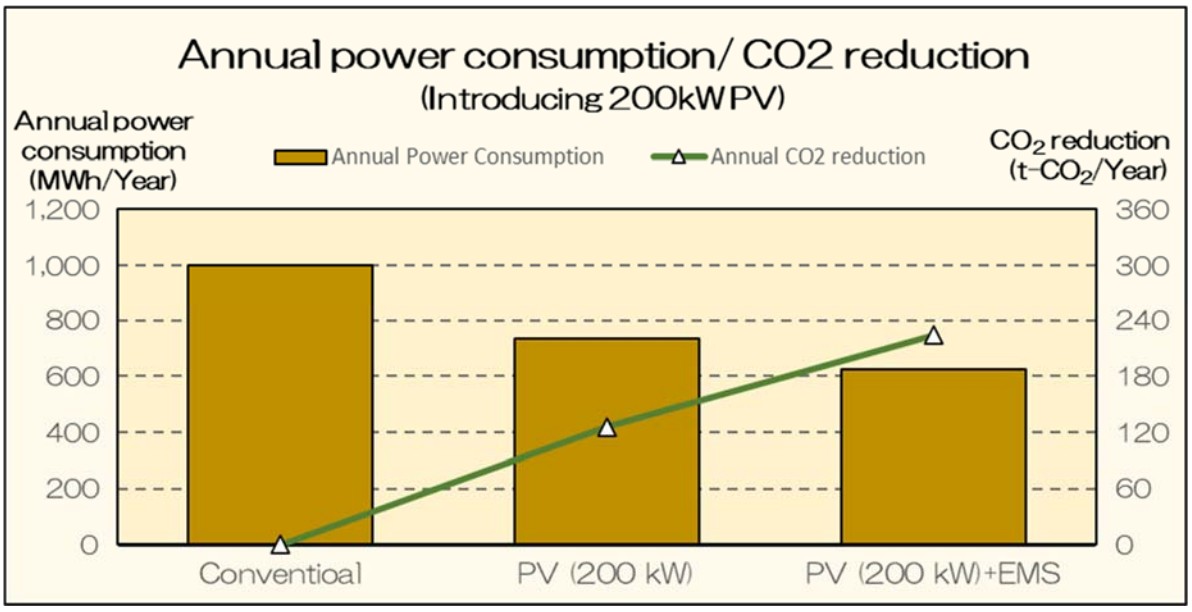
From a~e of Table 4.17, the annual GHG emissions reductions when a 200 kW solar power system is installed for an EV bus system are 267 t-CO2. In addition, the annual GHG emission reductions when EMS and storage batteries besides on the above solar power system are installed is 224 t-CO2, assuming a 15% reduction effect, indicating the reduction effect of EMS.

Table 4.17 Results of the study of EMS technology introduction in the new city hall in Pekanbaru City

#	Items	Figure	Unit	Remarks
a	Annual power consumption on the city hall	1,000	MWh/Year	Hypothesis data
b	Annual power generation (PV system)	267	MWh/Year	Solar power capacity: 200 kW Source: Global Solar Atlas[3]
c	Emission Factor	0.473	t-CO2/MWh	JCM model project (Renewable Energy, Sumatra)
d	Annual GHG reduction (PV system)	126	t-CO2/Year	= b × c
e	Reduction effects (Storage batteries + EMS)	15	%	Storage batteries capacity: 250 kWh Hypothesis data EMS= PV optimum control + lighting control + air conditioning control
f	Emission Factor	0.89	t-CO2/MWh	JCM model project (Energy saving, Sumatra)
g	Annual power reduction (PV system + Storage batteries + EMS)	377	MWh/Year	= a－((a - b) × (1－e /100))
h	Annual GHG reduction (PV system + Storage batteries + EMS)	224	t-CO2/Year	= d + (g - b) × f

Source: Prepared by Nippon Koei from materials provided by CSD

[3] https://globalsolaratlas.info/map?c=0.571257,101.372464,11&s=0.568597,101.423508&m=site&pv=ground,180,1,200

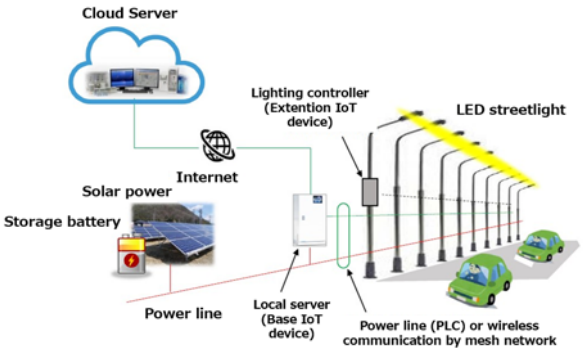


Source: provided by CSD

Figure 4.18 Results of the study of EMS technology introduction in the new city hall in Pekanbaru City

