Project commissioned by the Ministry of the Environment in 2021

Commissioned Task for an Intercity Collaborative Project for Actualizing a Decarbonized Society in 2021 (Project for helping develop a future city for attaining SDGs based on the intercity collaboration project among Toyama City, Bali, and Semarang)

Report

March 2022

Japan NUS Co., Ltd.

Toyama City

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Table of Abbreviations

Abbreviation	English/Indonesian	Japanese Translation
100RC	100 Resilient Cities	100 のレジリエント・シティ
BAPPEDA	Badan Perencanaan Pembangunan Daerah	地方開発計画局
BAU	Business as usual	成り行きシナリオ
BOE	Barrel of Oil Equivalent	石油換算トン
BRT	Bus Rapid Transit	バス高速輸送システム
CAPEX	Capital Expenditure	設備投資コスト
CNG	Compressed Natural Gas	圧縮天然ガス
DDF	Dual Diesel Fuel	ディーゼル油/CNG の混合燃料
DEPO	Depot	中継施設
DKP	Dinas Kebersihan dan Pertamanan	美化局
ESDM	Ministry of Energy and Mineral Resource	エネルギー鉱物資源省
FIT	Feed-in Tariff Program	固定価格買取制度
GNSSA	GERAKAN NASIONAL SEJUTA SURYA ATAP	屋根置き太陽光発電促進国民運動
IPP	Independent Power Producer	独立電源事業者
IRR	Internal Rate of Return	内部収益率
JCM	Joint Crediting Mechanism	二国間クレジット制度
KEN	Kebijakan Energi Nasional	国家エネルギー政策
MRU	Mobile Refueling Unit	コンプレッサー搭載ガス供給車
NDC	Nationally Determined Contribution	自国が決定する貢献
PLN	Perusahaan Listrik Negara	インドネシア電力公社
PPA	Power Purchase Agreement	電力売電契約
RAD-GRK	Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca	地方温室効果ガス排出削減行動計画
RAN-GRK	Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca	国家温室効果ガス排出削減行動計画
RPJMD	Rencana pembangunan jangka menengah daerah	地方中期開発計画
RPJMN	Rencana pembangunan jangka menengah nasional	国家中期開発計画
RUED	Rencana Umum Energi Daerah	地方エネルギー総合計画
RUEN	Rencana Umum Energi Nasional 2015-2050	新国家エネルギー政策
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik	インドネシア電力供給事業計画

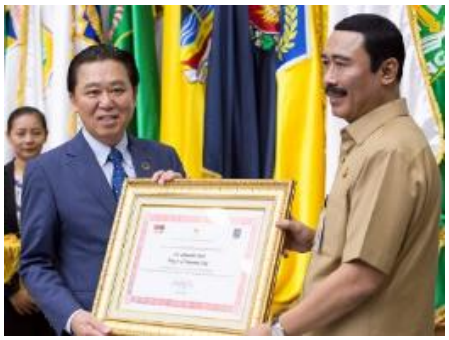
SDGs	Sustainable Development Goals	持続可能な開発目標
SPBG	Stasiun Pengisian Bahan Bakar Gas	ガス充填ステーション
TPA	Tempat Pembuangan Akhir	最終処分場
TPS	Tempat Pengolahan Sampah	一時集積場
JANUS	Japan NUS Co., Ltd.	日本エヌ・ユー・エス株式会社（本都市間連携提案事業者）

1. Background, Objectives, and Implementation Structure of Project

1.1. Background and Objectives

The Paris Agreement, which entered into effect in November 2016 and entered the implementation phase in 2020, calls for the acceleration of climate change measures by non-governmental entities, including municipalities and cities, in addition to the central government. In addition, the "Online Platform Ministerial Meeting on Recovery from the COVID-19 and Climate Change/Environmental Preparedness" held in September 2020 also confirmed the need for decarbonization policies for local governments with activities directly related to communities and the importance of local community-led development approaches. In Japan, too, the government has declared its goal of reducing greenhouse gas emissions to zero by 2050, aiming for a decarbonized society, and the number of municipalities declaring virtually zero CO2 emissions has skyrocketed to over 300.

Thus, the role of cities and local governments in considering and implementing specific local climate change measures and projects is becoming increasingly important. In order to realize a decarbonized society all over the world, it is necessary to accelerate the movement toward building a sustainable decarbonized society, especially in Asia where economic growth is remarkable. There is a growing international movement to support the efforts of cities to decarbonize and lower the carbon footprint of their activities, as these cities are the places that support social and economic development.



In addition, under the current situation of the spread of COVID-19, cities have to deal with the challenges related to the spread of the infection and at the same time readjust and consider new measures to achieve sustainable development, and thus collaboration among cities to build new methods and new cities is extremely important.

In this project, Japanese research institutes, private companies, and universities, together with Japanese cities that have experience and know-how in building a carbon-free and low-carbon society, will conduct a research project to support overseas local governments in their efforts to build a carbon-free and low-carbon society, to realize a carbon-free domino, and to introduce equipment that will contribute to shaping a carbon-free and low-carbon society.

In this task, based on the above objectives, the two municipalities of Bali Province and Semarang City, Indonesia, will collaborate with Toyama City, to support the efforts of the two municipalities that are proactive in decarbonization policies. They will deepen a cooperative relationship while working together with companies in Toyama City to realize the creation of a next-generation province and city.

Toyama City is a future city for attaining SDGs, and has been promoting various initiatives with the aim to contribute to Indonesia by collaborating with local governments there. Toyama City has a deep connection with Indonesia. In 2014, under a technical cooperation agreement with Tabanan Regency, Bali Province, Toyama City introduced a small-scale hydroelectric power generation system utilizing JICA projects, and since then, the city has made cooperation agreements with Semarang, Banda Aceh, and Tobintinggi Cities, as well as Tabanan, Klungkung, and Lebong Regencies, etc., and has organized projects that contribute to achieving the SDGs.

In 2018, Toyama City became the first Japanese municipality to receive a letter of appreciation from Indonesia’s Ministry of Home Affairs for its achievements. As a future city for attaining SDGs, Toyama City has positioned itself as an advocate of SDG 17 aiming to "revitalize global partnerships" (as stated within the SDGs) with its initiatives, and plans to promote further international collaboration.

Bali has been implementing the "Tourism Future City Support Project by Toyama City and Bali

Province through Inter-city Cooperation", as a JCM inter-city cooperation project.The project provided support for the low-carbon tourism sector, mainly in the hotel and transportation industries. In addition to providing support to establish policies for fuel conversion, the project also provided support in applying for JCM equipment subsidy projects, business matchmaking, and workshops as part of JCM project formation activities.

However, just as projects for energy conservation and the introduction of renewable energy in large hotels were taking shape, the spread of COVID-19 made investment in tourism businesses difficult.

Therefore, in the last fiscal year, we shifted our focus to the greatest environmental challenge facing Bali Province, which is traffic congestion and the resulting air pollution and CO2 emissions caused by exhaust gas.

The Dual Diesel Fuel (DDF) system, which is a technology applied to the FY 2018 JCM Subsidy Project, "Introduction of Compressed Natural Gas (CNG) and Diesel Co-firing System to Public Transport Buses in Semarang" realized by Toyama City in Semarang, was considered as a promising technology. From the viewpoint of reducing emissions by using fossil fuels with lower emission factors, this is only a transit point toward decarbonization, but the low-carbonization enabled by this technology is highly feasible in the transportation sector, and can be expected to have a definite emission reduction effect.

Since DDF can function only on diesel fuel, it can be operated even when there is a shortage of gas fuel in areas where gas supply facilities are inadequate, and its high local adaptability is another advantage.

It is also cheaper than diesel in terms of calorific value, which is a great economic advantage for users. Furthermore, since it is applied through the modification of existing vehicles, it can be implemented at a low cost. From these perspectives, DDF is a cost-effective low-carbon technology that can be widely used in many vehicles.

We know the local contractors that can do the work, and we can build a system for maintenance and after-sales services. In addition to vehicles, the application of this technology can also be considered for fishing boats with outboard motors and diesel fuel powered private power generation facilities.

Figure 1-1 DDF system and a case of installation in a public bus in Semarang

Source: Produced by JANUS

The gas distribution situation in Indonesia is not optimal. Although the nation is implementing measures to promote the use of its large natural gas reserves in response to the decline in oil production, most of the natural gas produced is either exported or supplied to large-scale users (such as LNG-fired power plants), and the country is not equipped to supply the potential urban demand.

The cooperation of the Ministry of Energy and Mineral Resources (ESDM), responsible for energy policies, and Pertamina Gas, a major gas distributor, is essential for the stable supply of gas.

As for the gas supply to the transportation sector in Bali, under a cooperative agreement between the Governor of Bali Province and the Minister of ESDM, Pertamina Gas, a state-owned gas company, has decided to enter the gas business field in Bali Province. Bali Province and Toyama City have agreed to work together to promote the project as an inter-city collaboration. This year, we have just formed a MoU for the expansion of gas utilization in Bali

The previous project in Semarang City had encountered problems with gas supply even after the start of monitoring due to the inadequate maintenance of the gas supply system. In this project, we decided to examine the establishment of a system that can guarantee a stable gas supply, with advice from Semarang City, which faced these challenges.

In 2017, the partnership between Toyama and Semarang cities was expanded to include the "Support project for the realization of a low carbon society: the resolution of disaster prevention, environmental, and energy issues to build a resilient city" and “Research Project for the Development of a Compact City Transportation System” as part of "Inter-city Collaboration Project for the Realization of a Low-carbon Society." In the same year, we signed the "Cooperation Agreement on the Establishment of the Environment and Public Transportation in Toyama and Semarang Cities", and initiated “the Project for low-carbon systems by installing energy-saving equipment in Semarang City” as “Inter-city Collaboration Project for the Realization of a Low-carbon Society in 2018.”

In 2019, the "Semarang City Clean Energy Promotion Project Based on a Low-carbon Society Scenario" was implemented as part of "JCM Intercity Collaboration Project For FY 2019", and the formation of a project to subsidize the construction of a new sewing factory in Semarang City as well as the construction of the Semarang City Hall was discussed. In addition to preparations to apply for a JCM equipment subsidy project this fiscal year, support has been provided for the implementation of ownership procedures and the stabilization of CNG gas supplies for the current JCM equipment subsidy project, "CNG and Diesel Co-firing System Installation Project for Public Transport Buses in Semarang City."

Also, Semarang City advised the Bali Province government on its role as a local government and experience in policy making and implementation during the FY 2019 JCM project, and contributed to the understanding of the effects of the inter-city collaboration.

In promoting low-carbon policies and JCM projects based on Toyama City's inter-city collaboration initiatives, it is necessary to study and implement measures in Indonesia, as the laws and regulations, responsibilities and authority of local governments differ from those in Japan. In light of this, the horizontal deployment of the results and experiences of the Indonesian local government involved will accelerate the implementation of low-carbon policies and the utilization of JCM projects. In this project, Semarang City is positioned as an advisor in the initiatives of Toyama City and Bali Province, and the two cities will continue to cooperate and collaborate to promote environmental policies related to low-carbon and decarbonization, and to share knowledge on the details of JCM projects.

We also know that there is still abundant low-carbon potential in Semarang City, and other potential sites with unrealized projects for the introduction of low-carbon technologies and JCM

commercialization.

Last fiscal year's project was focused on flood control pumps and waste collection vehicles, and the results of cost effectiveness and greenhouse gas reduction were estimated. In the project this fiscal year, we investigated the possibility of installing the actual equipment further.

In addition, since diesel fuel will be used for approximately half of the heat requirements even after the installation of fuel conversion equipment, the possibility of adopting exhaust gas purification technologies applied in Japan will be examined to reduce nitrogen oxides (NOx) and other air pollutants and to further reduce carbon emissions.

The details of the project will be described below, but it aims to strengthen solidarity between Bali Province and Semarang City to achieve the SDGs by working to realize JCM projects to introduce decarbonization and low-carbon technologies to potential sites in Semarang City.

1.2. Implementation structure and details of this task

The implementation structure and outline of this project are as shown below.

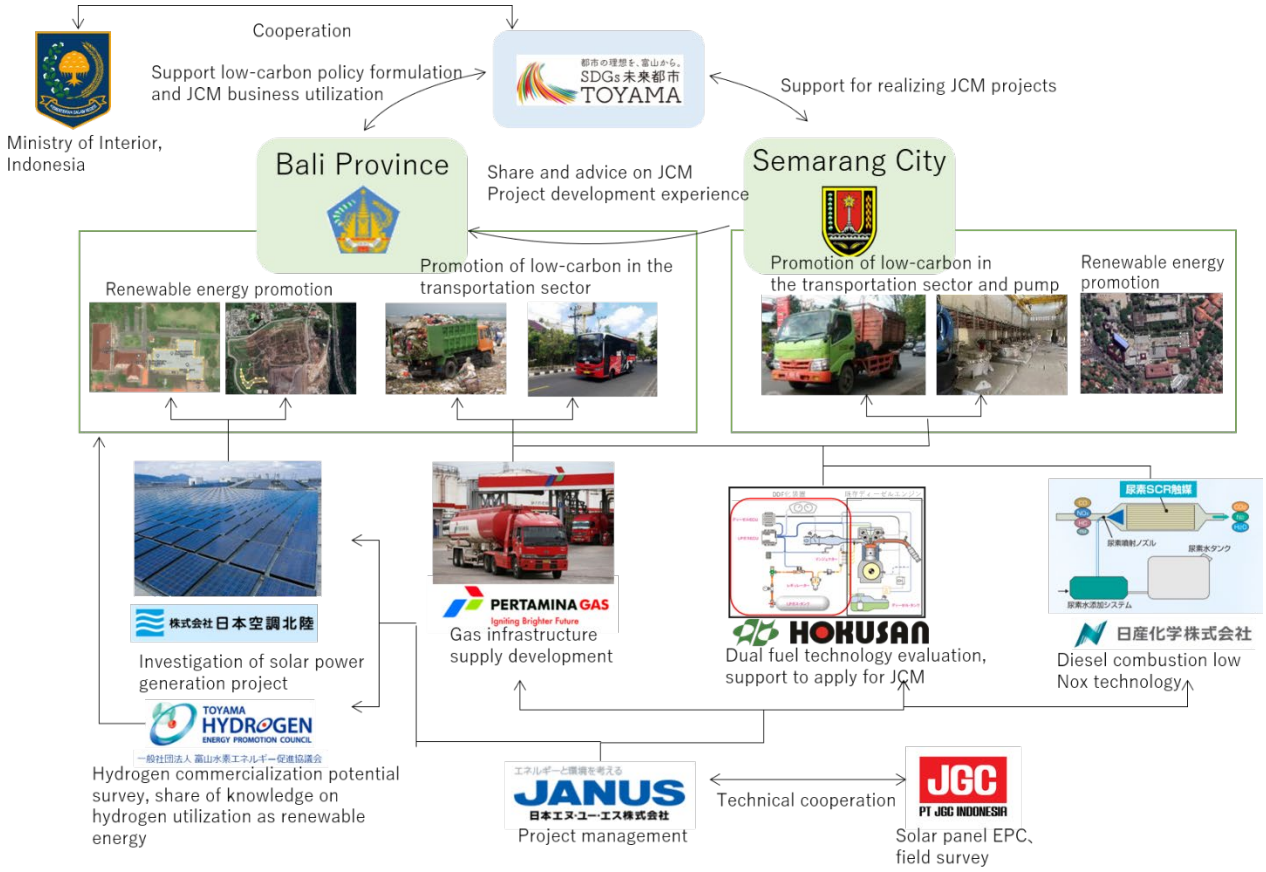


Figure 1-2 Entire implementation structure for this task

Source: Produced by JANUS

2. Discussion on a Commercialization Plan

2.1. Indonesia's Low-carbon Policy Initiatives

2.1.1. Low-carbon Policies of Indonesia' Central Government

One of the pillars of Indonesia's low-carbon policy is the "National Action Plan for Greenhouse Gas Emission Reduction (Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca: RAN-GRK)," which was formulated as a presidential decree in 2010.

The plan calls for a national commitment to reduce greenhouse gas emissions targeting a 26% reduction from the (business as usual: BAU) scenario by 2020. However, since the government has also announced its goal of reducing greenhouse gas emissions by 41% with international support, the Joint Crediting Mechanism (JCM) is also expected to be utilized. In this context, Japan and Indonesia signed the JCM in October 2013, and Indonesia became Japan's eighth JCM target country.

Although the 2010 Action Plan was declared during the former President Yudhoyono's term of office, the current President Joko Widodo announced his commitment to make a nationally determined contribution (NDC) to reduce GHG emissions by 29% from BAU in 2030, which is in line with the RAN-GRK target, and a declaration committing to reduce it to 41% with international support (such as JCM) at the COP in Paris on December 21, 2015. Since the aforementioned RAN-GRK was a GHG emission reduction target until 2020, the RAN-GRK Executive Office held workshops across Indonesia in 2017 to have discussions with local governments after the submission of the NDC, to have them reconsider their target values to be in line with the NDC[1].

It is worth mentioning here that the latest version of the NDC was released in August 2021, announcing the aim to achieve "carbon neutrality," which means virtually zero greenhouse gas emissions by 2060 at the latest.

The goal of virtually zero greenhouse gas emissions was submitted to the UN for the 26th Conference of the Parties (COP26) at the UN Framework Convention on Climate Change (UNFCCC) in Glasgow as a long-term strategy for low-carbon and climate resilience. However, it maintains the existing target for 2030, which is a 29% reduction in greenhouse gas emissions compared to the case where no additional measures are taken (BAU), and a maximum reduction of 41% with international aid.

The reduction targets by sector are 24% for forestry and other land-use sectors and 16% for energy. In the energy sector, the plan includes phasing out coal-fired power generation, accelerating the shift to hydropower, biomass power energy, hydrogen, floating and roof-mounted solar power, geothermal power, and shifting from high-cost diesel to gas power and new renewable energy.

While Indonesia's domestic system has many challenges to overcome in the rapid transition to renewable energy, including the fact that the supply of cheap energy to low-income groups is an important element of the government's support base, the new National Energy Policy (Rencana Umum Energi Nasional 2015-2050: RUEN) formulated in 2015 sets a target to reduce the share of

[1]https://energypedia.info/wiki/Indonesia:_From_Mitigation_Action_Plans_To_Integrated_Low_Carbon_Development_Planning

oil from 49% to less than 22% in the country by 2025. In addition, the shares of natural gas will increase from 20% to 22%, coal from 24% to 32%, and renewable energy from 6% to 23%. With the above revision of the NDCs and the gradual reduction of coal-fired power generation, the National Energy Strategy is also expected to be revised in the future, but for the time being, it is expected that measures will be taken in line with the above goals.

Nuclear power is positioned as the last option. The shift from the direct use of fossil fuels to electricity will be promoted, and the installed power generation capacity will be increased from the current 44 GW to 115 GW by 2025.

The following national energy policy goals have also been set.

1) Energy elasticity (energy consumption growth/economic growth rate): The elasticity value should be less than 1 in 2025 to meet the economic growth target.
2) Energy intensity (energy consumption per unit of GDP): Improve by 1% per year until 2025.
3) Electrification rate: 85% by 2015, and closer to 100% by 2020.
4) Household gas usage rate: 85% by 2015
5) Ratio of new/renewable energy to primary energy: Increase to 23% by 2025 and 31% by 2050.

The National Energy Policy (RUEN) is structured to encompass low-carbon policies with natural gas and renewable electricity, and the relevant policies can be understood as low-carbon.

The overall picture of the policies and low-carbon measures using natural gas and renewable electricity are summarized in Table 2-1.

Table 2-1 Positioning of the power derived from natural gas and the power derived from renewable energy in the national energy policy

Item	Description
Goals	■To increase the roles of businesses that lead the transition to a market economy for the efficient operation of the economy ■To develop energy to be exported, and strengthen the base for use of energy for domestic consumers ■To cement strategic partnerships inside and outside Japan ■To become less dependent on foreign countries, and enhance local content
Strategies	■To correct the difference in price between domestic and exported ones ■To help design a master plan for energy ■To introduce the market mechanism involving producers and consumers ■To allocate the roles of the private and public sectors in large-scale development ■To support the private sector in energy development ■To promote the development of technologies and personnel

Item	Description
	■To establish a framework for cooperation among energy-related staff ■To brush up the business management skills in energy-related sections
Action plans (gas)	■To improve the access to domestic and overseas gas resources for securing the supply ■**To increase the reserve and output of gas by offering incentives** ■**To raise gas supply by constructing LNG stations, CNG transportation facilities, and gas distribution networks** ■To research new fields, including small-scale LNG and liquefaction technologies, and develop technologies ■To apply gas prices for realizing economic value that matches the construction of gas supply systems ■To obligate domestic enterprises to supply gas to domestic markets ■To optimize the order of priority for domestic gas supply (for fertilizers, for power generation, for government-run gas companies, and for industrial use) ■To utilize flare gas with small-scale LNG/LPG in an optimal manner
Action plans (gas pipeline)	■To continue the construction of pipelines for establishing domestic gas transportation systems ■**To increase gas supply by constructing LNG stations, CNG transportation facilities, and gas distribution networks** ■To use CNG in regions where pipelines cannot be constructed ■To determine the prices for gas transportation and distribution with pipelines in accordance with economic principles ■To construct LNG plants and LNG acceptance stations in regions where demand for gas is high in Java ■To implement ASEAN gas pipeline plans
Action plans (natural gas and LPG)	■ To increase LPG supply in regions where natural gas cannot be supplied ■The government will establish a quality control system for LPG. ■To promote LPG, DME, GTL products, etc. ■To curb petroleum consumption and **promote the use of** LPG and **natural gas** in the transportation section ■To set standards for gas and **intensify competition in the trade of natural gas and LPG**

Item	Description
Action plan (electricity and electrification)	■To upgrade power plants using natural gas and LPG with pipeline networks ■To enhance power generation with renewable energy, diversify fuels for power generation, and reduce petroleum consumption ■To increase power generation using low-grade coal ■To export electric power generated at distant places to neighboring countries ■To develop small-sized gas power generators ■To develop new power generation technologies, such as cogeneration and fuel cells ■To establish power generation operation methods for environmental conservation
Action plans (consumer-use, commercial section)	■To promote the use of natural gas and coal ■To construct roads and storage depots for transporting coal and briquettes ■To recommend energy-saving devices ■To convey information on energy-saving devices to consumers ■To develop transportation technologies, small-scale storage facilities, etc. for facilitating the shift to natural gas consumption
Action plans (industrial section)	■To promote the switch from in-house power generation to the purchase of electricity from electric power suppliers ■To support gas-using factories ■To research, carve out, and promote the use of gas instead of petroleum ■To promote the use of cogeneration-type power generators ■To promote the use of local energy in regions where electrification has not been conducted ■To use briquettes in small factories, including tea plantations, rubber factories, and greenhouse farms
Action plans (transportation section)	■To promote land transportation systems using CNG and LPG ■To promote the use of alternative energy to oil, such as LNG, DME, and gas hydrate ■To develop biodiesel fuel ■To develop electric vehicle systems for public transportation in urban areas ■To set automobile fuel standards

Source: Produced with reference to "PERATURAN PRESIDEN REPUBLIK INDONESIA NOMOR 22 TAHUN 2017 TENTANG RENCANA UMUM ENERGI NASIONAL" in the website of Department of Energy & Mineral Resources; https://www.esdm.go.id/assets/media/content/content-rencana-umum-energi-nasional-ruen.pdf, acquired on Jan. 20, 2020

2.1.2. National Medium-term Development Plan (RPJMN)

In January 2020, the Indonesian government announced a new National Medium-term Development Plan (Rencana pembangunan jangka menengah nasional: RPJMN). The plan assumes an average annual growth rate of 5.7 to 6.0% in real GDP, which will require an investment of approximately IDR35,000 trillion to achieve. It had also set a goal of raising the gross national

income (GNI) per capita to between USD5,810 and USD6,000 as of 2012[2].

In the RPJMN, the President's nine missions and five directives have been established, and from these, seven development issues are presented as below. In the development agenda, challenges include requirements for development that is environmentally friendly, that improves disaster resilience, and takes climate change countermeasures into account.

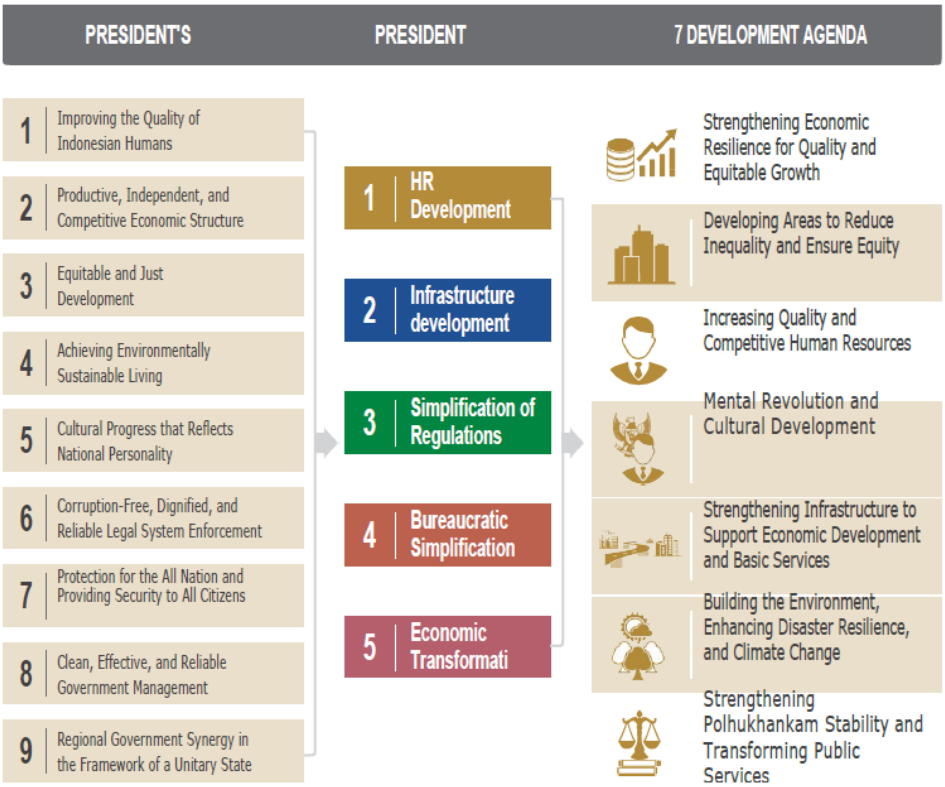


Figure 2-1 Mid-term development plan (RPJMN), presidential directives, and 7 development issues

Source: Medium-term development plan (RPJMN, 2020-2024)

The RPJMN's macro-development goals also mention GHG emission reduction targets, with a target of 27.3% GHG reduction by 2024 in order to achieve the 29% reduction in 2030, relative to BAU, listed in the aforementioned NDC (see the figure below).

[2] Ministry of National Development Planning of Indonesia, "Rencana Pembangunan Jangka Menengah Nasional 2020-2024, Narasi (Mid-term National Development Plan) "

Figure 2-2 Mid-term management plan (RPJMN), macro-development goals for 2020-2024

Source: Medium-term development plan (RPJMN, 2020-2024)

Energy development plans show that the country continues to rely on fossil fuels, and energy self-sufficiency, which was 75% as of 2018, is expected to decline to 28% by 2045. In order to compensate for this, the government is promoting the use of renewable energy, as stated in the aforementioned RUEN, with the goal of increasing their share to 23% by 2024.

The plan outlines the following policies for energy development

1) Accelerating the development of renewable energy
2) Increasing the supply of biofuels
3) Enhancing energy security and energy conservation
4) Increasing energy supply to industry
5) Development of NRE (New/Renewable Energy) and support for industry

The target for natural gas supply is to increase production from 1.1 million BOE/day in 2018 to 1.2 million BOE/day by 2024.

In achieving the target of increasing renewable energy, the government has also specified that it will focus on the development of renewable energy derived from oil palm, with an expected investment of IDR32 trillion by 2024.

The diversification of power sources has not kept pace with the demand for electricity in urban areas, and dependence on energy derived from fossil fuels persists. Photovoltaic power generation has not been widespread, but this is considered because the supply of solar panels is limited to expensive domestic panels of low quality, and the development of the grid and a purchase system has not progressed sufficiently to create a foundation for the use of renewable energy.

[Gas Supply Project]

The national medium-term plan for 2020-2024 lists priority projects to be implemented by the government, and one of those mentioned in the gas supply plan is "Project No. 35: Development of

gas infrastructure to supply gas to 4 million households," indicating the expansion of gas supply[3].

As the background of the project, it aims to maximize the use of domestic gas, and the gas supply network in urban areas is not sufficiently developed, with only 530,000 dwelling units receiving gas. The project aims to expand the gas supply infrastructure from 2020 to 2024, and to supply gas to 4 million households by 2024. Accordingly, capital expenditure is expected to be IDR38.4 trillion. In particular, since Semarang City is listed as a priority region for installation, it is expected that the backbone infrastructure for gas supply will be developed, and that the gas supply for industrial use as well as transportation will be improved.

2.1.3. National plans and local governments

The relationship between the national and local governments is somewhat unique in Indonesia. In order to understand the linkage between the local governments of Bali Province and Semarang City and their policies and national plans in the next chapter, it is necessary to understand the system of national management. The next section will provide an overview of the structure of the central and local governments in Indonesia.

The 1945 Constitution, enacted at the time of Indonesia's independence, provided for a republican form of government with the president as the head of state, and the National Council positioned as the highest legislative body.

The 32-year long regime of the second president, Suharto, resulted in a dictatorial democracy with a concentration of power, corruption, and suppression of speech, and in response, attempts were made to reduce and decentralize the power of the president since the 2000s through amendments to the constitution, and a political system has been established to prevent the concentration of power, such as the current two-term limit of 10 years for the president.

There was a major policy shift to decentralization since the Suharto era. Since the 2000s, decentralization has become a global trend, especially in Europe and the U.S. Indonesia, due to its historical and ethnic background, was well suited for decentralized governance, and the positioning of local governments in policy has become important.

Local governments in Indonesia breaks down to provinces, regencies and cities. Unlike in Japan, regencies and cities are not hierarchical but equal under the state, with the main distinction being that rural areas are called regencies and urban areas are called cities. Towns and villages are constituted as subordinate organizations of regencies and cities.

Figure 2-3 shows the relationship between the legislature, the executive branch, the judiciary, and the central and local governments in Indonesia.

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[3] Ministry of National Development Planning of Indonesia, “Rencana Pembangunan Jangka Menengah Nasional 2020-2024, Proyek Prioritas Strategis (Mid-term National Development Plan, List of Prioritized Projects)”

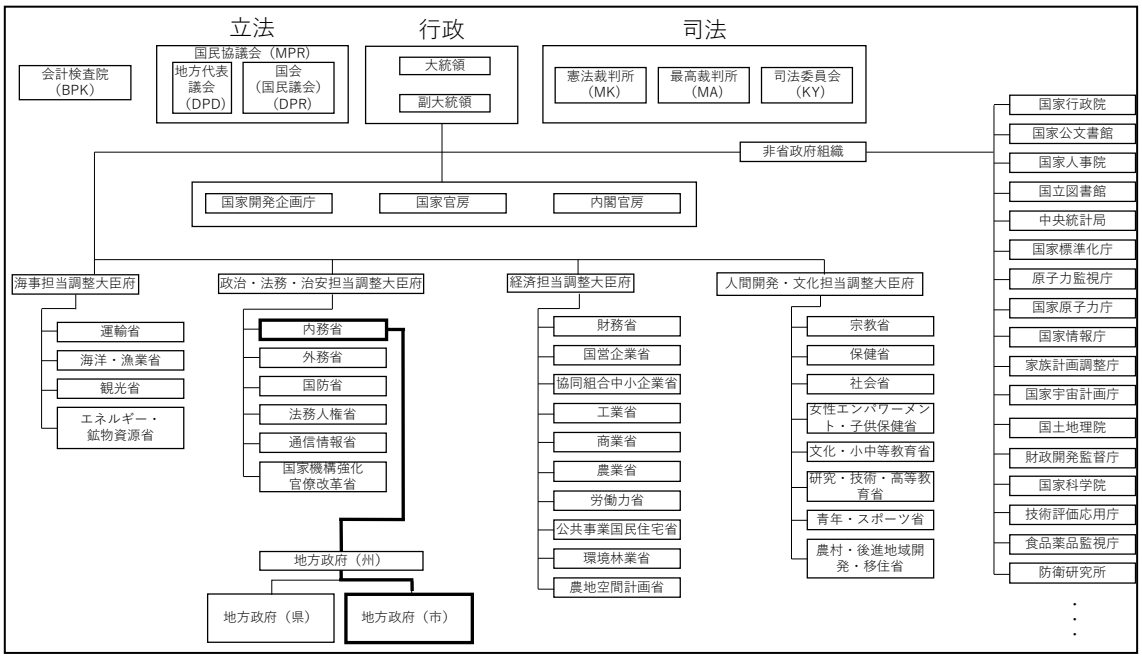

Figure 2-3　National organizational chart of Indonesia

Source: Prepared based on Annual Report on Asian Trends produced by the JETRO Institute of Developing Economies in 2019

As mentioned above, Indonesia has been working to decentralize centralized power, and to achieve this, a decentralization law was enacted in 1999. However, the decentralization system at this time negated the hierarchical relationship between the national government, provinces, regencies, and cities, and granted a wide range of powers, which led to confusion, such as the passage of ordinances with provisions incompatible with the Constitution, laws, and decrees. In response to this, the new Decentralization Law was enacted in 2004, which clearly defined the administrative and supervisory functions of the national government, provinces, regencies and cities, and stipulated that the Ministry of the Interior is responsible for supervising local autonomy, that provinces are not equal to regencies or cities, but are positioned above them, and that provincial governors have the authority to provide guidance and supervision to regencies and cities.

The rights and obligations of local governments are stipulated in “Law No. 32 in 2004 of the Republic of Indonesia on Local Administration," as follows:

Table 1-3 shows the rights and obligations of local governments, and Table 1-4 shows the mandatory tasks of provincial and regency/city governments.

Table 2-2　Rights and obligations of municipalities

Local rights in the implementation of autonomy	Local obligations in implementing autonomy
a. Own coordination and implementation of administrative work b. Election of local executives c. Management of local officials d. Management of local assets e. Collection of local taxes and local user contributions f. Earning revenue sharing from the operation of local natural and other resources g. Obtaining other legitimate sources of income h. Acquisition of other rights as stipulated by relevant laws and regulations	a.Resident protection, as well as national unity, unity, harmony, and maintenance of unitary state integrity of the Republic of Indonesia b. Improving the quality of life of residents c. Development of democratic life d. Achieving fairness and equality e. Improving basic education services f. Establishment of health service facilities g. Installation of appropriate social and public facilities h. Development of social security system i. Creating local plans and land use plans j. Development of productive resources in rural areas k. Environmental protection l. Management of inhabitant-related office work m. Conservation of social and cultural values n. Formulation and implementation of relevant laws and regulations in line with that authority o. Other obligations stipulated by relevant laws and regulations

Source:「UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 32 TAHUN 2004 TENTANG PEMERINTAHAN DAERAH DENGAN RAHMAT TUHAN YANG MAHA ESA PRESIDEN REPUBLIK INDONESIA」、 Bagian Ketiga Hak dan Kewajiban Daerah pasal 21,https://www.dpr.go.id/dokjdih/document/uu/33.pdf

Table 2-3　Duties of the governments of provinces, regencies, and cities

Mandatory work of the state municipality	Obligatory work of prefectures and municipalities
a.Development planning and control b. Land use planning, implementation and supervision c. Maintaining public order and social stability d. Installation of public facilities / equipment e. Response to the health sector f. Implementation of education and allocation of potential personnel g. Solving social problems across prefectures and cities h. Implementation of services in the labor sector across prefectures and cities i. Promotion of small and medium-sized enterprises, cooperatives across prefectures and cities j. Environmental management k. Implementation of land management services across prefectures and cities l. Implementation of resident service and resident registration service m. Implementation of general administrative office services n. Implementation of investment office services across prefectures and cities o. Implementation of other services that the prefecture / city has not yet implemented p. Implementation of other obligatory work specified by relevant laws and regulations	a.Development planning and control b. Land use planning, implementation and supervision c. Maintaining public order and social stability d. Installation of public facilities / equipment e. Response to the health sector f. Implementation of education g. Solving social problems h. Implementation of services in the labor sector i. Cooperatives promote SME promotion j. Environmental management k. Implementation of land management services l. Implementation of resident service and resident registration service m. Implementation of general administrative office services n. Implementation of investment office services o. Implementation of other basic services p. Other obligatory work stipulated by relevant laws and regulations

Source：「UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 32 TAHUN 2004 TENTANG PEMERINTAHAN DAERAH DENGAN RAHMAT TUHAN YANG MAHA ESA PRESIDEN REPUBLIK INDONESIA」、 Bagian Ketiga Hak dan Kewajiban Daerah pasal 22,https://www.dpr.go.id/dokjdih/document/uu/33.pdf

Environmental management is specified as mandatory in both provincial and regency/city affairs, indicating that they are responsible for environmental protection in harmony with planning and control of development. Naturally, the central government is also responsible for these areas, and they are organized as areas of division of labor between local and central government. The areas of responsibility for the central government are clearly delineated: i.e., diplomacy, national defense, public security, etc., are under the exclusive jurisdiction of the central government.

In order to analyze the position and efficacy of low-carbon policies, it is necessary to organize Indonesia's development planning and budgeting systems.

Budgeting in Indonesia is based on development plans set by the local government, and planning administration and budgeting are integrated into a system in which plans are directly linked to the budget.

The basis of the development plan is "Law No. 25 in 2004 on the National Development Planning System," and Article 3 of this law states that "the national development plan is a macro-plan for all aspects of the environment surrounding people's lives, and is a means for the integration of the Republic of Indonesia" and the objectives are (a) To coordinate among development stakeholders, (b) To realize integration, unity and synergy in development in coordination among governments, regions, non-governmental organizations, (c) To make the planning system comprehensive in terms of planning, budgeting, implementation and evaluation, and to ensure consistency among them, (d) To maximize public participation, and (e) To maximize the efficiency and efficacy of development, to ensure equity, and to utilize resources sustainably. The planning system of the development plan is shown in Table 1-5.

Table 2-4　Development plans in Indonesia[4]

Plan classification	Central government	Local government
Long-term plan (20 years)	National long-term development plan (RPJP:Rencana Pembangunan Jangka Panjan)	Local long-term development plan (RPJPD:Rencana Pembangunan Jangka Panjan Daerah)
Medium-term plan (5 yeard)	National Medium-Term Development Plan (RPJM:Rencana pembangunan jangka menengah)	Local Medium-Term Development Plan (RPJMD：Rencana pembangunan jangka menengah daerah)
	Government Agency Strategic Plan (Renstra-KL : Rencana Strategis Kementerian/Lembaga)	Local institution strategic plan (Renstra-SKPD : Rencana Pembangunan Jangka Menengah Satuan Kerja Perangkat Daerah)

[4] Council of Local Authorities for International Relations, "Indonesian local autonomy," 2009, http://www.clair.or.jp/j/forum/series/pdf/j29.pdf, acquired on January 20, 2020

Action plan（1 year）	Government action plan （RKP：Rencana Kerja Pemerintah）	Local Government Action Plan （RKPD：Rencana Kerja Pemerintah Daerah ）
	Governmental agency action Plan （Renja-KL：Rencana Kerja Kementerian/Lembaga)	Local agency action plan （Renja-SKPD:Rencana Kerja Satuan Kerja Perangkat Daerah)

Source：「UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 32 TAHUN 2004 TENTANG PEMERINTAHAN DAERAH DENGAN RAHMAT TUHAN YANG MAHA ESA PRESIDEN REPUBLIK INDONESIA」

(1) **Long-term Development Plan**

The National Long-term Development Plan (RPJP: Rencana Pembangunan Jangka Panjang) is a 20-year national vision, goal and direction of national development to achieve the vision and mission of the Indonesian Constitution, and is established by law. In addition, local long-term development plans in local governments are determined by local ordinances based on the national long-term development plan [Article 4 (1), Article 5 (1), Articles 10-13 of Law No. 25 in 2004 on the National Development Planning System].

(2) **Medium-term development plan**

The National Medium-Term Development Plan (RPJM: Rencana Pembangunan Jangka Menengah) is an administrative plan established by a presidential decree within three months of the President's inauguration, based on the direction of the National Long-Term Development Plan established by law, to coincide with the five-year term of office of the President. This plan sets forth the vision, goals, and policy management plan of action for the five years of the President's term of office, including (1) development strategies, (2) general policy plan of action, (3) action plans for provincial and non-provincial government agencies and localities, and (4) macroeconomic frame, from which the strategic plan for provincial and non-provincial government agencies (Renstra-KL: Rencana Strategis Kementerian/Lembaga) will be formulated.

The local medium-term development plans are prepared based on the national long-term and medium-term development plans. It provides the vision, goals, and direction of regional development for the five years of the term of office of the head of the local government, and is defined by the decree of the local head of government, and the Strategic Plan of the Department of Works and Technical Institutions (Renstra-SKPD: Rencana Strategis Satuan Kerja Perangkat Daerah) is based on this plan [Article 4(2), Article 5(2), Articles 14-19 of Law No. 25 of 2004 on National Development Planning System].

(3) **Government Action Plan**

The Government Action Plan (RKP: Rencana Kerja Pemerintah), based on the National Medium-term Development Plan, is set by a presidential decree during the previous year and is intended to provide direction for (1) priority development projects and (2) economic and fiscal policies for the following year, while providing the necessary financial framework. The plan will be used as a

guideline for the national budget for the following year, and based on this plan, the action plan for each ministry and non-ministerial government agency (Renja-KL: Rencana Kerja Kementerian / Lembaga) will be established. This plan will be used as a guideline for local budgeting and as a guideline for seeking the participation of residents and the private sector in development. Based on this, the Action Plan for Business and Technical Institutions (Renja-SKPD: Rencana Kerja Satuan Kerja Perangkat Daerah) is established [Article 4(3), Article 5(3), Articles 21-27 of Law No. 25 in 2004 on the National Development Planning System].

As for the development plan of each local government and the central government, each local government should refer to the central government's development plan as shown in Figure 1-7. In the case of low-carbon measures, the central government's development plan will be compiled in a way that each local government will reflect the optimized initiatives in its development plan based on the situation of its jurisdiction.

Under these circumstances, when analyzing the low-carbon policies of the central government, it is necessary to bear in mind their relationship to central and local development plans based on their contents.

