FY2022　Project for Ministry of the Environment Japan

FY 2022
City-to-City Collaboration Programme for Zero-carbon Society

Project to Promote SDGs Future City with Renca, Santiago

Final Report

March 2023

Nippon Koei Co., Ltd.
Toyama City

FY 2022
City-to-City Collaboration Programme for Zero-Carbon Society
Project to Promote SDGs Future City with Renca, Santiago

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Abbreviations

ART	Advanced Rapid Transit
CCU	Carbon dioxide Capture and Utilization
CGS	Co-Generation System
CN	Carbon Neutral
COP	Conference of the Parties
COVID-19	Coronavirus Disease of 2019
CSR	Corporate Social Responsibility
DDF	Diesel Dual Fuel
DEL	Directorate of Local Economic Development
DIDECO	Directorate of Community Development
DIMAO	Directorate of Environment, Cleaning and Ornament
DOM	Directorate of Municipal Works
ESCO	Energy Service Company
EV	Electric Vehicle
FC	Fuel Cell
FCEV	Fuel Cell Electric Vehicle
GEC	Global Environment Centre Foundation
GHG	Greenhouse gas
ICT	Information and Communication Technology
JCM	Joint Creditting Mechanism
KPI	Key Performance Indicator
LED	Light Emitting Diode
METI	Ministry of Economy, Trade and Industry
MW	Mega Watt
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreemen
PV	Photovoltaic
SDGs	Sustainable Development Goals
SECPLAN	Communal Planning Secretary
SMI	Sakai Mobility Inovation
SPEC	Special Presidential Envoy for Climate
SPEC	Special Presidential Envoy for Climate
UNFCCC	United Nations Framework Convention on Climate Change
VPP	Virtual Power Plant
V2H	Vehicle to Home
ZEB	Net Zero Energy Building

CHAPTER 1. BACKGROUND AND OBJECTIVES

1.1 BACKGROUND

The 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), held in November 2021, confirmed a new global goal of limiting the temperature increase to 1.5°C above pre-industrial levels. To achieve this goal, it is essential for each country to accelerate its efforts at various levels, such as state, city, and district levels. In Japan, the goal of a decarbonized society with zero greenhouse gas (GHG) emissions by 2050 has been declared, and the number of municipalities declaring virtually zero CO_2 emissions has rapidly increased to more than 600 (as of April 30, 2022). Under the regional decarbonization roadmap formulated in June 2021, advanced measures are being created in each region, and efforts are being made to expand these measures throughout the country.

As described above, the role of cities and municipalities in considering and implementing specific regional climate change measures and projects is becoming increasingly important. To realize a decarbonized society in the whole world, it is necessary to accelerate the movement toward building a sustainable decarbonized society, especially in Asia, where economic growth is remarkable, and there is a growing international movement to support cities' efforts to decarbonize their cities, which are places of activity that support social and economic development.

In addition, under the current situation of the spread of COVID-19, cities are being forced to recalibrate and consider new measures to achieve sustainable development at the same time as dealing with challenges related to the spread of the virus.

In this City-to-City Collaboration Programme, Japanese research institutes, private companies, universities, etc., together with Japanese cities that have experience and know-how in the formation of decarbonized societies, conduct a research project to support overseas municipalities in forming decarbonized societies and introducing facilities that will contribute to forming them.

In 2020, the Government of Chile updated its nationally determined contribution (NDC) and set an interim target of 95 $MtCO_2eq$ of greenhouse gas (GHG) emissions by 2030, an emissions peak by 2025, and a carbon budget not exceeding 1,100 $MtCO_2eq$ from 2020 to 2030 with a vision to achieve carbon neutrality by 2050[1]. In 2019, Government also announced a plan to close all coal-fired power plants by 2040 and achieve carbon neutrality in the energy sector by 2050, and to aim at 70% of the energy mix to be based on renewable energy by 2030.[2] To achieve these government targets as well as green recovery from COVID-19 pandemics, there are high expectations for reduction of GHG emissions and financial support by JCM model projects mechanisms.