4.2.2 Project of LED street lightings with control system

The Pekanbaru City Transportation Department 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 a combination of LED streetlights and CSD's EMS technology, which will enable smart management of power consumption and reduce electricity costs and GHG emissions through optimal operation. Not only will the conversion to high-efficiency LEDs and the combination of IoT technology and optimal operation provide significant energy savings, but the EMS technology will also enable various settings, fault monitoring, schedule control, and so on at the center, which is expected to significantly reduce OM costs.



Source: Prepared by Nippon Koei from materials provided by CSD

Figure 4.19 Image of combination of LED streetlights and EMS technology

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

<Main measures>

I. Energy savings and reduction of CO2 emissions through remote monitoring and control

II. Energy saving by dimming control based on time of day, ambient brightness, and traffic volume

III. Reduction of CO2 emissions through the use of renewable energy sources (e.g., solar power) as power sources for streetlight

<Results>

In order to study the possibility of introduction LED streetlight and applying EMS technology, we calculated the GHG reduction. Each value was calculated by referring to local information from Pekanbaru City, 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)

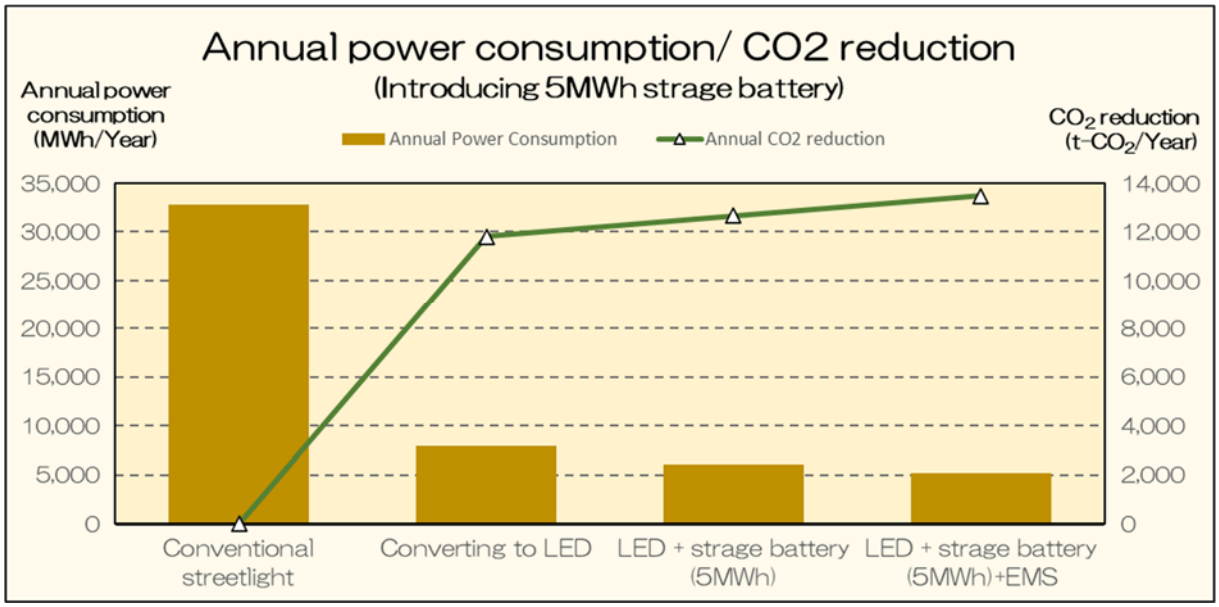
The overall effect was assumed to be 15% in this study

Table 4.18 Results of study on introduction of LED streetlight and EMS technology