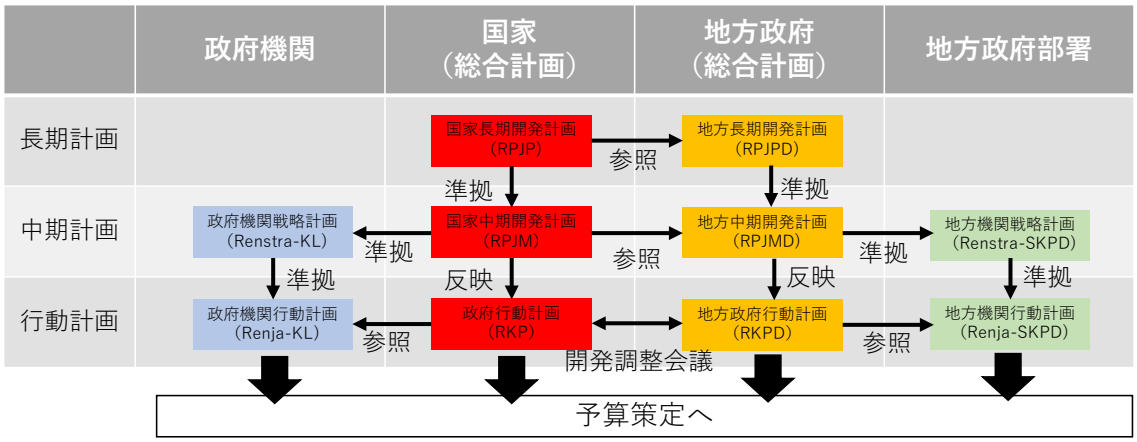

Figure 2-4　Relations of development plans of the central and local governments

出所）インドネシア国民協議会ウェブサイト：「UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 32 TAHUN 2004 TENTANG PEMERINTAHAN DAERAH DENGAN RAHMAT TUHAN YANG MAHA ESA PRESIDEN REPUBLIK INDONESIA」を元に作成、https://www.dpr.go.id/dokjdih/document/uu/33.pdf、2020 年 1 月 20 日取得。

2.2. Bali Province

2.2.1. Bali Province's Initiatives for Realizing a Low-carbon Society

(1) Primary Policies and Measures

① Bali Province's Medium-term Development Plan (RPJMD)

As stated in Section 2.1.2, Indonesia has formulated the RPJMN, and in line with this, provincial medium-term development plans (Rencana pembangunan jangka menengah daerah: RPJMD) have been formulated in each province. The latest RPJMD in Bali is for the period from 2018 to 2023[5].

The RPJMD is closely related to the RPJMN, and the 22 development missions set out in the Bali RPJMD (2018-2023) are set to align with the seven development missions of the RPJMN (2015-2019).

Regarding the statements related to energy development in the Bali RPJMD, Mission 21 out of the 22 missions is relevant. The following is an excerpt from Mission 21 of the 22 missions. Each Mission has its own set of targets, and each target has its own set of indicators for achievement.

Table 2-5 RPJMD of Bali Province: Mission 21

Mission 21: To actualize a Bali Krama lifestyle by developing a clean, green, beautiful environment							
Goal 2: To realize a clean, green, beautiful living environment							
Index: Environmental index (IKLH)							
Index	Unit	2018 (reference year)	2019	2020	2021	2022	2023
1. Water quality index	Index	63.2	64.7	66.2	67.7	69.2	70.7
2. Air quality index	Index	92.0	92.4	92.9	93.4	93.9	94.4
3. Reduction of GHG emissions	**(%)**	**8.4**	**9.4**	**10.4**	**11.4**	**12.3**	**12.3**
4. Ratio of renewable energy	**(%)**	**0.4**	**0.4**	**1.1**	**7.1**	**13.8**	**20.0**

Source: Mid-term development plan of Bali (RPJMD)

(2) Energy-related Policies of Bali Province

① Energy Policy of Bali Province

Bali Province has been developing policies to promote the development of renewable energy, and according to interviews with government officials of the province, the relevant laws and regulations include the following.

- Regulations relating to Bali Province's Comprehensive Energy Plan (2020-2050) (Rencana Umum Energi Daerah: RUED) (No.9/2020)

[5] Mid-term development plan of Bali (RPJMD, 2018-2023)

- Governor's Regulations on Clean Energy in Bali Province (No. 45/2019)
- Governor's Regulations on Battery Powered Electric Transports (No. 48/2019)
- Governor's Regulations on Energy Planning in Bali Province 2020-2039 (No. 123/03-M/HK/2020)

② Integrated Energy Plan of Bali Province (RUED)

In Indonesia, based on its National Energy Policies (Kebijakan Energi Nasional: KEN) and its New National Energy Policies (RUEN), each province has developed a comprehensive energy plan (RUED).

In September 2020, Bali Province also formulated the "Regulations relating to Bali Province's Comprehensive Energy Plan (2020-2050)," which stipulates policies to promote the use of clean energy. Clean energy in this context refers to natural gas and new and renewable energy. In its long-term energy plan, Bali Province aims to increase its share of renewable energy in its power supply structure from 0.27% in 2015 to 11.5% in 2025 and 20.1% in 2050. In principle, the RUED plan will be reviewed every five years.

In terms of the ratio of fossil fuels in the power supply composition, the plan is to reduce the ratio of coal-fired thermal power in the future and eliminate it by 2050. Oil use will be reduced from what was 75.7% in 2015 to 45% by 2050. Regarding the share of gas in the power supply structure, it was 4.4% in 2015, but is slated to increase to 56.2% by 2025, after which it is expected to decrease.

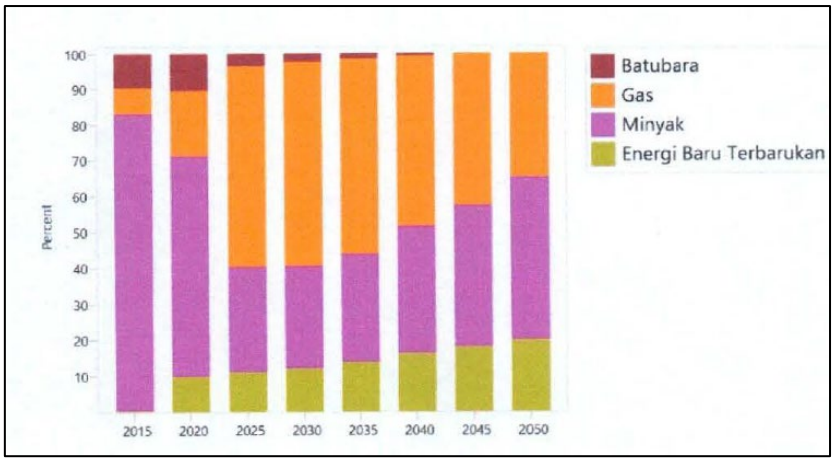

Figure 2-5 Future Power Supply Composition in Bali Province

Source: Regulation (RUED) (No.9/2020) on the Comprehensive Energy Plan for Bali Province (2020-2050).
Legend from top right: coal, gas, oil, renewable energy

Table 2-6 Future Power Supply Composition in Bali Province

Energy category	2015	2025	2050
	(%)		
Coal	19.6	3.3	0.0
Gas	4.4	56.2	34.9
Petroleum	75.7	29.3	45.0

New renewable energy	0.3	11.5	20.1

Source: Regulation (RUED) (No.9/2020) on the Integrated Energy Plan for Bali Province (2020-2050)

In addition, the long-term greenhouse gas emissions in RUED are as follows (Table 2-4). As a result of future economic growth and increased consumption, emissions are expected to increase from 6,154,000 t-CO_2/year in 2015 to 9,296,000 t-CO_2/year in 2030 and 21,279,000 t-CO_2/year in 2050.

It can be observed that the impact of the transportation sector is particularly large in this category, accounting for nearly two-thirds of the total. Considering the fact that diesel fuel is the primary fuel used in the transportation sector in Bali, the low-carbon potential of fuel change in the transportation sector is significant.

Table 2-7 Projected Greenhouse Gas Emissions for Bali Province
(in thousands of metric tons of CO2)

Sector	2015	2020	2025	2030	2035	2040	2045	2050
Industry	167	202	246	317	415	556	742	936
Transport	4,236	4,878	5,524	6,342	7,518	9,115	11,133	13,570
General household	353	434	486	503	517	527	535	542
Commerce	597	707	771	1,096	1,580	2,260	3,125	4,154
Other	801	844	879	1,039	1,238	1,465	1,762	2,076
Total	6,154	7,065	7,906	9,296	11,268	13,923	17,298	21,279

Source: Regulations regarding the comprehensive energy plan of Bali (2020-2050) (RUED) (No. 9/2020)

The Bali Province RUED sets out three main policies, and concurrently, six supporting measures have been developed to support them. The following are excerpts from the main policies of the Bali RUED regarding gas supply and renewable energy.

Table 2-8 Bali Energy Development Plan (RUED, 2020-2050) Primary policies for gas supply and renewable energy development

Strategy	Program	RUED Activities	Related institutions	Period
Policy 1: Access to energy according to local demand for energy				
Improvement in the reliability of production, transportation, and electricity distribution for energy supply	Development of infrastructure for fuel and LPG	● Development of networks for fuel supply, such as gas stations and APMS ● Development of LPG supply networks, such as SPBE (LPG filling stations)	ESDM, Pertamina, and private enterprises	2020-2050
	Development of infrastructure	**Production of roadmaps for infrastructure and gas supply, and development of LNG**		

Strategy	Program	RUED Activities	Related institutions	Period
	for natural gas supply	**infrastructure in northern and southern Bali**		
Policy 2: Priority items for clean energy development				
Promotion of use of natural gas (LPG, LNG, and CNG)	**Development of infrastructure for natural gas supply**	**Development of infrastructure for supply and transportation in northern and southern Bali**	ESDM, Bali Development Planning Bureau, private enterprises	2020-2050
Policy 3: Use of renewable energy in local areas				
Promotion of use of new renewable energy	Improvement in the share of new renewable energy in the composition of power sources	New renewable energy development goal to be attained by 2025: 228 MW **1) Solar power: 213 MW** 2) Micro-hydroelectric: 2.8 MW 3) Rooftop solar panels: 10 MW 4) Biomass: 0.9 MW 5) Wind power: 1.3 MW New renewable energy development goal to be attained by 2050: 537 MW **1) Solar power: 500 MW** 2) Micro-hydroelectric: 6 MW 3) Rooftop solar panels: 20 MW 4) Tidal power: 4 MW 5) Biomass: 3 MW 6) Wind power: 4 MW	Ministry of Labor, Land, and Immigration, Development Bureau, private enterprises, Ministry of Transportation, Ministry of Marine Fisheries, and Ministry of Public Works	2020-2050

The six measures that support the primary policies are as follows:

- Support Measure 1: Energy conservation and diversification
- Support Measure 2: Environment and safety
- Support Measure 3: Energy pricing, subsidies and incentives
- Support Measure 4: Infrastructure development and access to infrastructure for residents and the energy industry
- Support Measure 5: Research, development, and application of energy technologies
- Support Measure 6: Institutions and financial contributions

The following is a selection of policies related to gas supply and renewable energy.

Table 2-9 Bali Energy Development Plan (RUED, 2020 - 2050) Primary support measures for gas supply and renewable energy development

Strategy	Program	RUED Activities	Related institutions	Period
Supportive measure 1: Conservation and diversification of energy				
Diversification of energy	**Replacement of diesel fuel with gas in the residential and transportation fields**	● To revise gas measures in the transportation field ● **To increase vehicles equipped with CNG engines** ● **To allocate the local budget (APBD) for promoting the use of gas fuel** ● To promote the use of gas for housing and develop infrastructure by constructing city gas networks ● To install biogas digesters in 150 houses by 2025 *All of them comply with RPJMD and the strategic plan.	ESDM, Bali Development Planning Bureau, private enterprises, etc.	2020-2050
Use of gas energy in the transportation field	**Optimization of gas use in the industrial, electric power, housing, and transportation fields**	● Natural gas shall be used for governmental vehicles in areas where gas infrastructure and battery-type electric vehicles have been already developed. *Stipulated in the ordinance and the governor's order		
Supportive measure 3: Energy prices, subsidies, and incentives				
Fair energy price	Calculation of appropriate energy prices for supplying renewable energy by utilizing local resources	● **Survey on the feasibility of development of systems for solar power, bio energy, wind power, and tidal power generation** ● **Setting of special/clean electric power prices for producing opportunities to invest in renewable energy, and establishment of regulations for the cooperative scheme**	ESDM, Bali Development Planning Bureau, and private enterprises	2020-2050
Incentives for use of renewable energy	**Provision of energy subsidies and incentives**	**Design of measures regarding the subsidies for electric charges to poor citizens and the development of a new scheme for subsidies for electric charges (funded by local budgets)**		

In addition to the RUED, the Governor's Regulations on Clean Energy in Bali Province (No. 45/2019) outlines measures for independent clean energy production in the province, and as part of its efforts to promote renewable energy, the government has stated that it will replace the use of diesel and heavy oil with gas, rooftop solar power, biofuels, and other potential renewable energy sources.

The following table shows the roof-mounted solar PV installation projects underway in 2020.

Table 2-10 Rooftop solar power generation projects underway in Bali in 2020

Funding source	Facility capacity [kWp]
Funds from ESDM Renewable Energy/Energy Saving Bureau, Phase I (7 sites)	270
Funds from Korean KEA and BAPPENAS (including recharging equipment installed in solar power systems)	6.6
Funds from ESDM Renewable Energy/Energy Saving Bureau, Phase II (2 sites)	150

Source: Produced with reference to "Proposal Bali Mandiri Energi Dengan Energi Bersih Di Provinsi Bali" in Bali (2020)

(3) Demand for Electric Power and the Potential for Renewable Energy in Bali Province

Currently, approximately 70% of the electricity supply to Bali Province is generated within Bali, with most of the power coming from thermal power, and the remainder procured via undersea cables from the Java Island. The composition of thermal power generation within the Bali Province is dominated by coal-fired power generation, with natural gas being used for the rest (there is also a diesel power plant, but it is currently inactive).

The total installed capacity of electric power in Bali Province is 926 MW as of 2019, which would be 1,261 MW if the inactive diesel oil-based generation capacity is included. The province aims to increase its installed capacity by 6% annually until 2039, and aims to expand it to 3,206 MW around 2035-2039[6] (Table 2-8).

As the installed capacity increases, Bali Province plans to increase the ratio of gas-fired power generation. In accordance with PLN's Indonesia Power Supply Business Plan (Rencana Usaha Penyediaan Tenaga Listrik: RUPTL) 2019-2028, the government plans to shift to natural gas as fuel for thermal power generation, and a 350 MW x 2 gas-fired power plant is to be developed in Celukan Bawang, in the northern region of the Bali island, to meet future electricity demand.

Table 2-11 Future power generation capacity and forecast for Bali

	2020-2025	2025-2030	2030-2035	2035-2039
Target facility capacity [MW]	1,418	1,897	2,539	3,206
Peak demand [MW]	1,091	1,459	1,953	2,466

Source: Produced with reference to "Proposal Bali Mandiri Energi Dengan Energi Bersih Di Provinsi Bali" in Bali (2020)

[6] Bali (2020) "Proposal Bali Mandiri Energi Dengan Energi Bersih Di Provinsi Bali" (Policy for self-sufficiency of energy supply by adopting clean energy)

As of 2019, the installed capacity of renewable energy is 1.8 MW for small hydropower and approximately 4 MW for solar power, which is less than 1% of the power supply composition. On the other hand, however, Bali's renewable energy generation potential is estimated to be as high as 3,686 MW, and future development is anticipated.

Table 2-12 Potential for Bali Province's Generation of Renewable Energy

Category	Tidal	Wind	Biogas	Biomass	Solar	Water	Geo-thermal	Micro-hydroelectric
Facility capacity [MW]	320	1,019	45	147	1,254	624	262	15
Total [MW]	3,686							

Source: Produced with reference to "Proposal Bali Mandiri Energi Dengan Energi Bersih Di Provinsi Bali" in Bali (2020)

2.2.2. Discussion for the formulation of a commercialization plan for shift to natural gas

As stated in 2.2.1(2), Bali Province has been working to establish policies to promote the development of renewable energy, and based on interviews with government officials of the province, four related laws have been established. In particular, the RUED, which is a regional development plan formulated in September 2020 based on the national plans KEN and RUEN, has the promotion of natural gas utilization and the development of natural gas supply infrastructure as its primary policies.

Regarding the current status of natural gas supply infrastructure in Bali Province, three gas filling stations (Stasiun Pengisian Bahan Bakar Gas: SPBG) were built in 2013 under the ESDM initiative, but there has been no progress since then. As of 2015, gas consumption in Bali Province was only about 40 liters per day, and although the Bali Land Transportation Organization requested Pertamina Gas, the national gas company, to increase gas demand and improve SPBG[7], the current situation is still far behind that of other provinces in Java.

As part of operations in the last fiscal year, we exchanged opinions with PT Pertagas Niaga, the gas distributor of PT Pertamina Group, an oil and gas company in Bali Province and Indonesia, to understand the feasibility and plans for gas supply.

Bali Province's view was that it would depend on infrastructure development and on Pertamina Gas's plans, while Pertamina Gas's decision to enter the gas supply business depending on the demand in Bali Province, with both sides keeping a close eye on each other.

Therefore, in the previous fiscal year, we conducted the assessment of the potential as shown below, calculated the scale and effects of gas demand, and confirmed the possibility of developing gas infrastructure based on these results in this fiscal year.

(1) Discussion on change of fuel for sightseeing buses, etc. to gas

1) Estimation of CO_2 Emissions Reduction

① Energy Demand and CO_2 Emissions from Diesel Vehicles in Bali Province

In last fiscal year's survey, Bali Province's fuel consumption data was collected from a variety of reference material, and it was found that 520 kl/day of diesel fuel is consumed in the province. Annually, this would amount to 189,800 kl/year.

Since the CO_2 emission factor per liter of diesel is 2.619 kg-CO_2, the CO_2 emissions resulting from the consumption of 189,800 kl amounts to 497,086 t-CO_2.

In the change of fuel for these diesel vehicles to gas, the results of the "Project to Install CNG and Diesel Co-firing Equipment in Public Transport Buses in Semarang City," which was implemented as a JCM equipment subsidy project in 2018, showed that a 30-40% reduction in CO_2 emissions can be achieved. As a low-carbon initiative in Bali Province, the change of fuel for diesel vehicles to gas is one of the most effective ways to significantly reduce CO_2 emissions.

Based on the number of vehicle registrations in Bali, tourist buses account for a large proportion

[7] https://regional.kontan.co.id/news/organda-minta-pertamina-tambah-spbg-di-bali

of diesel vehicles. Due to the spread of COVID-19, it can be inferred that operation has greatly decreased since 2020. Looking back at the impact of COVID-19 on tourism in Bali, restrictions were placed on visa-free travel that had been granted to 160 countries in March of 2020, and from 2021, due to concerns over the spread of the new variants, restriction measures were placed even on travelers with visas.

Due to these circumstances, services provided by buses for tourism have decreased significantly. However, since the same scale of tourism demand is expected again after the containment of the pandemic, preparations for efforts to reduce emissions are necessary. In addition, it is expected that trucks and other vehicles, such as those used for public transportation and waste collection, will continue to operate in the same capacity as before during the COVID-19 crisis, as they are essential to society.

When planning a JCM equipment subsidy project, it is preferable to select vehicles that operate on a regular schedule, since equipment that can be expected to reduce emissions with a reasonable degree of reliability is most suited. In this survey, we analyzed the effects of public transportation (bus), which is a socially essential service that must be operated continuously even in the midst of COVID-19, as well as amidst the spread of further infection.

② Public Bus Service in Bali Province

One of the public buses operating in Bali Province is the Trans Metro Dewata, which has been in operation since September 2020.

The company owns 105 buses and operates on four bus routes from 5:00 a.m. to 9:00 p.m., every 10 minutes, making 96 trips each way per day.

Figure 2-6 Vehicles of Trans Metro Dewata

出所）Bali Backpacker's Guidelines "Bali Trans Metro Dewata Bus", https://bali-backpacker.com/trans-metro-dewata-bus-stop-halte-shelter/、2021 年 2 月取得

Figure 2-7 Leaflet of Trans Metro Dewata

出所）Bali Backpacker's Guidelines "Bali Trans Metro Dewata Bus", https://bali-backpacker.com/trans-metro-dewata-bus-stop-halte-shelter/、2021 年 2 月取得

Bus routes are as follows:

Table 2-13 Operation information on Trans Metro Dewata

Route No.	Route	No. of stops	Vehicles	One-way Distance [km]
Route I (K1B)	Kuta Central Parking Lot - Bus Station	40	31	63.6 km
Route II (K02)	Ngurah Rai Stadium - Airport	24	22	30.2 km
Route III (K3B)	Sanur Beach - Kuta North	24	20	43.0 km
Route IV (K4B)	Bus Station - Ubud	32	32	55.3 km

Source: Made by JANUS from Bali Backpacker's Guidelines "Bali Trans Metro Dewata Bus", https://bali-backpacker.com/trans-metro-dewata-bus-stop-halte-shelter/

Bus routes for each line are shown below.

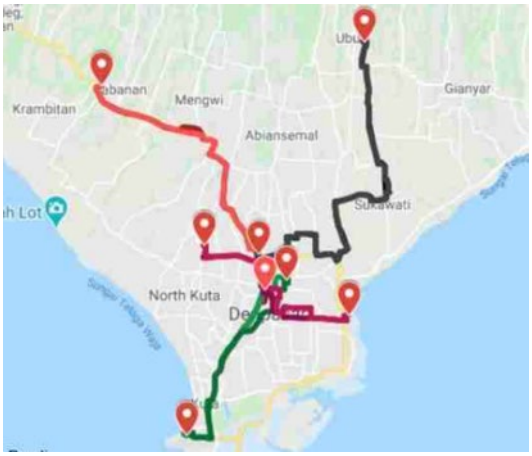

Figure 2-8 Bus routes of Trans Metro Dewata

Source: Produced by JANUS with reference to Bali Backpacker's Guidelines "Bali Trans Metro Dewata Bus", https://bali-backpacker.com/trans-metro-dewata-bus-stop-halte-shelter/

Based on this information, we estimated the fuel consumption and CO_2 emissions of Trans Metro Dewata vehicles. First, based on the distance traveled and the number of trips for each route, the total daily round trip distance for the four routes is 36,883.2 km. Assuming that there are 300 days of operation per year, the annual distance traveled would be 11,064,960 km.

The bus used in Trans Metro Dewata is a medium-sized bus manufactured by Mitsubishi Motors, and is the same type of bus as the ones operated by Trans Semarang in the "Project to Install CNG and Diesel Co-firing Equipment in Public Transport Buses in Semarang City," which was implemented as a JCM equipment subsidy project in 2018, so fuel efficiency data, etc., can be taken from the project data.

Table 2-14 Number of trips, distance, and fuel consumption for each route

Route number	Number of runs [Times/one-way]	One way distance [km]	Round-trip distance [km/day]	Annual mileage distance [km/year]	Estimated fuel cost*[km/l]	Fuel consumption [l/year]
Route I (K1B)	96	63.6	12,211.20	3,663,360	4.7	779,438
Route II (K02)	96	30.2	5,798.40	1,739,520	4.7	370,111
Route III (K3B)	96	43	8,256.00	2,476,800	4.7	526,979
Route IV (K4B)	96	55.3	10,617.60	3,185,280	4.7	677,719
Total	384	192.1	36,883.20	11,064,960	-	2,354,247

*Refer to the figures for the same type of public bus in Semarang City (Trans Semarang).

Based on these values, the net calorific value of diesel fuel and the CO_2 emissions are calculated, and the results are as follows.

Table 2-15 Estimated CO_2 emissions for each route

Route number	Fuel consumption [l/year]	Net heat generation amount* [GJ/kl]	CO_2 emissions** [t-CO_2/year]
Route I (K1B)	779,438	37,943	2,755
Route II (K02)	370,111	18,017	1,308
Route III (K3B)	526,979	25,653	1,862
Route IV (K4B)	677,719	32,991	2,395
Total	2,354,247	114,605	8,320

*The net heat generation amount is 48.68 GJ/kl, which is the lower IPCC default value shown in Table 1.2 of Chapter 1 of Volume 2 of the 2006 IPCC Guidelines for Greenhouse Gas Inventories.

**Emission factors are IPCC default values given in the 2006 IPCC Guidelines for Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.2. A low reading of 0.0726 t-CO_2/GJ was taken.

Trans Metro Dewata is the only operator that continues to routinely consume fuel of this magnitude for public transportation service operations.

In considering JCM equipment subsidies, it is preferable to target a single entity from the perspective of smooth project organization, establishment of a monitoring system, etc., because a structure involving many local entities poses many challenges from the perspective of coordination. From this point of view, Trans Metro Dewata is the most promising operator for the shift from Diesel/CNG fuel blend to Dual Diesel Fuel (DDF) for buses in Bali Province.

The fuel changeover project using CNG in Trans Metro Dewata applies the same type of

methodology as the "Project to Install CNG and Diesel Co-firing Equipment in Public Transport Buses in Semarang City," which was implemented as a JCM equipment subsidy project in 2018, and based on calculation results of this methodology, the emissions from the project (over a 5-year period) is 32,562 t-CO_2. When subtracted from the reference emission rate of 41,602 t-CO_2/year, the result is 9,039 t-CO_2/year, which is the emission reduction in the project period.

2） Evaluation of economical performance

① Equipment installation cost

The equipment required for CNG co-combustion in diesel engine vehicles includes gas fuel injectors for the CNG tank and the engine system, a computer that calculates and controls the optimal co-combustion rate, and a user interface device that includes a fuel gauge and DDF mode switching.

The installation of the equipment will require the cost of these devices, installation work by engineers, the cost of test operation, etc.

In the "Project for Installation of CNG and Diesel Co-combustion Equipment for Public Transport Buses in Semarang City," which was implemented as a JCM equipment subsidy project in 2018, these costs were found to be approximately 1 million yen per medium-sized bus.

Since Trans Metro Dewata owns 105 medium-sized buses, the initial investment required to introduce the system will be around 105 million yen, or 14,170,040,486 rupiah.

② Operation cost

DDF is a technology that is expected to not only reduce CO_2 emissions, but also reduce operating costs thanks to the difference in fuel price between diesel and CNG as well as the effect of improved fuel efficiency. The current consumption of diesel fuel is 1,667,591 L/year and the price is 7,150 rupiah/L. The fuel cost based on this value would be about 16.8 billion rupiah (16,832,864,6810 rupiah), or about 124.7 million yen.

③ Economical simulation

For switching to CNG as fuel, it is necessary to adequately assess the price of natural gas supply in Bali. This is because the Indonesian government has set low prices for natural gas supply especially to the transportation sector, in order to make better use of the natural gas produced in the country, but the prices are different in areas where pipeline transportation is available compared to other areas. For example, in Jakarta, the price per unit volume of CNG is set at 3,100 rupiah/LSP, but the price before pipeline construction in Semarang is 4,500 rupiah/LSP, because the transportation cost of CNG is added to the price.

Since the pipeline is not yet in place in Bali, the calculation here is tentatively based on the same value of 4,500 rupiah/LSP as in Semarang.

As a result, we found that the fuel cost reduction effect is about 12.4 billion rupiah for a five-year projection.

Without JCM equipment subsidies, the recoupment period would be 6 years, and assuming that JCM equipment subsidies cover 40%, the recoupment period would be 4 years. The results of the economical calculation are shown below.

Table 2-16 Results of economical calculation for DDF installation with JCM equipment subsidy to Trans Metro Dewat

Diesel price	7,150	IDR/L
CNG price	4,500	IDR/L
Reference fuel price		
Diesel	16,832,864,681	IDR
Project Fuel price		
Diesel	10,133,384,538	IDR
CNG	4,216,456,034	IDR
Total	14,349,840,572	IDR

Fuel price reduction effect	2,483,024,109	IDR/year
Initial investment	14,170,040,486	IDR
Investment payback year	6	year
Initial investment with JCM subsidy	8,502,024,291	IDR
Investment payback year with JCM subsidy	4	year

	Reference cost			Project cost				Benefit
	CAPEX	Diesel cost	Total	CAPEX	Diesel cost	CNG cost	Total	
0	0			8,502,024,291				-8,502,024,291
1		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
2		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
3		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
4		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
5		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
6		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
7		16,832,864,681	16,832,864,681		10,133,384,538	4,216,456,034	14,349,840,572	2,483,024,109
合計		117,830,052,766	117,830,052,766		70,933,691,765	29,515,192,238	100,448,884,003	17,381,168,763

- Cashflow and IRR

	0	1	2	3	4	5	6
FCF	-8502024291	2,483,024,109	2,483,024,109	2,483,024,109	2,483,024,109	2,483,024,109	2,483,024,109
	-8502024291	-6,019,000,183	-3,535,976,074	-1,052,951,965	1,430,072,144	3,913,096,253	6,396,120,362
IRR（10 year）	26%				Investment payback		

Source: Made by JANUS

(2) **Discussion on switching to gas for waste collection vehicles**

The province of Bali generates about 4,300 t of waste per day, of which 60% is organic waste and 20% is plastic waste. Of the total waste, 52% is not disposed of properly due to illegal dumping, open burning, etc. The rest is delivered to final disposal sites under the jurisdiction of local governments[8].

There are eight final disposal sites in Bali, and waste from Denpasar, Badung, Gianyar, and Tabanan in southern Bali is delivered to the Sarbagita Final Disposal Site (Tempat Pembuangan Akhir: TPA) in Suwung, south of Denpasar. It is said that the waste generated from the above four provinces in the southern part of Bali accounts for 80% of the total waste volume of the entire Bali Province, making it the largest TPA in Bali. The amount of waste brought in per day, which was around 800 t in 2014, temporarily dropped to 500-600 t due to the coronavirus pandemic, but it has now reached 1,150 t[9]. With an estimated daily delivery volume of 2,400 tons, the situation is very critical as the remaining life of the TPA is about 3-5 years as of 2016, according to an official of the Denpasar City Cleaning Department, which manages the TPA[10]. The Bali Provincial Government is planning to start to build a waste-to-energy plant in 2019 to promote waste management in the TPA, but construction has been delayed due to a lack of investors[11].

Figure 2-9 Firefighting operations being carried out at TPA Sarbagita final disposal site, September 27, 2019

Source: BPBD Bali/Mongabay Indonesia

In addition, the methane gas generated from the accumulated waste has caused frequent fire accidents, and the odor from fires and TPA has seriously affected the tourism industry and the lives of the surrounding residents in Bali Province.

Waste collection in the province of Bali is under the jurisdiction of the local government's Department of Beautification (Dinas Kebersihan dan Pertamanan, DKP) or outsourced to private companies, but the collection is not fully implemented in municipalities that cannot allocate a budget for waste collection. In areas where the collection is not carried out, there emerged problems, such as residents illegally dumping garbage into rivers, causing flooding, and the incineration of garbage on roadsides, causing smoke pollution and health concerns for nearby residents.

In the case of Denpasar City, waste is brought by residents to a temporary collection point near their homes (Tempat Pengolahan Sampah (TPS)) between 5:00 p.m. and 7:00 p.m. daily, and then

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[8] MONGABAY, “Inilah Data dan Sumber Sampah Terbaru di Bali”, https://www.mongabay.co.id/2019/07/02/inilah-data-dan-sumber-sampah-terbaru-di-bali/, obtained in Feb. 2021

[9] Tribun-Bali, “Sampah ke TPA Sarbagita Suwung Mencapai 1.150 Ton per Hari, Bali Rencanakan Bangun PSEL”, https://bali.tribunnews.com/2020/11/21/sampah-ke-tpa-sarbagita-suwung-mencapai-1150-ton-per-hari-bali-rencanakan-bangun-psel?page=1, obtained in Feb. 2021

[10] JFE Engineering Corporation, Intercity collaboration project in 2016 “Report on the project for generating power from waste in Bali, Indonesia,” https://www.env.go.jp/earth/coop/lowcarbon-asia/project/data/JP_IDN_H28_01.pdf、2021 年 2 月取得

[11] Greeners.co., “Revitalisasi TPA Sarbagita Suwung Bali Tak Kunjung Selesai”, https://www.greeners.co/berita/revitalisasi-tpa-serbagita-suwung-bali-tak-kunjung-selesai/, obtained in Feb. 2021

transported to the TPA through a relay facility (DEPO)[10]. The local government is responsible for transporting the goods from TPS to TPA or DEPO to TPA. In Denpasar City, 127 TPS/DEPOs have been established, where waste is transshipped to the 121 waste collection vehicles (as of 2019)[12] owned by the city, and waste is delivered to the TPA on average 3-4 times per day[13]. The following is the process flow of waste collection in Denpasar City.

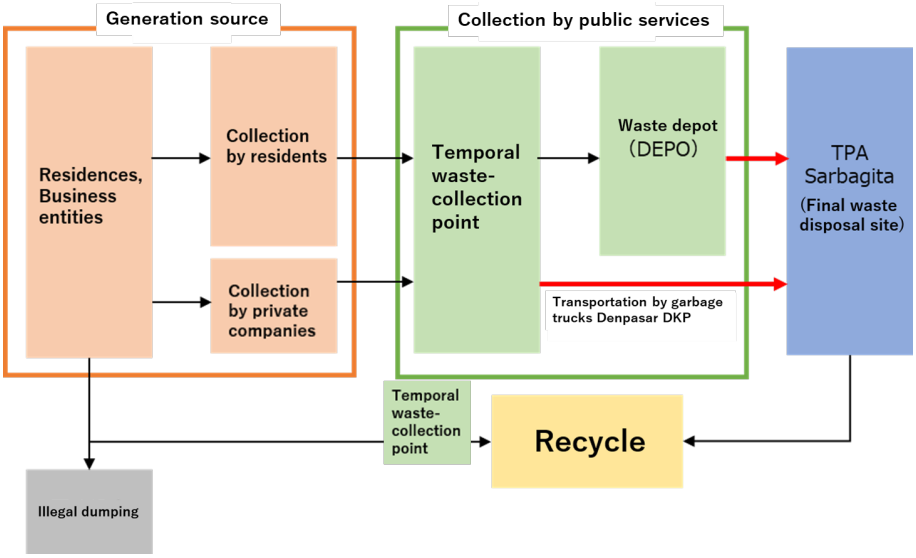


Figure 2-10 Waste Collection Flow in Denpasar City

Source: Produced by JANUS with reference to JFE Engineering Corporation, Inter-city Cooperation Project in FY 2016 "Report on Waste Power Generation Project in Bali Province, Indonesia" https://www.env.go.jp/earth/coop/lowcarbon-asia/project/data/JP_IDN_H28_01.pdf

1） Estimation of CO_2 emission reduction

As mentioned above, waste collection and disposal services are provided by the cities and provinces in the province of Bali, as in other regions. The municipality with the largest amount of waste generation in Bali Province is Denpasar City, and this study uses data on waste collection vehicles in Denpasar City for the calculations.

Based on the data of waste-related vehicles under the jurisdiction of Denpasar City, the target number of vehicles is 121, and they go back and forth between the disposal site and the collection site about four times a day.

As there is no clear route for each vehicle, we used 15 km from the center of Denpasar City to the final disposal site as the average distance. With four round trips per day, the total distance traveled by the 121 vehicles would be 7,260 km, and the total distance traveled per year would be 2,649,900

[12] STATISTICS INDONESIA, "Environment Statistics of Indonesia 2020," https://www.bps.go.id/publication/download.html?nrbvfeve=NWE3OThiNmI4YTg2MDc5Njk2NTQwNDUy&xzmn=aHR0cHM6Ly93d3cuYnBzLmdvLmlkL3B1YmxpY2F0aW9uLzIwMjAvMTEvMjcvNWE3OThiNmI4YTg2MDc5Njk2NTQwNDUyL3N0YXRpc3Rpay1saW5na3VuZ2FuLWhpZHVwLWluZG9uZXNpYS0yMDIwLmh0bWw%3D&twoadfnoarfeauf=MjAyMS0wMi0yNyAxMTozNjo0NQ%3D%3D, obtained in Jan. 2021

[13] Midori Sangyo Co., Ltd. and NTT Data Institute, MOFA ODA Overseas Economic Cooperation Project in 2013 "Survey for a project of disposing of organic waste by producing biogas and compost in Denpasar, Bali, Indonesia," https://www.mofa.go.jp/mofaj/gaiko/oda/seisaku/kanmin/chusho_h25/pdfs/5a11-1.pdf, obtained in Jan. 2021

km.

Assuming that the fuel consumption of waste collection vehicles is comparable to that of a medium-sized bus, and adopting the value of 4.7 km/l from the "Project on Installation of CNG and Diesel Co-combustion Equipment for Public Transport Buses in Semarang City," which was implemented as a JCM equipment subsidy project in 2018, the fuel consumption required for these trips is 563,809 l/year. The CO_2 emissions are 9,963 t-CO_2/year for the 5-year project period (lifetime of the facility).

The CO_2 emissions (project emissions) from the introduction of DDF will be as follows

Table 2-17 CO_2 Emissions after Introduction of DDF (Project Emissions)

CO2 emission from CNG consumption	1,022	t/5 year
CO2 emission from CNG consumption	2,580	t-CO_2/5 year
Diesel consumption	1,476	kl/5 year
CO2 emission from diesel consumption	5,218	t-CO_2/5 year
CO2 emission from DDF	7,798	t-CO_2/5 year

Source: Produced by JANUS

The value obtained by subtracting the project emissions from the reference emissions value of 9,963 t-CO_2/5 years is 2,165 t-CO_2/year, which is the CO_2 emission reduction effect of the project.

2） Evaluation of economical performance

① Equipment installation cost

The number of waste collection vehicles to be refurbished is assumed to be 121 as described above. Like Trans Metro Dewata, if we assume that the DDF system will be installed in vehicles at 1 million yen per vehicle, the cost for 121 vehicles would be 121 million yen or 16,329,284,750 rupiah.

② Operation cost

As in the case of the Trans Metro Dewats study, the conversion to DDF is expected to reduce operating costs due to the difference in fuel price between diesel and CNG as well as improved fuel efficiency. The current diesel consumption is 563,809 L/year based on the above assumptions, and the diesel price is 9,500 rupiah/L for industrial use (unsubsidized). The operating cost (fuel cost) based on this value is about 5.3 billion rupiah (53,356,180,841 rupiah), or about 40 million yen.

③ Economical simulation

As in the Trans Metro Dewata study, the CNG price is set at 4,500 rupiah/LSP as an assumption for the calculation. As a result of the calculation, it was found that the fuel cost reduction effect would be about 1.1 billion rupiah/year. Without subsidies, the recoupment period would be 15 years, and

with subsidies for JCM equipment, the recoupment period would be 9 years, assuming that the subsidy covers 40%.

The calculation results are shown below.

Table 2-18　Simulation results of economic efficiency of DDF introduction with JCM equipment subsidy for vehicles related to waste collection in Denpasar

Diesel price	9500	IDR/L
CNG price	4500	IDR/L
Reference fuel price		
Diesel	5,356,180,851	IDR
Project fuel price		
Diesel price	3,224,420,872	IDR
CNG	1,009,781,043	IDR
Total	4,234,201,915	IDR

Economic effect	1,121,978,936	IDR/year
Initial investment	16,329,284,750	IDR
Investment payback year	15	year
Initial investment with JCM subsidy	9,797,570,850	IDR
Investment payback year with JCM	9	Year

year	Reference cost			Project cost				Benefit
	Initial investment	Diesel cost	Total	Initial investment	Diesel cost	CNG cost	Total	
0	0			9,797,570,850				-9,797,570,850
1		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
2		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
3		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
4		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
5		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
6		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
7		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
8		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
9		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
10		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
11		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
12		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
13		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
14		5,356,180,851	5,356,180,851		3,224,420,872	1,009,781,043	4,234,201,915	1,121,978,936
合計		74,986,531,915	74,986,531,915		45,141,892,213	14,136,934,596	59,278,826,809	15,707,705,106

- Cashflow and IRR

	0	1	2	3	4	5	6
FCF	-9,797,570,850	1,121,978,936	1,121,978,936	1,121,978,936	1,121,978,936	1,121,978,936	1,121,978,936
	-9,797,570,850	-8,675,591,914	-7,553,612,978	-6,431,634,042	-5,309,655,106	-4,187,676,169	-3,065,697,233
IRR（14 years）	7%						

	7	8	9	10
FCF	1,121,978,936	1,121,978,936	1,121,978,936	1,121,978,936
	-1,943,718,297	-821,739,361	300,239,575	1,422,218,511
			Investment payback	

Source: Made by JANUS

(3) **Discussion on feasibility of gas supply by Pertamina Gas**

Based on the above estimates for public buses and waste collection vehicles, we discussed with Pertamina Gas the feasibility of a gas supply service for this scale of demand. As mentioned above, an MoU has been signed between Japan NUS and Pertamina Gas to pursue these studies.

The economical considerations for each item of public buses and waste collection vehicles are made from the perspective of both companies. Pertamina Gas, which supplies gas to the two companies, will also need to determine the prospects for recoupment of the investment costs associated with the construction of new supply infrastructure and the development of new services.

As mentioned above, the gas price has been set at 4,500 rupiah/LSP, which is the price at which gas is sold in Semarang. This is a target price level to meet the recoupment period and IRR mentioned above, as the difference between this fuel and diesel fuel is an economic advantage for public buses and waste collection companies.

Based on the company's various management data, Pertamina Gas made an estimate of the possible launch of gas supply services based on multiple supply chain routes.

The first proposed route is to transport CNG by land from East Java. The supply would be conducted by MRU, a vehicle that compresses and fills CNG.

In this case, a unit price of 8,933 rupiah/LSP (16.5 US dollars/MMBtu) was proposed as the gas supply price at which Pertamina Gas could deploy its services. It was suggested that an additional cost of 25.75 billion rupiah (about 200 million yen) would be required to operate the system for five years if it is offered to operators at 4,500 rupiah/LSP.

The second proposed route is the marine transport of LNG from the Bontang LNG terminal on the Kalimantan Island. In this case, a gas supply price of 6,389 rupiah/LSP (11.8 US dollars/MMBtu) was proposed as the price at which the service could be deployed, as it could be supplied at a lower price than in the case of land transportation due to the ability to transport large volumes.

The price was not as high as the originally assumed price of 4,500 rupiah/LSP, and if the gas is

supplied to the operator at the price indicated above, an additional cost of 10.97 billion rupiah (about 90 million yen) will be required for the five-year operation. However, this plan was dependent on Bali's plans to develop an LNG hub, and it would be a year or longer before supply would be available.

In the case of land transportation, if the price issue can be cleared, the service could be launched within a year.

The calculation results obtained from Pertamina Gas are shown below.