[1] https://mma.gob.cl/wp-content/uploads/2020/07/Ingles-21-julio.pdf

[2] https://www.gob.cl/noticias/presidente-pinera-presento-plan-para-cerrar-todas-las-centrales-energeticas-carbon-para-que-chile-sea-carbono-neutral/

At the municipal level, Renca Municipality, located in the capital city of Chile, Santiago, is one of the municipalities where GHG emission sources such as thermal power plants and factories are concentrated. Renca has been actively committed to climate change issues and announced participation in Race to Zero campaign at COP26 in 2021, as a first municipality of Chile. As one of the solutions to achieve the target of Race to Zero, there are high expectations for knowledge and information sharing through city-to-city collaboration projects and financial support through JCM model projects.

1.2 OBJECTIVES OF THE PROJECT

This project has mainly two purposes: i) support Renca municipality develop policies/plans to achieve their goals for Race to Zero, and ii) reduce GHG emission by formulation of JCM projects following the needs of the companies in Renca using the technology such as energy saving, renewable energy, and hydrogen energy, and implemented the following activities.

＜City-to-city collaboration activities: Support for policy formulation＞

- Sharing information on the methods of target setting and progress monitoring of decarbonization and the SDGs
- Visualization of the progress for SDGs by Renca municipality using an assessment tool, namely “TSUMUGI@”, and discussion to advance their activities for SDGs
- Sharing information on the decarbonization lead by the local government in Japan

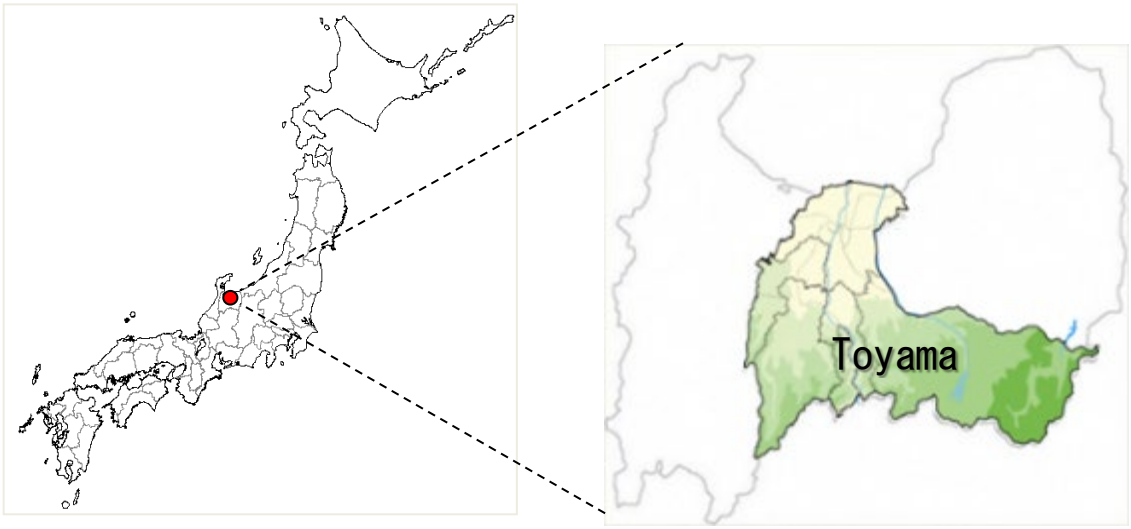
＜JCM project formation activities＞

- Formulation of JCM model projects etc.

1.3 CITIES PARTICIPATING IN THE PROJECT

1.3.1 Toyama City

Toyama City is the capital and the largest city of Toyama Prefecture, located in the central and southeastern part of the prefecture, and is designated as a core city. The location map of Toyama City is shown in the following figure, and the main statistics of the city are shown in the following table.