#	Items	Figure	Unit	Remarks
a	Preconditions	-	-	Number of streetlights: 30.000 Lighting time of streetlights: 12 hours Power consumption of conventional streetlights: 250W
b	Annual electricity consumption (Conventional)	32,850	MWh/Year	= a ($30000\times12\times250\times365\times10^{-6}$)
c	Annual electricity consumption (LED light)	7,884	MWh/Year	Power consumption of LED lights: 60W $=30000\times12\times60\times365\times10^{-6}$
d	Annual electricity reduction (LED light)	24.966	MWh/Year	= b – c
e	Emission Factor	0.473	t-CO2/MWh	JCM model project (Renewable Energy, Sumatra)
f	Annual GHG reduction (LED light)	11,809	t-CO2/Year	= d × e
g	Annual electricity reduction (PV + storage batteries)	1,825	MWh/Year	Storage batteries capacity: 5 MWh
h	Annual electricity reduction (LED light + PV system + storage batteries)	26,791	MWh/Year	= d + g
i	Annual GHG reduction (LED light+ PV system + storage batteries)	12,672	t-CO2/Year	= e × h

#	Items	Figure	Unit	Remarks
	Reduction effects (EMS)	15	%	Hypothesis data EMS=lighting control
	Emission Factor	0.89	t-CO2/MWh	JCM model project (Energy saving, Sumatra)
	Annual electricity reduction (LED light+ PV system + storage batteries + EMS)	27,700	MWh/Year	= b－((c - g)×(1－i /100))
	Annual GHG reduction (LED light+ PV system + storage batteries + EMS)	13,481	t-CO2/Year	= i + (l - h)×j

Source: Prepared by Nippon Koei from materials provided by CSD



Source: CSD

Figure 4.20 Results of study on introduction of LED streetlight and EMS technology

CHAPTER 5 ISSUES AND INGENUITY OF THE PROJECT UNDER COVID-19 PANDEMIC

The field surveys, consultations between the two cities, local workshops, City-to-City Collaboration seminars, etc., which should have been major activities if 2021 were a normal year, were held completely online and conducted under physical restrictions due to the impact of the spread of COVID-19 after January 2020 in the City-to-City Collaboration programme of FY2021. However, some of the activities were carried out with ingenuity or replaced by alternative activities even against the backdrop of the COVID-19 pandemic. Also, some activities were postponed until FY2022. Those activities are summarized below for reference in FY2022.

5.1 Impact of COVID-19

According to a report by the International Monetary Fund (IMF) (January 2022), the global economic growth rate is expected to slow to 5.9% in 2021 and 4.4% in 2022 due to the global spread of the new coronavirus[4].

In addition, the economic growth rate of Indonesia is still low, although it is on a recovery path, falling to 5.0% in 2019, -2.0% in 2020, and 3.1% in 2021[5].

As of March 6, 2022, the total number of people infected with the new coronavirus in Indonesia exceeded 5.72 million, making Indonesia the country with the highest number of infected people in Southeast Asia[6]. In Riau province, as of March 5, 2022, a total of 144,418 people had been infected, and the disease is spreading at a rate of several hundred people per day[7].

Table 5.1 COVID-19 infection status in Riau province (as of March 5, 2022)

NO	DISTRICT / CITY	NUMBER OF CASES			NUMBER OF CURE CASES			NUMBER OF DEATH CASES		
		03 March 2022	04 March 2022	CUMULATIVE CASES	03 March 2022	04 March 2022	CUMULATIVE CASES	03 March 2022	04 March 2022	CUMULATIVE CASES
1	PEKANBARU	60573	264	60837	55874	384	56258	1328	3	1331
2	KAMPAR	9765	35	9800	8773	77	8850	408	2	410
3	PELALAWAN	3621	8	3629	3323	3	3326	184	0	184
4	INDRAGIRI HULU	6685	50	6735	6152	31	6183	206	2	208
5	INDRAGIRI HILIR	5825	33	5858	5519	5	5524	192	0	192
6	DUMAI	11099	57	11156	10297	31	10328	250	0	250
7	KEP. MERANTI	2151	6	2157	1974	0	1974	75	1	76
8	BENGKALIS	9376	20	9396	8749	16	8765	414	3	417
9	SIAK	10210	13	10223	9596	33	9629	310	2	312
10	KUANTAN SINGINGI	5834	15	5849	5529	21	5550	165	0	165
11	ROKAN HILIR	5449	47	5496	5092	10	5102	218	1	219
12	ROKAN HULU	5704	19	5723	5080	19	5099	360	0	360
13	LUAR PROVINSI	7459	100	7559	6307	0	6307	106	1	107
TOTAL		143751	667	144418	132265	630	132895	4216	15	4231

Source: Partially added by Nippon Koei from the special website of COVID-19, Riau province (https://corona.riau.go.id)