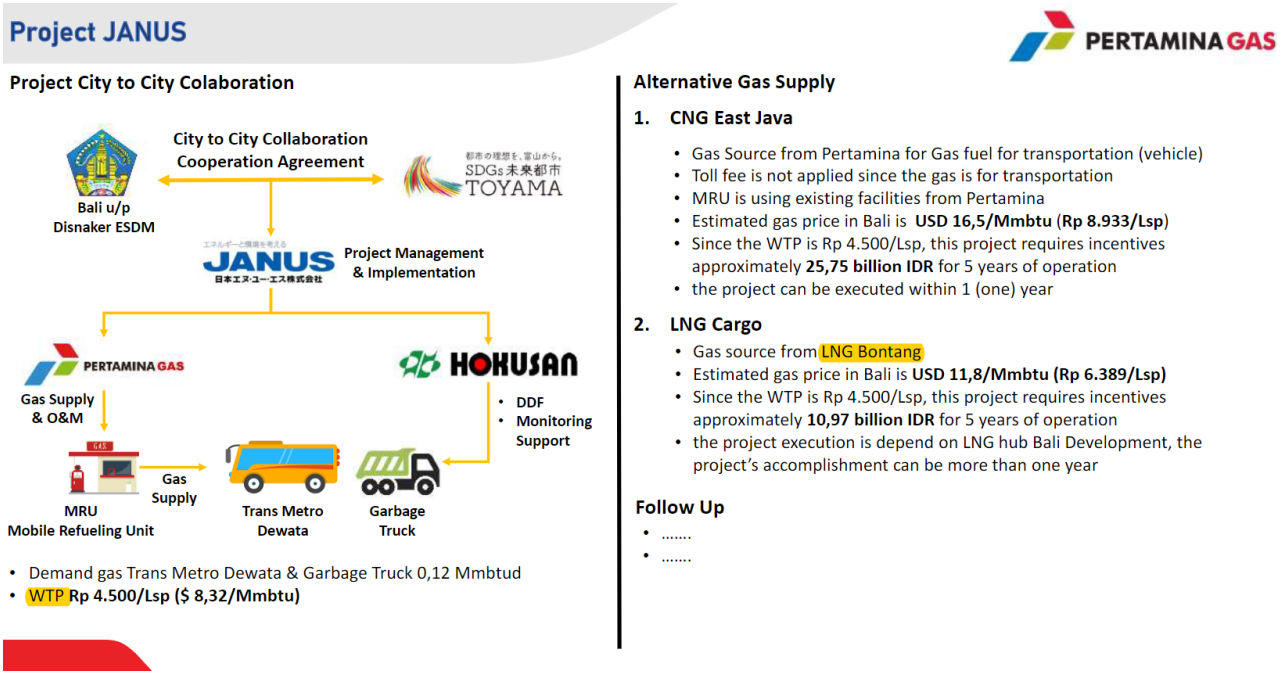


Figure 2-11 CNG Supply Price Estimate by Pertamina Gas

The city of Denpasar, which operates the public bus service and waste collection vehicles, has expressed its view that it will be difficult to commercialize the project if the ROI takes more time than mentioned above because the economic benefits of DDF conversion would not be feasible. For example, in the case of 6,389 rupiah/LSP, it is estimated that the operator will be able to obtain economic efficiency of about 1 billion rupiah annually, but the period until the investment is recouped will be as long as 21 years.

Therefore, based on Pertamina Gas's view that unit cost is expected to decrease due to increased demand, we discussed ways to increase demand by examining any possible further modification of vehicles to reduce unit cost.

On the other hand, from the perspective of the JCM equipment subsidy project, it was considered necessary to note that, in addition to the expected risks of considering a project that targets multiple businesses at the same time, as mentioned above, there are many issues from the viewpoint of coordination when many local businesses are involved, and it is necessary to target a single business for smooth project organization and establishment of a monitoring system.

Therefore, we approached Pertamina Gas to study the possibility of using their oil and gas transportation vehicles. Discussions were held on the number of vehicles owned, fuel consumption, and the potential cost savings of converting these vehicles to DDF ones, as it is expected that Pertamina Gas will have sufficient management and supply incentives for its own vehicles.

Potential users

- Could your company's vehicles (lorries etc.) be candidates for installation of DDF system in JCM scheme?
  If possible, please share with us
  - Number of vehicles
  - Specification (Exhaust gas amount, Engine type)
  - Actual diesel fuel consumption data (L/vehicle/year)

- Any information regarding other potential gas users?
- Could you share us with the situation of existing DDF systems installed Patraniaga vehicles?

Existing CNG stations

- Please share us with the exact locations of existing CNG stations in Bali by local operators or related staffs.
- Please share us with whether the gas stations are still utilized.

Figure 2-12 Data requests for vehicles owned by Pertamina Group

As a result of the interviews, it was found that it is difficult to target oil and gas transportation vehicles because the number of vehicles in operation in Bali is small, and the operation itself is under the control of transportation companies outside the Pertamina Group, while there are many owners.

In the course of these discussions, and referring to the case of Semarang City, which will be discussed later, we came to realize that at the current stage when the gas infrastructure is still in the process of development, even in Semarang City, where an infrastructure plan has been formulated and supply has already started, there are issues of unstable supply. In addition, the city is expected to take a step forward from the fossil fuel natural gas in order to decarbonize their society, and we have come to see the high potential of using hydrogen as a fuel for transportation that is locally produced and locally consumed.

Since Pertamina Gas is also considering the use of hydrogen, we decided to start discussions on the possibility of using hydrogen in parallel with the plan to promote natural gas and low-carbon transportation.

(4) Feasibility of using hydrogen in Bali

① Discussion on the possibility of hydrogen utilization in collaboration with Pertamina Gas

Indonesia has been facing an issue with oil import due to its financial burden for many years. Thus, it has been promoting measures to reduce oil imports by increasing the use of locally produced coal

and natural gas. Based on this national need, the Pertamina Group has been developing and disseminating biofuel and renewable energy to fulfill the national demand, and it has become more active in recent years. As for hydrogen, PGE, an SPC that generates electricity from geothermal heat and is a part of the Pertamina Group, can produce approximately 8,600 kg of hydrogen per day. In addition, the Plaju refinery and the Cilacap refinery have just started producing blue hydrogen and hydrogen via water electrolysis using electricity derived from renewable energy.

Given all these efforts, we received great interest when we introduced Toyama City's hydrogen utilization initiatives. We agreed to exchange information and conduct a joint study on hydrogen production using renewable energy in Bali. Hokusan Co., Ltd. collaborated with us to provide the basic information that will be the basis for the study, including the results of comparison of the price per heating value between diesel fuel and hydrogen.

Fuel			Price(YEN)/Unit(MMBTU)	Price(IDR)/Unit(MMBTU)
City gas (LNG)			1,982-3,398	258,453-443,100
Diesel			3,605	470,093
Fuel			**Cost(YEN)/Unit(MMBTU)**	**Cost(IDR)/Unit(MMBTU)**
Hydrogen	By-product hydrogen	Caustic soda	570	74,328
		Steel	684-912	89,193-118,925
		Petrochemistry	570	74,328
	Purpose production (existing facility)	Petroleum refining	656-1,055	85,542-137,572
		Ammonia	N. A.	N. A.
	Purpose production (New facility)	Fossil fuel reform	884-1,654	115,274-215,682
		Water electrolysis	2,395 (grid power) 2,167-3,878(solar, PV)	312,309 (grid power) 282,577-505,693(solar, PV)

※Retail price for hydrogen is 2,999 YEN (390,777 IDR)/ MMBTU

1MMBTU=28.32㎥　1N㎥=0.03507MMBTU　1ℓ=38.04MJ=0.036055MMBTU
1㎥=35.17MJ=0.033335MMBTU　　1YEN=130IDR

Figure 2-13　Comparison in price between diesel and hydrogen presented to Pertamina Gas

This would be the first fuel type that Pertamina Gas manufactures and supplies, and we intend to proceed with step-by-step development through small-scale demonstrations. Therefore, we decided to consider a business plan involving Bali and related organizations.

② Joint investigation with Bali and related organizations on the feasibility of using hydrogen

Bali is a region with advanced measures against climate change. It is working on initiatives that include projects that contribute to decarbonization in collaboration with the Indonesian National Development Planning Agency (BAPPENAS). Based on this, we had the opportunity to exchange opinions with BAPPENAS.

As Bali does not have sufficient knowledge about hydrogen utilization, they expressed their wish

to have an opportunity to share the information with Udayana University and Bali's National Research and Innovation Agency (BRIN). Since the G20 will be held in Bali in 2022, they wanted to show the world that Bali adopts advanced technology and takes measures against climate change. BAPPENAS also mentioned that the agency agrees with Bali's plan and is ready to work together. Based on this interest in the topic, the Embassy of Indonesia in Japan and Toyama City exchanged opinions, and the ambassador inquired about the possibility of holding a seminar with affiliated local organizations and companies and confirmed that the embassy would cooperate upon organizing it.

Therefore, we coordinated with the Bali side and prepared for the Toyama City and the Bali Province's Hydrogen Seminar, held on January 31, 2022. The details of the seminar will be mentioned below. The seminar deepened the understanding of hydrogen technology and anticipated the current technical issues and dissemination challenges. We received positive comments from multiple entities regarding our plan to adopt hydrogen technology through various programs.

In the case of adopting green hydrogen (hydrogen derived from renewable energy), it is indispensable to secure energy sources for production. In particular, the water electrolysis method using solar power generation as an energy source is the mainstream method.

In the Intercity Collaboration Program, we have studied the commercialization of solar power generation. However, due to the fact that the FIT (Feed-in Tariffs) system in Indonesia is still under development and the grid connection restrictions are considerable, the usage of solar power is not expanding rapidly as in Japan. Conversely, due to these institutional restrictions, the method of storing electric power in the form of hydrogen, independent of the grid, can be expected to become widespread. Hence, we examined the feasibility of using solar power generation in Bali from this perspective this year.

2.2.3. Study for developing a plan for adopting solar power generation

(5) Solar power generation

In the previous years' projects, we selected potential sites and estimated the amount of power to be generated. The target sites were office buildings such as hospitals and government facilities, and public land.

The Ministry of Energy and Mineral Resources has issued a notification "Surat Edaran MESDM No. 363/22 / MEM.L / 2019" to promote the installation of solar power generation systems. The notification recommended installing rooftop solar power energy systems in government facilities to reduce the government budget, disseminate renewable energy, and decrease greenhouse gas emissions.

Figure 2-14 The Ministry of Energy and Mineral Resources' efforts related to the installation of solar power generation systems

Source: Ministry of Energy and Mineral Resources's website [14]

The Center for Community Based Renewable Energy (CORE), which is part of Udayana University (a national university located in Bali), announced: "Bali's Proposed Plan for Installing Rooftop Solar Power Equipment to Achieve Self-Sufficiency."

The proposed plan shows the potential of adopting solar energy as it states that Bali's target is to build a solar power plant with a capacity of 108 MW by 2025. It also indicated that the installation capacity of the solar power plants in Bali as a whole is 1,254 MW.

This plan also mentions the possibility of installing rooftop solar power equipment in public facilities and states that it is a "very promising location to install them." Based on this information, we calculated the amount of power to be generated and cost at the following locations last year.

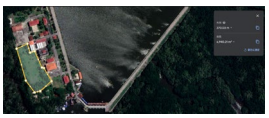
Figure 2-15 Bali's Proposed Plan for Rooftop Solar Power Equipment Installation to Achieve Self-Sufficiency

CORE, “Peta Jalan Pengembangan PLTS Atap Menuju Bali Mandiri Energi”, 2019

Table 2-19 Suggested locations, their area, general conditions, installation capacity, and amount of power to

[14] Kementerian Energi dan Sumbur daya Mineral「KEBIJAKAN, REGULASI DAN INISIATIF PENGEMBANGAN ENERGI SURYA DI INDONESIA」,2019. http://iesr.or.id/wp-content/uploads/2019/10/2019-10-10-Bahan-Paparan-Akselerasi-PLTS-Mencapai- 65-GW-pada- 2025-IESR.pdf, obtained in Apr. 2020

be generated

地点名	面積［m3］	スクリーンショット	導入ポテンシャル/メリット	課題/懸念事項	モジュール容量、PCS容量 [kW]	年間発電量 [kWh]	概算金額 [USD]
財務省バリ庁舎ビル	2217.27		・平屋根とみられ、一定規模の面積を確保可能	・強度不明	103.5kw 345W*300枚	156,315	126,657.00
デンパサール市Suwung浄水場	1000.77		・伝統的な瓦屋根ではなく設置可能性あり ・一定面積を確保可能	・強度不明	144.9kw 345W＊420枚	218,841	175,004.00
デンパサール市貯水場施設周辺敷地	6904.21		・一定の面積を確保できる ・水面等への設置（浮体式）も可能かもしれない ・ポンプ場があり、自家消費が可能 ・地域への供給（地域貢献）策もある ・公共事業省管理のため電気関係のエンジニアが常駐	・伐採、整地が必要 ・屋根置きではないため、PLNの新制度（屋根隠岐への優遇策）は使えない可能性がある	621.0kw 345W＊1800枚	937,889	898,276.00
デンパサール市最終処分場跡地	4179.48		・一定面積を確保できる ・埋め立て完了地点から順次公園として増設されるが、その一部を太陽光パネル設置に充てることができる可能性がある ・廃棄物処理関連の設備に電力供給するほか、地域への供給（地域貢献）等に活用できる可能性	・屋根置きではないため、PLNの新制度（屋根隠岐への優遇策）は使えない可能性がある	285.66kw 345W＊828枚	431,429	415,182.00

The amount of CO_2 emission reduction at these locations was calculated using the Methodology ID_AM013 (Installation of Solar PV System). In addition, the estimate of initial investment and the amount of the subsidy by the JCM equipment subsidy program (an estimate of 30%) are shown below.

Table 2-20　CO_2 emission reduction at each suggested location

候補地点名	年間発電量 [kWh]	排出削減量 [t-CO_2/年]	プロジェクト期間排出削減量 [t-CO_2]
財務省バリ庁舎ビル	156,315	96.29	1,637
デンパサール市　Suwung 浄水場	218,841	134.81	2,292
デンパサール市貯水場施設周辺敷地	937,889	577.74	9,822
デンパサール市最終処分場跡地	431,429	265.76	4,518
合計	1,744,474	1,075	18,268

Source: Produced by JANUS

Equipment installation costs include panels, PCS, other peripheral equipment, transportation costs, construction costs, grid connection construction costs, and various taxes. In this study, the average values were calculated based on the construction cases in Japan and were applied to this case. Each location's installation costs are shown below.

Table 2-21　Equipment installation costs

候補地点名	概算金額 [USD]	概算金額 [JPY]*
財務省バリ庁舎ビル	126,657	13,298,985
デンパサール市　Suwung 浄水場	175,004	18,375,420
デンパサール市貯水場施設周辺敷地	898,276	94,318,980
デンパサール市最終処分場跡地	415,182	43,594,110
合計	1,615,119	169,587,495

Source: JANUS

* The conversion rate was assumed to be 1 US dollar = 105 yen for calculation.

In Indonesia, there are a minimum of four solar power generation projects that have been reported. As having cases that adopted similar technology (similar technology already selected) to our project affect the JCM financial support rate, the subsidy rate for this project is expected to be 30%. 30% would be estimated to be 50,876,249 yen. Dividing this value by the amount of CO_2 emission reduction, the cost-effectiveness of CO_2 emission reduction would be 2,785 yen/t-CO_2, which is an appropriate value in an equipment subsidy project.

Based on this result, we decided this year to discuss the commercialization of solar power generation with Persada Bali, a company in charge of construction projects for the public sector, including renewable energy projects. Bali Province introduced us to Persada Bali, a public company with a track record in installing rooftop solar power generation equipment for public facilities.

Our interview pointed out the following issues that might arise upon commercialization.

- ✓ Since the outbreak of the COVID-19 pandemic, the government's budget has been tight, which might make it difficult to secure initial investment.
- ✓ Currently, the FIT system has not been developed. Thus, it may not be possible to sell electricity, or the purchase price may be low, making securing economic efficiency difficult.
- ✓ Even in the case of private power generation, it is necessary to discuss the interaction with the grid with PLN, and there may be restrictions depending on the system conditions.
- ✓ While there are preparations to adopt the PPA system, detailed contracts and operations need to be discussed with PLN, and since there are no previous cases, no facilities adopting the PPA system have reached the operations stage.

PLN has approved the following models as solar power generation methods. While the Power Purchase Agreement (PPA) that falls under (3) is included, it seems that the procedures and details for operations are undecided.

(1) A model in which PLN installs a rooftop solar power generation system on the roof of a customer's building and is in charge of operating the system. The customer pays the initial investment.
(2) A model in which PLN provides a comprehensive service from installing to

maintaining the rooftop solar power generation system. Customers pay electricity charges as usual while receiving a special price (the amount specified by the government and PLN). PLN bears the initial investment.

(3) A model in which the customer can install a rooftop solar power generation system in their building in cooperation with a business entity. The financing and management of the rooftop solar power generation equipment will be determined based on an agreement between the two parties. The service provider bears the initial investment.

(4) A model in which a customer installs or manages a rooftop solar power generation system in their building in cooperation with an organization such as the engineering service company ESCO. ESCO bears the initial investment.

Given these circumstances, the hydrogen utilization shown in the previous chapter may be one of the solutions to some of the challenges to disseminating solar power generation.

In recent years, efforts have been made in Japan to produce hydrogen from renewable energy surplus electricity to serve as a renewable energy adjustment capacity method. This is because the water electrolysis used to produce hydrogen from electric power has an excellent load response and can be used for system frequency adjustment by considering it as a way to integrate a demand response model. It is based on the idea of effectively using surplus electricity via output control in Japan. However, even if we want to use the entire amount of renewable energy for hydrogen production, as mentioned above, the water electrolyzer has the characteristic of absorbing the load. Thus, the generated power can be effectively used and would not be restricted by output suppression.

We compared this method with storage batteries from the aspect of stable power generation output. The charge/discharge efficiency of lithium-ion batteries is said to be 90 to 95%, and it is possible to build a stable private power generation system by storing surplus power and discharging it when supply is insufficient.

On the other hand, the larger the scale, the more problems related to cost and the installation area arise. Moreover, considering the natural discharge in batteries, it is difficult to use them for long-term power storage.

Due to such limitations to storage batteries, other options suitable for larger scales and ways to store energy other than electricity were reviewed. One of these advantageous ways is storing energy in the form of hydrogen and keeping it in fuel cells. Hydrogen has an electrolytic efficiency of 80% x the fuel cell's power generation efficiency of 55% = about 44%. If we add the thermal energy resulting from the cogeneration (combined heat and power) method, it would be about 70%. If we add a hydrogen storage tank, it would easily increase the capacity at a low cost. Additionally, natural discharge does not occur in these storage tanks, which enables large-scale energy storage across seasons and years[15].

In the future, we plan to select a model site for hydrogen utilization and study the grid restrictions

[15] Fumio Nishiwaki: “The unstability of power generation with renewable energy should be covered by hydrogen”: Toyo Keizai Online, 2018. https://toyokeizai.net/articles/-/231887?page=3

in Bali and how to use it in a way that would result in energy and economic benefits.

2.3. Semarang City

2.3.1. Semarang City's Effort for Realizing a Low-carbon Society

(1) Main Policy and Strategies

Semarang City is the capital of Central Java Province, and the province has set a target to replace 21% of its energy supply with renewable energy by 2025. Central Java Energy and Mineral Resources Agency is striving to produce 17% of the province's energy supply from solar and geothermal energy by 2025, and at present, renewable energy meets 10% of the province's electricity demand. Further, it aims to reduce the GHG emissions by 46% by 2020.

Semarang City also developed Semarang City Climate Change Strategy in 2010-2020 in 2012, and launched the following 7 strategies[16]:

(1) Improve energy efficiency
(2) Develop an integrated waste management system
(3) Control diseases caused by climate change impact
(4) Improve water supply and distribution services
(5) Skill development for disaster control associated with climate change
(6) Control inundation caused by floods and tides
(7) Building management and effective use of space

To achieve the goal of reducing GHG emissions, the city has been actively engaging in intercity collaboration and adopting low-carbon technologies leveraging JCM Equipment Subsidy Project, so they have know-how of adopting fuel changeover technologies in the transportation field. Also, Semarang City was selected as "100 Resilient Cities (100RC)," and the city's efforts as a coastal city to be resilient to disasters like floods, and also to climate change.

In Central Java Province with Semarang City as its capital, "The Regional Action Plan for Reducing Greenhouse Gas Emission (RAD-GRK)" was enacted in 2012, and "General Plan of Regional Energy (RUED)" was enacted in 2018, as its energy-related policy. RAD-GRK and RUED are described in the following sections respectively.

(2) Energy-Related Policy of Central Java Province

① Regional Action Plan for Reducing Greenhouse Gas Emissions 2020 (RAD-GRK)

In Central Java Province with Semarang City as its capital, "The Regional Action Plan for Reducing Greenhouse Gas Emission (RAD-GRK)" was enacted in 2012. A target value in reduction of greenhouse gas in RAD-GRK is in line with RAN-GRK in Indonesia, which was enacted in the form of an executive order in 2010, which aims to reduce GHG by 26% by 2020, like RAN-GRK. Also, total GHG emissions in Central Java Province was calculated in the plan, which was

[16] Initiative for urban climate change and environment (IUCCE), "Climate Change Mitigation Action Plan Of Semarang City In 2018-2030", http://iucce.org/index.php/home/article_pub/105

29,418,849 t-CO_2 in total in 2008, but the emission volume for 2010 was 39,886,167 t-CO_2, which revealed that carbon dioxide emissions had increased rapidly within a couple of years. According to an analysis of factors causing GHG emissions, most of the emission has been attributed to 6 sectors: energy, transportation, industry, farming, forestry, and waste management. GHG emissions from the energy sector include those from energy consumption from fuel, coal and power, and in the transportation sector, all energy arising from transportation is counted. In the industrial sector, emission arising from industrial processes is included, and in the agricaltural sector, emission from fermentation and management of livestock wastes and the methane production caused by the metabolism of bacteria in agricultural production, as well as emission associated with N2O production are included. Finally, in the forestry sector, emission from all vegetation coverage caused by land uses of forest, plantations, and other land uses are included, and in the waste management sector, waste management at TPA, post offices, incineration, household and domestic waste management are included. If we put these 6 sectors into order from the largest emission volume, energy, farming, waste management, forestry and then industrial. The target value of GHG emissions reduction for each sector is outlined in the table below.

Table 2-22 Greenhouse Gas Reduction Target for Each Sector in Central Java Province

label 3.8. GHG Emission Reduction Target

Bidang	Emisi GRK		Drop Target		Aksi Plan	Implementing Institution
	2010	2020	Tons of CO2	%		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Farming	6,395,328	8,964,816	392,200	4.37	Low production of varieties, low emission, irrigation efficiency, use of fertilizers organic, livestock waste treatment, utilization waste agriculture	TPH Agriculture Office, PSDA Office, BLH, Department of Animal Husbandry and Animal Health
Forestry	118,765	730,843	114,000	15.60	Control Fire andan hut land, Rehabili atsi forest andan land, Prevention logging/ logging wild.	Service Forestry, Service Plantation 'Service PSDA, BLH
Energy	16,191,639	29,970,000	3,934,008	13.12	Energy development renewable (biofuel, geothermal, water, solar power), efficiency energy, use of gas fuel (BBG)	ESDM Office, Dinhub, Animal Husbandry Service
Transportation	9,737,000	25,078,000	3,134,784	12.50	Transport management review, improvement l ali bag vehicle feasibility testing	Dishub, Dinas Bina Marga
Indu stri	1,394,548	4,146,926	390,000	9.40	Efficiency of use	Industry and Trade Office,
Waste Management	4,668 .898	6,286 .219	1.40,000	22.27	Development of regional landfills, 3R-based waste management and management domestic and industrial wastewater.	BLH, Department of Human Settlements and Spatial Planning

Source: The Regional Action Plan for Reducing Greenhouse Gas Emission 2020 (RAD-GRK)

The following summarizes an outline of reduction target and strategies for each sector.

Table 2-23 Central Java Province's GHG Emissions Reduction Targets and Strategies for each Sector

Department	Goals and Strategies
Agriculture	Reduce GHG emissions from the agricultural sector in a broad sense and minimize the impacts of climate change to achieve agricultural development

	goals. (1) Improve the understanding of farmers and related parties to predict climate change. (2) Enhance the capacity of the agricultural sector to adapt to climate change, including sustainable agricultural development. Establish a climate change insurance system. (3) Implement efficient technologies to reduce GHG emissions.
Forestry	Achieve sustainable forestry as a life support system for the welfare of the community in the next 20 years. The achievement of the vision will be achieved through balanced forest management along three dimensions of forest function: ecological, economic, and social.
Energy	The reduction of GHG emissions through energy management and conservation of environmental functions will be achieved through the promotion of renewable energy in the region by central and local governments. The goal is to achieve an optimal energy mix by 2025, as follows a. Oil: 20% or less b. Natural gas: 30% or less c. Coal: 33% or less d. Biofuel: At least 5% e. Geothermal energy: At least 5% f. Renewable energy, including biomass, nuclear, hydro, solar, and wind: At least 5% g. Coal liquefaction: At least 2%
Transportation	Develop a comprehensive approach to GHG reduction and identify a set of practical policies. Strategies for reducing GHG emissions in the transportation sector include the following Improving the energy efficiency of transportation, using technologies to reduce GHG emissions from vehicles (greener transportation), and using information technology (the Internet). Reduce the need to travel by car as much as possible by using telecommunications, such as information technology and communication devices, as an alternative to transportation.
Industry	Technological innovations to increase energy efficiency, diversify energy sources, and reduce CO2 emissions in the cement, textile, and transportation equipment industries.
Waste Management	In order to reduce greenhouse gas emissions from the waste sector, it is necessary to collect landfill gas from outdoor dumping sites that have been converted to sanitary landfills and create new sanitary landfills. It is also necessary to close all illegal dumping sites by 2015. Other possible solutions

	include reducing the amount of waste at the source, such as households, and implementing the 3Rs (Reduce, reuse, recycle) at the source, such as final processing sites. The final processing of waste differs between urban and rural areas in Indonesia, with urban areas focusing on landfill technologies (open dumping, controlled landfill, and sanitary landfill), while rural areas adopt composting technologies. On the other hand, the 3Rs can be applied to both urban and rural areas.

Source: Regional Action Plan to Reduce Greenhouse Gas Emissions in Central Java Province 2020 (RAD-GRK)

② General Plan of Regional Energy (RUED)

Central Java Province is one of the major production areas for oil and gas in Indonesia, the primary energy source in the province is still fossil fuel, and the demand for oil and LPG is increasing by 5.5% each year. However, since there is a limit on the amount of fossil fuel, the distribution of renewable energy utilizing the province's privileged nature is recommended. The following figures show the energy mix as of 2016, and the energy mix goal for 2025.

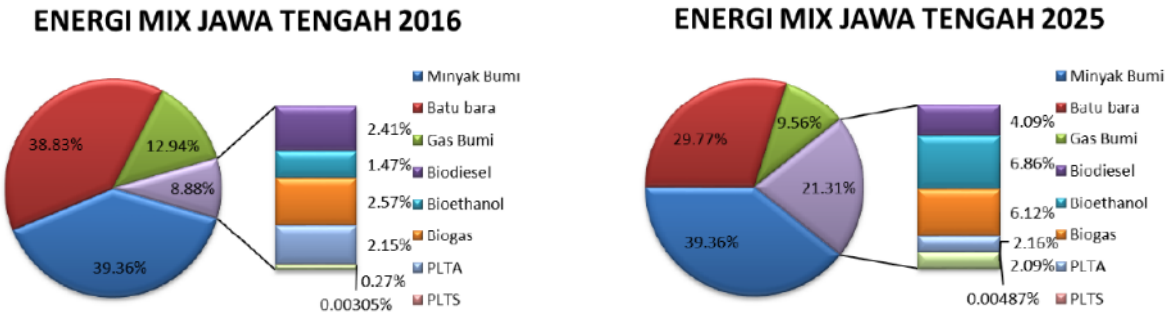


Figure 2-16 Central Java Province Energy Mix as of 2016 and Target Energy Mix for 2025

Note: Legend: red = coal, blue = oil, green = gas, purple = renewable energy (from the top, biodiesel, bioethanol, biogas, rooftop solar power, other solar power)

Source: Central Java Province General Plan of Regional Energy (RUED) (No.12/2018)

The three main causes for the dependency on fossil fuel are shown. The first cause is the continued use of old equipment in Central Java Province, and fossil fuel is used as fuel for the equipment. Next, equipment using fossil fuel works more efficiently than the ones using renewable energy, and can output a larger amount of energy, and finally, Indonesia government continues to provide subsidies for fossil fuel, which makes it affordable for citizens.

RUED goals that are in line with RUEN objectives are as follows.

i) Decrease dependency on oil, and reduce the ratio of oil in the energy mix to 25% or less by 2025

ii) Increase the ratio of renewable energy in the energy mix by 23% or more by 2025, and 31% or more by 2050.

iii) Improve the peoples' access to energy, to achieve the 100% electrification rate by 2020.

iv) Promote energy saving, and bring the value of energy elasticity to below 1 by 2025.

v) Secure energy buffer reserves in the area.

2.3.2. Discussion for Development of a Plan for Commercializing Fuel Changeover to Natural Gas

In the survey in the last fiscal year, we discussed a low-carbonization project through changeover to gas for pumps and vehicles powered by diesel fuel, by leveraging the natural gas infrastructure more in Semarang City. Expanding gas demand was expected to lead to more robust infrastructure, and to eventually contribute to a stable operation of JCM Equipment Subsidy Project that started monitoring in 2019.

In this fiscal year, while we planned to conduct more detailed studies in the potential sites selected based on the survey in the last fiscal year, delays in a project related to maintenance of gas pipelines and challenges in gas supply on JCM Equipment Subsidy Project became evident, so we decided to readjust the potential sites while coping with these matters.

As the background and challenges of JCM Equipment Subsidy Project determine whether our fuel changeover project will be successful, this section is focused on this point.

(1) Progress of and Problems with JCM Equipment Subsidy Project

As previously described, in response to the Intercity Collaboration Program between Toyama City and Semarang City, we started refurbishing 72 buses owned by Trans Semarang, a municipal transportation corporation, to install the DDF system to switch from diesel fuel to dual fuel (gas + diesel) in the JCM equipment subsidy project in 2018, to achieve low carbonization in the transportation sector, and this project was completed in 2019.

At the beginning of this project, they had already implemented a demonstration project, and sufficient reduction effect would be anticipated if supply was available. Even in test runs after the modification, they witnessed about 40% reduction effect based on the difference in GHG emission coefficient and improved fuel consumption. The specifications of the modified busses and the reduction amounts are as follows.

Table 2-24 Public Buses Equipped with the DDF System in JCM Equipment Subsidy Project and Reduction Effect (Based on Test Runs)

Bus type	Before remodeling	After remodeling	Amount of reduction
Middium bus（47 units）	**12,903**	**7,556**	**5,347**
Big bus（25 units）	**12,367**	**7,241**	**5,126**
Total	**25,270**	**14,796**	**10,474**

Because it matches the gas promotion program in Indonesia, we also received support requests from Banda Aceh City, Tebing Tinggi City and other local governments. This accomplishment was presented in Asia EST Forum in 2019, catching the interest of Malaysia Iskandar Region over gas

changeover in public transportation and JCM Equipment Subsidy Project, which connected us to City-to-City Collaboration Project with the region.

In the transportation sector, while there are few accomplishments in CDM and JCM, potential spread can be considered as an effective transition method for transportation-derived GHG, and also as part of this City-to-City Collaboration Project, we have just conducted a survey on potential sites in anticipation of such spread, including the discussion on Bali Province.

The point of this technology is that it can generate the GHG emissions reduction effect mentioned above just by modifying buses, without a need to replace the existing buses. The construction cost is low and the construction period is short, and because such modification can be removed when selling the vehicles, it won't affect the asset value of the buses.

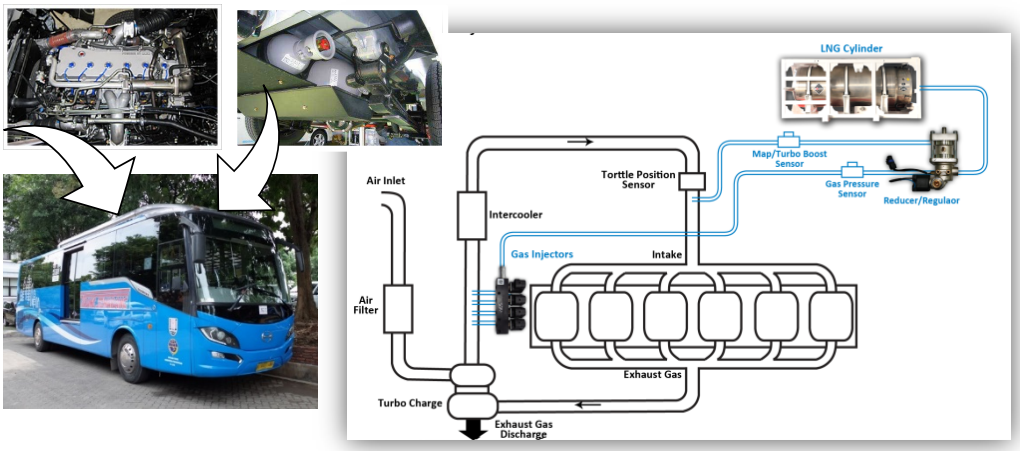


Figure 2-17 Schematic Diagram of Public Bus with the DDF System

As these characteristics are very effective from the aspect of economic viability, our counterpart of the project, which is Trans Semarang, a public transportation provider, has upgraded all 235 vehicles into the DDF version spending their own funds, including the 72 buses modified with the JCM Equipment Subsidy.

A problem here is fuel gas supply. At the start of this project, Pertagas Niaga, which is responsible for gas supply, signed a purchase agreement with us to commit to constant supply, and we did not think there would be any supply issues based on their business structure which had been generating revenue from gas sales. However, there was a delay in their construction schedule for gas stations that were scheduled to open, and we encountered a situation where a method for temporary gas supply until the opening of the gas station did not function.

For a temporary measure until the opening of the gas stations, the following method was proposed by Pertagas Niaga. They use gas tanker trucks from their gas base in West Java to transport gas on land, then supply gas using vehicles called MRU equipped with a mobile compression supply system (compressor). At this time, overlading in MRU occurred, which resulted in frequent occurrence of breakdowns and stopped gas supply frequently.

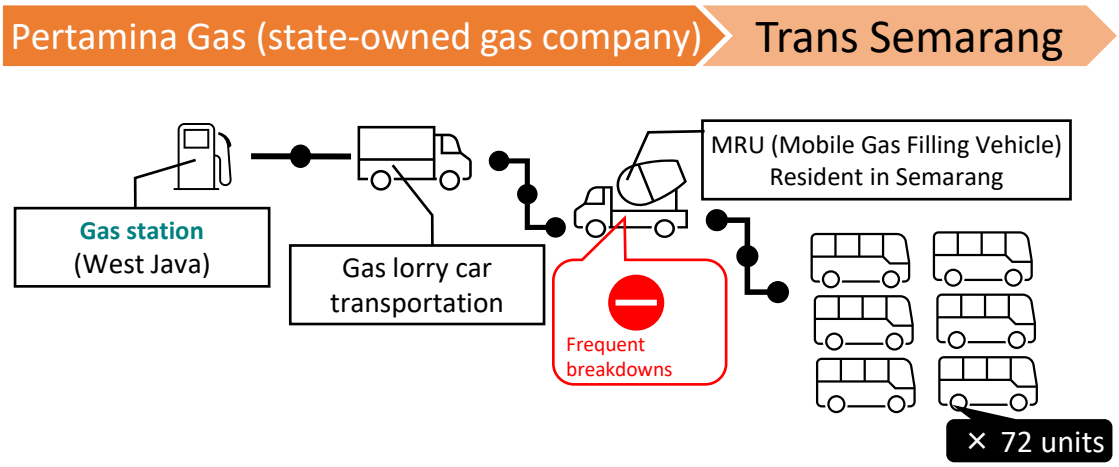


Figure 2-18 Temporary Measure until Gas Station Opening

This supply system was presented by Pertamina Gas Group including Pertagas Niaga as a structure to expand their supply service to areas with no connected pipelines, which is feasible in principle, and because there were similar supply cases in other countries, it was presumed to function sufficiently, taking the above commitment letter into consideration.

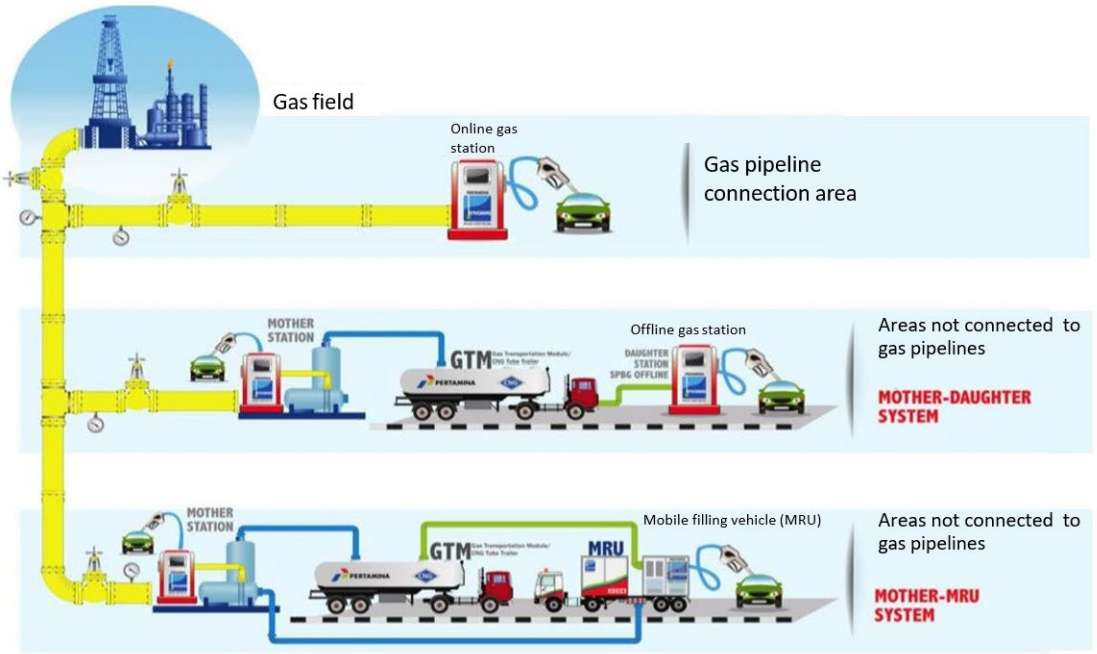
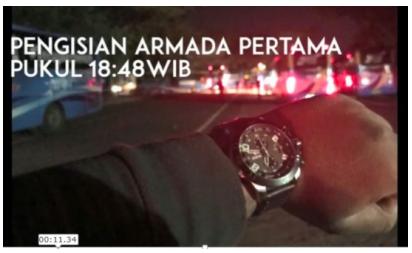


Figure 2-19 Supply System to Areas without Connected Gas Pipelines Proposed by Pertamina Gas

Nevertheless, once they actually commenced the operation, they found out that there was a need for more supply time than expected due to their supply timing and overload in MRU (compressor).



18:48 Start

Congestion waiting for supply continues until midnight

Hokushi Employee and President of Trans Semaran Ade (at that time)

02:59 Supply completed

Figure 2-20 Status of Gas Supply By MRU

First, as a problem with the timing of supply, tanker trucks can be refueled only during a period from the end of their last run to their return to the garage, because they are in operation with a tight schedule from the start of operation in the early morning to the last operation. Before the gas changeover, they were operated with the same schedule with diesel fuel.

When supplying CNG, the gas tank on a gas tanker truck can hold high pressure, which allows gas supply to run at adequately fast pace, and it can supply gas with less impact on the compressor, however, the pressure level in the gas tank drops gradually, and it makes gas supply depend on the compressor on MRU. At this point, the compressor needs time to cool down, and a pressure accumulator requires time for recompression in the middle of supplying, which required 8 hours for refueling 72 vehicles.

The overloading of a compressor resulted in a breakdown, which led Pertagas Niaga to commit to increasing the number of MRU trucks, however, there was a period of time when the supply had to be suspended for a certain period, because the parts required to fix MRU are produced overseas and it took time to procure such parts and to call in engineers.

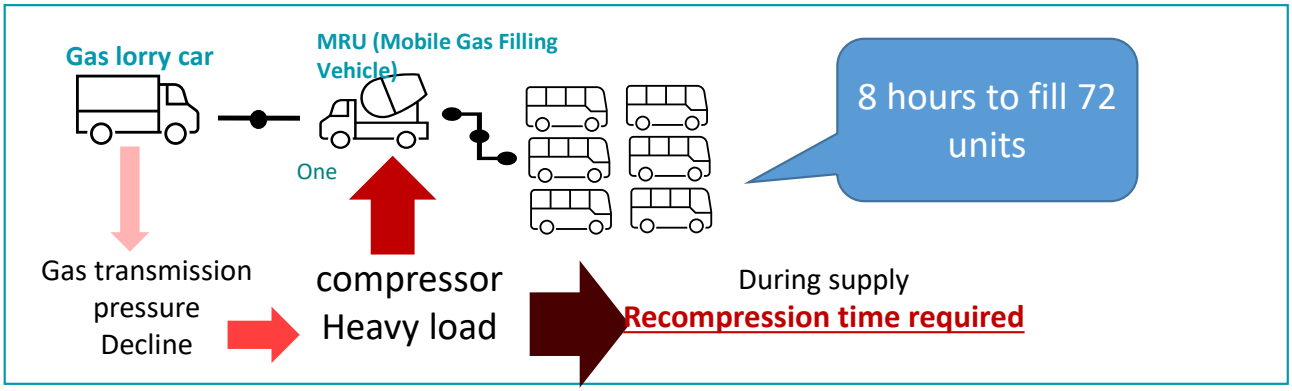


Figure 2-21 Problems with Gas Supply Using MRU

In response to this situation, the representative company Hokusan Co., Ltd worked with Trans Semarang and Pertagas Niaga to cope with the problems by sending their employees to the site, in addition to working with Toyama City to approach relevant organizations such as Semarang City and the Department of Energy and Mineral Resources, in order to obtain quicker responses from Pertagas Niaga. This includes issuing a response request letter addressed to the mayor of Semarang City from the mayor of Toyama City.