Source: Toyama City

Figure 1-1 Location map of Toyama City

Table 1-1 Outline of Toyama City

#	Item	Overview
1	Area	1,241.70 km^2
2	Population	409,075 (as of December 2022)
3	Population density	329 people/km^2 (as of December 2022)
4	Number of households	184,036 (as of December 2022)
5	Number of businesses	22,883 (Economic Census for Business Frame in 2019)
6	Major industries	Wholesale and retail trade:348 establishments (18.6%) Real estate and goods leasing:238 establishments (12.8 %) Construction industry:197 establishments (10.6%) (Basic Survey of Economic Census, 2019)

Source: Prepared by Nippon Koei based on the Toyama City

Toyama City has been actively publishing its efforts to build a sustainable city both in Japan and abroad (Table 1-2). Toyama City has experience of international cooperation in environmental and agriculture fields, including the Ministry of the Environment's City-to-City Cooperation Project, mainly in Southeast Asia, especially in Indonesia.

The major initiatives by Toyama are summarized as follows.

Table 1-2 Activities of Toyama City for Sustainable Urban Development and City-to-City Collaboration

Year	Item	Overview
2008	ECO Model City	Efforts to shift to a "low-carbon society" and CO_2 reduction plan based on the compact urban development were highly evaluated.
2011	Environmental Future City	The strategic proposal for a compact city was considered to be a model for solving the problems faced by local cities. It also plays a role in disseminating Toyama City's knowledge and various initiatives both nationally and internationally.
2014	Sustainable Energy for All	A plan aimed at improving energy efficiency was formulated to achieve the targets proposed by the United Nations SE4ALL.
2014	100 Resilient City	Toyama City was selected by the Rockefeller Foundation as one

Year	Item	Overview
		of 100 Resilient Cities (RC100) that have resilience to risks and challenges faced by cities, such as natural disasters.
2016	G7 Toyama Environment Ministers Meeting	Promoting city-to-city collaboration for development of resilient cities that have the best balance between quality of life, economic growth and the environment. Mayor Mr. Mori summarized the discussions in the parallel session "The Role of Cities" as the Chair of session.
2018	FY2018 City-to-City Collaboration Project between Toyama City and Bali, Indonesia	Toyama City, as a diverse environmental city, shared their knowledge with Bali, and examined the application of JCM model projects with low-carbon projects (energy saving, renewable energy, fuel conversion, etc.) in which companies in Toyama City have.
2018	SDGs Future Cities and model project for SDGs of local government	Toyama City was selected by the Cabinet Office as a municipality that integrally commit to a wide range of social and environmental issues.

Source: Prepared by Nippon Koei based on information provided by Toyama City.

The background of starting city-to-city collaboration between Toyama City and Renca Municipality is summarized in the following table.

Table 1-3 City-to-City collaboration between Toyama City and Renca Municipality

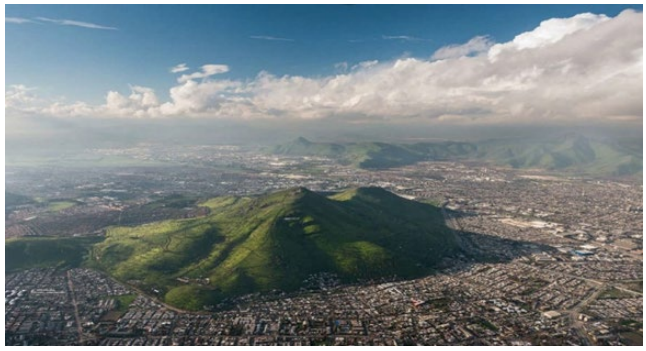
#	Period	Overview
1	March 2019	Mayor of Toyama and Renca exchanged their opinions at OECD Meeting.
2	May 2019	Toyama and Renca signed a cooperation agreement.
3	December 2019	Discussions between Renca and Toyama in Madrid (during COP25 of UNFCCC) was made on renewable energy and city-to-city collaboration project. Toyama provided information on its initiative for SDGs. Mayor of Renca expressed his interest in city-to-city collaboration project with Toyama.
4	March 2020	Information sharing on the municipal response to Covid-19.
5	September 2020	Started city-to-city collaboration project of Ministry of the Environment, Japan
6	August 2021	Started the second year of city-to-city collaboration project
7	June 2022	Started the third year of city-to-city collaboration project

Source: Prepared by Nippon Koei based on information from Toyama City

1.3.2 Renca Municipality, Santiago City

The partner city, Renca Municipality, is one of the 32 administrative municipalities of Santiago City, the capital of Chile, and has the following characteristics.