4 IMF website: https://www.imf.org/ja/Publications/WEO/Issues/2022/01/25/world-economic-outlook-update-january-2022

5 IMF data base: https://www.imf.org/en/Publications/SPROLLS/world-economic-outlook-databases

6 Peta Sebaran | Covid19.go.id : https://covid19.go.id/peta-sebaran/

7 https://corona.riau.go.id/

5.2 Issues and ingenuity of the project under COVID-19 pandemic

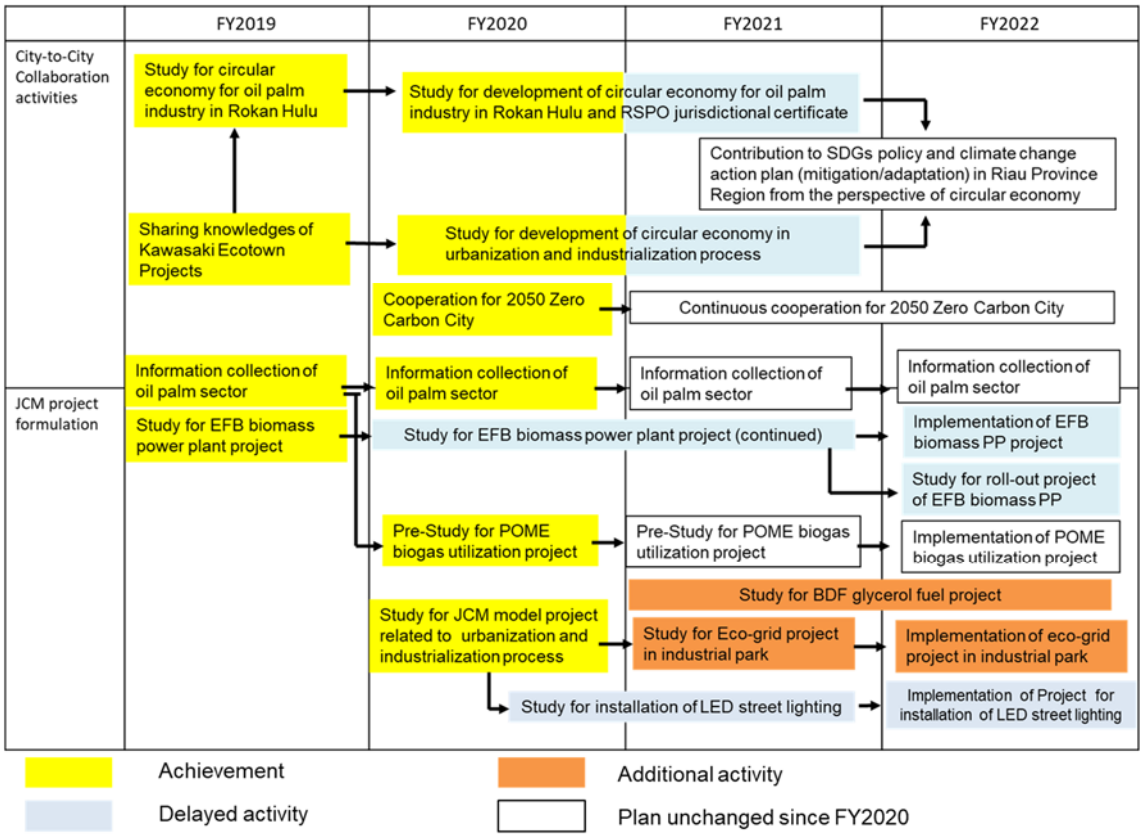
Due to the impact of the spread of COVID-19, there were some difficulties not only business trips from Japan but also smoothly conducting the LOI conclusion work and interviews with local companies, and so on. Therefore, activities were carried out remotely by utilizing two local companies and two local staff. As for the city-to-city cooperation activities, a local staff A facilitated the activities, who has been participating in this project since the first year and has a good network with the local government. For the study of JCM model project development, in addition to the two local subcontract companies, we conducted a field survey through mobilization of a local staff B, who has a good and comprehensive knowledge and experiences in palm oil related technologies and businesses and who can easily gather information from private companies as one of the experts in a central government agency for innovative technology development. In this way, by using the right person in the right place, we were able to carry out the activities smoothly.

Although the above measures have mitigated the impact of the new coronavirus, in FY2022 and later, it will be essential to discuss closely with relevant entities for formulating JCM Model Project among Japanese companies and local entities. It means that more ingenuity or other ways will be needed if the COVID-19 spreading continues.