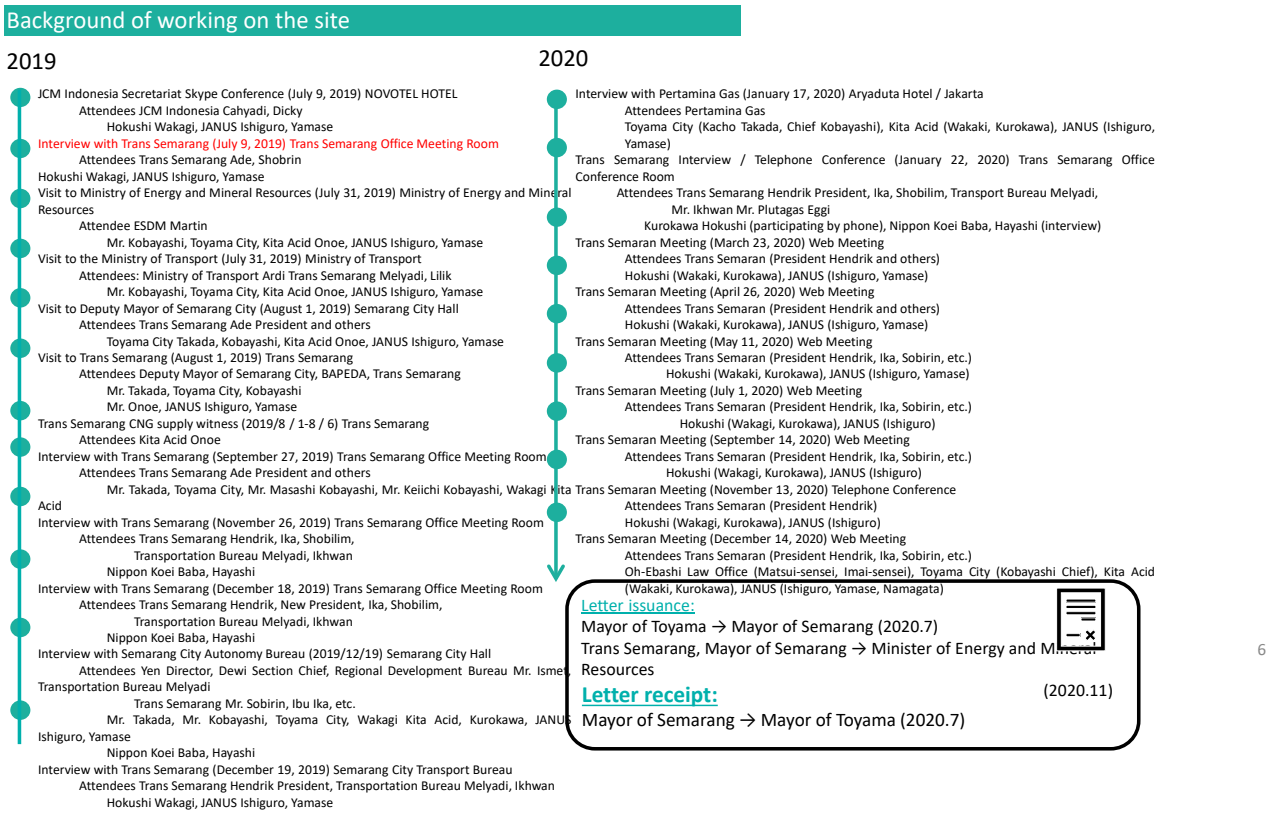


Figure 2-22 Approach to Local Parties for Solving Problems (2019-2020)

To solve underlying problems, it is necessary to open gas stations early, so we have had numerous discussions including issuance of letters, while focusing on the completion of gas stations.

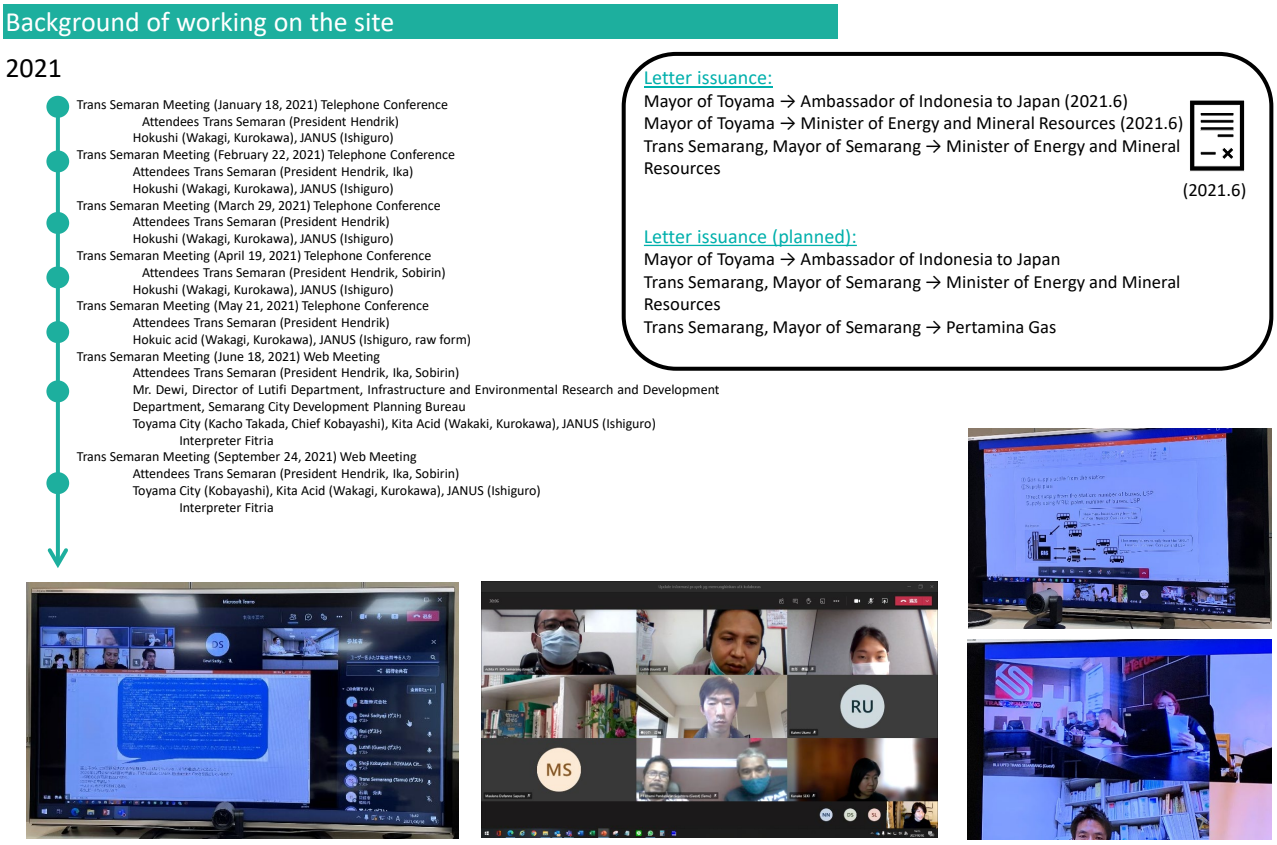


Figure 2-23 Approach to Local Parties for Solving Problems (2019-2020)

These actions turned out to be effective, and one of the 4 gas stations to be established was finally opened in August 2021. The sequence of events from the start of the project through the opening of the gas station is described below.

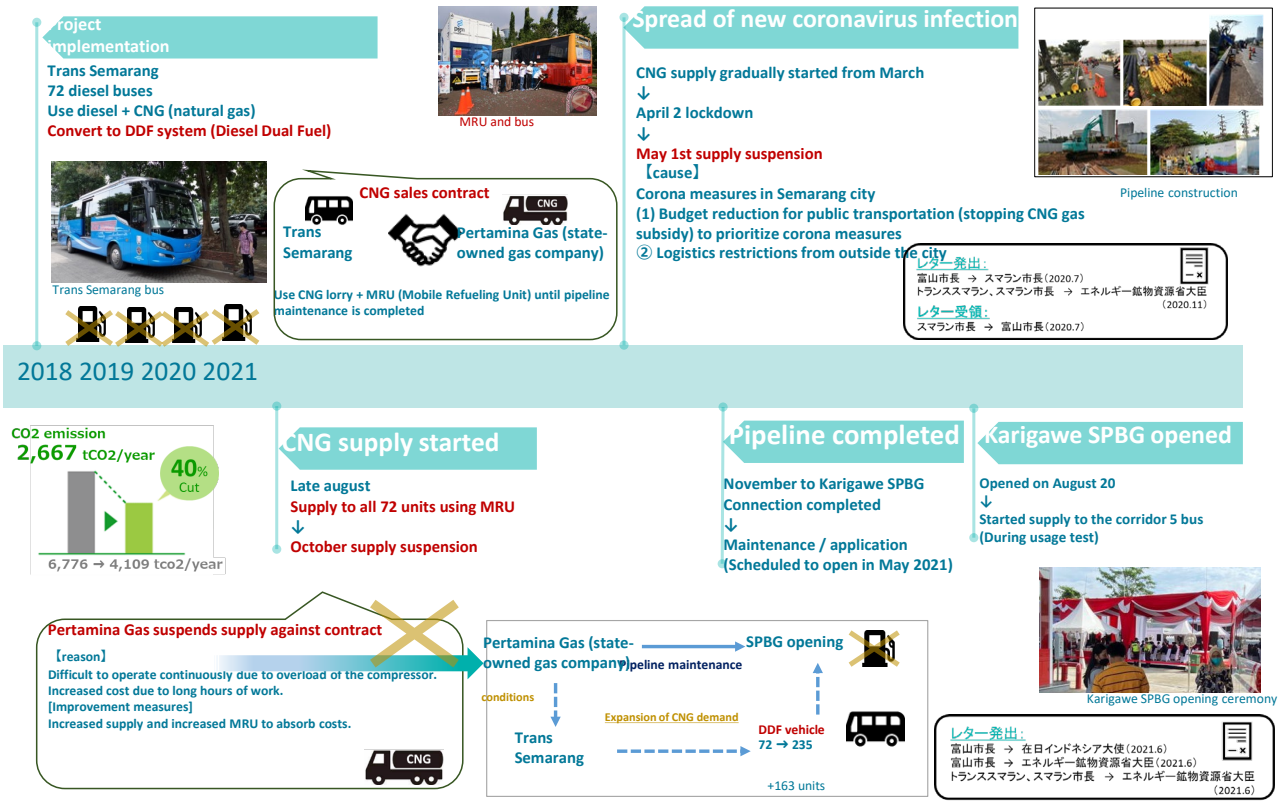


Figure 2-24 Sequence of Events until the Establishment of the Gas Supply Station

We expected that supply would stabilize through the establishment of the gas station, however, as of February 2022, they have not reached to full supply yet. In the background, we encountered a problem of unbalanced supply cost because the location of the opened gas station is distant from some of the routes.

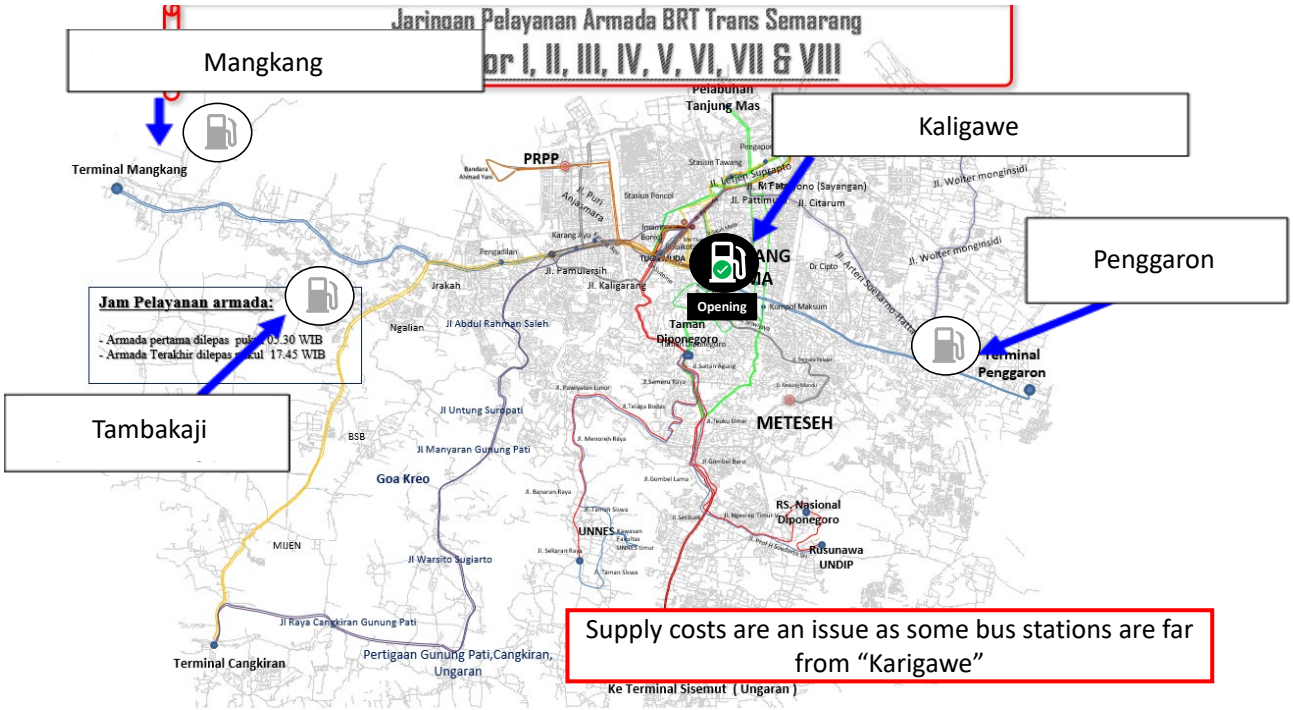
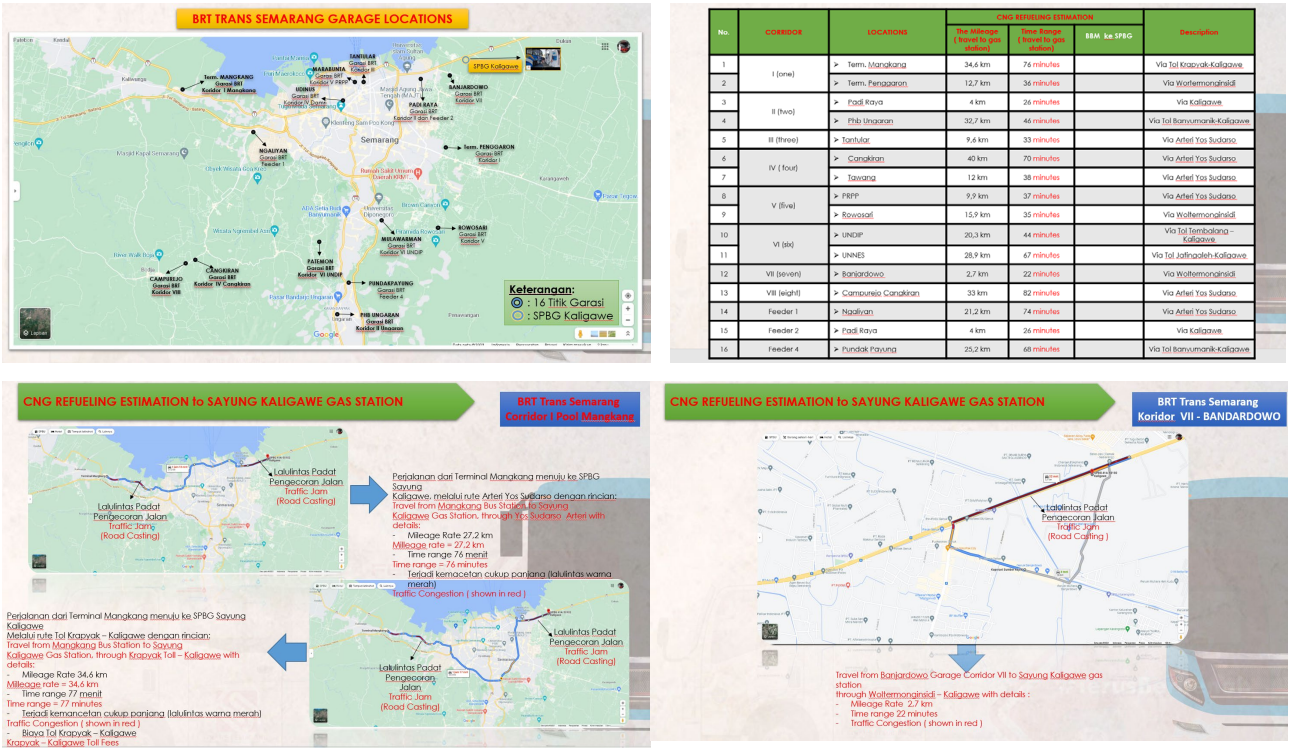


Figure 2-25 Sequence of Events until the Establishment of the Gas Supply Station



No.	CORRIDOR	LOCATIONS	CNG REFUELING ESTIMATION: The Mileage (travel to gas station)	CNG REFUELING ESTIMATION: Time Range (travel to gas station)	CNG REFUELING ESTIMATION: BBM ke SPBG	Description
1	I (one)	Term. Mangkang	34,6 km	76 minutes		Via Tol Krapyak-Kaligawe
2		Term. Penggaron	12,7 km	36 minutes		Via Woltermonginsidi
3	II (two)	Padi Raya	4 km	26 minutes		Via Kaligawe
4		Phb Ungaran	32,7 km	46 minutes		Via Tol Banyumanik-Kaligawe
5	III (three)	Tantular	9,6 km	33 minutes		Via Arteri Yos Sudarso
6	IV (four)	Cangkiran	40 km	70 minutes		Via Arteri Yos Sudarso
7		Tawang	12 km	38 minutes		Via Arteri Yos Sudarso
8	V (five)	PRPP	9,9 km	37 minutes		Via Arteri Yos Sudarso
9		Rowosari	15,9 km	35 minutes		Via Woltermonginsidi
10	VI (six)	UNDIP	20,3 km	44 minutes		Via Tol Tembalang - Kaligawe
11		UNNES	28,9 km	67 minutes		Via Tol Jatingaleh-Kaligawe
12	VII (seven)	Banjardowo	2,7 km	22 minutes		Via Woltermonginsidi
13	VIII (eight)	Campurejo Cangkiran	33 km	82 minutes		Via Arteri Yos Sudarso
14	Feeder 1	Ngaliyan	21,2 km	74 minutes		Via Arteri Yos Sudarso
15	Feeder 2	Padi Raya	4 km	26 minutes		Via Kaligawe
16	Feeder 4	Pundak Payung	25,2 km	68 minutes		Via Tol Banyumanik-Kaligawe

Figure 2-26 Supply Route Length Estimated by Trans Semarang

Therefore, for a permanent solution to the issue, we need to wait for the 4 stations in the plan to open. To realize this, we have been working with Toyama City, enlisting support from the Embassy of the Republic of Indonesia in Japan, to continue our appeal to Pertagas Niaga through the Department of Energy and Mineral Resources.

Since 2021, the Director of Oil and Gas in the Department of Energy and Mineral Resources has been attending the regular meeting to solve this issue, and because it takes a certain amount of time to open the remaining 3 stations even though we have been rushing, a proposition has been discussed to decentralize supply by distributing MRU to other gas station candidate points, from Kaligawa Gas Station that had already been opened. Compared to centralized supply, it gives less impact on MRU and also shows a possibility to shuttle high pressure gas, it can be considered effective as a temporary measure.

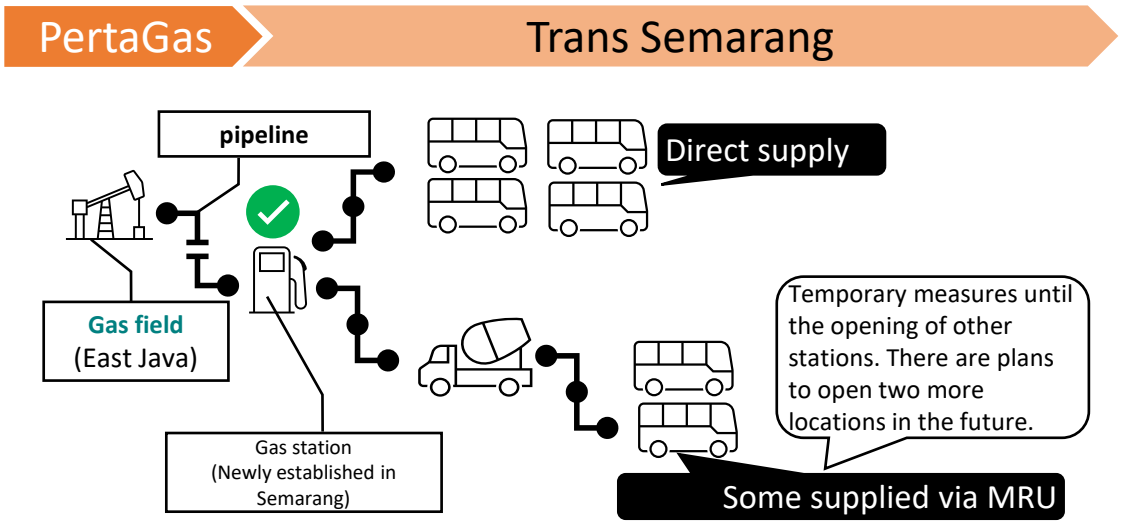
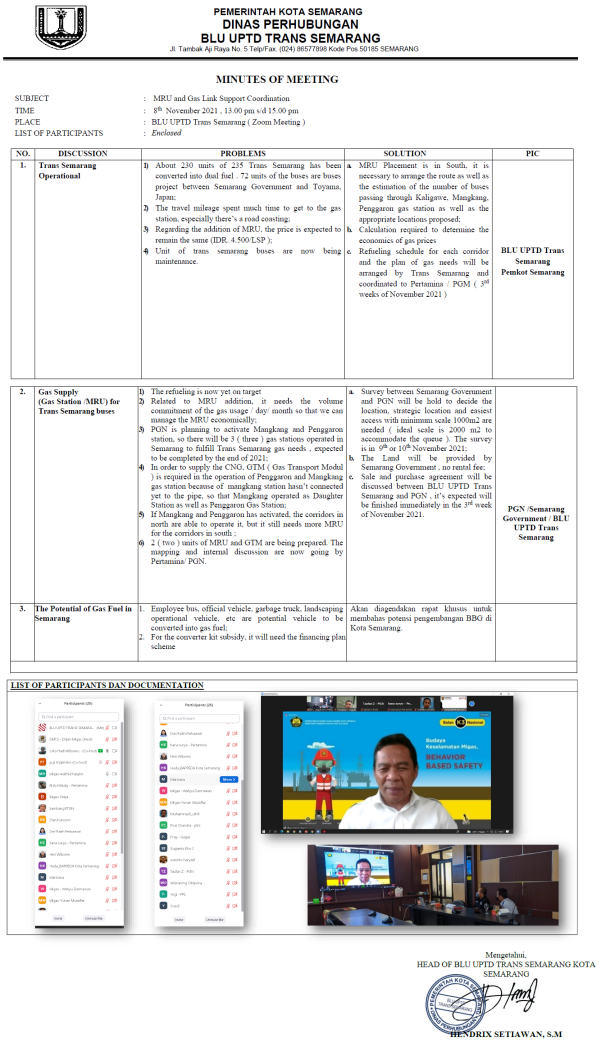


Figure 2-27 Proposed Gas Supply Route from the Already Opened Station

In order to operate such a gas supply system, an outlook of return on investment is also necessary for the gas supplier, Pertagas Niaga. In the meeting with the Director of Oil and Gas in the Department of Energy and Mineral Resources, we introduced a business opportunity by increasing gas demand, through an introduction of gas utilization potential in Semarang City.

As shown in the minutes of the meeting, Semarang City indicated that employee buses, public vehicles, waste collection vehicles, and landscaping vehicles have potential for gas changeover, therefore, we can expect to raise the priority of investment in gas supply infrastructure by presenting such demand, and to solve challenges including the early opening of the stations.



PEMERINTAH KOTA SEMARANG
DINAS PERHUBUNGAN
BLU UPTD TRANS SEMARANG
Jl. Tambak Aji Raya No. 5 Telp/Fax. (024) 86577898 Kode Pos 50185 SEMARANG

MINUTES OF MEETING

SUBJECT : MRU and Gas Link Support Coordination
TIME : 8th November 2021 , 13.00 pm s/d 15.00 pm
PLACE : BLU UPTD Trans Semarang (Zoom Meeting)
LIST OF PARTICIPANTS : *Enclosed*

NO.	DISCUSSION	PROBLEMS	SOLUTION	PIC
1.	**Trans Semarang Operational**	1) About 230 units of 235 Trans Semarang has been converted into dual fuel . 72 units of the buses are buses project between Semarang Government and Toyama, Japan; 2) The travel mileage spent much time to get to the gas station, especially there's a road cossting; 3) Regarding the addition of MRU, the price is expected to remain the same (IDR. 4.500/LSP); 4) Unit of trans semarang buses are now being maintenance.	a. MRU Placement is in South, it is necessary to arrange the route as well as the estimation of the number of buses passing through Kaligarve, Mangkang, Penggaron gas station as well as the appropriate locations proposed; b. Calculation required to determine the economics of gas prices c. Refueling schehule for each corridor and the plan of gas needs will be arranged by Trans Semarang and coordinated to Pertamina / PGM (3rd weeks of November 2021)	**BLU UPTD Trans Semarang Pemkot Semarang**
2.	**Gas Supply (Gas Station /MRU) for Trans Semarang buses**	1) The refueling is now yet on target 2) Related to MRU addition, it needs the volume commitment of the gas usage (day/ month so that we can manage the MRU economically; 3) PGN is planning to activate Mangkang and Penggaron station, so there will be 3 (three) gas stations operated in Semarang to fulfill Trans Semarang gas needs , expected to be completed by the end of 2021; 4) In order to supply the CNG, GTM (Gas Transport Modul) is required in the operation of Penggaron and Mangkang gas station becanse of mangkang station hasn't connected yet to the pipe, so that Mangkang operated as Daughter Station as well as Penggaron Gas Station; 5) If Mangkang and Penggaron has activated, the corridors in north are able to operate it, but it still needs more MRU for the corridors in south ; 6) 2 (two) units of MRU and GTM are being prepared. The mapping and internal discussion are now going by Pertamina/ PGN.	a. Survey between Semarang Government and PGN will be hold to decide the location, strategic location and easiest access with minimum scale 1000m2 are needed (ideal scale is 2000 m2 to accommodate the queue). The survey is in 5th or 10th November 2021; b. The Land will be provided by Semarang Government , no rental fee; c. Sale and purchase agreement will be discussed between BLU UPTD Trans Semarang and PGN , it's expected will be finished immediately in the 3rd week of November 2021.	**PGN /Semarang Government / BLU UPTD Trans Semarang**
3.	**The Potential of Gas Fuel in Semarang**	1. Employee bus, official vehicle, garbage truck, landscaping operational vehicle, etc are potential vehicle to be converted into gas fuel; 2. For the converter kit subsidy, it will need the financing plan scheme	Akan diagendakan rapat khusus untuk membahas potensi pengembangan BBG di Kota Semarang.	

LIST OF PARTICIPANTS DAN DOCUMENTATION

Mengetahui,
HEAD OF BLU UPTD TRANS SEMARANG KOTA SEMARANG

HENDRIX SETIAWAN, S.M

However, from the process of JCM Equipment Subsidy Project at Trans Semarang, we experienced the difficulty in eliminating issues solely with the decision-making and efforts of project operators and counterparts, during a project depending on an external infrastructure. A key to the solution was finally found only after we obtained assistance from local authorities like Toyama City and Semarang City.

From this experience, an approach to consideration of expanding into the next project on top of improving the infrastructure and having stable operation was considered adequate from the viewpoint of monitoring in JCM Equipment Subsidy Project. If there is a presupposition that infrastructure has been improved, GHG emissions reduction by utilizing gas and reducing the use of diesel fuel can be expected in each potential site shown in the next section.

(2) Changeover of Fuel for Flood Control Pumps

Semarang City is located in lowland facing the Java Trench, and suffers severe damage due to floods every year. As such, they have systems to prevent flood damage by draining river water from the swollen river around its mouth toward the regulating reservoir. In recent years, flood damage has

become more serious due to the impact of climate change. Meanwhile, because electricity for the pumps required for drainage is supplied by diesel power generators, they are facing cost issues and environmental challenges. Flood control is an adequate measure in climate change, however, the more systems and operation hours there are, the more GHG emissions would be generated, so it is regarded as a problematic structure that will cause a vicious circle on climate change. The reason behind the use of a diesel power generation system is because transmission system outage is anticipated since floods occur in the severe weather such as torrential rain.

Flood in Semarang city

Diesel generator at Semarang Central Pumping Station

Drainage pump at Semarang Central Pumping Station

Figure 2-28 Flood in Semarang City, Drainage Pump, Power Generation System

Source: Semarang City Public Works Department

In Semarang City, there are pump stations in 4 areas, Central, South, East and West, with about 133 pumps. Among them, there are 65 pumps that depend on the diesel power generators for pump power. Specifically, there are 40 pumps with more fuel usage and higher improvement requirements, and their fuel usage amount reaches 122,072 L per year.

Based on such circumstances, in the past year's survey, we discussed proceeding with decarbonization by installing the DDF system in power generating systems to use natural gas as well as fuel changeover. Furthermore, the DDF technology can be applied to all types of diesel engines, not only vehicles like buses, and it also has many implementation achievements in ships and power generators.

With regard to gas supply to power generation systems in the pump stations, we intend to procure a certain amount of gas as industrial gas, set up a tank filled with the gas in a pump station, and replace the tank when its residual amount gets low.

With this scheme, we don't presuppose daily supply like Semarang City public bus business, so a bottleneck in gas supply will be eliminated[17].

[17] Although the public bus business has tried to solve the problem by the same means, it has not been realized due to the problems specific to the fuel supply to the bus (gas amount, supply pressure, legal regulations, etc.).

During the season of frequent flooding, there is a possibility of a need to make the delivery daily, however, industrial gas can be ordered from various gas suppliers, regardless of public or private, unlike gas for transportation which is permitted to be sold only by designated business operators. In addition to having many more options of suppliers, we can also order from multiple companies at once, and keep full tanks to prepare for the expansion of demand.

By coordinating these technologies, we establish a system to deliver an appropriate amount of gas to pump stations in a timely manner, to realize the project and to give dependability of monitoring in JCM Project.

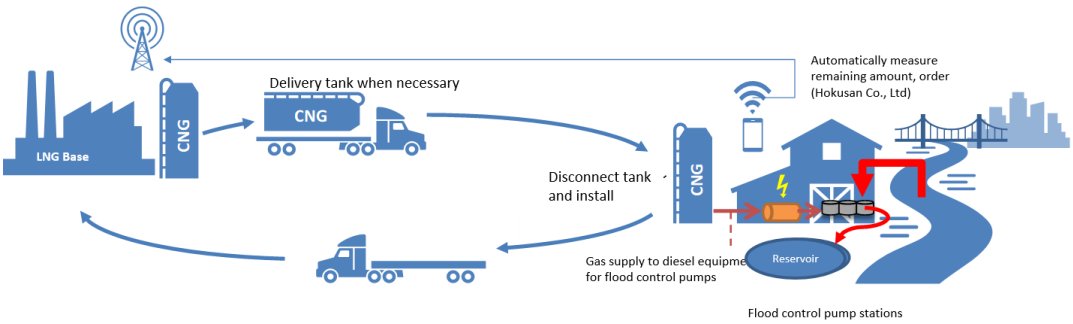


Figure 2-29 Method for supplying gas to a pump station for controlling floods in Semarang

Source: Produced by JANUS

1） Estimation of reduction of CO_2 emissions

① Overview of equipment

Through the survey last fiscal year, we found that the number of flood control pumps used in Semarang is 133 and the number of pumps operated with diesel power generators is 65, but in some cases, diesel power generators are used only when a power outage occurs, and power outages in PLN are decreasing year by year, so some pumps can be operated without relying on diesel power generators. However, diesel power generators are frequently used for 40 pumps mainly in the central pump station in Semarang, so annual fuel costs have been an issue for the public works bureau. We tried to estimate the amount of power and CO_2 emissions from fuel consumption. When fuel efficiency is assumed to be 0.3L/kWh, the figures become as follows.

Table 2-25 Reference CO_2 emissions of diesel power generators in the pump station

Fuel consumption	122,072	L/year
Fuel consumption[kl]	122.072	kl/year
Caloric value per year	5,942	GJ
Reference emission	431	t-CO_2/year
Reference emission per 15 years	6,471	t-CO_2/15 year

Source: Made by JANUS from the data provided by Semarang City

A diesel power generator has the same structure as a vehicle engine, and load is constant, so the DDF system is expected to be more effective than in the case of vehicles. Here, we estimated project emissions as follows, while assuming the same effect as that of vehicles.

The project period is set at 15 years for "internal combustion power or gas turbine power generation equipment," because the equipment that is subject to JCM is gas conversion equipment attached to a diesel engine.

Table 2-26 CO_2 emissions when DDF is adopted for diesel power generators in the pump station (project emissions)

CNG consumption	644	t/15 year
CO2 emission from CNG consumption	1,676	t-CO_2/5 years
Diesel consumption	959	kl/5 years
CO2 eimission form diesel consumption	3,389	t-CO_2/5 years
CO2 emission from DDF	5,065	t-CO_2/5 years

Source: Made by JANUS from the data provided by Semarang City

The reduction in emissions was calculated by subtracting the project emissions from the reference emissions, and it is about 1,406 t/15 years.

2） Evaluation of economical performance

① Cost for equipment installation

When we interviewed local enterprises that would refurbish the diesel power generators for pumps about costs, they answered that the cost for refurbishing a power generator would be nearly equal to that for a vehicle. The price varies according to the capacity of a storage tank, but as it is close to a diesel power generator, it is unnecessary to prepare a tank for each unit like vehicles, so it may be possible to reduce the cost. This issue needs to be discussed in detail, after checking the actual installation site, but in this survey, we discussed it while assuming that the cost is equal to the cost for DDF for vehicles.

The cost for adopting DDF is about 1 million yen/unit, so the cost for 121 pumps is 121 million yen (IDR5,398,110,661).

② Operation cost

The price of diesel fuel for the pump station is the price of industrial diesel fuel that is not covered by a subsidy, and the unit price is 11,220 rupiah/L. Since about 120,000 L is consumed per year, the annual cost is 824,528,000 rupiah or about 6.1 million yen.

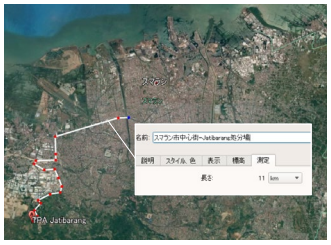
Since CNG, which would replace diesel fuel, is not for transportation, the industrial CNG price will be applied. The industrial CNG price had been higher than that for transportation, but it was decreased considerably in 2020, in accordance with the gas use promotion policy of the Ministry of Energy and Mineral Resources. The sectors covered by this policy are limited, and pump stations are not covered, but under the assumption that this policy will cover a wider range of fields and the CNG price will be about 4,000 rupiah/LSP, the investment will be recouped in about 15 years if there is no subsidy, and it will be recouped in 9 years if 40% of the cost is covered by a subsidy.

(3) Change of transportation fuel (waste collection vehicles)

There is Jatibarang Final Disposal Site in the mountainous area about 10 km from the center of Semarang, and waste is collected and transported by 105[18] waste collection vehicles from various places in the city. These vehicles make 5 runs per day, traveling 18 km on average per vehicle each way. Accordingly, the total travel distance of all vehicles is about 3.5 million km/year. These waste collection vehicles are powered by diesel fuel, so low-carbonization is expected by replacing the fuel with gas like the case of public buses.

Semarang City waste collection vehicles

Jatibarang Landfill



Distance from the city center

Figure 2-30 Waste collection vehicles and disposal sites in Semarang

Source: Produced with reference to the website of Semarang and Google Map

Figure 2-31 Waste collection area shown in the website of Cleaning Bureau of Semrang

[18] Metrosemarang, a local newspaper in Semarang, "DLH Operasikan 88 Kontainer Sampah Baru," 2018 https://metrosemarang.com/dlh-operasikan-88-kontainer-sampah-baru-54316

Source: Website of Cleaning Bureau of Semrang

All waste collection vehicles are under the control of Semarang and diesel fuel consumption is managed by the financial division of the city, so monitoring is easy. Accordingly, it is suited for JCM.

As mentioned above, it can be expected that the growth of demand for gas in Semarang through the above-mentioned fuel changeover project will contribute to the stabilization of gas supply in the "project for adopting CNG and diesel fuel co-combustion equipment for public buses in Semarang."

1） Estimation of reduction of CO_2 emissions

As mentioned above, in Semarang, 105 waste collection vehicles are in operation, travel 18 km/vehicle each way on average, and make 5 runs per day. The total travel distance of 105 vehicles is 9,450 km/day or 3,499,250 km/year. Since the emissions is nearly equal to that of medium-sized buses in the "project for adopting CNG and diesel fuel co-combustion equipment for public buses in Semarang," we used the value of medium-sized buses to estimate fuel efficiency, and the estimated fuel efficiency is 4.7 km/L.

Based on this, the current CO_2 emissions (reference emissions) was calculated as follows.

Table 2-27 Data and reference emissions

Operated vechicles	105	Vechicles
Round trip numbers	5	Round trip
Distance	18	km
Total driving distance	9,450	km/day
Total driving distance per year	3,449,250	km/year
Fuel consumption[kl]	734	kl/year
Reference	2,594	t-CO_2/year
Operated vechicles	105	Vechicles

Source: Produced by JANUS

The emissions after adoption of DDF using CNG (project emissions) is estimated to be 2,594 t-CO_2/year and 12,968 t-CO_2/5 years, as the project period is 5 years, while referring to the changeover rate, etc. in the "project for adopting CNG and diesel fuel co-combustion equipment for public buses in Semarang."

Table 2-28 Emissions after adoption of DDF (project emissions)

CNG consumption	1,330	t/5 years
CO2 emission from CNG	3,359	t-CO_2/5 years
Diesel consumption	1,922	kl/5 years
CO2 emission from diesel	6,792	t-CO_2/5 years

Peoject emission	10,151	t-CO_2/5 years

Source: Produced by JANUS

The reduction of emissions can be estimated by subtracting project emissions from reference emissions. The estimated reduction is 2,818 t-CO_2/5 years.

2） Evaluation of economical performance

① Equipment installation cost

With reference to the "project for adopting CNG and diesel fuel co-combustion equipment for public buses in Semarang," the cost for installing DDF equipment was set at about 1 million yen per unit. The total cost for refurbishing 105 units would be 105 million yen or 14,170,040,486 rupiah.

Regarding the cost effectiveness of CO_2 emissions reduction, if the equipment subsidy covers 40%, the subsidy will be about 42 million yen, and if it is divided by the CO_2 emissions reduction: 9,470 t-CO_2/5 years, we will obtain 4,435 yen.

② Operation cost

Regarding diesel fuel costs, the diesel fuel price that is not covered by a subsidy (9,500 rupiah) will be applied.

Since the current consumption is about 730,000 L per year, the fuel cost is about 51.7 million yen or 6,971,888,298 rupiah.

If it is assumed that the CNG price is 4,500 rupiah/LSP when DDF is adopted, the cost will be about 9.73 million yen or 1,314,384,415 rupiah as fuel changeover rate is 0.398%. The consumption of diesel fuel will be 0.602%, and its cost will be about 31.1 million yen.

The economic impact of the project is expected to be about 10 million yen or 1,460,427,128 rupiah per year.

While the initial investment amount is 105 million yen, the project is expected to reduce costs by about 10 million yen per year. It is expected that the investment will be recouped in about 10 years or in 6 years if the JCM equipment subsidy is granted.

When the gas infrastructure in Semarang is stabilized, it will be possible to change fuel for the above pump station and waste collection vehicles of Trans Semarang. Both projects are managed by Semarang (the bureau of public works and the bureau of the environment and forestry), so we tried to exchange opinions about concrete strategies for proceeding with the projects. On the other hand, the development planning agency, which coordinates intercity collaboration projects in Semarang, mentioned that it is necessary to stabilize the supply fuel in the public bus project of Trans Semarang when giving explanations to related sections, including the city assembly.

As the city finance worsened due to the spread of COVID-19, we would like to first concentrate on solving problems with the supply infrastructure.

(4) Discussion on adoption of NOx reduction equipment in the fuel changeover project

Both Semarang and Bali have environmental issues, including the reduction of greenhouse gas emissions for decarbonization, atmospheric pollution, water pollution, and waste management. In the intercity collaboration project, they requested Toyama City to also support measures other than decarbonization.

Every time we hold a discussion, they mentioned the worsening of atmospheric pollution, so we discussed co-benefit approaches as well as decarbonization measures.

Among air pollutants, the emitted substance closely related to this survey is nitrogen oxide (NOx). When fuel, such as petroleum, is combusted, the nitrogen (N) included in the fuel binds to the oxygen (O) in the atmosphere. The nitrogen oxide derived from fuel is called fuel NOx. In addition, when fuel or the like is combusted at a high temperature, the nitrogen in the air reacts with the oxygen in the atmosphere, and produces NOx, which is called thermal NOx.

When fuel or the like is combusted in boilers (which combust heavy oil and city gas) at factories and workplaces, automotive engines (which combust gasoline and light oil), etc., NOx is inevitably produced, and the amount of NOx produced is considered to increase as the combustion temperature is higher.

In Japan, strict environmental regulations are imposed on diesel vehicles, such as heavy-duty trucks and large-sized buses, because they emit a large volume of harmful gases that cause atmospheric pollution. According to these regulations, it is necessary to reduce particulate matter (PM) and nitrogen oxide (NOx). These two substances have a trade-off relationship, so that if one of them is reduced, the other increases. Accordingly, Nissan Diesel Kogyo, etc. are developing a system for selective catalytic reduction (SCR) of urea, based on the strategy of decomposing NOx selectively and discharging nitrogen gas (N_2) with purification equipment while inhibiting the production of PM by combusting fuel at a high temperature.

For “SCR of urea,” methods for effectively inducting “a selective reduction reaction” by adding urea solution (AdBlue: a trademark of the German Association of the Automotive Industry) have been researched, and at present, the emission of NOx is curbed significantly in Japan.

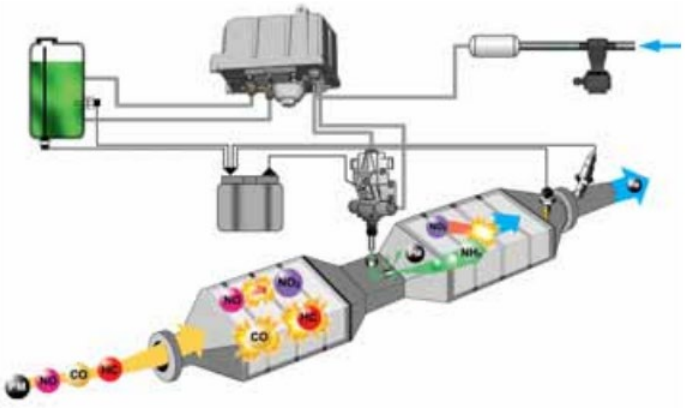


Figure 2-32 System for SCR of urea

Source: METI report of the conference on the distribution and future outlook of clean diesel vehicles

The system for urea SCR has the same mechanism as ammonia denitration adopted in large plants, such as power plants. Ammonia is difficult to handle, so the ammonia precursor is used for

automobiles. In the urea SCR system, the urea solution is sprayed into the exhaust gas, to produce ammonia and induce a reaction between ammonia and NOx to transform it into water and nitrogen, which are harmless.

According to the interview with Trans Semarang, the installation of such equipment did not progress in Indonesia. We received a comment that they want to use it for improving atmospheric pollution, but it is necessary to establish infrastructure for supplying the urea solution.