Estimated population: 608,470,000 (of which 11.9% is over 65) (as of 2020)
Area: 24.20km^2
Population density: 6,647/km^2 (as of 2020)
Climate: Mediterranean climate,
Annual rainfall about 281.0mm (Santiago City)
Geology: Renca hill is the symbol of Renca Municipality, located on the border with Kilicula Municipality to the north.

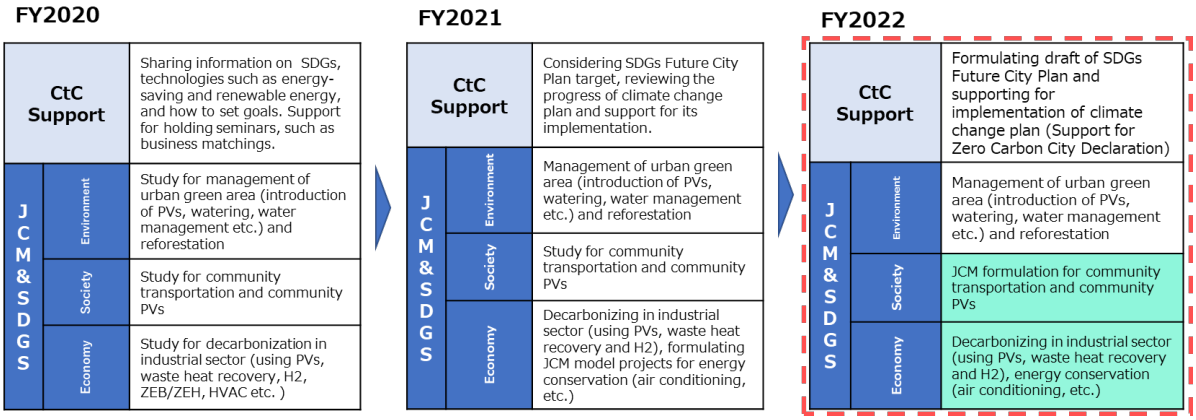


Source: Prepared by Nippon Koei from Instituto Nacional de Estadísticas

Figure 1-2 Location ap of Renca Municipality and Renca Hill

1.4 THREE-YEAR PLAN

In this project, based on the analysis of needs and issues of Renca Municipality, potential activities were examined as follows: 1) administrative support by city-to-city collaboration, 2) formulation of JCM model projects that contribute to the decarbonization of the city and 3) promotion of SDGs. The activities and targets for the three-year were planned as follows.