CHAPTER 6 PROGRESS AND OUTCOMES OF 3-YEAR PLAN

City-to-City Collaboration Project in Riau Province Region launched in 2019. At the beginning, 3-year plan was prepared and the theme was support on development of circular economy in the province region. Then, support for 2050 Zero-Carbon City of Pekanbaru City has been carried out since the second fiscal year.

The figure below is the 3-year plan as of when proposal for FY2021 was submitted. When preparing it, extension of the plan to FY2022 was proposed in consideration of delay of activities that occurred so that FY2020 project was adopted by second public offering and by limitation of a trip due to COVID-19 pandemic.



Source: Prepared by Nippon Koei

Figure 6.1 3-year plan (at the beginning of FY2021 project)

FY2021 was the final year of the 3-year plan. Progress and outcomes of the plan are summarized in Table 6.1.

Table 6.1 Progress and outcomes of 3-year plan

Sector	Progress and outcomes
(1) City-to-city collaboration activities	
Support for development of circular economy and green recovery	In the first year, know-how of Kawasaki City on circular economy, river purification, etc. was shared through the workshop in Riau while officials of Pekanbaru City visited facilities in Kawasaki City during Japan visit. Due to COVID-19 pandemic, all activities has been carried out since the second year. However, knowledge sharing was continuously implemented through online workshops and provision of videos. Also, business matching seminars between GIC members and Pekanbaru City were carried out one a year and GIC members introduced their technologies and products contributing to circular economy and green recovery.
Support for development of 2050 Zero-Carbon City	Since the second year, support for development of 2050 Zero-Carbon City of Pekanbaru City has been implemented. Through online workshops, Kawasaki City has been sharing overview and progress of zero-carbon strategy "Kawasaki Carbon Zero Challenge 2050". In addition, in the workshop of FY2021, DKI-JKT, who is implementing City-to-City Collaboration Project with Kawasaki City and published zero-carbon plan "RPRKD", had a presentation about their activities under the plan. Also, theme of LOI between Pekanbaru City and Kawasaki City, being prepared, will be 2050 Zero-carbon City under agreement of both cities and Pekanbaru City is positively considering about zero-carbon declaration.
(2) JCM project formulation studies	
Studies of projects for development of circular economy	EFB biomass power plant project The study has been carried out since the first year. Almost all studies for project development has been done by the end of the second year. However, PLN announced to aim at carbon neutral by 2050 and PT.PN group stopped all EFB utilization project for cooperation with PLN. Since EFB biomass power plant project also stopped, additional study about biomass fuel sources was implemented in FY2021. POME biogas utilization project The study started in the second year. Palm oil mill owned by PT.PN5 was decided to be study target and study of biogas generation amount, design of bio-CNG plant, consideration of CAPEX and OPEX of the plant were carried out. Also, Fuel switch (Diesel to bio-CNG) potential of public buses in Pekanbaru City was calculated. BDF nano-glycerol fuel project The study started in FY2021. Contacts to BDF factories for sample collection and study of glycerol market were carried out. Also, cooperation potential with oil palm industry development in Tenayan Industrial Park is being considered.
Studies of projects for development of zero-carbon city	In FY2021, studies for eco-grid project in an industrial park and project for installation of LED street lightings started and emission reduction by combination of energy saving/renewable energy and IoT technology was estimated. Since development of Tenayan Industrial Park is not proceed enough, study target in FY2021 was changed to city government offices.

Source: Prepared by Nippon Koei

CHAPTER 7 FUTURE PLANS

7.1 JCM Model Projects for FY2022

In this year's feasibility study (F/S), the stakeholders' intention was to propose the EFB power generation project as a JCM model project after 2022, as soon as the plant in Aceh, which is currently under construction, is completed. In addition, based on the results of this year's fuel study, not only the option to build an EFB power plant, but also a project to produce EFB-derived biomass fuel is being considered in parallel as promising, which is in line with the PLN's policy of biomass co-firing.

As for the POME biogas project, the Pre-F/S was completed this fiscal year, and with this information, in the next fiscal year, explanations will be started to the production side (each business that emits POME) and the use side (Pekanbaru City Bus Company and palm oil related companies that are interested in utilizing bio-CNG), and projects with companies that show interest will be developed. Although the source of biogas will be livestock manure instead of POME, there is a possibility of a bio-CNG project in other provinces in Indonesia that utilizes the technology studied this year and the results of the engineering study. Since the project proposal may be more progressed in terms of funding potential, starting with other provinces first may be considered. It is expected that showing successful examples in other provinces will accelerate the expansion of the biogas project in Riau. The project will be proposed for under the " Financing Programme to Demonstrate Decarbonization Technology for Realizing Co-Innovation".