In 2021, China stopped exporting urea, the supply of urea is insufficient in South Korea, etc. and the insufficiency of the urea solution is an issue also in Japan. On the other hand, Indonesia is a country producing ammonia, which is a raw material for the urea solution, and there is a plan to export it to South Korea, which is suffering the shortage of the urea solution.

From the viewpoint of decarbonization, the urea SCR system does not directly lead to the reduction of greenhouse gas emissions, but from the viewpoint of the above-mentioned co-benefit approach, we will propose that the system should be installed while changing fuel to contribute to the improvement of atmospheric pollution, and plan to discuss proposed technologies for improving the environment as well as decarbonization in cooperation with Trans Semarang.

2.3.3. Discussion on the commercialization of installation of solar power generation equipment

The City of Semarang has measures for promoting the distribution of renewable energy, and Central Java set a goal of increasing the ratio of reneable energy to 21% by 2025.

Th City of Semarang, too, has an interest in the adoption of solar power generation. Before the spread of COVID-19, there was a commercialization plan utilizing the JCM equipment subsidy project for installing solar panels in the city halld.

As mentioned above, the spread of COVID-19 forced them to revise the municipal budget, suspending their project, and the situation was unchanged in 2021. Under these circumstances, we researched to check whether there is room for cooperation in other projects.

The development planning agency of Semarang suggested the cooperation with BPS, which is a public construction company in Semarang, from the vewpoint of finding existing projects and collaborative projects. Then, we exchanged opinions with Nihon Kucho Hokuriku Co., Ltd. in Toyama City about the situation of the solar power project in Semarange and the possibility of collaboration.

At the beginning of the session for exchanging opinions, BPS explained that the current problem with solar power generation is the fact that owners cannot prepare the funds for initial investment in most cases.

When we discussed the Japanese PPA system and the progress of adoption of PPA in Indonesia, it was mentioned that if this system is established there, owners will probably get interested in it.

It was found that the owners who are interested in the adoption of solar power generation in Semarang include hospitals and schools. From hospitals, there are needs for improving the efficiency of heating and air-conditioning, and there is room for proposing it with the energy saving technology

of Nihon Kucho Hokuriku.

Regarding schools, the average scale is about 10 kWp. The City of Semarang is discussing the distribution of solar power generation, and it was recommended that equipment should be installed at one spot for demonstration for promotion rather than business for earning revenues. In order to discuss more details, including this point, we have requested the list of recommended sites.

Another candidate is a project for streetlights in Semarang. The City of Semarang has a plan to install 70,000 new streetlights, but if they receive power from the grid, the operation cost may become an issue, so they hope to compare estimated costs between the power grid and solar power generation.

Nihon Kucho Hokuriku provided the following information on streetlights powered by solar storage batteries, and informed them that the Japanese side could discuss this matter and support them. We interviewed them about expected illumination, budget, etc. in detail, and confirmed the steps for supporting price comparison, etc.

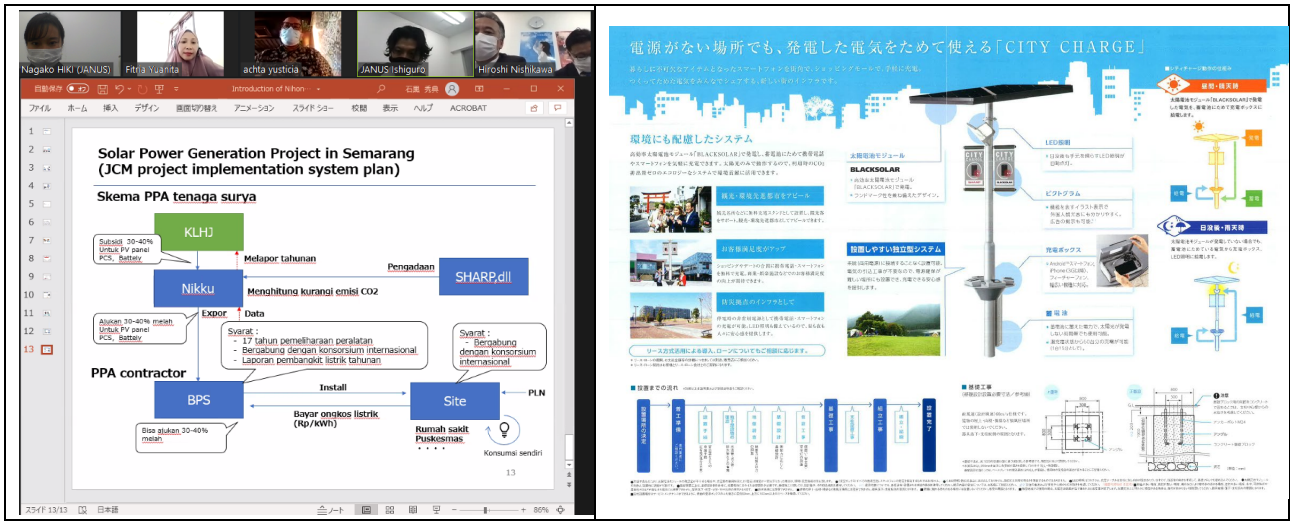


Figure 2-33 Exchange of opinions with BPS (left) and streetlights powered by solar storage batteries Nihon Kucho Hokuriku could provide

3. Establishment of a Project Implementation Structure

3.1. Bali

3.1.1. Transportation Fuel Changeover

(1) **Gas Changeover Project**

With regard to the Gas Changeover Project in Bali we have discussed, we discussed a system for building an international consortium formed by Pertamina Gas, a gas provider, Hokusan, a technology provider, and Trans Metro Dewata, a gas user and the public bus transportation business operator, or the City of Denpasar which runs waste collection vehicles, for a project implementation structure with a gas supply chain as a base.

Regarding the gas supply chain, under the condition that a unit price will be agreed with and a long-term contract will be signed for a fixed amount of gas, as described in Section 2.2.2, we can work with Pertamina Gas to invest in systems required for supply (CNG station, transportation vehicles, LNG satellites etc.) and evaluate it. The schematic diagram of the project implementation structure is shown in the figure below.

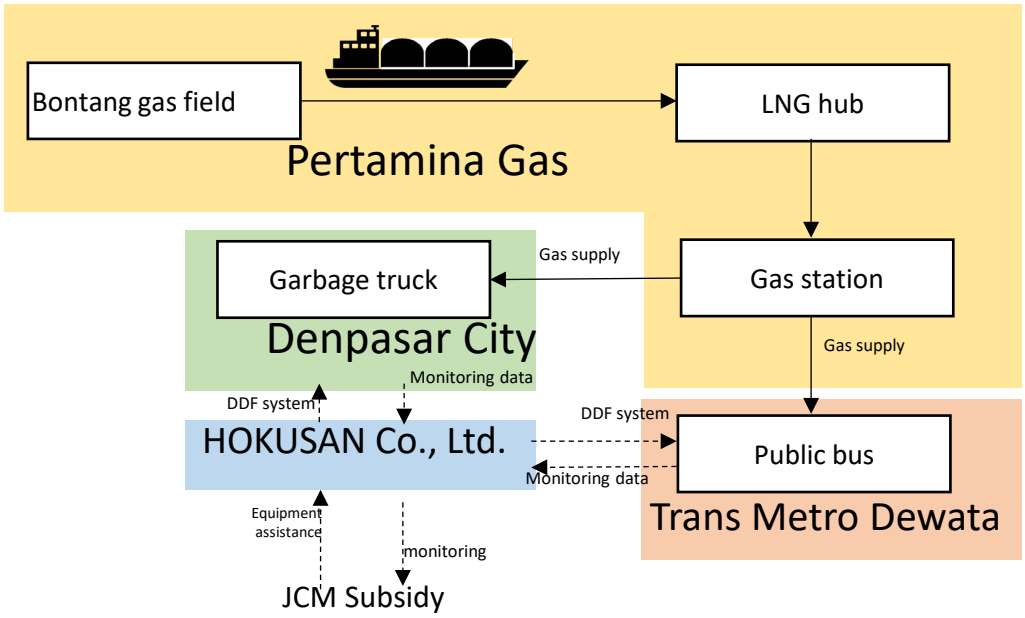


Figure 3-1 Project Implementation Structure (Fuel Changeover in Bali)

Source: Created by JANUS

(2) **Hydrogen Utilization Project**

As described in Section 2.2.2, the production and utilization of hydrogen generated from electrolysis using renewable energy is catching a high level of interest. As this item is also related to the solar power use discussed in the following section, the proposed system will be discussed in Section 3.1.2.

3.1.2. Operationalization of Solar Power Generation Adoption

Current development status of the solar power generation project in Bali indicates the project is still to be developed and detailed steps for the project are still uncertain, although the FIT system and the PPA model similar to a solar power purchase agreement are in the process of institutionalization.

Amid this situation, there is a concern that generated power may not be fully utilized, as output is curbed by system constraints. So, we discussed going independent from the grid, storing energy by creating hydrogen from water electrolysis, and utilizing it to supply the energy via fuel cells and to utilize it for transportation.

In this pattern, Nihon Kucho Hokuriku Co., Ltd., a solar power generation technology provider, and Hokusan, a provider of technology related to the use of hydrogen, will work together to form an international consortium with owners of buildings where solar panels would be installed.

In Indonesia, a license as a local company is required for procuring, installing, and constructing solar power generation systems, and each system has requirements, such as in-house production ratio. Neither Nihon Kucho Hokuriku nor Hokusan has any business licenses in Indonesia at the moment, therefore, a partnership with a local construction company is imperative. As such, we are considering working with JGC Indonesia (JGC Group), a Japanese company. This company is qualified for various construction works, constructions, and bidding in Indonesia, and we can establish a system in which Nihon Kucho Hokuriku and Hokusan are in charge of designing, managing, and overseeing the project as supervisors, and with JGC Indonesia responsible for the construction.

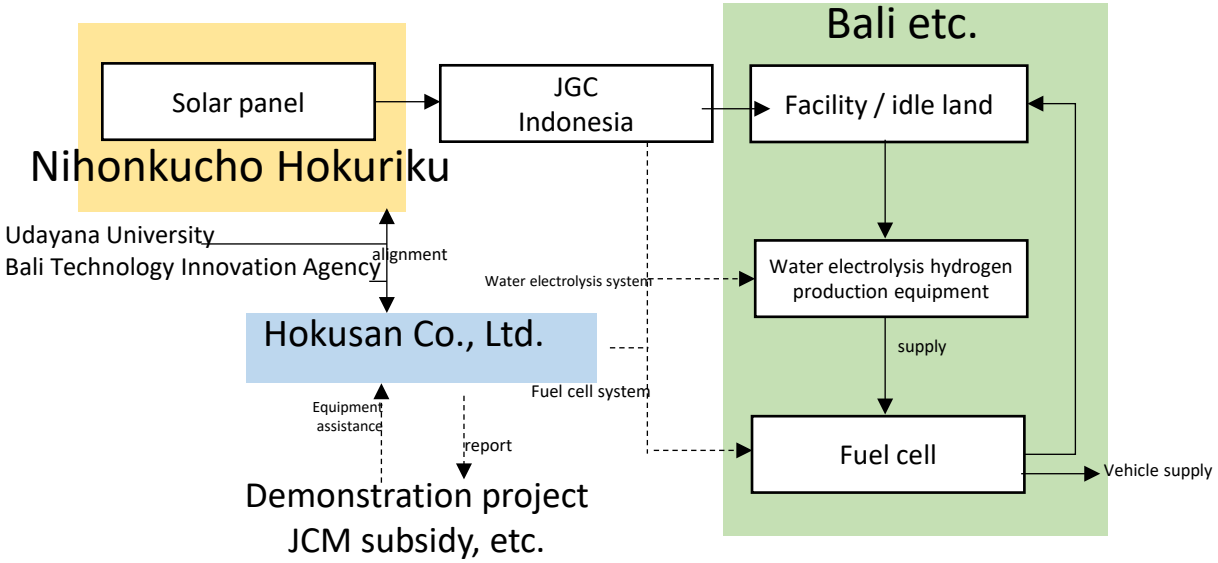


Figure 3-2 Project Implementation Structure (Bali Solar Power Adoption Project)

Source: Created by JANUS

3.2. Semarang City

3.2.1. Fuel Changeover

(1) Flood Control Pump Fuel Changeover

Semarang City Department of Public Works manages and operates a project for flood control pumps, and it works with Hokusan, a technology provider, as a representative business entity to form an international consortium. On the other hand, in terms of striving to stabilize gas supply, it is preferable to add a gas supply company (Pertamina Gas Niaga for Semarang City) to the consortium to build a more robust system.

As the flood control pumps are operated depending on the needs when a flood occurs, instead of a regular use of fuel, it is necessary to always keep a certain amount of fuel. As such, it is suitable to have CNG transportation trucks carry container-type tanks and replace them based on the usage. For managing such gas fuel usage and the residual amount, the know-how of Hokusan Co., Ltd. is indispensable. The implementation structure is shown in the figure below.

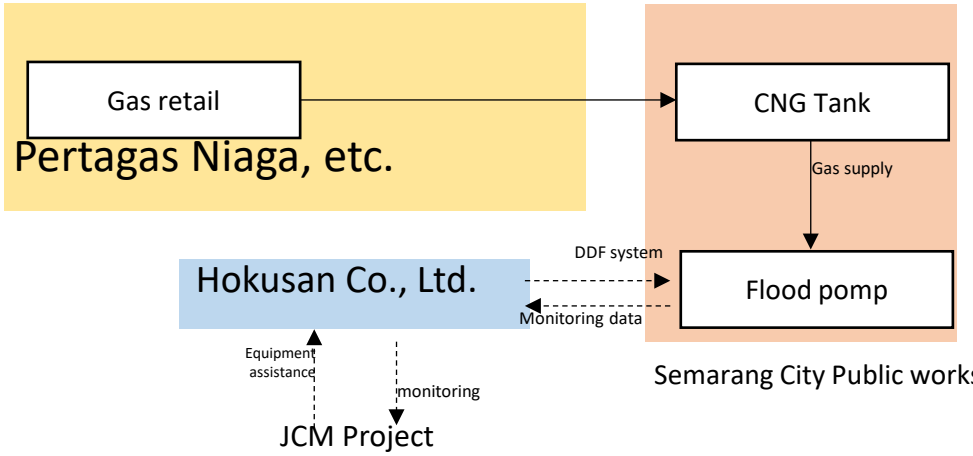


Figure 3-3 Project Implementation Structure (Semarang Flood Control Pump Fuel Changeover)

Source: Created by JANUS

(2) **Waste Collection Vehicles**

Waste collection vehicles are managed and operated by the Semarang City Environment Agency. This system will form an international consortium involving the Environment Agency, with the technology supplier Hokusan as a representative business entity. A proposed implementation structure is shown in the figure below.

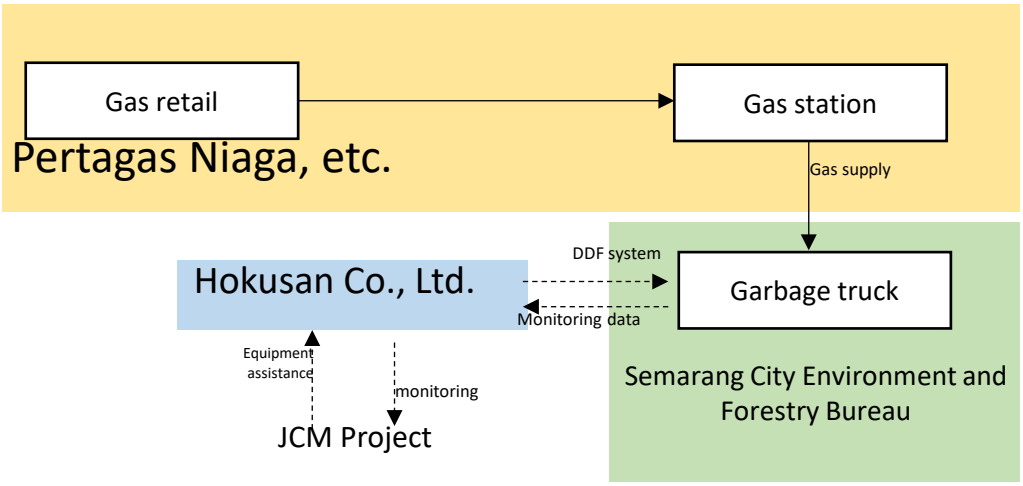


Figure 3-4 Project Implementation Structure (Semarang Waste Collection Vehicle Fuel Changeover)

Source: Created by JANUS

(3) Solar Power Generation Project

Based on the discussion with a public company BPS of Semarang City, we will discuss an implementation structure for the Semarang City streetlight improvement project as part of a solar power generation project. We envision that Nihon Kucho Hokuriku becomes a representative business entity, and with BPS as its business partner, to provide a proposal by bidding for projects of Semarang City.

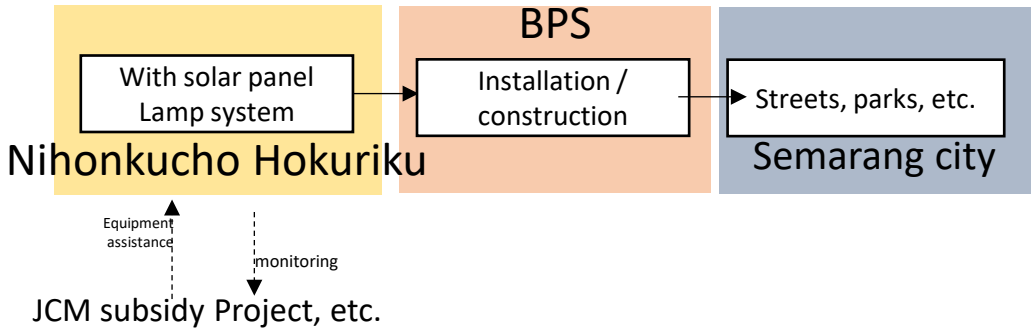


Figure 3-5 Project Implementation Structure (Semarang Solar Streetlight Installation Project)

Source: Created by JANUS

4. Intercity collaborations to realize a low-carbon society (discussions with local stakeholders)

As in the previous fiscal year, this fiscal year's intercity collaboration projects were carried out in the environment where field surveys and invitations were not possible due to the COVID-19. With the understanding of local stakeholders gained through explaining the contents of our surveys and the status of our programs via remote meetings and e-mails, and also with the help of the local government of Bali Province, the government officials of Semarang City, Pertamina, related central governments, and the Embassy of Indonesia in Japan, we have been able to continue collecting and examining the information.

Below is the summary of our activities.

Table 4-1 Activities in the current project

Date	Activity	Participating organizations
7/4/2021	Discussion with Pertamina Gas	Pertamina Gas, JGC Indonesia, JANUS
1/7/2021	Discussion with Pertamina Gas	Pertamina Gas, JGC Indonesia, JANUS
24/8/2021	Policy discussion with Bali	ESDM Bali, JANUS
6/9/2021	Policy discussion with Toyama City	Toyama city、JANUS
24/9/2021	Semarang City Fuel Conversion Business Policy Meeting	Toyama city、Semarang city、Trans Semarang、Hokusan、JANUS
30/9/2021	Intercity collaboration business kick-off meeting	MoEJ、Toyama city、HOKUSAN、Nippon Kucho Hokuriku、JANUS
5/10/2021	Exchange of opinions with the Embassy of Indonesia in Japan	Embassy of Indonesia、Toyama city、北酸、JANUS
7/10/2021	Kick-off / hydrogen utilization review meeting with Bali	Toyama city、ESDM Bali、BAPPENAS、Persada Bali JGC Indonesia、JANUS
25/10/2021	Kick-off meeting with Semarang city	Semarang city、Toyama city、HOKUSAN、JGC Indonesia、JANUS
5/11/2021	Exchange of opinions with the Embassy of Indonesia in Japan	Embassy of Indonesia、Toyama city、HOKUSAN、JANUS
16/11/2021	Semarang project Policy Meeting	Toyama city、HOKUSAN、JANUS
25/11/2021	Semarang City Solar Business Review	PT.BPS、Nippon Kucho

		Hokuriku、JANUS
3/12/2021	Hydrogen Seminar Planning Conference in Bali	Embassy of Indonesia、Toyama city、ESDM Bali、Udayana Univ、BRIN Bali、JANUS
16/12/2021	Hydrogen Seminar Preparatory Meeting in Bali	Toyama city、Hokusan、JANUS
22/12/2021	Hydrogen Seminar Preparatory Meeting in Bali	Embassy of Indonesia、Toyama city、Hokusan、JANUS
19/1/2022	Semarang City Gas Fuel Conversion Business discussion	Toyama city、Semarang city、Trans Semarang、Hokusan、JANUS
27/1/2022	Policy discussion with Semarang city	Toyama city、Semarang city、Trans Semarang、Hokusan、JANUS
31/1/2022	Toyama-Bali Hydrogen Seminar	Embassy of Indonesia、Bali、Toyama city、Hokusan、JANUS

Source: created by JANUS

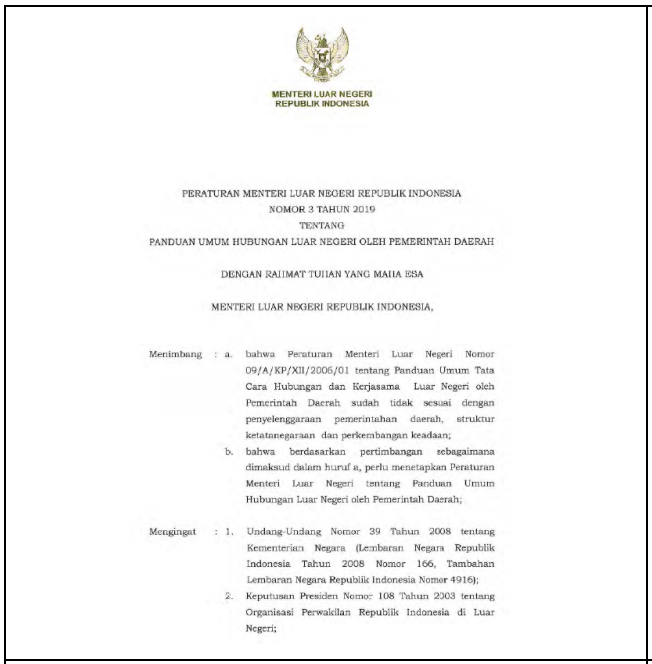
4.1. Topics discussed with Bali Province & Semarang

Through three official and multiple informal consultations, we have been working with the Province of Bali on various activities concerning our intercity collaboration project including the implementation policy consultation, exchange of opinions, policy consultations on countermeasures, and preparation for holding seminars.

The main topics that came up in the consultations were as follows:

(1) **Signing of MoU and Collaboration Framework**

During this fiscal year's project implementation, we were consulted by the Province of Bali regarding the MoU as the basis of our collaborations. Having concluded a partnership agreement, Bali Province and Toyama City had already been working together based on this agreement, but we were informed that because of the two new laws – the "Decree of the Minister for Foreign Affairs on Cooperation with Foreign Countries by Local Governments" (No.3 of 2019) and the "Decree of the Interior Minister on Cooperation Procedures with Overseas Regions and Institutions by Local Governments" (No. 25 of 2020) – they were obliged to follow the decrees in concluding the MoU, and submit business plans detailing cooperation contents, etc.



MENTERI LUAR NEGERI
REPUBLIK INDONESIA

PERATURAN MENTERI LUAR NEGERI REPUBLIK INDONESIA
NOMOR 3 TAHUN 2019
TENTANG
PANDUAN UMUM HUBUNGAN LUAR NEGERI OLEH PEMERINTAH DAERAH

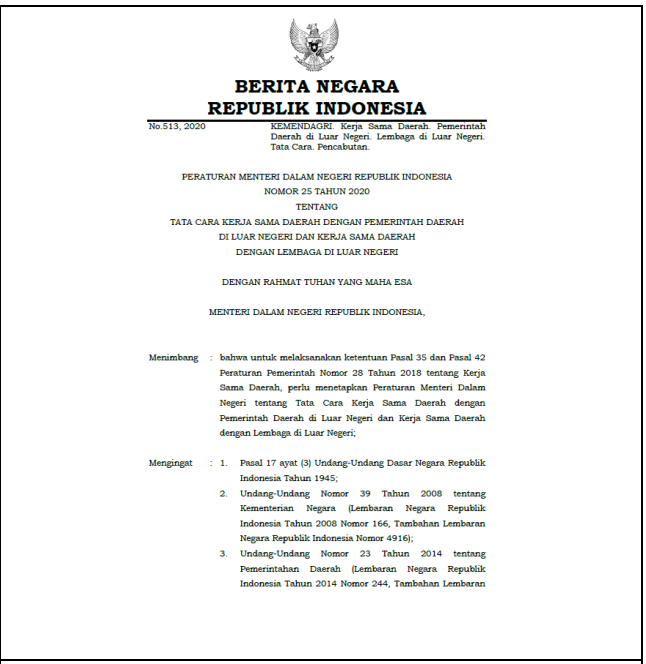
DENGAN RAHMAT TUHAN YANG MAHA ESA

MENTERI LUAR NEGERI REPUBLIK INDONESIA,

Menimbang : a. bahwa Peraturan Menteri Luar Negeri Nomor 09/A/KP/XII/2006/01 tentang Panduan Umum Tata Cara Hubungan dan Kerjasama Luar Negeri oleh Pemerintah Daerah sudah tidak sesuai dengan penyelenggaraan pemerintahan daerah, struktur ketatanegaraan dan perkembangan keadaan;
b. bahwa berdasarkan pertimbangan sebagaimana dimaksud dalam huruf a, perlu menetapkan Peraturan Menteri Luar Negeri tentang Panduan Umum Hubungan Luar Negeri oleh Pemerintah Daerah;

Mengingat : 1. Undang-Undang Nomor 39 Tahun 2008 tentang Kementerian Negara (Lembaran Negara Republik Indonesia Tahun 2008 Nomor 166, Tambahan Lembaran Negara Republik Indonesia Nomor 4916);
2. Keputusan Presiden Nomor 108 Tahun 2003 tentang Organisasi Perwakilan Republik Indonesia di Luar Negeri;

Regulation of Foreign Minister's Ordinance (Cover)



BERITA NEGARA
REPUBLIK INDONESIA

No.513, 2020 KEMENDAGRI. Kerja Sama Daerah. Pemerintah Daerah di Luar Negeri. Lembaga di Luar Negeri. Tata Cara. Pencabutan.

PERATURAN MENTERI DALAM NEGERI REPUBLIK INDONESIA
NOMOR 25 TAHUN 2020
TENTANG
TATA CARA KERJA SAMA DAERAH DENGAN PEMERINTAH DAERAH
DI LUAR NEGERI DAN KERJA SAMA DAERAH
DENGAN LEMBAGA DI LUAR NEGERI

DENGAN RAHMAT TUHAN YANG MAHA ESA

MENTERI DALAM NEGERI REPUBLIK INDONESIA,

Menimbang : bahwa untuk melaksanakan ketentuan Pasal 35 dan Pasal 42 Peraturan Pemerintah Nomor 28 Tahun 2018 tentang Kerja Sama Daerah, perlu menetapkan Peraturan Menteri Dalam Negeri tentang Tata Cara Kerja Sama Daerah dengan Pemerintah Daerah di Luar Negeri dan Kerja Sama Daerah dengan Lembaga di Luar Negeri;

Mengingat : 1. Pasal 17 ayat (3) Undang-Undang Dasar Negara Republik Indonesia Tahun 1945;
2. Undang-Undang Nomor 39 Tahun 2008 tentang Kementerian Negara (Lembaran Negara Republik Indonesia Tahun 2008 Nomor 166, Tambahan Lembaran Negara Republik Indonesia Nomor 4916);
3. Undang-Undang Nomor 23 Tahun 2014 tentang Pemerintahan Daerah (Lembaran Negara Republik Indonesia Tahun 2014 Nomor 244, Tambahan Lembaran

Regulation of Minister of Interior Ordinance (Cover)

Figure 4-1 Ministerial decrees requiring responses as part of intercity collaborations

Consequently, we carried out the procedures to update the MoU in cooperation with Toyama City, and a letter has been recently sent to the Governor of Bali Province.

(2) **Framework for hydrogen business promotion**

Regarding the deployment of hydrogen utilization technology, it is also increasingly adopted in various places in Japan as a useful decarbonization technology, but its economic costs remain an issue. As the same problem was clearly anticipated, when introducing the technology to Bali Province, it was decided that it was best to endeavor to build a demo-plant for demonstration and/or research first so that we can continue to organize the issues of popularizing the technology and propose new strategies. For this reason, we cooperated with the University of Udayana, a national university of Bali Province, as well as the Bali Province Technological Innovation Agency and agreed on the policies to keep organizing our research topics.

Figure 4-2　Meeting with the University of Udayana and the Bali Province Technological Innovation Agency

(3) **JCM Webinar**

The Global Environment Center, which is also a JCM facility subsidy project executing organization, holds JCM seminars designed for Indonesia every year with the aim of promoting understanding of the JCM funding projects. The 2021 seminars were again delivered in the webinar format. In addition to the conventional JCM facility subsidy projects, we received a request to present the intercity collaboration project "SDGs Future City Construction Support Project Utilizing Intercity Collaboration Project in Toyama City, Bali Province & Semarang City", alongside "Decarbonization Technology Creation and Dissemination Project through Co-Innovation" and "Hydrogen Production and Utilization Third Country Collaboration Project." This reports on the contents of activities. The materials used for the webinar are shown in the attached materials.

(4) **Online Tours**

With the cooperation of HIS (a leading travel agency), we hosted an online tour with the aim of sharing the concrete images relating to the exit strategies with the stakeholders by showing around the actual facilities (online), while introducing Toyama City's compact city strategy initiatives at the same time.

This event was shared with the other intercity collaboration project partners of Toyama City together with Japan NUS Co., Ltd., – Male City, Maldives; Iskandar and Kota Kinabalu City, Malaysia – and also attended by Semarang City and Bali Province.

1.　Summary

Date & Time: December 9, 2021, 16:00-18:00 (Japan time)
Attending Regions: Indonesia – Semarang City, Bali Province
Malaysia – Iskandar Region, Kota Kinabalu
Maldives – Male City
Format: Online (Zoom)
Objectives: An online tour was held for the guests from Indonesia, Malaysia, and the Maldives – the intercity collaboration project partners of Toyama City – to deepen the understanding of Toyama

City's environmental technology, explore further collaboration possibilities, and promote further communication between the cities by introducing Toyama City's environmental technologies and encouraging the exchanges of opinions.

2. Attendees

Japan NUS Co., Ltd. invited the stakeholders of the following three projects carried out in 2021.

・SDGs Future City Development Support Project Utilizing an Intercity Collaboration Project in Toyama City, Bali Province & Semarang City

・Decarbonized the Urban Development Project by Popularizing Decarbonized Transportation and Renewable Energy Using Biofuel

・ Toyama-Male Intercity Collaboration to Support the Development of Sustainable, Environmentally-Friendly Cities (Smart Cities)

The registrants were as shown in the table below (35 persons). As we adopted the format that allowed participation without registering, about 50 people including the registrants below attended.

【Indonesia】

Institution	Name
The National Research and Innovation Agency	Nizam Ghazali Eng. Sarjono M.Eng.
BLU UPTD TRANS SEMARANG	IKA PERMATASARI
Perusahaan Daerah Provinsi Bali	Ida Bagus Dwija Bhaskara
Department of Man Power and Energy Mineral Resources, Gov of Bali Province	Ida Bagus Setiawan

【Malaysia】

Institution	Name
Iskandar Regional Development Authority (IRDA)	ONG HWA CHONG Muhamad Nizam
Borneo Organisation Ltd	Boyd D Jouman
Kg. Kobuni Inanam	Emalia Rabin
Kota Kinabalu City Hall	Linda Manahan Tantinny Fung fauziahton ag samad
SESB	Adznina Eberahim MOHD AFIF BIN YUNUS

Dewan Bandaraya Kota Kinabalu	Jack Lo Linda Manahan

【Maldives】

Institution	Name
Housing Development Corporation Ltd	Ibrahim Naushad Ali Ahmed Shahud Zuhair
GeoTech Maldives	Mohamed Shumais Mahmood.riyaz
STELCO	Hassan Hasin Hussain
Maldives National University	Zeeniya Kamil Wadheea Thoufeeq
Male' Water & Sewerage Company pvt ltd.	Abdul Hameed Hussain Muhsina Mohamed

【Japan】

Institution	Name
JGC Holdings Corporation Jakarta Office	Hideaki Tanaka
Sato Kogyo Co., Ltd.	Osamu Hasegawa Kan Imai
Hitachi Zosen Corporation	Taiyo Miyagi
Kawada Industries, Inc.	Taro Kawada Yasuyuki Ooka
JETRO Toyama	Daisuke Takamura
Hokuden Engineering Consultants Co., Ltd.	Norifumi Emoto
Nippon Engineering Consultants Co., Ltd.	Gentaro Nagasawa

3. Schedule

On the day, we introduced Toyama City's environmental technologies using the videos taken in advance and exchanged opinions on each theme. The timetable was as below.

Time (JST)	Contents	Speaker
16:00	Event Purpose Explanation	JANUS
16:10	Greetings from the Ministry of the Environment	Yosuke Inoue, Strategy Office for International Collaborations & Environmental Infrastructure, International Cooperation Division, Ministry of the Environment
16:15	Opening remarks (pre-recorded)	Hirohisa Fujii, Mayor of Toyama City
16:20	*To Achieve global Carbon Neutrality* - International Cooperation (pre-recorded)	
16:30	Introduction to LRT (pre-recorded)	
16:35	Q&A	All
16:45	Introduction to solar power plants & construction site of water supply and sewage sanitation facilities (Nihon Kucho Hokuriku Ltd.) (pre-recorded)	
16:50	Q&A	All
17:00	Introduction to Hydrogen Stations (Hokusan Co., Ltd.) (pre-recorded)	
17:05	Q&A	All
17:15	Introduction to small hydroelectric power plant (Josai Park, Higashimachi, Higashi-Shinmachi Community Center Small Hydroelectric Power Plant) (pre-recorded)	
17:20	Q&A	All
17:30	Introduction to food recycling facilities (Toyama Green Food Recycle Ltd.)	
17:35	Q&A	All
17:45	Comments from each region	Attendees from all regions (Male, Bali, Semarang, Iskandar & Kota Kinabalu)

18:00	Closing remarks	Kobayashi, Chief of Toyama City’s Environmental Policy Division, Department of Environment

4. Q&A

4.1. Introduction to LRT (public transport)

- Kamisah (IRDA): What are Toyama City's policies for introducing the LRT? When setting it up in Malaysia, I feel the lack of policies there would make it difficult to combine it with existing means of transportation such as automobiles. If it could be incorporated into Malaysia, what kind of policy would be useful? Please also tell us about your existing results in Malaysia.
  - Kobayashi (Toyama City): Toyama City has the compact city policy which aims to increase the population by revitalizing public transport. We have to decide our policy measures in anticipation of the city’s future issues of aging and the declining population. For more details, I would like to discuss more about this when we talk about the intercity collaboration project with Malaysia.
  - Kamisah (IRDA): We in Malaysia are also elaborating on numerous policies and we feel that Toyama’s policies will help us.
- Mahmood Riyaz (Geotech Maldives): How much does it cost to use the bicycle-sharing scheme?
  - Kobayashi (Toyama City): If you use it for 30 min or less, you can use it with the registration fee only, which is ¥500 per month.
- Betty: What percentage of the Toyama City’s population use LRT?
  - Ran out of time, so the answer was promised to be forwarded at a later date.
  - The following answer was relayed to the registrants at a later date.

    “The average daily number of users of trams (total route length: approx. 15 km) was as follows in terms of the percentage per population of Toyama City:

    ・FY 2019 – approx. 4.8%

    ・FY 2020 – approx. 3.7%

Incidentally, FY 2020 saw a decrease in the number of users due to the effects of COVID-19.

- Kamisah (IRDA): Who operates the bike-sharing scheme (private sector, bus companies, city authority, etc.)?
  - Ran out of time, so the answer was promised to be forwarded at a later date.
  - The following answer was relayed to the registrants at a later date.

    “It is operated by a private business operator. Toyama City provides support from the side by subsidizing the maintenance of the hardware (setting up cycle stations).”

4.2. Introduction to solar power plants & construction sites of water supply and sewage sanitation facilities (Nihon Kucho Hokuriku Ltd.)

- Kamisah (IRDA): Are there any criteria for solar panel installation?
  - Nishikawa (Nihon Kucho Hokuriku): As long as there is sunlight, there’s no problem in

terms of where you install them. In many places, the panels are installed on the rooftop and vacant lots. Also, it's better if they are close to where the electricity is used.

- Kamisah (IRDA): How far away do they have to be from the buildings? What's the appropriate distance to be economically viable?
- Nishikawa (Nihon Kucho Hokuriku): Within the same building grounds would be the best.
- Kamisah (IRDA): Back in Malaysia, we do have some surplus pieces of land on the premises as well, so it would be great if we could use them in that way.
- Nishikawa (Nihon Kucho Hokuriku): Please let us know: if you can give us the information about this location, we can do the simulation into the amount of power generated, etc.

- Ong (IRDA): In the case of rooftop solar panels, how much space do you need to install them? And how much would that cost?
  - Nishikawa (Nihon Kucho Hokuriku): Their sizes really vary, so I'm sure you can find what's suitable for you. The price also varies depending on the location, so please let us know the information about the installation location.

4.3. Introduction to Hydrogen Stations (Hokusan Co., Ltd.)

- Jacklo (Kota Kinabalu): The project to utilize hydrogen as the fuel for automobiles is also ongoing in Malaysia, but it is not progressing there due to the problem that the filling equipment ends up becoming rather large. Was there any assistance from the government for the use of hydrogen in Toyama City?
  - Kurokawa (Hokusan): Regarding the installation of the two hydrogen stations, the Hydrogen Station Toyama received subsidies from METI and Toyama City, and the renewable hydrogen station (H2OneST unit) was assisted by MOE and Toyama City.
- Kamisah (IRDA): Are there any safety issues in using hydrogen?
  - Kurokawa (Hokusan): In Japan, it is installed in accordance with the High-Pressure Gas Safety Act. This law is extremely strict and maintenance has to be carried out once every three days to ensure safety.
- Kouju (SESB): Please tell us about the cost of producing hydrogen from sunlight.
  - Kurokawa (Hokusan): It would be rather difficult to say because it all depends on the location of the solar panel, the installation cost, and the sunshine conditions. In Japan, it is about the same price as gasoline.
- IDA AYU: When using hydrogen in automobiles, do you have to convert the vehicles? If there are specifications or the like for conversion, could you tell us about them?
  - Wakagi (Hokusan): It is difficult to convert vehicles to allow hydrogen to be mixed into combustion. You need purpose-built hydrogen vehicles from the beginning.

4.4. Introduction to small hydroelectric power plants (Josai Park, Higashimachi, Higashi-Shinmachi Community Center Small Hydroelectric Power Plant)

- Kouju (SESB): What is the energy price generated from a small hydroelectric power generation facility when FIT is taken into account?

- Ishiguro (JANUS): It is about 0.30 USD/kW.

- Kamisah (IRDA): You need flowing water to build hydroelectric power generation facilities. We have this location where water wells up and flows into the land. In such a case, do you think it's possible to set up a hydroelectric power generation facility by doing some construction work first?
  - Ishiguro (JANUS): The requirements for hydroelectric power generation are determined by the combination of the drop × flow rate × gravitational acceleration. So, I would imagine it's possible to build one there by creating this drop through some engineering work. We'll look at your site carefully and draw a suitable plan.
  - Kamisah (IRDA): Water is naturally flowing out from a higher ground, and the surrounding area is already earmarked for agriculture (planning stage).
  - Ishiguro (JANUS): Agriculture using irrigation channels is also popular in Toyama City, so we would love to show you some of our examples. This is also the theme linked to the SDGs.

4.5. Introduction to food recycling facilities (Toyama Green Food Recycle Ltd.)

- Jacklo (Kota Kinabalu): Are there any examples of utilizing gas that was generated from sewage?
  - Kobayashi (Toyama City): We have one in which the power is generated by utilizing the gas from the sewage water in the sewage treatment plant within the perimeter of Toyama City.

4.6. Comments from each region

- Luthfi (Semarang City): Since the mayors of Toyama City and Semarang City signed an agreement in 2011, we have carried out numerous different activities. In 2018, with the assistance of the Ministry of the Environment through the JCM project, we were able to convert our public buses to DDF, with the help from Toyama City and Hokusan. Initially, it was 72 buses, now we have 235. A new CNG station is due to be completed at around the beginning of next year, and five mobile CNG stations will also be installed. We will continue to bring in various renewable energy technologies to promote the renewable energy further in Semarang City.
- Kamisah (IRDA): We have been conducting intercity collaboration projects with Toyama City since 2020. We were introduced to various low-carbon technologies and are currently focusing on bus (BRT) conversion projects. At IRDA, we also have our own policies, but the reality is that we have not been particularly successful in actually implementing our policies, so we would like to learn from Toyama's policies. I was also very interested by those small hydroelectric generators. We are currently looking to turning a 310-acre piece of land into agricultural land, and we would like to consider the system combining the agricultural irrigation and small hydropower. Today's online tour was very helpful.
- Jacklo (Kota Kinabalu): The mayor of Kota Kinabalu is also proud of our intercity collaboration project. Kota Kinabalu City is located in the State of Sabah, which is rich in water resources, and we are blessed with the long daylight hours, so we want to use our natural resources wisely

to promote the spread of renewable energy.

- Ibrahim (Maldives HDC): We have been conducting intercity collaboration projects in cooperation with JANUS since 2020. In November 2020, JANUS members visited the Maldives to exchange opinions and we have been working on the concrete reviews on introducing the technologies. We are interested in various technologies such as public transportation and waste recycling systems shown today, and we would like to consider bringing in those technologies that suits the Maldives.

4.7. Additional questions

- Jacklo (Kota Kinabalu): There are always costs to carry out any project. Are there any Japanese government subsidies that can be used to implement projects in Kota Kinabalu City?
  - Ishiguro (JANUS): As a beneficiary of the intercity collaboration project, it is probably possible to utilize the JCM facility subsidy project. It might also be possible to access various budgets of the Japanese government. Let's keep thinking about the budget that matches the contents of our projects.
- Trans Semarang: How can the waste separation system be improved?
  - Kobayashi (Toyama City): You need to do two things for waste separation: creating separation rules and establishing the facilities to handle the separated waste. Waste separation works when you can manage both well.

5. Scenes on that day

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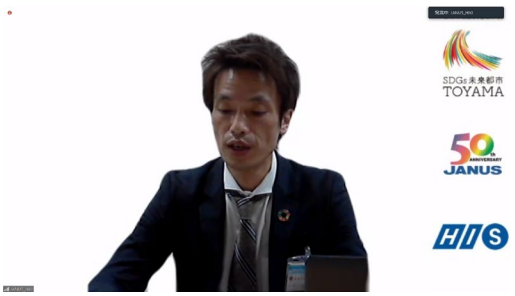
<tr><td> 
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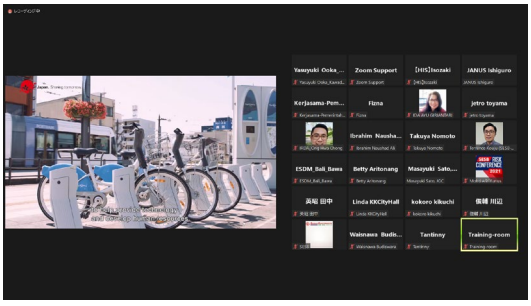
<tr><td>Toyama city Opening remarks</td><td>Greeting form Mayor of Toyama city</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>During the movie screening</td><td>Toyama city, Nippon Kucho, Hokusan, JANUS</td></tr>
</table>

4.2. Items discussed with the Indonesian Embassy in Japan

We had an opportunity to have a meeting with the ambassador Heri of the Indonesian Embassy in Tokyo regarding the policy for discussing hydrogen use with Bali, and received advice about commercialization approaches.

Firstly, he mentioned that the technology of using hydrogen could attract attention in Indonesia, too, and pointed out that it is indispensable to deepen the understanding of points of the technology, problems to be solved for installation, roles of related staff for installation, and system development.

In this situation, the G20 conference in Bali will be a good opportunity to inform people around the world that forward-looking initiatives have been started for coping with climate change and realizing decarbonization, and he commented that commercialization projects would be welcomed.

As a concrete method, he suggested that a seminar inviting related staff and enterprises should be held. He also mentioned that the Embassy can cooperate with us in holding the seminar and support us in inviting related staff and coordination, so we decided to prepare for the seminar in cooperation with the Embassy.

Before holding the seminar, we held a tour in Toyama City and introduced activities there, in order to introduce the situation of use of hydrogen energy in Toyama City to the officials of the economic division of the Embassy.

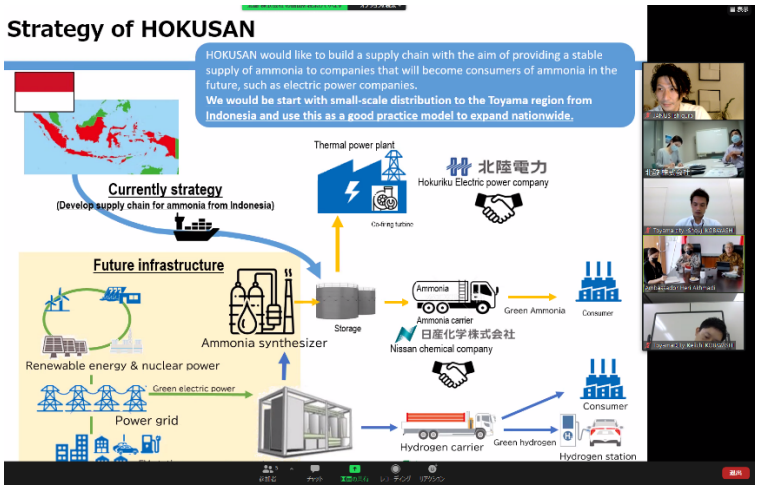


Figure 4-3 Meeting with the ambassador Heri in Tokyo (Oct. 5, 2021)

Figure 4-4　Meeting with the ambassador Heri (Nov. 5, 2021)

Figure 4-5　Tour at the hydrogen station in Toyama City for the officials of the Indonesian Embassy in Tokyo

4.3.　Toyama-Bali Hydrogen Seminar

(1)　Details of the seminar

While enlisting support from the Indonesian Embassy in Tokyo, Bali and Toyama City jointly held a seminar on hydrogen technologies. Hokusan Co., Ltd. gave explanations about the initiatives of Toyama City, the details of hydrogen-using technologies, the possibility of collaboration, and approaches, and then a session of questions and answers was held.

The leaflet and agenda of the seminar are shown below. The projection images and minutes on that day are shown in the attached documents.

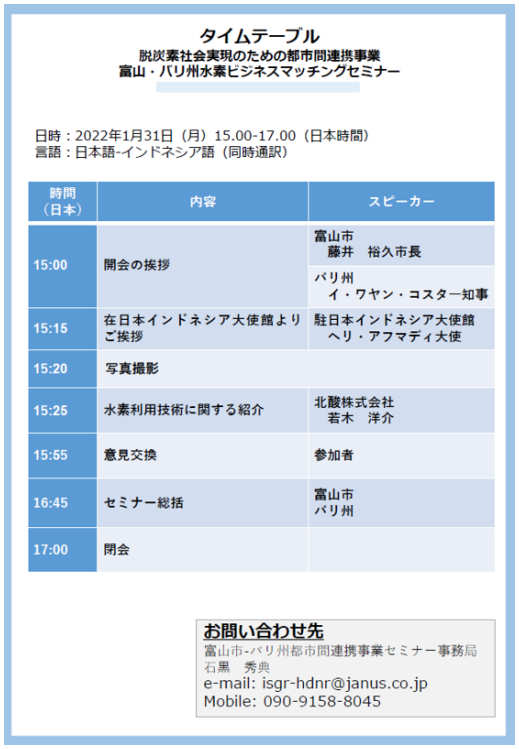


Figure 4-6　Leaflet and agenda of the seminar

At the beginning of the seminar, opening addresses were delivered by Mr. Hirohisa Fujii, the mayor of Toyama City, Mr. Ida Bagus Arda, the head of the Bureau of Energy, Labor, and Mineral Resources, Bali, and Mr. Tri Purnajaya, a minister of the Indonesian Embassy in Japan.

Figure 4-7　Opening addresses (From left: Mr. Hirohisa Fujii, the mayor of Toyama City, Mr. Ida Bagus Arda, the head of the Bureau of Energy, Labor, and Mineral Resources, Bali, and Mr. Tri Purnajaya, a minister of the Indonesian Embassy in Japan)

At the beginning of the seminar, the mayor Hirohisa Fujii mentioned that Toyama City implemented some measures for solving various issues in Bali through the intercity collaboration project with Bali and enacted Toyama City Energy Vision for reducing greenhouse gas emissions to zero in accordance with the Paris Agreement and issued a declaration for realizing a zero-carbon city by 2050. In addition, he mentioned that Japan would lead decarbonization as represented by the Prime Minister Kishida in COP26 and Toyama City will enhance its activities with this seminar as a start in parallel with national campaigns.

In addition, Mr. Ida Bagus Arda, the head of the Bureau of Energy, Labor, and Mineral Resources, Bali mentioned that the Bali government produced policies for using clean energy for the harmony

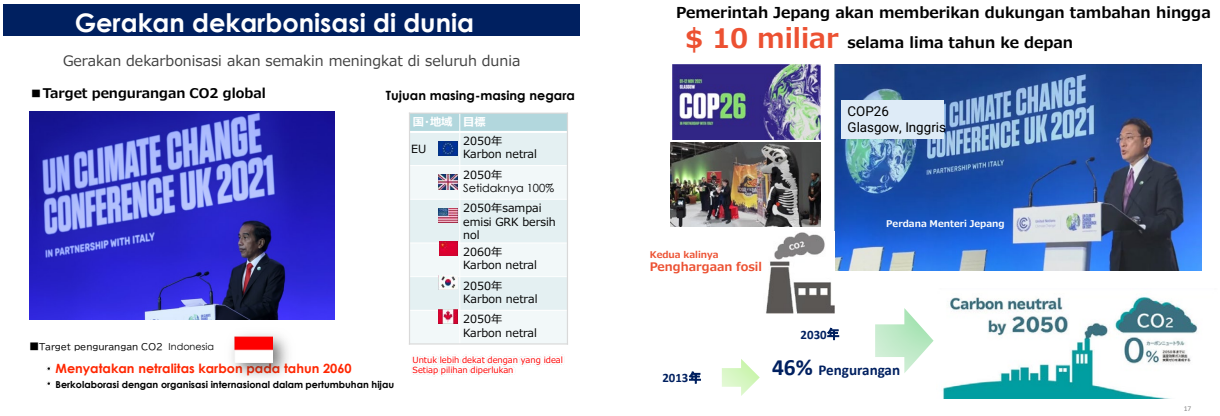
with the environment, which is the development vision of Bali. The officials of Bali recognize that it is necessary to deepen the understanding of technologies and conduct R&D in order to promote clean energy in Bali and it is indispensable to foster understanding while involving experts, intellectuals, and those who engage in actual tasks. In this light, he expressed his expectation that hydrogen will be understood more deeply through this seminar and used in a sustainable manner in Bali, as hydrogen is expected to facilitate the use of clean energy in Bali although it is a new technology.

Mr. Tri Purnajaya, a minister of the Indonesian Embassy in Japan mentioned, representing the Embassy, that the cooperation between Toyama City and Bali in the renewable energy field in Bali is welcomed and the Embassy is making efforts to facilitate the cooperation between the two countries according to the commitments of the Japanese and Indonesian governments for coping with climate change, which is a global issue. As Indonesia will host the G20 conference in 2022, they would like to commit themselves to the distribution of renewable energy, and he mentioned that Japan is the largest partner of Indonesia in the renewable energy sector and further collaboration with Japan is anticipated because measures for achieving carbon neutrality cannot be completed by Indonesia alone. In this seminar, ideal methods for collaboration between Toyama City and Bali were discussed, and they commented that this seminar would contribute to the realization of their goals.

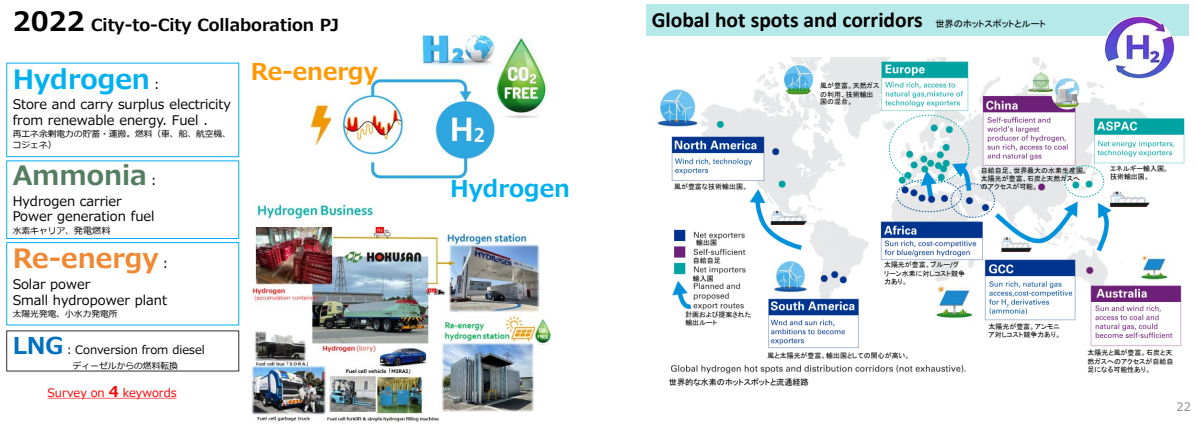
Figure 4-8 Participants in the seminar

Hokusan Co., Ltd. introduced the global trends of hydrogen use and new technology development as well as general information on hydrogen, and cases of utilization of hydrogen energy in Toyama City, and explained candidate technologies that may be adopted in Bali.

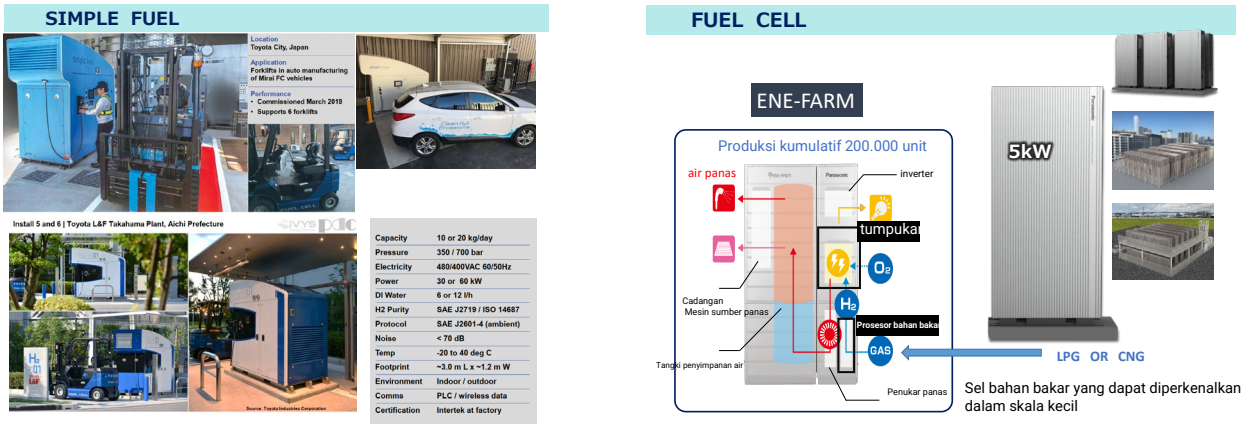
As a candidate technology, they introduced Simplefuel, which realizes the manufacturing, compression, and refueling processes at low cost with compact equipment for utilizing hydrogen in transportation, and ENE-FARM, which generates power with fuel cells from natural gas and heats water.



Trends towards decarbonization of Indonesia and Japan



Toyama City's Hydrogen Utilization and Global Hydrogen Demand Trends



Technology that can be expected to be deployed in Bali

Figure 4-9 Reference material of Hokusan Co., Ltd. for introducing the hydrogen technology (excerpt)

(2) Feedback and matching results

This seminar was attended by around 100 people, including the officials of Bali and the central government of Indonesia (BAPPENAS, BRIN, and the Ministry of Energy and Mineral Resources) and the staff of research institutes, colleges, and private enterprises. When we conducted a

questionnaire survey about the exchange of opinions and concrete cooperation after the seminar, over 70% of respondents hoped that matching will be conducted and answered that they are interested in especially security, economic performance, and efficiency. When we asked them whether they engaged in some activities related to hydrogen energy, most of them answered that there were no such activities or plans, except the researchers in fuel cells.

In addition, they enumerated many issues related to resources, including human resources and funds. On the other hand, over 80% of them answered that cooperation, including the sharing of detailed information, is demanded.

Based on this result, Toyama City and Hokusan reached an agreement for planning a project focused on hydrogen and preparing for proposals from the next fiscal year.

5. Summary of Results & Future Prospects

During the current survey, we conducted the assessments to identify the business potential and problems for the JCM Equipment Subsidy Project and the decarbonization process in two local authorities – the Province of Bali and the City of Semarang – keeping in mind the low-carbon policies at the national, state, and local-authority levels respectively, and came to be convinced of the feasibility of each project plan that would lead to the forming of the projects through the JCM Equipment Subsidies. Regarding the new collaboration subjects such as the use of hydrogen, we were also able to establish the foundation for discussions through seminars involving embassies, relevant ministries, and various businesses.

On the other hand, the spread of COVID-19 continuing since the last year has had a major impact on our activities over the past two years and, while we have been able to gather information on potential sites and prospective projects even in the online environment, we have found ourselves in the situation where the speed of progress has been hindered during the stage leading to the essential transitions to establish projects, such as system construction, site confirmation and contract negotiations.

Yet again it has exposed the limitations of online surveys for the purpose of problem-solving discussions and decision-making in the face of the projects that have been considered to have potential.

Though the current survey was carried out in the final year of our three-year project, these circumstances meant that we were unable to reach the point of starting the application process for the JCM Equipment Subsidy Projects.

Regarding the future, there are buds of projects that may lead to business realization by continuing further examinations under the framework of intercity collaboration projects, including the materialization of hydrogen utilization technologies, and there is a strong demand from the local institutions to continue our project.

In addition, Toyama City is promoting its initiatives as a future city for attaining SDGs and intends to continue cooperation through intercity collaborations by sharing, approaching local communities, and exploring possibilities for all activities related to achieving the SDGs, as well as climate change

mitigation measures.

With Indonesia having declared its 2060 carbon neutral target, with regard to climate change measures, it is hoped that the Province of Bali, a world-famous tourist destination and where there is culturally and ideologically a strong support for environmental conservation and symbiosis, will issue a decarbonization declaration. The year 2022 is timely to present such a policy in conjunction with the G20 hosted by Indonesia.

Under these circumstances, it is desirable to continue our collaboration on policy proposals, needs recognition, feasibility study, and plan formulation through the intercity collaboration projects.

Based on these considerations, the future business plan assuming the continuation of intercity collaboration projects is shown in the figure below as the summary of the current report.

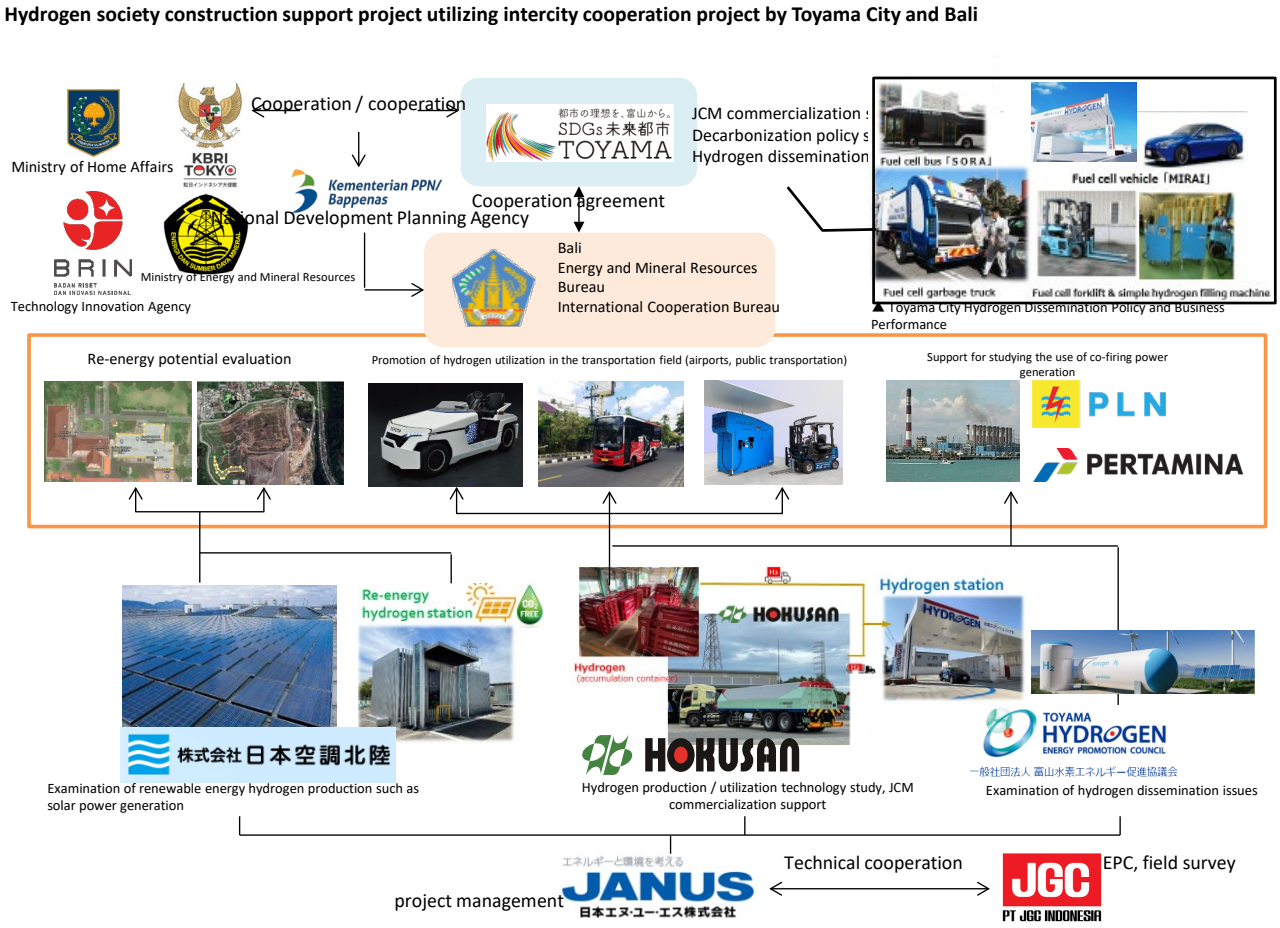
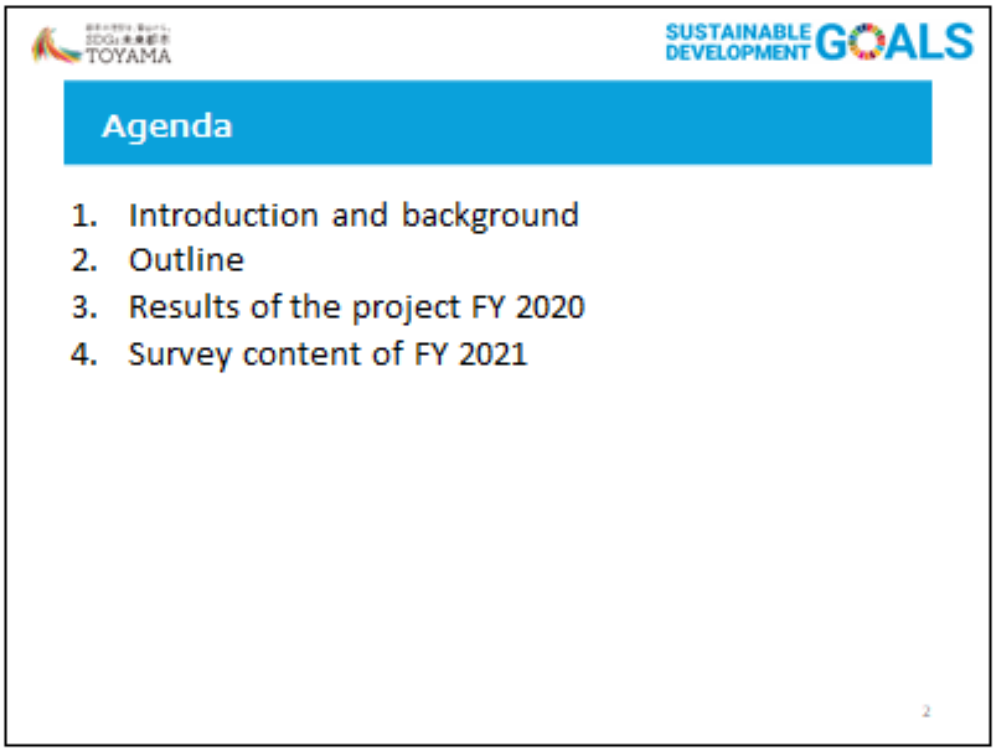


Figure 5-1 Gist of the plan for continuing intercity collaboration in the next fiscal year (provisional)

Attached Documents

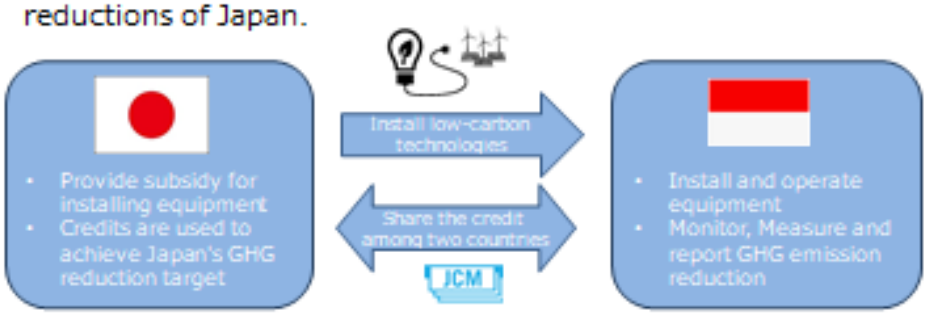
Attached Document 1: Reference material for the kickoff meeting
Attached Document 2: Reference material for JCM webinar
Attached Document 3: Reference material for Toyama City-Bali Seminar on Hydrogen (Hokusan Co., Ltd.)
Attached Document 4: Minutes of Toyama City-Bali Seminar on Hydrogen

Attached Document 1: Reference material for the kickoff meeting (Semarang)



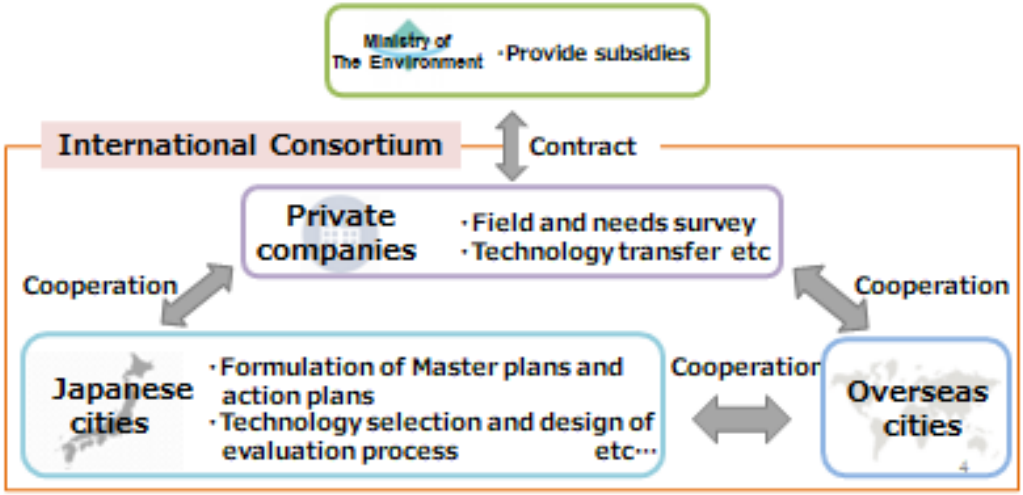
Joint Crediting Mechanism (JCM)

- It is a program implemented by the Japanese government in order to reduce greenhouse gas(GHG) emissions
- Subsidies will be provided for up to 50%, or 2 billion JPY (approx. 20 million USD), for introducing the Japanese low carbon technology.
- GHG reductions due to the installation of equipment will be issued as a credit and a part of it will be counted as the amount of reductions of Japan.



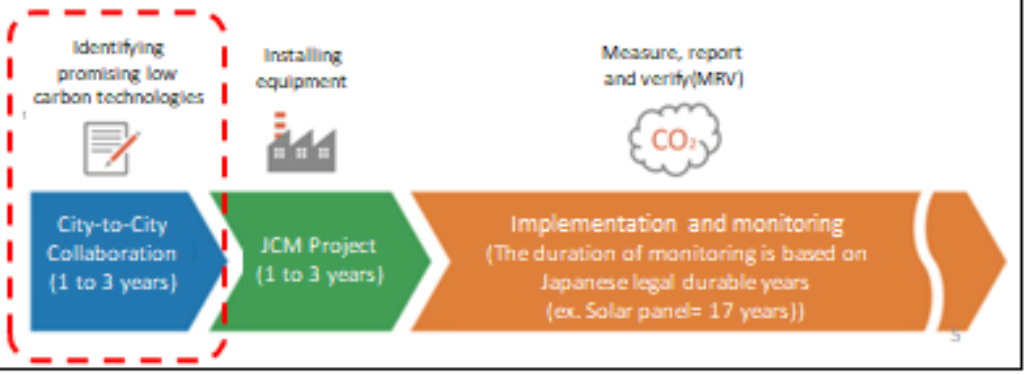
City-to-City Collaboration

- It conducts feasibility studies for projects that will **lead to JCM projects** in the future.
- It supports the construction of basic systems such as the formulation of master plans that lead to low carbonization.



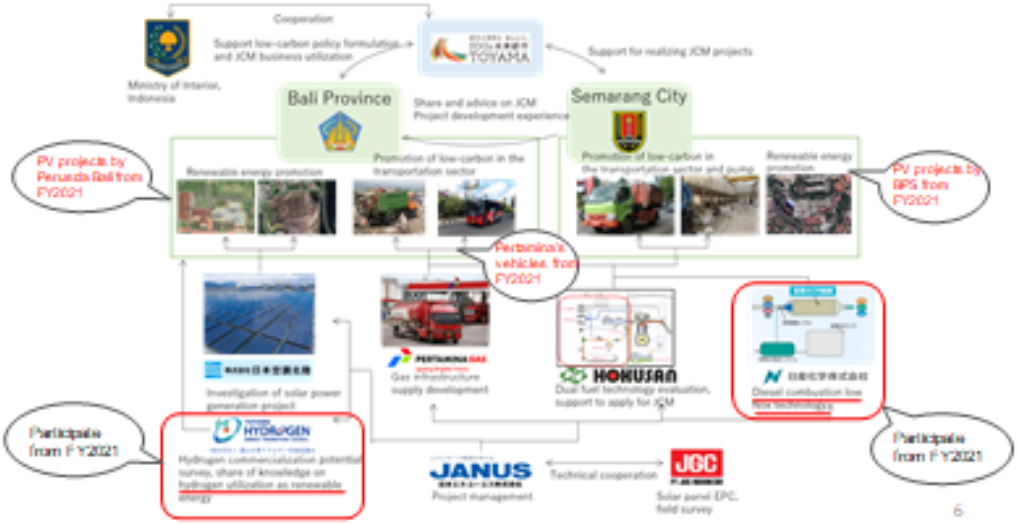
City-to-City Collaboration

- The Ministry of the Environment, Japan has secured a budget to support feasibility studies for JCM projects based on city-to-city collaboration.(※ This project is based on this system)
- The Ministry of Economy, Trade and Industry has also secured a budget to support a feasibility study to promote JCM projects.



2. Outline of the project

1. Transportation fuel conversion by utilizing CNG and diesel co-firing (DDF) technology
2. Renewable energy promotion project centered on solar power generation
3. Survey for hydrogen technology introduction in Bali



3. Results of the FY 2020 project

Activities

Main activities	Results
Meeting with Bali Province, Udayana University and Perusda Bali	We shared policy and goals with Bali province and related stakeholders. We exchanged opinions on the effects, challenges, and implementation system of gas conversion projects and solar power generation projects.
Meeting with PT. Pertamina Gas	We exchanged opinions on the possibility of gas supply in Bali and reached the MOU for future research cooperation.
Information gathering and analysis	Data analysis was carried out based on the web information and acquired information via site survey.

Estimation of of economic effect, CO2 emission reduction

Project	Economic effect [Million yen/year]	CO2 emission reduction [t-CO2/FY]	JCM subsidy [USD]	Cost-effectiveness [JPY/t-CO2]
DDF for public transportation (Trans Metro Dewata)	4	9,039	400,000	4,646
Garbage trucks (DLH Denpasar)	9	4,330	461,000	11,179
Total Solar panel (Ministry of finance, Denpasar City Water Purification Plant, Denpasar City Reservoir, Final Disposal Site)	-	18,268	484,536	2,785

Above results were estimated based on some assumptions.
Detailed estimations (with actual running data/gas demand/cost of infrastructure investment) are necessary for application of JCM projects.

TOYAMA

SUSTAINABLE DEVELOPMENT GOALS

4. Survey for FY2021 project

①Transportation Fuel Conversion Project

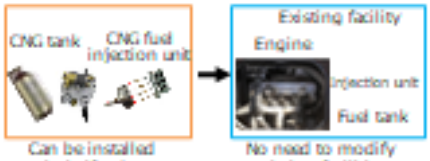
②Survey for hydrogen technologies introduction

①Transportation Fuel Conversion Project in Bali

Gas supply plan for transportation in Bali

- Main transportation fuel in Bali is diesel (however it causes air pollution and increases CO2 emission)
- Natural gas is recommended according to "Clean Energy Governor Ordinance"

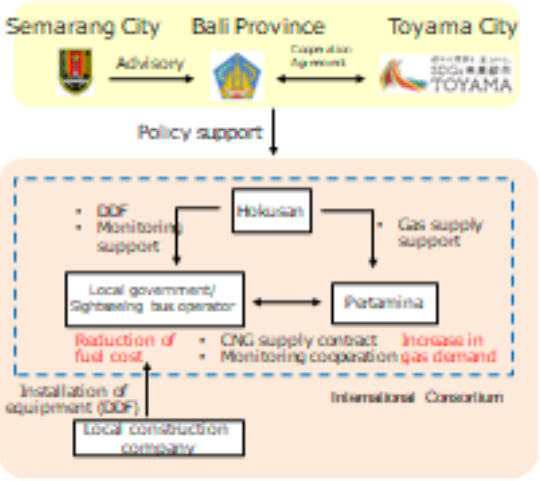
Outline of the Project



Can be installed in half a day

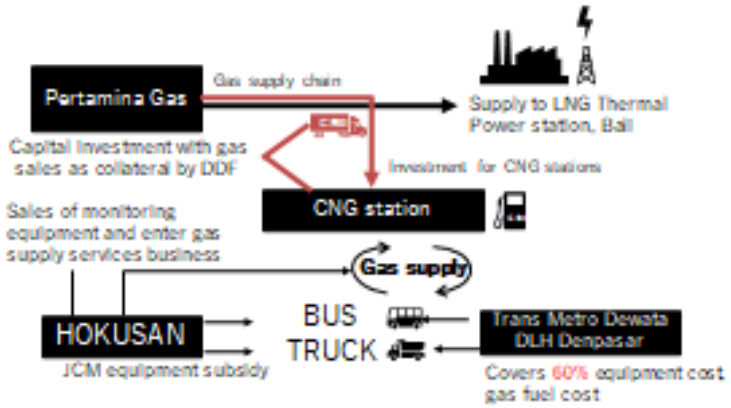
No need to modify existing facilities

Structure of the Project



Achieve maintaining of clean air environment and reduction of fuel cost by implementing fuel conversion of transportation fuel

① Transportation Fuel Conversion Project (JCM project implementation system plan)



- ✓ We will proceed with the examination for gas supply capital investment decision by Pertamina Gas based on MoU with JANUS.
- ✓ Pertamina gas **recommend a CNG purchase guarantee**
- ✓ Since the introduction of DDF = purchase guarantee, it may be possible to make an investment decision if an agreement can be reached on the supply amount, price, and period.
- ✓ Business feasibility of CNG station maintenance costs and transportation costs is the key.

①Discussion regarding DDF

Potential users

- Could your company's vehicles (lorries etc.) be candidates for installation of DDF system in JCM scheme?
  If possible, please share with us
  - Number of vehicles
  - Specification (Exhaust gas amount, Engine type)
  - Actual diesel fuel consumption data (L/vehicle/year)

- Any information regarding other potential gas users?
- Could you share us with the situation of existing DDF systems installed Patraniaga vehicles?

Existing CNG stations

- Please share us with the exact locations of existing CNG stations in Bali by local operators or related staffs.
- Please share us with whether the gas stations are still utilized.

② Survey for hydrogen technology introduction

Hydrogen technology development situation

Current

- Policies related to hydrogen energy development have not been developed
- Some verification project are ongoing.

Future

- **Promotion of renewable energy in off-grid area/remote ilands**
  →Expecting energy storage by hydrogen
- **Dissemination of FCV in the future to reduce consumption of fossil fuel.**

② Survey for hydrogen technology introduction

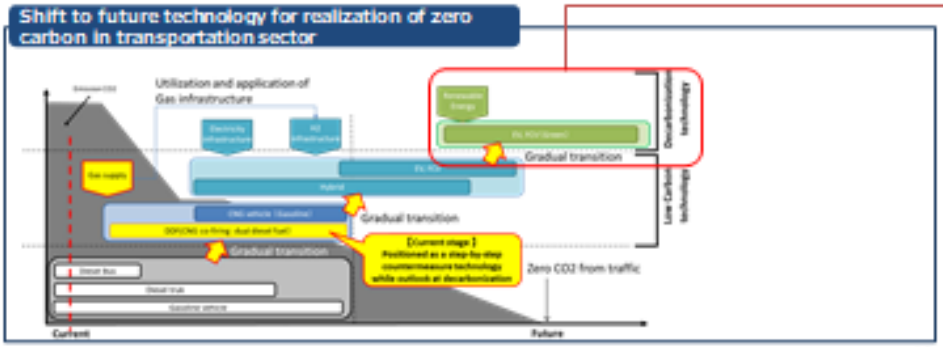
- Identification of hydrogen development challenges
- Consideration of verification

→ Implementation of verification project → Dissemination in business scale (FCV, power generation)

[Survey]
- Toyama hydrogen energy promotion council, Hokusan
- Collaboration with BAPPENAS, EMBASSY OF INDONESIA in Tokyo and BPPT

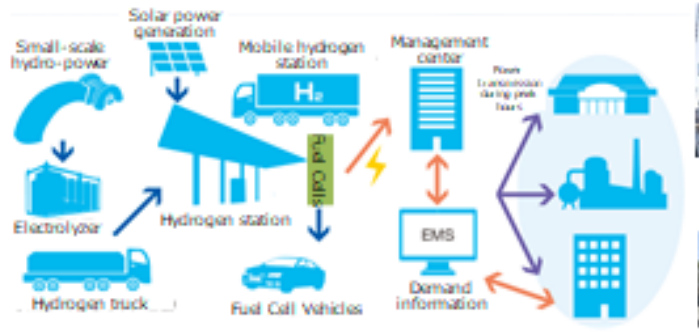
Application for NEDO scheme

Shift to future technology for realization of zero carbon in transportation sector



② Survey for hydrogen technology introduction (examples of hydrogen technologies development in Toyama)

Toyama city model




Hydrogen station in Toyama city


Fuel cell garbage truck

出典：資料1 p8. 21～22 （一社）富山県水素エネルギー促進連絡会「富山水素エネルギー利活用ビジョン・ロードマップ」

- Toyama City and local companies are building a model for local production and local consumption of hydrogen, including the operation of hydrogen stations and fuel cell vehicles.
- They can provide know-how and technical expertise in such hydrogen utilization technologies.

②Discussion regarding hydrogen technology introduction

- Idea for green hydrogen production in Bali
  - Please let us know about the possibility of using green hydrogen by utilizing renewable energy sources such as solar and wind power, for example, supplying hydrogen to FCVs.
- Idea for hydrogen production by natural gas in Bali
  - Please let us know if there are any transportation that could be converted to use hydrogen energy.

7. REFERENCE MATERIAL

Action Plan for Pertamina
(1. Calculation and estimation of gas demand in Bali)

Please confirm the following items.

- Whether the gas consumption by proposed project (gas consumption by public buses and garbage trucks) is enough;
- If it is not enough, how much additional gas is necessary combining other demands, such as hotels and industries to make a decision for investment of gas infrastructure;
- How many and where additional gas stations are necessary in Bali based on the existing SPBG and bus routes;
- Share whether CAPEX and OPEX would be feasible based on the proposed project;
- Share the price of gas for users (we understand the LNG in Bali is 18-21USD/MMBUT, but we suppose the price for end-users is different with subsidy).

Action Plan for Pertamina
(2.Potential users for gas (owners of DDF system))

Please confirm the following items.

- Pertamina Gas has their own trucks which may be potential for DDF installation, but they have already had DDF for some of their vehicles, and they don't use them often since the lack of gas infrastructures. Please confirm the following items.
- Check whether company's vehicles are still candidates for DDF installation;
  - ✓If the vehicles might be candidate for installation of DDF, please share with us the approximate number.
- Contact person in charge (Patraniaga?) and confirm the situation of use (places and frequency of DDF).

Action Plan for Pertamina

(3. Situations of three CNG stations (SPBG at Nusa Dua, Hayam Wuruk Denpasar and in Luk-Luk in Badung Regency))

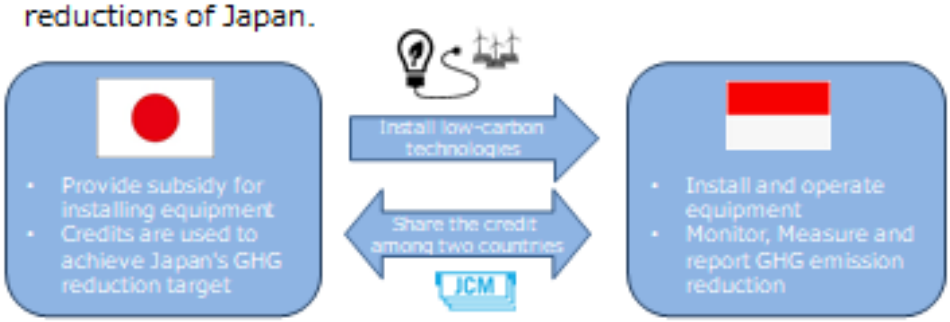
Please confirm

- The exact locations by local operators or related staffs;
- Whether the existing suspended gas stations can be utilized if the gas demand is enough.

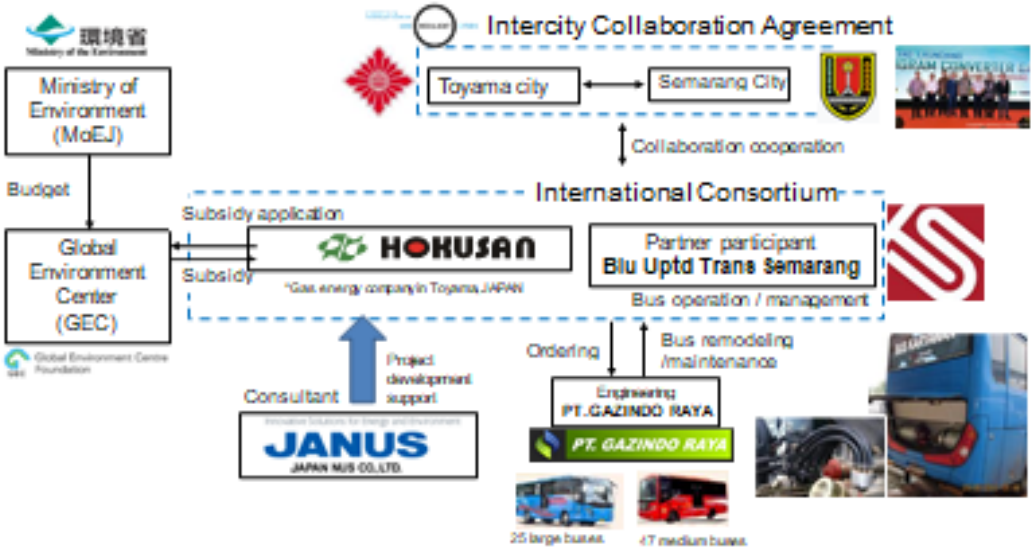
https://regional.kontan.co.id/news/organda-minta-pertamina-tambah-spbg-di-bali

Joint Crediting Mechanism（JCM）

- It is a program implemented by the Japanese government in order to reduce greenhouse gas(GHG) emissions
- Subsidies will be provided for up to 50%, or 2 billion JPY (approx. 20 million USD), for introducing the Japanese low carbon technology.
- GHG reductions due to the installation of equipment will be issued as a credit and a part of it will be counted as the amount of reductions of Japan.



Case study:Semarang achievement



- ✓ Contribution to reducing CO2 emissions from public transportation in Semarang
- ✓ The effect of reducing fuel costs was also obtained.