Regarding the biodiesel production-derived glycerol fuel business, it is possible to consider the introduction of the technology to a major palm company that was matched through this project this year. It is taking time for discussions as the palm company often requests face-to-face meetings, but the communication will be followed up.

At present, among these projects, the one that could be applied for as a JCM-related project early in FY2022 is a proposal for a bio-CNG project (assuming it is proposed by Co-Innovation) in another province in Indonesia. The other projects will be continued to be studied for the application in the middle or later of FY2022 as well.

Regarding projects that contribute to the formation of zero-carbon cities, it is important for potential representative companies to travel to Indonesia to collect further data and hold discussions to finalize the business model. In particular, since the initial cost of the proposal to introduce EMS and renewable energy to the new city government buildings is not expected to be large, the effort will be continued to apply the project for JCM model project within FY2022.

7.2 Strategy for City-to-City Collaboration Project in Phase 2

The original three years plan is completed in FY2021, while JCM project has not yet been achieved due to the impact of COVID-19 and the fact that the second year of the project was adopted in the second round, which delayed activities. On the other hand, after three years of the project, Pekanbaru City stated at this year's seminar that they will proceed with the Zero Carbon City 2050 Declaration, and the LOI between Pekanbaru City and Kawasaki City that will guarantee the support is almost finalized and expected to be signed soon.

Therefore, it is highly significant to continue this city-to-city collaboration project next year and beyond. The policy for continuation of Phase 2 (FY2022-FY2024) is shown in 7.2.1 and 7.2.2.

As for Rokan Hulu regency, it is not likely that Rokan Hulu will be proposed as a partner in Phase 2, since discussions with the new members of the government of the regency could not be resumed remotely. On the other hand, since it is highly likely that palm oil mills in Rokan Hulu regency will continue to be targeted in the formation of the JCM project, to attempt contacting them for the implementation of the project will be continued.

7.2.1 City-to-City Collaboration activities in Phase 2

Theme of the Phase 2: Realization of decarbonization dominoes with Pekanbaru City at its heart

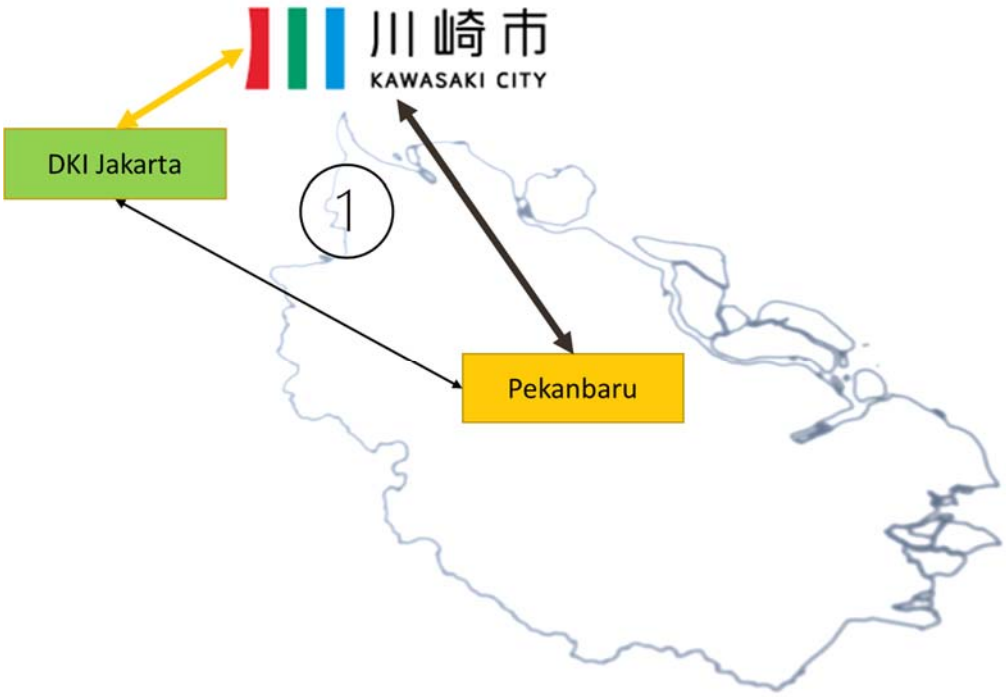
This year, the Special Capital Region of Jakarta (DKI-JKT), as Kawasaki's partner in the city-to-city collaboration, was invited to participate in a seminar in Pekanbaru to introduce its efforts and laws and regulations for decarbonization. Questions were actively raised among the Indonesian local governments, and it was confirmed that the coordination of two city-to-city collaboration projects of Kawasaki city is effective.