Case study: Other renewable energy project in Indonesia

PV(Solar) power project in Bogor

Ministry of the Environment Japan
↓ Subsidy
Next Energy CO LTD
↓ PV panel
PT Indasso Aroma

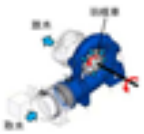
Indasso Aroma will install solar power on the roof of its flagship food and flavor factory in Bogor.

The electricity generated will be used for self-consumption within the factory. It will reduce the electricity purchased from PLN and replace coal-derived electricity to reduce CO2 emissions of 369 tons per year.

Micro Hydro power project in Flores

Ministry of the Environment Japan
↓ Subsidy
Aura Green Energy CO LTD
↓ Micro hydro
PT GOSE PENANAMKNOD

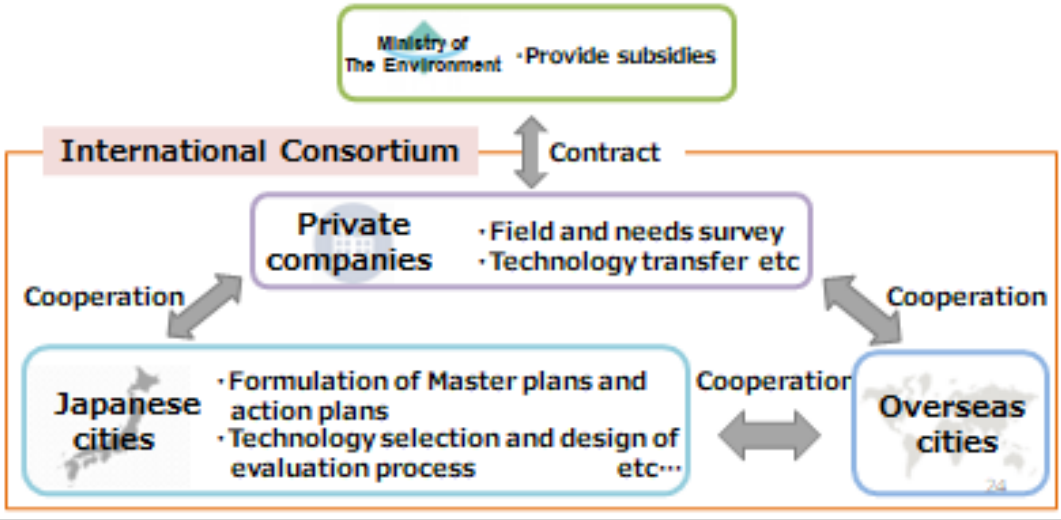
A 2 MW small hydropower facility will be installed on the Wae Lega River in Flores Island.



It will sell electricity to Indonesia's state-owned power company and reduce greenhouse gas (GHG) emissions by 6839 tons annually.

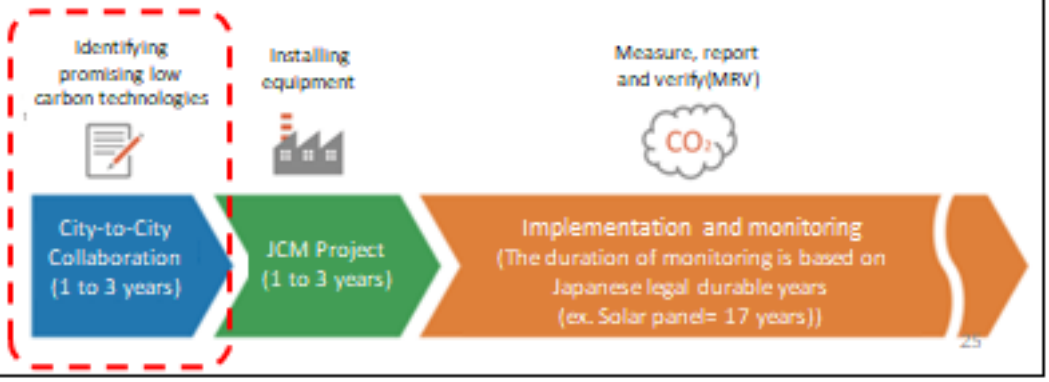
City-to-City Collaboration

- It conducts feasibility studies for projects that will **lead to JCM projects** in the future.
- It supports the construction of basic systems such as the formulation of master plans that lead to low carbonization.



City-to-City Collaboration

- The Ministry of the Environment, Japan has secured a budget to support feasibility studies for JCM projects based on city-to-city collaboration.(※ This project is based on this system)
- The Ministry of Economy, Trade and Industry has also secured a budget to support a feasibility study to promote JCM projects.



SDGs TOYAMA

SUSTAINABLE DEVELOPMENT GOALS

2. Project outline and survey implementation structure

- Purpose, Survey and System of the Project

SUSTAINABLE DEVELOPMENT GOALS

3. Introduction of Stakeholders

-Toyama City

- Regional Resource Recycle System Association

-Hokusan Co., Ltd.

-Nihon Kucho Hokuriku Ltd.

-JGC HOLDINGS CORPORATION

- Japan NUS Co., Ltd.

Toyama City

3. INTRODUCTION OF STAKEHOLDERS

■Toyama City, which is known as an "Environmental Future City" and "SDGs Future City", is highly acclaimed for its achievements in the development of compact city through public transportation and the use of renewable energy such as small hydropower. It is the only city that has been certified as an "improving energy efficiency city".

Toyama City

- Toyama City, which is known as an "Environmental Future City" and "SDGs Future City", is highly acclaimed for its achievements in the development of compact city through public transportation and the use of renewable energy such as small hydropower. It is the only city that has been certified as an "improving energy efficiency city".
- Toyama City has a track record of introducing low-carbon technology with Semarang City through the implementation of City-to-City Collaboration and the JCM Project.

Regional Resource Recycle System Association

一般社団法人
地域資源循環システム協会
Regional Resource Recycle System Association

- Established with the aim of promoting both "energy creation" and "energy saving" businesses, and disseminating and penetrating regional recycling-oriented society, local energy production and consumption, and social systems to realize a lasting and healthy environment and life.
- Founded in 2015
- Conduct research projects on regional recycling-based energy business, environment, energy saving and EMS.

3. INTRODUCTION OF STAKEHOLDERS

Hokusan Co., Ltd HOKUSAN

- Toyama City Gas Supply Company
- Aside from the core business of procuring and supplying industrial gas and LP gas, the company also sells related materials, and works on hydrogen energy diffusion as an alternative energy.
- Founded in 1937, 145 employees
- In the past, it has a track record of implementing a JCM project (public transport bus fuel conversion) together with Toyama City and JANUS.

Since its founding, Hokusan has been engaged in the gas supply business for all vehicles including automobiles, and its wide experience and knowledge have been highly evaluated.

3. INTRODUCTION OF STAKEHOLDERS

Nihon Kucho Hokuriku Ltd.

株式会社日本空調北陸

- A total support company for building equipment, including maintenance of building equipment, equipment/environmental diagnosis, and solution proposals, and it also works on renovation construction.
- Founded in 1977, 199 employees
- Duties:
  1. Design and construction of air conditioners and piping systems
  2. System and equipment maintenance
  3. Operation and management of hospital facilities
  4. Solar panel design and construction

3. INTRODUCTION OF STAKEHOLDERS

Japan NUS Co., Ltd. JANUS

- We provide consulting on the environment and energy field, and have a track record of adopting and implementing JCM projects and City-to-City collaboration in the past.
- Founded in 1971, 175 employees
- The track record in Indonesia are as follows
  - 2014 JCM Feasibility Study "3.7 MW Run of river Small Hydropower"
  - 2018 JCM project of CNG mixed combustion of public transportation in Semarang City, Indonesia
  - 2019 Infrastructure development research project for JCM project (Banda Aceh and Tobintingi City)
  - 2020 City to city collaboration to realize a zero carbon society

JGC Holdings Co., Ltd.

- JGC Global Co., Ltd.
  - Oil and gas business
  - Infrastructure business
- JGC Indonesia
- JGC Corporation
- Japan NUS Co., Ltd.

JGC HOLDINGS CORPORATION

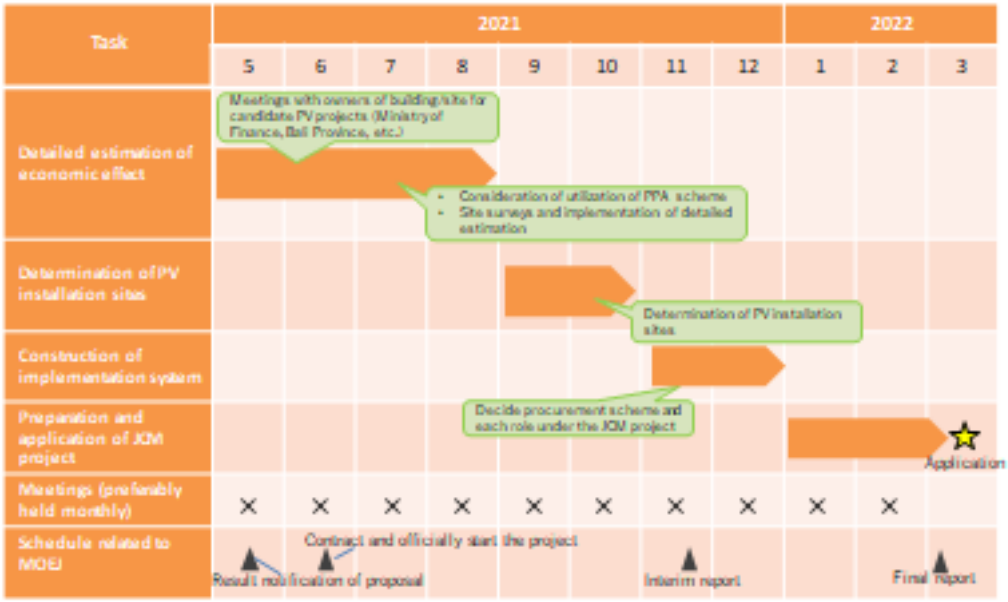
- EPC (design, procurement, construction) of various plants in Japan and overseas. Over 20,000 projects have been carried out in 80 countries around the world, and they have received world's highest level evaluation from customers all around the world, including Japanese oil companies, oil majors, and national oil companies.
- Founded in 1928, 7,607 employees
- Since JANUS and JGC Global are the same JGC group, we have the advantage of being able to provide consistent services from consulting to EPC. JGC Global also has a branch in Indonesia, where can provide additional support system including EPC.

5. Schedule

5. Tentative schedule for transportation fuel conversion project

Task	2021								2022		
	5	6	7	8	9	10	11	12	1	2	3
Detailed estimation of economic effect	Data collection (Meetings with Denpasar DHL/Trans Metro Dewata)			Necessary estimation calculated by Pertamina Gas (gas demand, gas price and cost estimation of gas stations)							
Decision making for investment of gas infrastructure		Decision making for investment of gas infrastructure				Determination of fuel conversion vehicles					
Construction of implementation system											
Preparation and application of JCM project					Decide procurement scheme and each role under the JCM project						Application
Meetings (preferably held monthly)	×	×	×	×	×	×	×	×	×	×	
Schedule related to MOEJ	Result notification of proposal	Contract and officially start the project					Interim report				Final report

5. Tentative schedule for solar power generation project



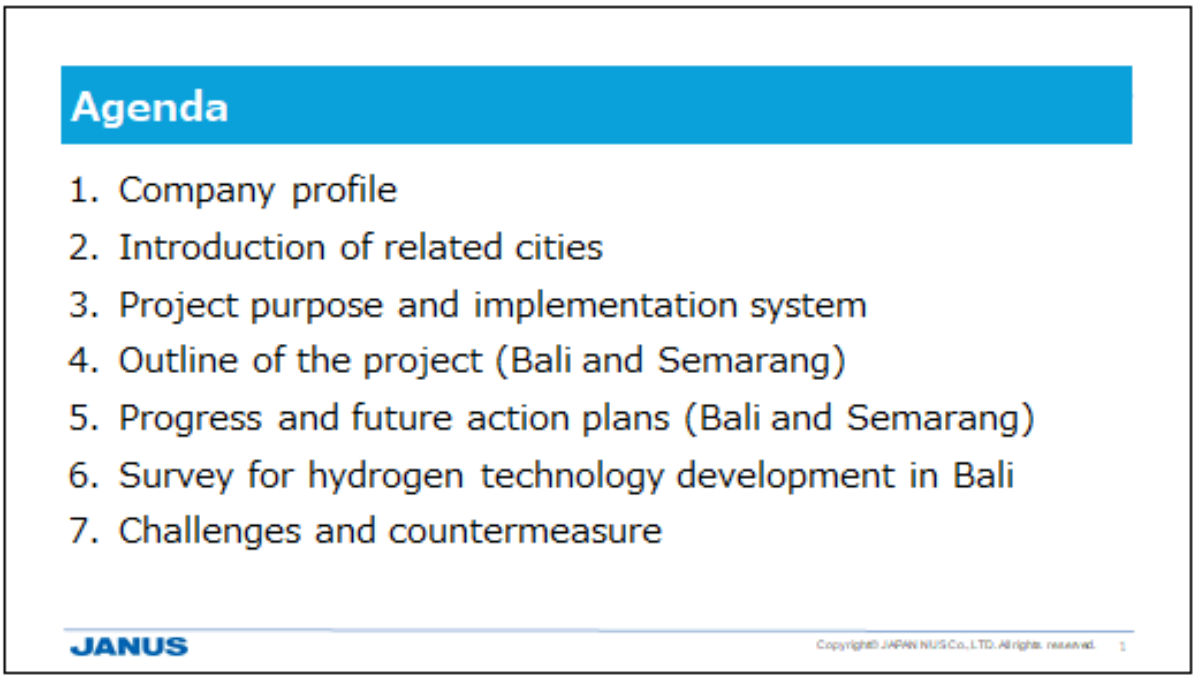
6. Summary of each role

We humbly expect the following roles for each stakeholders to gather necessary information and realize the projects

	JANUS / Toyama / Hokuriku / JGC	Bali Province (ESDM Bali)	PERTAMINA GAS	Perusda Bali
Throughout the project	• Support of low-carbon policy implementation and provision of Toyama City's technologies and JCM project experience • Project management and implementation	• Support the study team to connect with BAPPENAS		
Transportation fuel conversion (public buses and garbage trucks)	• Calculation and estimation of gas demand in Bali with Pertamina based on the data obtained • Consideration of implementation system • Provision of DDF operation and JCM experience (by Hokusan)	• Support to connect with ① DLH Denpasar ② Bali Department of Transportation for collecting necessary data and discussing implementation system and budget. Note) JANUS is now contacting to Trans Metro Dewata	• Calculation and estimation of gas demand in Bali • Confirmation of possibility to use the existing gas stations • Judgement for investment of gas stations • Consider whether Pertamina's own trucks can be candidates for fuel conversion	• Involvement in procurement
Solar power project	• Consideration of new PPA scheme to reduce burden of initial investment • Site survey (by JGC Indonesia) • Provision of solar power technologies (by Nihon Kucho Hokuriku)	• Support to connect with ① Ministry of Finance, Bali Government ② Water Purification Plant in Denpasar ③ Denpasar Reservoir facility ④ Denpasar waste final disposal site ⑤ PLN		• Site survey (or by JGC Indonesia) • Introduce future PV projects

Note) Letters in red indicate the new candidate projects

Attached Document 2: Reference material for JCM webinar



1. Company profile

Japan NUS Co., Ltd.

- ✓ Our expertise: Consultancy services in Energy and Environment business field
- ✓ Established in 1971
- ✓ About 200 employees (March 2020)
- ✓ JGC HD (Japanese oil and gas EPC) group company

Our Expertise

Track records of JCM related project

- 2014 JCM Feasibility Study "3.7 MW Run-of-river Small Hydropower" in Sulawesi, Indonesia
- 2018 JCM project of CNG mixed combustion of public transportation in Semarang City, Indonesia

- 2019 Infrastructure development research project for JCM project (Banda Aceh and Tebing Tinggi City)
- 2020 City-to-city collaboration to realize a zero-carbon society in Bali, Semarang in Indonesia/ Iskandar, Kota Kinabalu in Malaysia/Male in Maldives

2. Introduction of Related Cities

TOYAMA ⟷ Cooperation ⟷ Bali / Semarang

Toyama City

- Known as an **"Environmental Future City"** and **"SDGs Future City"**
- Highly acclaimed for its achievements in the development of **compact city through public transportation and the use of renewable energy such as small hydropower**, certified as an "improving energy efficiency city".
- Has a track record of introducing low-carbon technology with Semarang City through the implementation of City-to-City Collaboration and the JCM subsidy project.


Bali Province

Main Experiences for JCM/City-to-city collaboration project

- **2014: Started cooperation with Toyama City** under the cooperation agreement for sustainable energy supply
- 2017: Cooperation agreement for environment management between Toyama City

- Willing to address air pollution mainly caused by transportation sector in its province and tries to reduce GHG emission.
- Has a goal to disseminate renewable energy from 0.27 % in 2015 to 11.5 % in 2025 based on "General plan of regional energy for the province of Bali 2020-2050".

Semarang, Central Java

Main Experiences for JCM/City-to-city collaboration project

- **2014: Selected as "100 Resilient City"** proposed by Rockefeller Foundation.
- 2018: Conducted JCM subsidy project "Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang"

- Aims to reduce GHG emission by 29 % from BaU scenario by addressing the improvement of energy consumption in industries, commercial and residential use.
- **Conducted the JCM project, "Introduction of CNG-Diesel Hybrid Equipment to Public Bus in Semarang" with Toyama City in 2018.**

3. Project purpose and implementation system

Project Purpose

Toyama City, Toyama local companies, and the cities in Indonesia (Bali, Semarang) cooperate to **conduct the feasibility study mainly for formulation of JCM project** as below;

① Transportation fuel conversion project

utilizing CNG and diesel co-firing (DDF) technology

② Solar power generation project

focusing on government facilities

③ Hydrogen technology development survey

in Bali (from this year)

Implementation system

4. Outline of the project (Transportation fuel conversion)

① Transportation fuel conversion by DDF (DDF Project)

Fuel conversion potential

- **Diesel is still consumed as main transportation fuel** in Bali and Semarang which causes air pollution and large amount of CO2 emission.
- Electricity/hydrogen are expected as future transportation fuels…
- **Natural gas consumption is recommended** in national, provindal level (ex: NDC, RUEN (Grand National Energy Plan 2015-2050)).

Outline of the project

- Select JCM candidate facilities and collect fuel consumption data
- Estimate economic effect and GHG reduction effect of DDF project

JCM candidate facilities in DDF project

DDF (Dual Diesel Fuel) system

Equipment to be installed: CNG tank, CNG fuel injection unit

Can be installed in half a day

Existing facility: Engine

No need to modify existing facilities

Both diesel and CNG are combusted simultaneously

Share DDF project know-how

Semarang has conducted DDF project in 2018

4. Outline of the project (Solar power generation)

②Solar power generation (Solar power generation project)

Situation of PV installation in Bali and Semarang

- Installation of PV is expected as a main renewable energy source, but very few have been installed.
  - ✓ Installed Capacity (2019):
    - Bali : **4MW** (**0.3 %** of total installed capacity of 1,200 MW)
    - Semarang: **Only 95kW**
- **PV installation to the government facility is recommended** ("Surat Edaran MESDM No. 363/22/MEM.L/2019" and "Bali independent energy development plan", etc.).


Solar panel on roof


Roof of villa type hotel

Hotels in Bali:
- ✓ Problems of strength of roof
- ✓ The industry is hit strongly by Covid-19.

Outline of the project

- Select the government facilities from satellite data.
- Estimate power generation, GHG reduction


Satellite image around Denpasar City


Building of Ministry of Finance, Bali Government


Water purification plant


Final Disposal site


Example of estimation:
Module capacity[kW] 285.66 kW, estimated annual power generation [kWh] 431,429 kWh

5. Progress and future action plans (Bali and Semarang)

①、②Progress and plan of the DDF and Solar power generation project

Progress and plan

JCM project formulation

FY2020

- Establish stakeholders' relationship
- Estimate project's effect

Completed
- Selection of JCM candidate facilities
- Estimation of economic effect
- Estimation of low carbon effect
- Knowledge sharing for policy making by Toyama city
- Consideration of project policy

Rough estimation based on assumptions.
Need more detailed estimation and plan including site survey.

FY2021

Prepare JCM project formulation

GOAL
- Determination of installation targets
- Construction of implementation system
- Preparation of JCM application documents

Strategy
- Consideration of detailed economic effect
- Discussion of JCM formulation of candidate owners
- Consideration of gas stations construction by Pertamina (only for DDF project)
- Consideration of PV installation scheme (only for PV project)

FY2022

Application of JCM project

GOAL
- Application of JCM project
- Procurement of fund, preparation of bid

Strategy
- Contract for gas supply (only for DDF project)
- Contract for electricity sales (only for PV project)
- Construction of EPC implementation system (only for PV project)

FY2023・2024-

Construction, Operation

GOAL
- Construction, installation of equipment
- MRV

生形1

Action plans for this fiscal year

6. Survey for hydrogen technology development in Bali

③ Survey for hydrogen technology development

- Bali RUED (comprehensive energy plan) indicates the future energy mix.
- It aims to **expand the ratio of renewable energy and assumes most of them as solar power.**

Bali energy policy (2020-2050) (RUED)

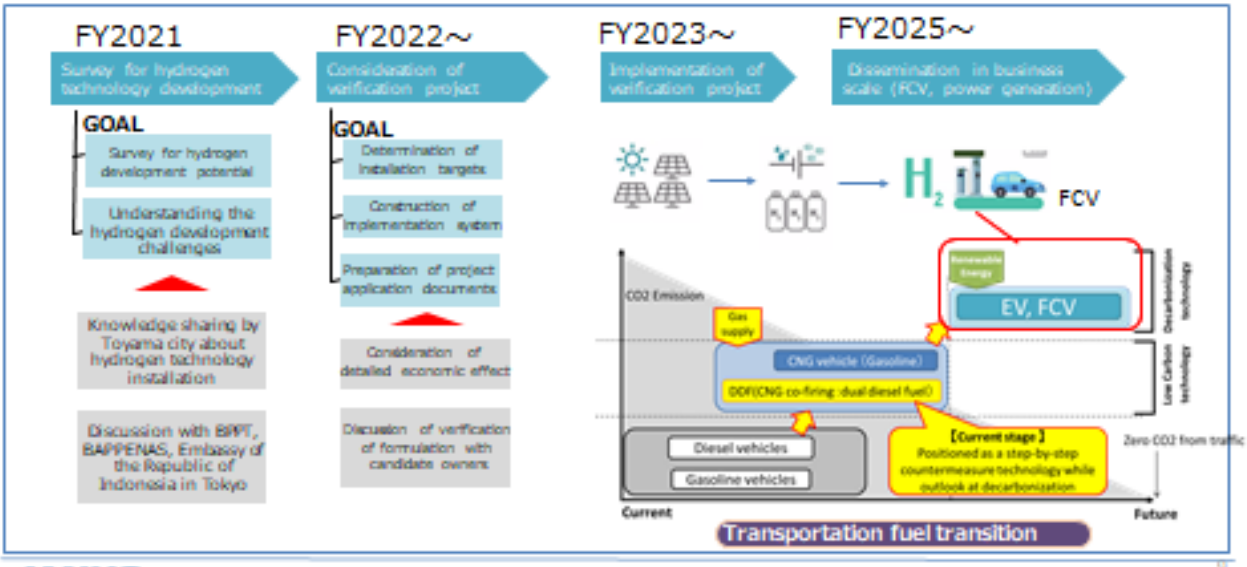
Energy type	Unit	2015	2025	2050
1. Coal	(%)	19.6	3.3	0.0
2. Gas	(%)	4.4	56.2	34.9
3. Oil	(%)	75.7	29.3	45.0
4. Renewable Energy	(%)	0.3	11.5	20.1

- ✓ PV is not a stable energy, so it is necessary to prepare backup electric power source for adjusting fluctuations.
- ✓ It is considered that hydrogen energy development is necessary, which is not constrained by grid limitation.
- ✓ Pertamina is carrying out a demonstration project in-house, and there is a request for cooperation to proceed with studies and investigations on hydrogen energy development in Bali.

- TOYAMA HYDROGEN ENERGY COUNCIL and Toyama local companies are building **a model for local production and local consumption of hydrogen**, including the operation of hydrogen stations and fuel cell vehicles.
- They can **provide know-how and technical expertise in such hydrogen utilization technologies.**

6. Survey for hydrogen technology development in Bali

③ Survey for hydrogen technology development (Future action plans)



7. Challenges and countermeasure

The difficulty because of COVID-19

✓ Restriction of conducting site survey

→Alternative method FY2021: Online video survey with support from JGC Indonesia

Solar power project

✓ Challenges in the burden of initial investment

→Better to propose the project by solar PPA scheme.

1) Initial cost: Covered by PLN
Maintenance cost: Covered by PLN
Electricity generated: Purchased by PLN
2) Initial cost: Covered by PPA business entity
Maintenance cost: Determined by consultation
Electricity generated: Determined by consultation

Promising solar PPA schemes in Indonesia

Hydrogen survey

✓ Undeveloped hydrogen related to policies and plans

→ Survey for potential hydrogen technology development including gray hydrogen utilizing abundant natural gas resources in Indonesia as transition technology

Cooperation with national stakeholders

→ Develop not only provincial, city level stakeholders, but also national level stakeholders, such as BAPPENAS (Ministry of National Development Planning of the Republic of Indonesia) and Embassy of the Republic of Indonesia in Tokyo

JANUS

SDGs未来都市 TOYAMA

SUSTAINABLE DEVELOPMENT GOALS

Thank you for your attention!

HOKUSAN

株式会社日本空調北陸

TOYAMA HYDROGEN ENERGY PROMOTION COUNCIL

JANUS

JGC

JANUS

Attached Document 3: Reference material for Toyama City-Bali Seminar on Hydrogen (Hokusan Co., Ltd.)

SUSTAINABLE DEVELOPMENT GOALS

都市の理想を、富山から。
SDGs未来都市
TOYAMA

Seminar hidrogen di BALI

H_2

HOKUSAN

Proyek kerjasama antar kota di Bali
Prospek bisnis energi hidrogen

31 Januari 2022

HOKUSAN

Sejak didirikan, Hokusan telah terlibat dalam bisnis pasokan gas untuk semua kendaraan termasuk mobil, dan pengalaman serta pengetahuannya yang luas telah sangat dievaluasi..

Profil Perusahaan

- Perusahaan Pasokan Gas Kota Toyama
- Didirikan pada tahun 1937, 145 karyawan
- Selain dari bisnis inti pengadaan dan memasok gas industri

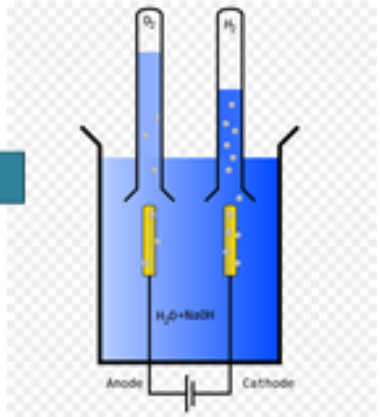
HOKUSAN

Konten bisnis

1 3

Pabrik hydrogen

Air dielektrolisis untuk membuat hidrogen.



soda api

klorin

O_2

H_2

Stasiun hidrogen

H2One STUNT

Dengan listrik yang dihasilkan dari energi terbarukan Menghasilkan hidrogen dan mengisi kendaraan sel bahan bakar dengan hidrogen.

Mengapa hidrogen ?

Apa itu Hidrogen?

◆Hidrogen adalah yang paling ringan
Unsur yang paling melimpah (70%) di alam semesta

◆Ada terutama dalam bentuk senyawa seperti air laut di bumi

Stand Obor Olimpiade Tokyo 2020

Hidrogen tidak menghasilkan CO_2 saat dibakar !

➔ Energi bersih

TOKYO 2020

Nyala api yang tidak Mengeluarkan karbon dioksida

Menghasilkan hidrogen dengan energi terbarukan

発電の常識を変えてみせる。

Keuntungan dari Hidrogen

Nol emisi H_2O

Bisa diangkut

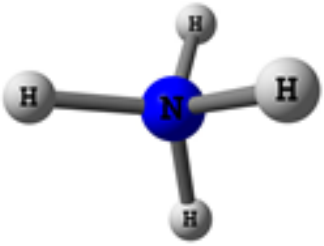
Tidak ada emisi karbon dioksida

Dapat dibuat dari air menggunakan energi terbarukan

Bisa diselamatkan

Amonia

juga merupakan anggota hidrogen



NH_3

① Dapat membawa hidrogen secara efisien
② Tidak ada karbon yang dipancarkan bahkan jika dibakar
③ Dapat dibuat di seluruh dunia

Pemanasan global

11

Bencana akibat hutan lebat

Topan

Penurunan es Aktik dan Antartika

Kematian karang

Kekeringan

Cuaca ekstrim di seluruh dunia !

Batas bumi !!

12

Berapa banyak lagi CO2 yang bisa dikeluarkan?

~ Emisi CO2 kumulatif yang diizinkan dan emisi CO2 yang terkandung dalam cadangan bahan bakar fosil yang dapat dipulihkan ~

Emisi CO2 kumulatif sekitar 3 triliun ton, dan suhu global rata-rata naik 2 ° C (IPCC).
Sudah sekitar 2 triliun ton telah dibuang, dan sisanya 1 triliun ton
(sekitar 30 tahun dengan kecepatan saat ini).

Kurangi penggunaan minyak dan batu bara

GX GREEN TRANS FORMATION

Upaya internasional

"Perjanjian Paris" diadopsi pada COP21 pada tahun 2015

Sebagai tujuan jangka panjang global, menjaga kenaikan suhu rata-rata di bawah 2 ° C dan melakukan upaya untuk mempertahankannya pada 1,5 ° C.

Tindakan khusus melawan perubahan iklim

Gerakan dekarbonisasi di dunia

Gerakan dekarbonisasi akan semakin meningkat di seluruh dunia

■ **Target pengurangan CO2 global**

■Target pengurangan CO2 Indonesia

- Menyatakan netralitas karbon pada tahun 2060
- Berkolaborasi dengan organisasi internasional dalam pertumbuhan hijau

Tujuan masing-masing negara

国・地域	目標
EU	2050年 Karbon netral
	2050年 Setidaknya 100%
	2050年sampai emisi GRK bersih nol
	2060年 Karbon netral
	2050年 Karbon netral
	2050年 Karbon netral

Untuk lebih dekat dengan yang ideal
Setiap pilihan diperlukan

Pemerintah Jepang akan memberikan dukungan tambahan hingga

$ 10 miliar selama lima tahun ke depan

Kedua kalinya
Penghargaan fosil

2030年

2013年

46% Pengurangan

Carbon neutral by 2050

17

2022 City-to-City Collaboration PJ

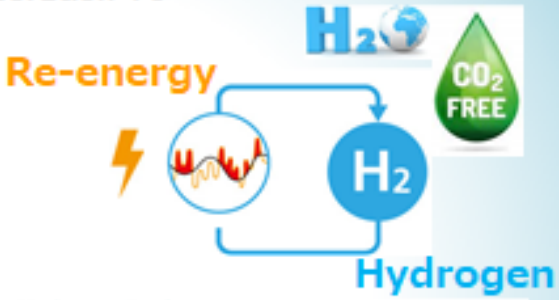
Hydrogen :
Store and carry surplus electricity from renewable energy. Fuel .
再エネ余剰電力の貯蓄・運搬、燃料（車、船、航空機、コジェネ）

Ammonia :
Hydrogen carrier
Power generation fuel
水素キャリア、発電燃料

Re-energy :
Solar power
Small hydropower plant
太陽光発電、小水力発電所

LNG : Conversion from diesel
ディーゼルからの燃料転換

Survey on **4** keywords



Hydrogen Business

Development of “hydrogen / ammonia” for fuel 燃料用 水素アンモニアの開発

Power plant 【発電】

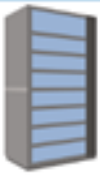
Exclusive firing
Co-firing to thermal power plant
専焼、火力発電への混焼

Industry 【産業】

Co-firing
混焼

Transportation 【輸送】

engine
エンジン



Fuel cell
燃料電池

Power plant 【Ammonia】 発電所（アンモニア）

JERA

Ammonia co-firing to coal-fired power plant

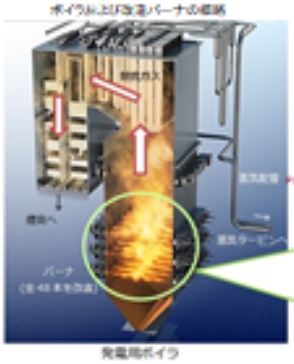
-JERA Hekinan Thermal Power Station(Aichi) -

Demonstration period: June 2021 to March 2025
From August 2021, mixed combustion started at Unit 5 (power generation output: 1 million kW).
Aim for 20% mixed combustion.

石炭火力発電所へのアンモニア混焼-JERA碧南火力発電所-
実証期間：2021年6月～2025年3月
2021年8月より5号機（発電出力：100万kW）にて混焼開始、
20%混焼を目指す。

Boiler and modified burner

ボイラおよび改造バーナの概略

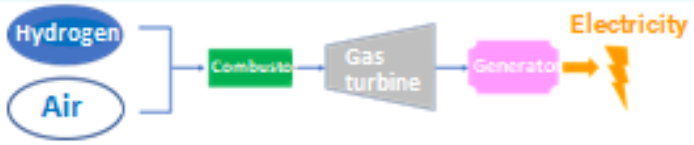


発電用ボイラ

アンモニア混焼バーナ概略図
（既存バーナを一部改造することで対応）

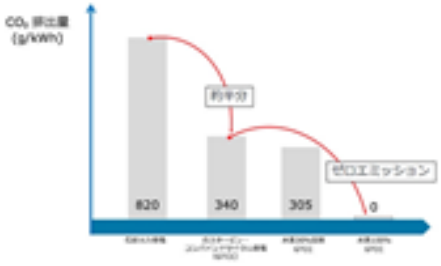
Ammonia mixed combustion burner
It can be handled by partially modifying the existing burner.

Industry -gas turbine- 【Hydrogen】



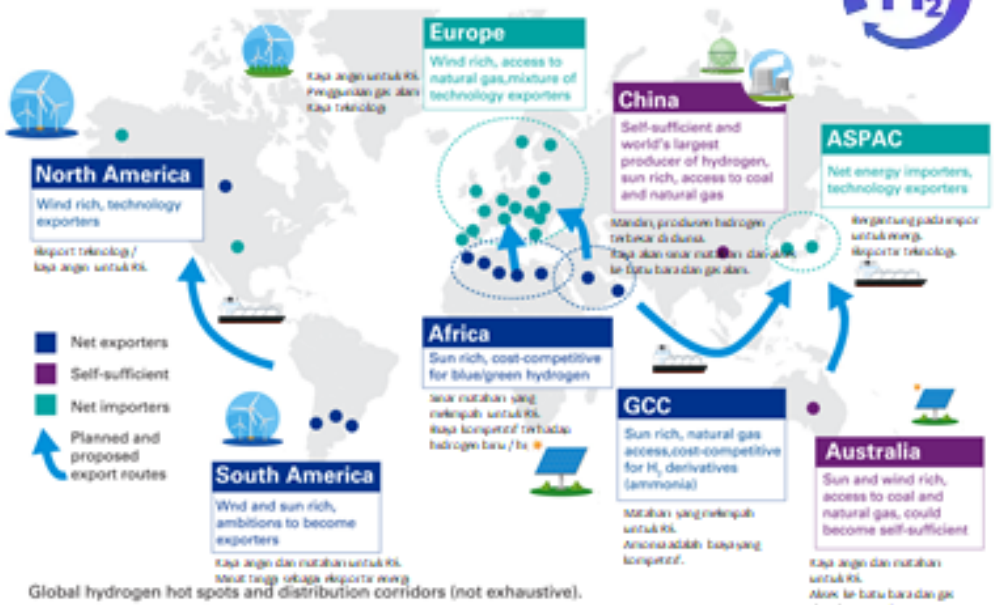
Hydrogen gas turbine
Kawasaki
Mencapai 100% hidrogen (penembakan eksklusif) dengan pembakaran bersama hidrogen dan gas alam.
Berhasil mengembangkan turbin yang dapat menangani hidrogen tanpa mengubah badan turbin menjadi gas alam.

Hydrogen gas turbine
MITSUBISHI
Menyelesaikan teknologi pembakaran campuran 30%. Mendukung kelas 30.000 hingga 1,28 juta kW. Bertujuan untuk pembakaran 100% hidrogen.



21

Global hot spots and corridors 世界のホットスポットとルート

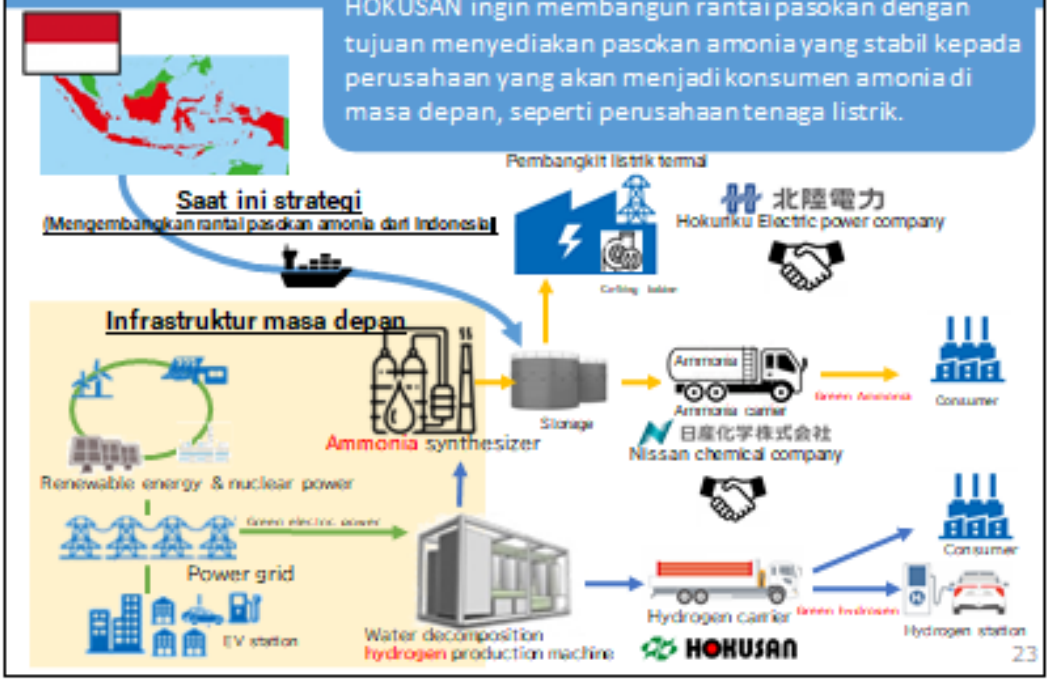


Global hydrogen hot spots and distribution corridors (not exhaustive).

22

Strategy of HOKUSAN

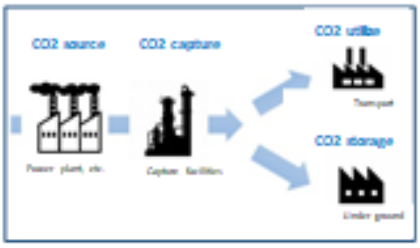
HOKUSAN ingin membangun rantai pasokan dengan tujuan menyediakan pasokan amonia yang stabil kepada perusahaan yang akan menjadi konsumen amonia di masa depan, seperti perusahaan tenaga listrik.

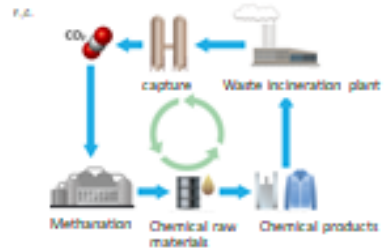


23

CCUS (Carbon dioxide Capture, Utilization or Storage)

Teknologi yang memisahkan dan memulihkan CO2 yang terkandung dalam gas buang dari pembangkit listrik tenaga panas dan pabrik, menggunakannya secara efektif sebagai sumber daya untuk produksi tanaman dan produksi produk kimia, atau menyimpannya di lapisan bawah tanah yang stabil.





Studi kasus kelayakan

"CCS" feasibility study for clean fuel ammonia production

Started JCM feasibility study for "CCS" demonstration project.

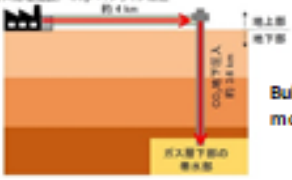
CCS実証プロジェクトに向けたJCM設備補助の開始について

JANUS 日本エネルギー・エックス株式会社 / J-POWER

Gundih gas field located in Central Java: Conducted JCM feasibility study, etc.