In the phase 2 of the project, Pekanbaru City will be supported for developing a decarbonization plan by introducing the knowledge and experience of Kawasaki City and the DKI Jakarta, and then expand those experiences and knowledge to 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 the decarbonization dominoes to Riau Province and each municipality (city and province). Rather than Kawasaki working directly with many municipalities, the approach is to support the key municipalities that will be the starting point of the dominoes. The City of Pekanbaru will be supported in FY2022 and FY2023 in the formulation of the decarbonization plan, while the implementation of the JCM project, which will lead to actual GHG reductions, will be promoted in FY2023 and FY2024.

In particular, as for the possibility of applying the technologies studied in this project besides Pekanbaru City, the potential of Dumai city, where many palm oil-related industries are located in the coastal area, and central palm oil production areas such as Rokan Hulu regency, are

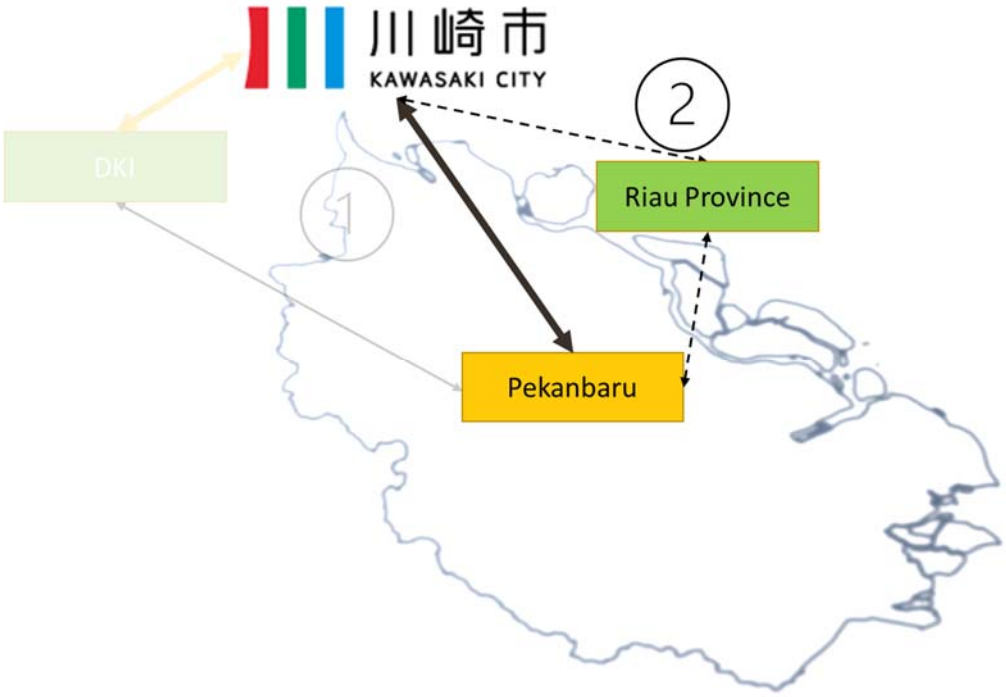
considered to have high potential in Riau Province, and collaboration with those municipalities is expected.

The image of the decarbonization domino with Pekanbaru City at its heart is as follows.



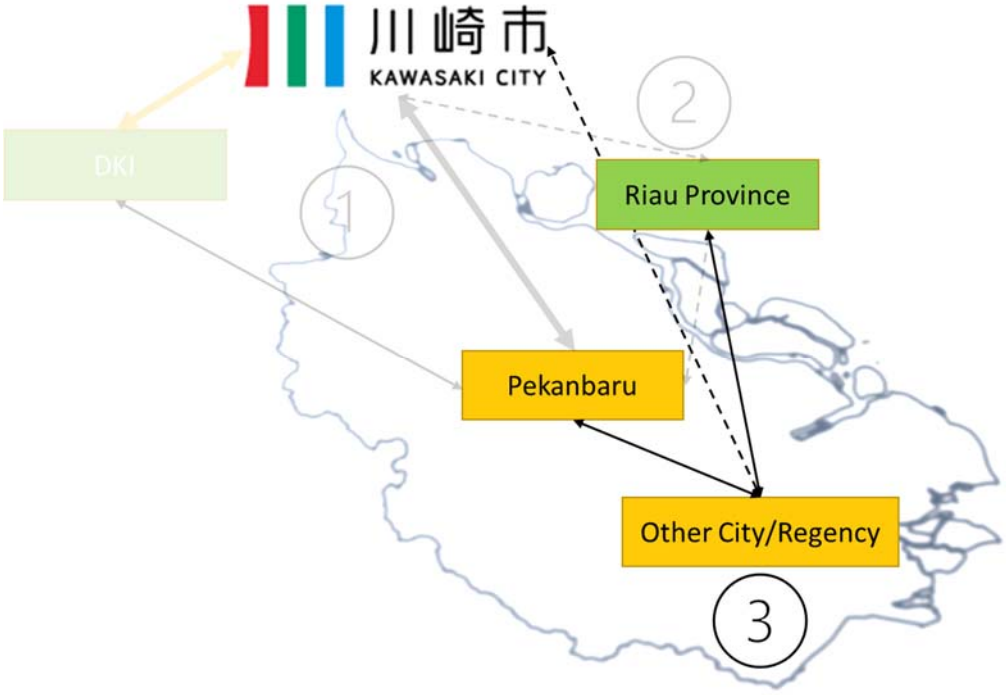
Source: Nippon Koei

Figure 7.1 Step 1: Decarbonization Planning of Pekanbaru City supported by Kawasaki City and DKI Jakarta



Source: Nippon Koei

Figure 7.2 Step 2: Collaboration with Riau Province for Decarbonization Planning of Pekanbaru City supported by Kawasaki City



Source: Nippon Koei

Figure 7.3 Step 3 Decarbonization Dominoes in Riau Province with Pekanbaru City as its heart

7.2.2 JCM project formulation

Based on the results of this year's study, the following candidate decarbonization technologies will be positioned in the decarbonization plan of Pekanbaru city which is to be studied in Phase 2 so that they can be introduced through JCM projects.

(1) EFB biomass power generation project

Project will be started in Riau after the completion of the Aceh EFB power plant by Aura Green Energy. On the other hand, given the growing demand for biomass fuels from PLN, a shift to the EFB-derived biomass fuel supply business is also considered promising, and these two approaches will be pursued together to solve the issue of utilizing EFB in Riau, a palm-producing region.

(2) POME biogas utilization project

Based on the results of this year's study, the basic estimation of project cost and plant design have been finalized, and the results are now ready to be compiled into a project package and explained to the companies to be involved. The results of last year's study showed that significant GHG reduction effects can be expected. Even it is more likely that the co-innovation project of this technology will be realized in other provinces first, it will be even better when a project will be developed in Riau as a more persuasive plan by taking advantage of the results of adoption in other provinces.

(3) BDF glycerol fuel project

As for the glycerol fuel business, this year's study revealed that under the current situation in Riau, it would be more desirable to introduce the glycerol fuel business at the same time as the introduction of a new palm oil mill than to apply it to an existing palm oil mill. As a major palm oil company is planning to set up a palm oil mill in Tenayan Industrial Park in Pekanbaru City, discussions with that company will be continued as a top priority.

(4) EMS technology in the new government buildings of Pekanbaru City

Since last year, it was explained to the Tenayan Industrial Park that decarbonization of electricity is important to attract promising companies. However, due in part to the impact of COVID-19, the status of companies' operation in Tenayan Industrial Park has been slower than planned. Therefore, based on this year's study, it was concluded that it is desirable to introduce renewable energy + EMS + electricity storage technology to the new city government building complex of Pekanbaru (adjacent to Tenayan Industrial Park) and demonstrate its GHG reduction in order to show the achievements more quickly. Based on the results of the demonstration, it will be effective to proceed to preparatory activities for further large-scale

installation in the industrial park, and therefore, the project targeting the new city government building complex will be undertaken as a first JCM model project.

(5) Use of LED streetlights

The plan to replace streetlights managed by Pekanbaru Transportation Department with LEDs will continue to be studied for commercialization in the next fiscal year, as its effectiveness has been confirmed through this year's study. Feasible business model is required for developing a JCM model project.

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