図－1 日尼両国の実施体制

図－2 プロセス概念図



Building "CCS" business model in Asia

Studi kasus kelayakan

Approved the Tanggu LNG project (development plan including **CCUS**)

LNG Plant

The Tanggu LNG project in West Papua, Indonesia has been approved by SKK Migas (Indonesia Oil and Gas Upstream Business Supervision and Execution Agency) for a development plan that includes a CCUS project. From now on, the basic design will start.

produksi LNG
1,4 miliar kaki kubik / hari

2,1 miliar kaki kubik / hari

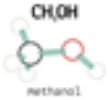
sojitz
New way, New value
双日株式会社

Toward the development of the methanol and ammonia industry

メタノールとアンモニア産業の開発へ

Methanol plant (East Kalimantan Island, Bontang)
The only methanol producer. Production **capacity 660,000 / ton year**

sojitz
New way, New value
双日株式会社



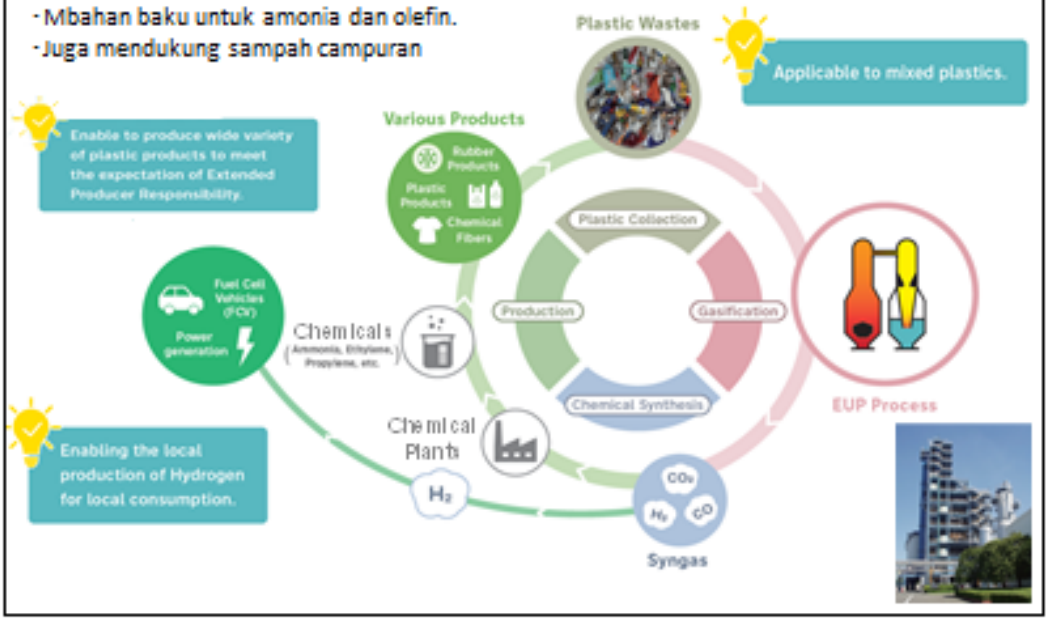
Methanol demand **to 2 million tons**
Toward the development of the methanol and ammonia industry in the Bintuni Bay industrial area

Considering construction of a new methanol plant

Waste to Hydrogen

Memproduksi hidrogen dari limbah plastik

- Oksidasi dan gasifikasi limbah plastik dengan oksigen dan uap. Hidrogen dapat dipulihkan.
- Mbahan baku untuk amonia dan olefin.
- Juga mendukung sampah campuran



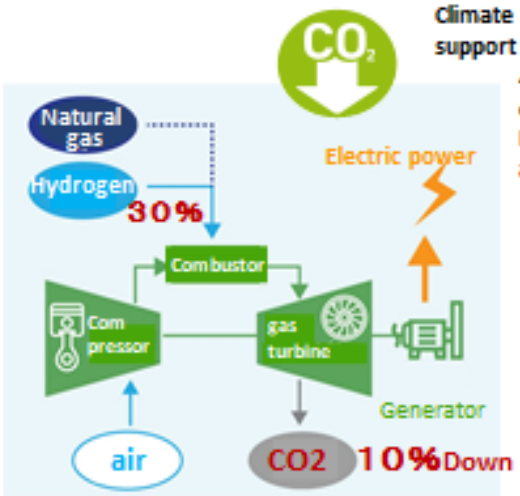
Menuju dekarbonisasi

~ Technology introduction to power plants ~

Climate change countermeasure support for developing countries

Additional contributions of up to $ 10 billion over the next five years.

Energy for thermal power generation goes to ammonia and hydrogen.



Membakar hidrogen atau hidrogen + bahan bakar lainnya dengan turbin gas untuk mendapatkan gaya rotasi dan menghasilkan listrik

PLN PERTAMINA

HOKUSAN TOYAMA HYDROGEN

FS (Feasibility Study)

Implementation

※ image

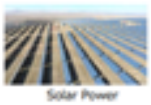
Memfasilitasi ekspansi global Infrastruktur Lingkungan melalui JCM

<FY2030 Target >

- **Aiming for a cumulative GHG emission reduction of about 100 million tons of CO2 from JCM projects through public-private partnerships**
  (maximum project size of about 1 trillion Japanese Yen (approx. ten billion USD) through public-private partnerships with a diversification of funds accelerating the implementation of projects).
- The project will also be used for Japan's emission reduction goal.

⇒To realize above, MOEJ will proceed condition arrangement for JCM expansion

1. **Renewable Energies**
   (Solar Power, Wind Power, Hydro Power, Geothermal Energy, Biomass Energy, Green Hydrogen, and so forth)


Solar Power


Wind Power

2. **Green Logistics** (Including Cold Chain)
   (Non-Fluorocarbon Cooling System, Modal Shift, Airports, Ports and Harbors, and so forth)


High-Efficient Freezer


Modal Shift

3. **Waste management Infrastructure**
   (Waste to Energy, Recycling system, Landfill and so forth)

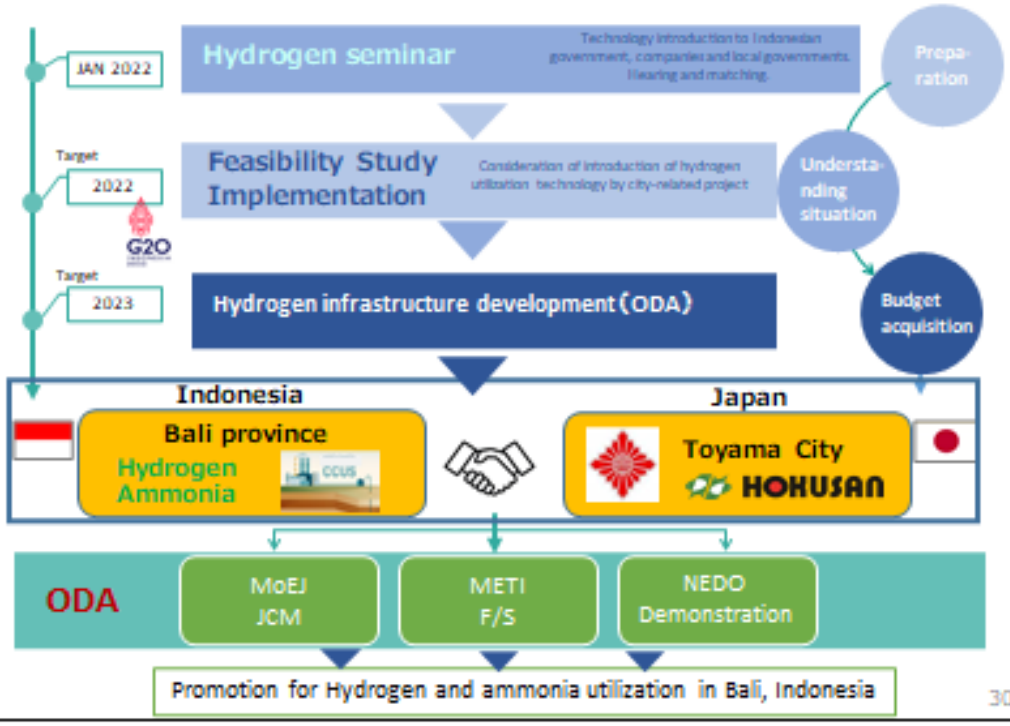

Waste to Energy


Improvement of landfill (Fukuoka method)

※ Further including energy efficient facilities, effective use of energies, CCUS, fluorocarbons recovery and destruction, Johkasou, and REDD+, in addition to the above

29

Realisasi bisnis melalui City-to-City Collaboration PJ



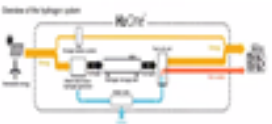
30

Contoh upaya pengembangan energi hidrogen di Indonesia

Rencana pengembangan energi hidrogen di Pulau Sumba

Pengembangan pembangkit listrik tenaga surya/angin dan sistem penyimpanan hidrogen oleh French HDF Energy

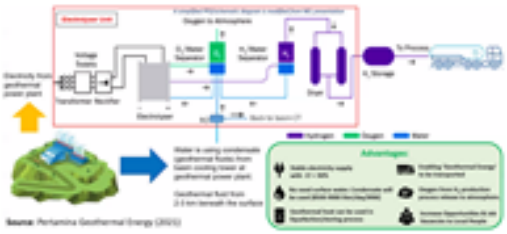
Demonstrasi hidrogen oleh BPPT dan Toshiba



Pilot Project for Demonstration (BPPT – Toshiba) Hydrogen Based Autonomous Electricity System (H2One) Application of Hydrogen Technology for Smart Grid System in Baron

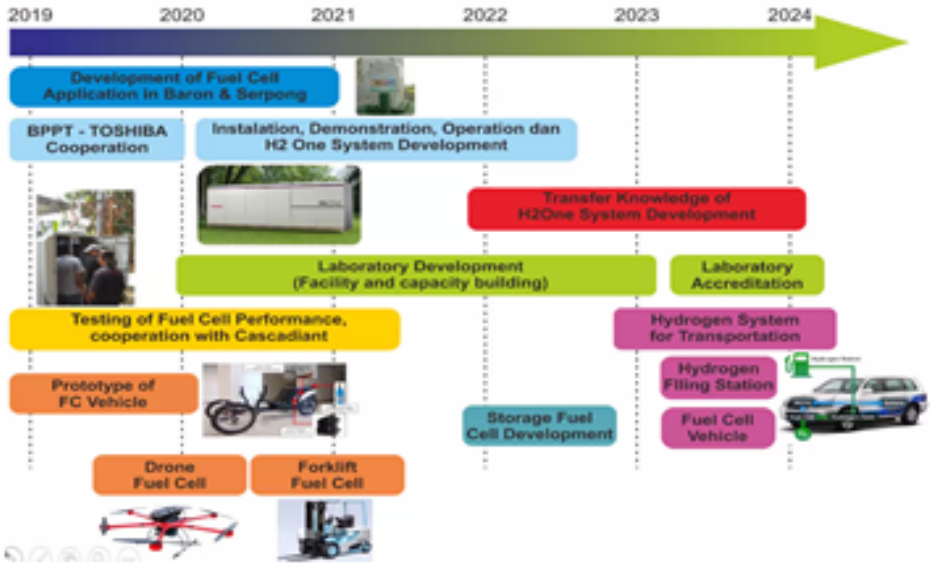
Sistem pasokan energi hidrogen mandiri untuk pulau-pulau terpencil

Demonstrasi Pertamina / GIZ



Demonstrasi produksi hidrogen memanfaatkan pembangkit listrik tenaga panas bumi
Diminta untuk menyelidiki pengenalan teknologi hidrogen dalam rangka kerjasama antar kota

Road Map of Fuel Cell and Hydrogen Technology



Badan Pengkajian dan Penerapan Teknologi (BPPT), Indonesia (April 2021) "Tren Terbaru Energi Hidrogen di Indonesia"

Stasiun hidrogen kecil mandiri

simple.fuel.™

simple.fuel. is an
all-in-one on-site hydrogen
generation and dispensing solution

simple.fuel. uses water and electricity
to generate high purity hydrogen,
compress, store and dispense to
350 or 700 bar.

:ctive

IVYS Energy Solutions

PDC MACHINES.COM

SIMPLE FUEL

Architecture

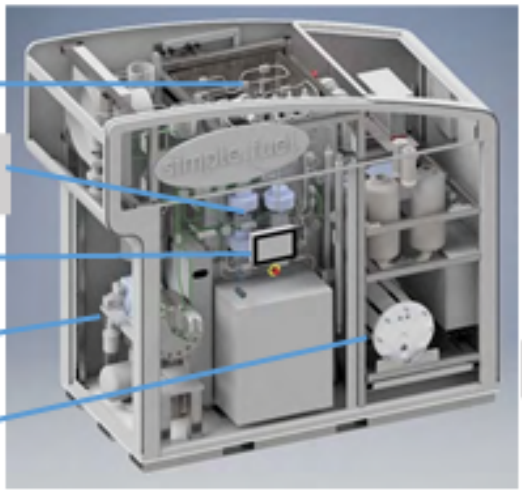
H2 Storage
4.8 kg
2-hr firewall

H2 Valve Panel
1. Initial equalization
2. 2. Boost

Control Panel
PLC Remote access

Compressor
H2 to 350-700 bar
Top off vehicle

Electrolyzer Stack
20 kg/day



Minimal setbacks
Adjacent to building

Moved Easily
Plug and play

Standardized
product
•NFPA (US)
•IOS (Australia)
•CE (Europe)
•KHK (Japan)

Simplified Permitting
Factory 3rdParty Cert

SIMPLE FUEL

Location
Toyota City, Japan

Application
Forklifts in auto manufacturing of Mirai FC vehicles

Performance
- Commissioned March 2019
- Supports 6 forklifts

Install 5 and 6 | Toyota L&F Takahama Plant, Aichi Prefecture

Capacity	10 or 20 kg/day
Pressure	350 / 700 bar
Electricity	480/400VAC 60/50Hz
Power	30 or 60 kW
DI Water	6 or 12 l/h
H2 Purity	SAE J2719 / ISO 14687
Protocol	SAE J2601-4 (ambient)
Noise	< 70 dB
Temp	-20 to 40 deg C
Footprint	~3.0 m L x ~1.2 m W
Environment	Indoor / outdoor
Comms	PLC / wireless data
Certification	Intertek at factory

SIMPLE FUEL

Mobil penarik sel bahan bakar hidrogen

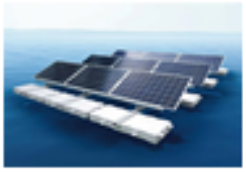
Pengenalan energi terbarukan dan infrastruktur hidrogen ke fasilitas bandara

Bus sel bahan bakar hidrogen

Forklift sel bahan bakar hidrogen

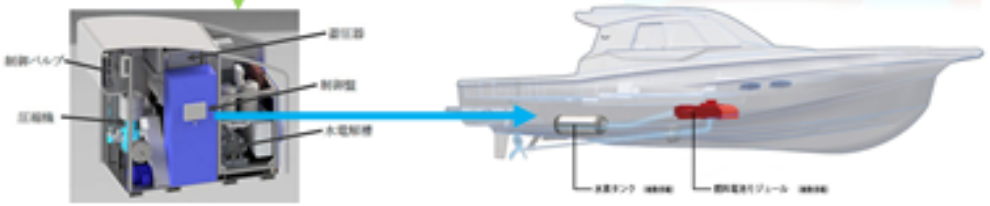
SIMPLE FUEL

Pengenalan energi terbarukan dan infrastruktur hidrogen ke kapal kecil



simple.
.fuel.™

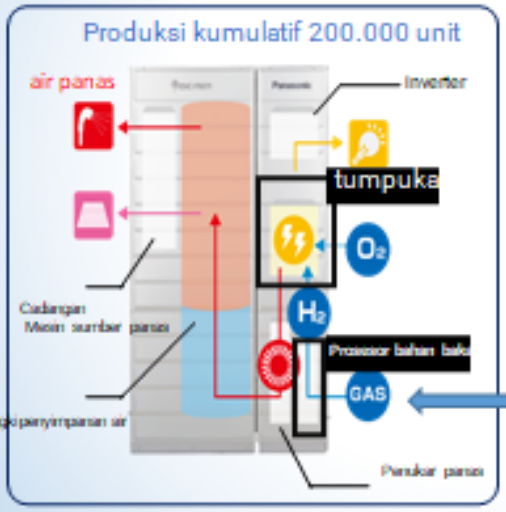
RE100



Sistem sel bahan bakar untuk kapal

FUEL CELL

ENE-FARM



LPG OR CNG

Sel bahan bakar yang dapat diperkenalka dalam skala kecil

Transportation 【Hydrogen】

Fuel cell

Fuel cell Railroad vehicle
「HYBARI」
JR East、TOYOTA、HITACHI
2 car train,maximum speed100km/h、
Cruising range140km
Scheduled to start testing in 2022

Fuel cell ship IWATANI, Kansai Electric Power and others
full length:30m,Gross weight:60t,
100people、Speed:9knot・20km/h,
Expo 2025 Osaka / Kansai Expo scheduled to be commercialized as a passenger ship.

Fuel cell vehicleTOYOTA
Cruising distance 850km、5 seater、
tank capacity 5.5kg
Started sales in 2014
Spread in Japan:6,500units

Fuel cell large truck
ASAHI,Seino Transportation,YAMATO transport,TOYOTA and others
Gross weight25t、tank70MPa、
Cruising range600km
Scheduled to start testing in 2022

Hydrogen engine

Hydrogen engine bus
Tokyo City University
Maximum output：105kw/3000rpm
Maximum torque:350Nm/2000rpm
2009Proven

Liquefied hydrogen transport ship

Ship for transporting liquefied hydrogen
Full length:116.0m,Gross weight:
8,000t,
Cargo tank volume: 1,250m3,
Power：Diesel power generation・electricity, Speed: 13.0knot,25people

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Masa depan hidrogen

Membantu mendekarbonisasi seluruh wilayah dengan elektrifikasi dan hidrogen
Mengusulkan bisnis yang melibatkan kredit karbon

Terima kasih !
Mari bertemu kembali

HOKUSAN CO.,LTD

Attached Document 4: Minutes of Toyama City-Bali Seminar on Hydrogen

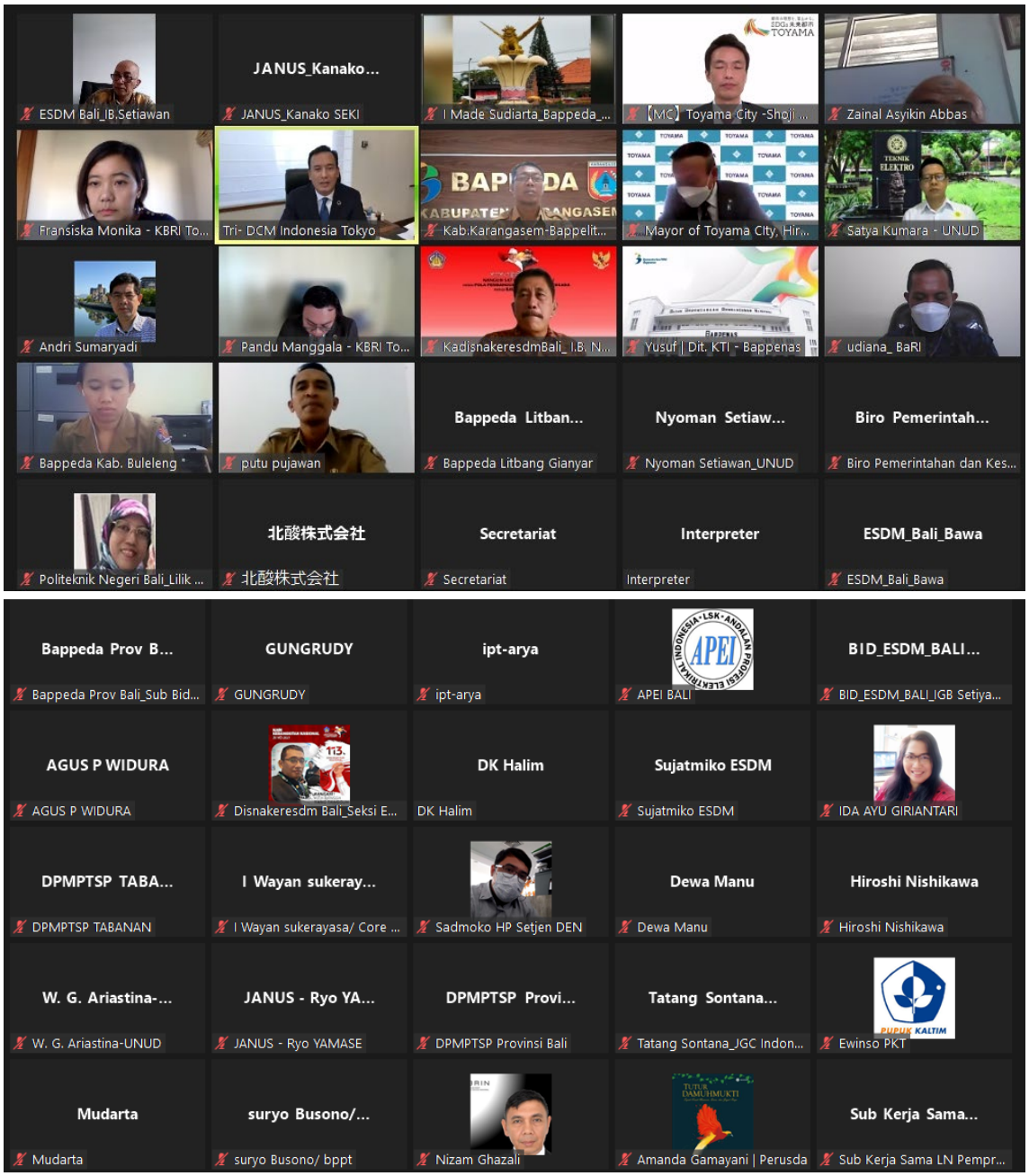
Hours 時間	Program プログラム	Speaker / Presenter 発表者
13.00 – 13.15 WIB 14.00 – 14.15 WITA 15.00 – 15.15 JST	Opening Remarks 開会あいさつ	Mr. Hirohisa Fujii　Mayor of Toyama City 富山市　藤井　裕久市長
		Bali Province Dinas Ketenagakerjaan dan ESDM Provinsi Bali Ida Bagus Ngurah Arda バリ州　エネルギー労働・鉱物資源局長 イダ・バグース・アルダ局長
13.15 – 13.20 WIB 14.15 – 14.20 WITA 15.15 – 15.20 JST	Welcoming Remarks from the Embassy of Indonesia in Japan 在日本インドネシア大使館よりご挨拶	Deputy Chief of Mission - Mr. Tri Purnajaya Embassy of the Republic of Indonesia 駐日本インドネシア大使館 トリ・プルナジャヤ公使
13.20 – 13.25 WIB 14.20 – 14.25 WITA 15.20 – 15.25 JST	Photo session 写真撮影	Speakers and Participants 参加者各位
13.25 – 13.55 WIB 14.25 – 14.55 WITA 15.25 – 15.55 JST	Introduction to hydrogen utilization technology 水素利用技術に関するご紹介	Mr. Yosuke Wakaki HOKUSAN Co., Ltd. 北酸株式会社　若木洋介様
13.55 – 14.45 WIB 14.55 – 15.45 WITA 15.55 – 16.45 JST	Discussions ご意見交換	All Participants 参加者各位
14.45 – 14.55 WIB 15.45 – 15.55 WITA 16.45 – 16.55 JST	Closing remarks セミナー総括	Representative of Toyama City Representative of Bali Province 富山市及びバリ州
14.50 – 15.00 WIB 15.50 – 16.00 WITA 16.50 – 17.00 WITA	Closing	

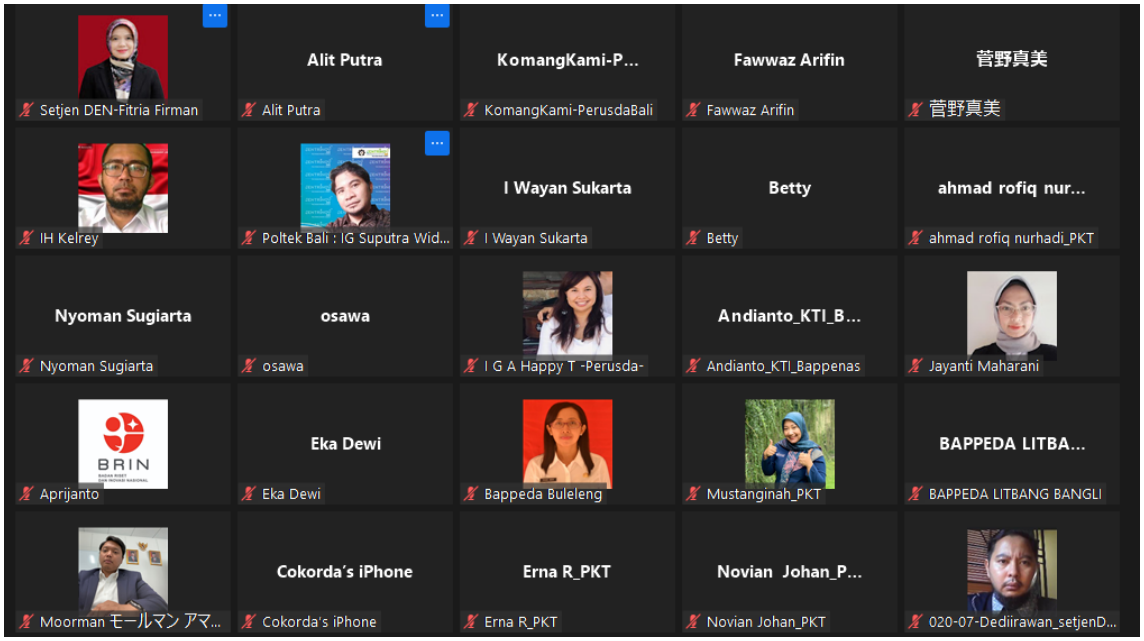
・ Address of the mayor

- Head of ESDMArda of Bali

- Minister Tri of the Indonesian Embassy in Japan

15:18 Participants

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Alit Putra
Alit Putra
KomangKami-P...
KomangKami-PerusdaBali
Fawwaz Arifin
Fawwaz Arifin
菅野真美
菅野真美
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Poltek Bali : IG Suputra Wid...
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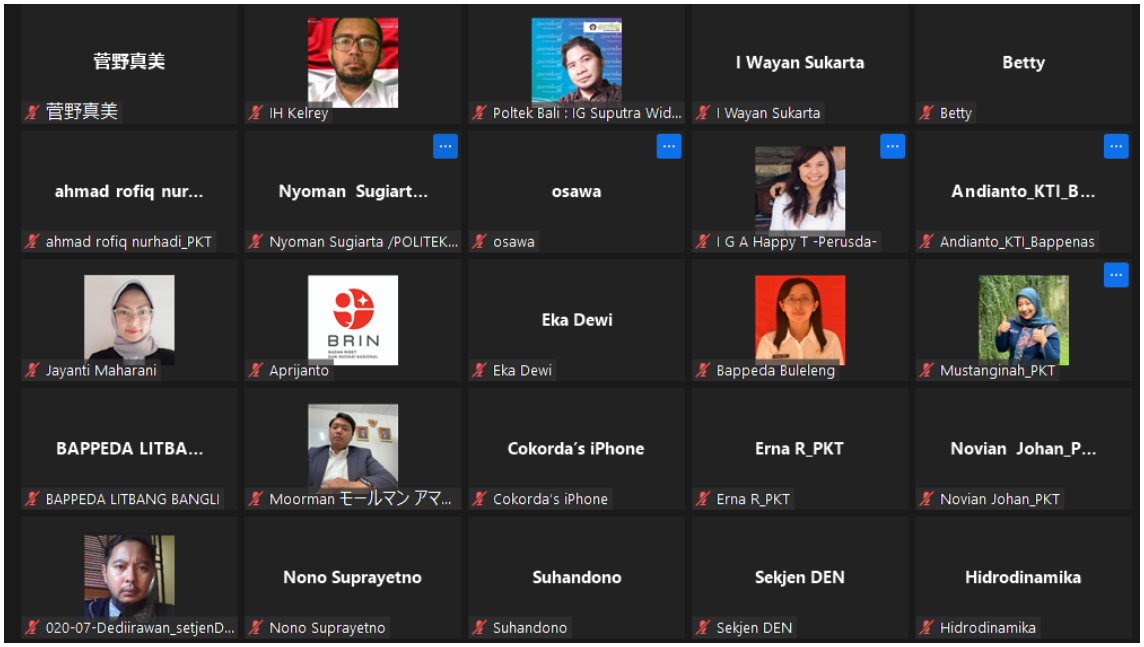
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BAPPEDA LITBANG BANGLI
Moorman モールマン アマ...
Cokorda's iPhone
Cokorda's iPhone
Erna R_PKT
Erna R_PKT
Novian Johan_P...
Novian Johan_PKT
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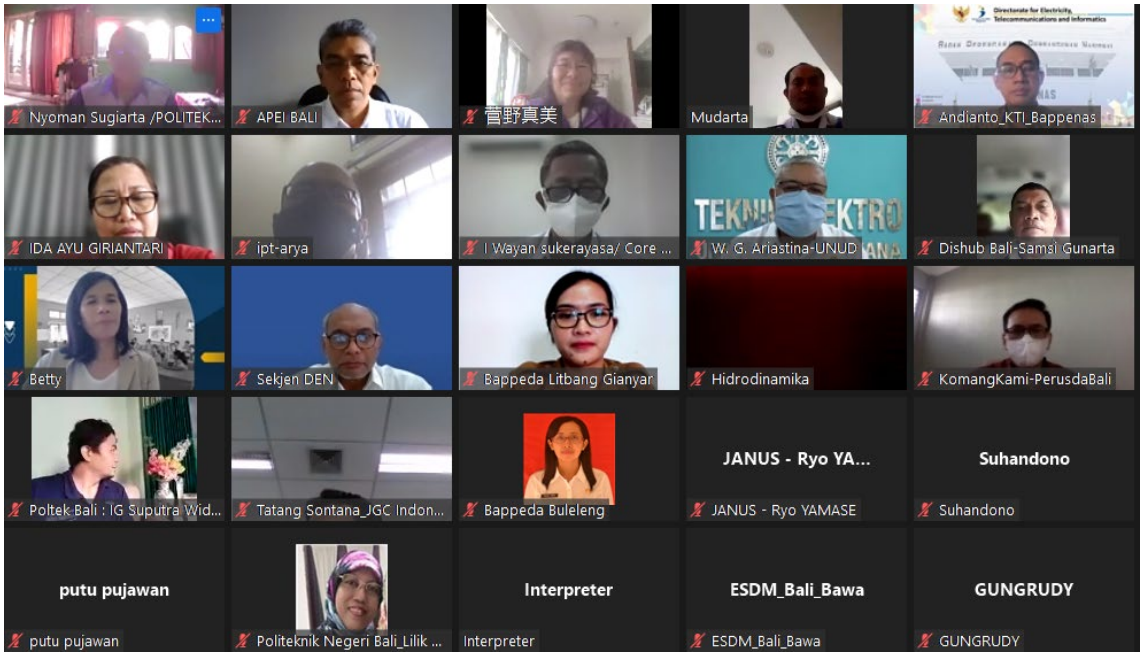
Nono Suprayetno
Suhandono
Suhandono
Sekjen DEN
Sekjen DEN
Hidrodinamika
Hidrodinamika

- Group photo


ESDM Bali_IB.Setiawan
JANUS_Kanako...
JANUS_Kanako SEKI
I Made Sudiarta_Bappeda_...
【MC】Toyama City -Shoji KOB...
Zainal Asyikin Abbas
Fransiska Monika - KBRI To...
Tri- DCM Indonesia Tokyo
Kab.Karangasem-Bappelit...
Mayor of Toyama City, Hir...
Satya Kumara - UNUD
Andri Sumaryadi
Pandu Manggala - KBRI To...
KadisnakeresdmBali_I.B. N...
Yusuf | Dit. KTI - Bappenas
udiana_ BaRI
Bappeda Kab. Buleleng
putu pujawan
北酸株式会社
Nyoman Setiawan_UNUD
Biro Pemerintahan dan Kes...
Secretariat
Bappeda Prov Bali_Sub Bid...
Hiroshi Nishikawa
JANUS - Ryo YAMASE
Dewa Manu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putu pujawan
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Interpreter
Interpreter
ESDM_Bali_Bawa
ESDM_Bali_Bawa
GUNGRUDY
GUNGRUDY

- Presentation by Hokusan

- Address of Toyama City

- Bali

----------Q&A----------

- Zainal: Hydrogen has been already utilized since 1981, but back then natural gas was converted into hydrogen. I've been on the team since 1985 and received training from Chiyoda Kako at an ammonia production plant. Hydrogen has a very high heat quantity, and its potential is massive, but the small molecule size is a problem. It is hoped that Japanese technology will enable us to start storing hydrogen - in any case, we need the technology to handle it. The use of hydrogen as energy is also being considered here in Indonesia and we believe that hydrogen can be utilized as a resource in the way described earlier. I would like to assist with hydrogen production in Indonesia with Japan's initiative. I wish the project a great success. I've also been involved in several projects led by BPPT.
- Satya Kumara (Udayana University): Do you have any future plans to introduce small-scale pilot projects and hydrogen supply facilities in the future?
  - Hokusan: We are hoping to do that somewhere in the Province of Bali and are currently looking for a partner.
- Sekjen DEN: Which is the most economical when hydrogen is compared to other clean energy sources?
  - Hokusan: As of now, other clean energy sources are more cost-effective, but the cost will eventually drop when hydrogen is manufactured on a larger scale. It would be even better if hydrogen can be produced through renewable energy.
- Francisca: You mentioned that you are looking for a partner in Bali: what are the prerequisites?
  - Hokusan: We are looking for an existing energy supplier or energy user who would be able to realize decarbonization by using hydrogen.
- BAPPENAS Yusuf: There are green hydrogen and grey hydrogen. Could you share your views on when green hydrogen would become commercially available when you draw the economic efficiency curves of the renewable hydrogen and natural-gas-derived hydrogen?
  - Hokusan: It is cheaper to make it from natural gas now. When the infrastructure for renewable energy is better established in the future, the environmental value of renewable hydrogen is expected to increase and so will the demand for it, eventually pushing the cost down.
  - BAPPENAS Yusuf: Exactly how much is the difference?
  - Hokusan: I will mention the difference in economic scale when I return to this topic later.
- BAPPENAS Yusuf: What are the current needs in Japan regarding the ammonia supply chain? Green or grey? If there is a plan to gradually replace it with the green hydrogen in the future, please tell us about it too.
  - Hokusan: In Japan, hydrogen is manufactured from natural gas and naphtha. Coal-fired power plants in Japan are obligated to do the mixed combustion with ammonia.
  - BAPPENAS Yusuf: What does it mean to be mixed with coal? Is it a mixture of coal and hydrogen?
  - Hokusan: Since it becomes a gas in the combustion furnace, ammonia can be matched in

from the burner in this state and burned together. The fact that coal-fired power plants are matched with ammonia and natural gas is hydrogen is due to the difference in combustion speed.

  - Francisca: Mitsubishi is considering mixed combustion at power plants in Surabaya and Pyton. Theirs is the mixed combustion of coal and ammonia and they are discussing the supply chain.

- Alit Putra: Might there be the issue of safety regarding the storage of hydrogen? Even if it leaks, it has no smell or color, which makes it difficult to detect. How can we ensure its safety?
  - Hokusan: It is basically stored in high-pressure containers. Although structurally the leakage is not likely, they are designed to leak safely and disperse the leakage very quickly as a safety measure in the unlikely event of a leak. In addition, Japan has an advanced sensor technology, and hydrogen detectors are attached to ensure safety.
- Sekjen DEN: Is hydrogen derived from water?
  - Hokusan: We do not stick to water. Currently, water decomposition accounts for most of the production, but producing hydrogen from coal and oil is also an efficient method although carbon needs to be replaced by CCS or a different substance.
- Alit Putra: Teknologi hidrogen memerlukan tempat penyimpanan yang terjamin keamanannya dan itu masih sulit untuk direalisasikan.. Hidrogen yang bocor dari tabung penyimpanannya tidak dapat terdeteksi, dikarenakan sifat hidrogen yang tidak berwarna dan tidak berbau. Hal tersebut dapat menyebabkan sumber ledakan dan kebakaran pada ruangan tempat penyimpanan tabung gas hidrogen. Bagaimana cara memastikan hal tersebut?
  - Hokusan: It may be stored and used in other situations like using the hydrogen produced in the summer in the winter.
- Zainal: Regarding safety and risk issues, there was an accident in which a concrete tank of cooling water exploded at a fertilizer plant, killing two people. Hydrogen-related tragedies have already been caused twice in fertilizer plants. We do have to balance safety and technology.
- Suryo: I am a former BPPT employee. I did some research into fuel cells in the past. I think hydrogen storage could pose a problem. Do you use hydrogen storage alloys or tanks?
  - Hokusan: In Japan, we generally use compressed hydrogen. It is stored at a high pressure such as 90 MPa.
- ESDM Setiawan: I have a question about the EUP process – how much waste can be used to ensure economic efficiency?
  - Hokusan: At the smallest scale, it is possible to operate at about 150 t/day.
- BAPPENAS Yusuf: Bagaimana tingkat NOx apabila PLTU menggunakan ammonia?
  - Hokusan: In Japan, we are also managing to keep it below the level set by air pollution regulations. For this purpose, catalysts are mixed to reduce the concentration of nitrogen oxides.
- Suryo: For storage, might it be better to use hydrogen storage alloys?
  - Hokusan:

- Zainal: We have already experienced two hydrogen explosions. I hope that they will be used as the beacon to diffuse safety among Indonesian people. I would like to propose that by cooperating with Japan, it is possible to manufacture larger-scale hydrogen plants. I would keep insisting that we will solve the problem with technologies. We greatly hope that the hydrogen industry will grow in Indonesia.
- Yosi (Pertamina Gas): We would like to provide as much support as possible in developing clean energy sources including hydrogen in the future. We have also signed a MoU with JANUS, so we would like to continue to cooperate in the future.
- Nyoman Sugiarta: How expensive is hydrogen electrolysis technology? Would it also require electric energy? What kind of power is used in the case of Bali?
  - Hokusan: The cost of using electrolysis has to be as low as possible. To achieve this, we are considering using renewable energy actively. The renewable energy potential isn't simple in Bali, but something like floating solar panels may be suitable.
- Satya Kumara: Is the carbon tax already applied in Japan? How much if it is?
  - Toyama City: It has not yet been introduced in Japan.
- Zainal: Technically, electrolysis using marine resources tends to be expensive. There are many such facilities in Indonesia. It is necessary to use such energy such as hydropower and geothermal energy wisely. If hydrogen is produced by electrolysis using seawater, substances required in different industries can be also produced. So, would it be better to do electrolysis using seawater while simultaneously producing various by-products even if it costs more to some extent?
- BAPPENAS Yusuf: I have a question to Mr. Zainal. When it comes to electrolysis of seawater, does it mean that seawater is used? Wouldn't problems like corrosion become an issue? I usually associate electrolysis with fresh water.
  - Zainal: It is easy to see many potential risks, but we have to overcome them. We also offer corrosion-proof products. With certain chemical substances, we should be able to contain the level of corrosion. You're going to use a lot of electric energy, but it's important where you bring low-cost electricity from. Solar may be expensive now in terms of panel prices, but there are ways to make them cheaper. It may also be necessary to promote more renewable energy such as geothermal energy.
- BAPPENAS Yusuf: There is a plan to relocate the capital and hydrogen is expected to be one of the new energy sources in the new capital. We have a high hope for the green hydrogen in the long term.
- Mudarta: Is hydrogen technology widely used in the transportation field? If so, what are its potential challenges?
  - Hokusan: Safety regulations are strict in Japan, and the problem is that the measures against safety regulations are costly.
- Satya Kumara: How do you go about using the renewable energy in Toyama City? Are you giving citizens any incentives to prevent depopulation?
  - Toyama City: Hydrogen stations are being installed and promoted. We are also testing

hydrogen vehicles for waste collection vehicles in our city. There are also plans to start new experiments in the future.

----------Chat Box----------
From Ewinso PKT to everyone 03:27 PM
selamat siang Bapak/Ibu Panitia, mohon dapat di share materinya apabila berkanan. terima kasih
From Fransiska Monika - KBRI Tokyo to everyone 03:28 PM
Materi akan disampaikan pada sesi penutupan nanti.
From Satya Kumara – UNUD to everyone 03:48 PM
Dalam rencana ke depan, apakah akan ada pilot proyek pabrik hydrogen skala kecil dan mesin yg disuplai hidrogen sbg pengenalan transfer teknologi ini di Bali atau bagaimana. Terima kasih.
From Sekjen DEN to everyone 03:49 PM
Hydrogen ini jika dibandingkan dengan energy lainnya seperti BBM, BBN (biosolar) dan batery listrik untuk kendaraan mana yg lebih ekonomis, trims
From Alit Putra - PD. BMB - PLTS 1 MWp Bangli to everyone 03:58 PM
Teknologi hidrogen memerlukan tempat penyimpanan yang terjamin keamanannya dan itu masih sulit untuk direalisasikan.. Hidrogen yang bocor dari tabung penyimpanannya tidak dapat terdeteksi, dikarenakan sifat hidrogen yang tidak berwarna dan tidak berbau. Hal tersebut dapat menyebabkan sumber ledakan dan kebakaran pada ruangan tempat penyimpanan tabung gas hidrogen. Bagaimana cara memastikan hal tersebut?
From Sekjen DEN to everyone 04:02 PM
hydrogennya apakah berasal dari water (H20) ?
From Alit Putra - PD. BMB - PLTS 1 MWp Bangli to everyone 04:06 PM
Is it possible hydrogen produced from excess renewable energy could in turn provide a source of energy storage that is released when wind and sunlight levels are low? That would address one of the primary concerns about the intermittent nature of solar and wind energy.
From ESDM Bali_IB.Setiawan to everyone 04:15 PM
konichiwa mina-san...menyambung tanggapan p.satya kumara, terkait waste (plastik atau amonia) menjadi energi hidrogen...secara skala teknis
From Fransiska Monika - KBRI Tokyo to everyone 04:16 PM
Bapak Ibu, berikut disampaikan materi yang disampaikan ole Hokusan pada Seminar kali ini. Sekiranya ada informasi tambahan yang diperlukan, silahkan mengajukan melalui email ke economics@kbritokyo.jp
Terima kasih
From Poltek Bali : IG Suputra Widharma to everyone 04:20 PM
Teknik penyimpanan hidrogen banyak telah diteliti. Pengembangan teknologi penyimpanan hidrogen dengan penyimpanan fisik hidrogen, yang meliputi hidrogen terkompresi, kriogenik dan terkompresi krio. Demikian juga penyimpanan adsorpsi, di mana kerangka logam-organik, bahan berbasis karbon, dan polimer organik berpori. Selanjutnya, penyimpanan kimia hidrogen dalam bentuk hidrida logam, organik cair, amonia, asam format, dan metanol.
Terima kasih 🙏
From Yusuf | Dit. KTI – Bappenas to everyone 04:21 PM
Bagaimana tingkat NOx apabila PLTU menggunakan ammonia?

From suryo Busono/ bppt/LBT to everyone 04:23 PM
hYDROGEN STORAGE SEBAIKNYA PAKAI NiNh (METHAL HYDRID)? menghidari kecelakaan kayak di Bontang /PKT
From Yosi Aditya Sembada to everyone 04:30 PM
Terima kasih, dari saya belum ada tanggapan
Mohon maaf untuk izin leave karena saya ada meeting lain
From Nyoman Sugiarta /POLITEKNIK NEGERI BALI to everyone 04:33 PM
Seberapa mahal teknologi elektrolisis hydrogen ini...untuk elektrolisis juga perlu energi listrik.. (listrik apa yang dipakai spt di bali) bandingkan dg baterai itium
From Satya Kumara - UNUD to everyone 04:36 PM
Apakah di Jepang sudah diterapkan pajak karbon oleh pemerintah kpd pihak2 yang mengemisikan karbon? Kira2 brp besaran pajak per kg karbondioksida yg diemisikan? Terima kasih.
From Mudarta - Dishub Bali to everyone 04:38 PM
Apakah teknologi hidrogen Ini sudah ditetapkan secara luas di Sektor transportasi. Kira2 apa tantangan utama dalam implementasinya?
From Satya Kumara - UNUD to everyone 04:44 PM
Bagaimana Pemerintah Toyama dalam mengembangkan atau mempercepat pemanfaatan energi terbarukan, mislanya hydrogen FC atau yg lain, di masyarakat? Apakah misalnya memberikan insentif atau hal lain kpd masyarakat? Terima kasih.
From Ewinso PKT to everyone 04:46 PM
Terkait dengan Feasibility Study CCS/CCUS apakah perusahaan kami (Pupuk Kaltim) dapat lngsung bekerjasama dengan toyama-hokusan ?