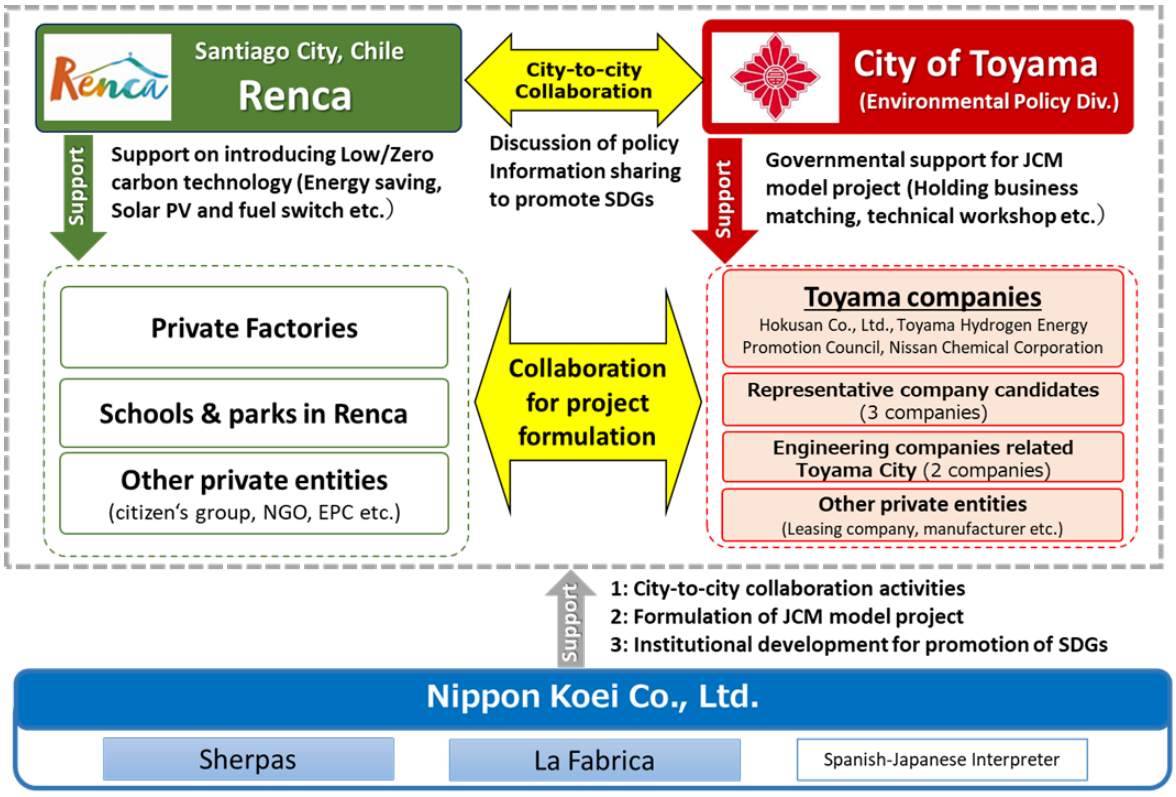
Source: Nippon Koei

Figure 1-3 Three-year plan

1.5 IMPLEMENTATION STRUCTURE OF THE PROJECT

The implementation structure of this project is shown in the following figure. Under the umbrella of collaboration between the two local governments, companies of both cities carried out activities for JCM model project formulation, and Nippon Koei plays a role of supporting the whole process as a consultant.

Since there was a possibility of cancellation of the travel to Chile due to the pandemic of COVID-19, implementation structure in Chile was strengthened to facilitate smooth discussions and conduct research activities with Renca Municipality and local companies, namely La fabrica and Sherpas, by subcontracting with public enterprises of Renca and local consultants.



Source: Nippon Koei

Figure 1-4 Implementation structure

1.6 SCHEDULE

The schedule of this project is shown in the following figure.

#	Project overview	June	July	August	September	October	November	December	January	February	March
City-to-City Collaboration Project											
1	Meetings between Toyama and Renca										
	1)Sharing SDGs activities and technologies such as energy-saving and renewable energy and target settings		→	→	→	→	→	→	→	→	
	2)Sharing information on Xero Carbon City Declaration		→	→	→	→	→	→	→	→	
2	Visualization and improvement of efforts to address SDGs by TSUMUGI@		→	→	→	→			→	→	
JCM Formulation											
1	Meetings and survey for JCM formulation		→	→	→	→	→	→	→	→	
2	Discussions on the consortium for JCM application for this and next fiscal years		→	→	→				→	→	
3	Planning MRV draft for JCM application for this and next fiscal year		→	→	→	→			→	→	
4	Preparation for JCM formulation after next fiscal year							→	→		
5	Support for project implementation					→	→	→	→	→	
Others (Regular meetings and events)											
1	Monthly progress report			▼	▼	▼	▼	▼	▼	▼	▼
2	Report meeting to MOEJ (about 3 times)				▼			▼		▼	
3	Workshop in Chile (Webinar)								▼		
	Meeting with Renca (online) about once or twice a month				▼	▼	▼		▼	▼	
4	Meeting designated by MOEJ: Chile (online)									▼	
5	Meeting designated by MOEJ: Japan (online)										▼
Survey and report											
1	Survey in Chile and sharing information		⇢	⇢	⇢	▼	⇢	▼	⇢	→	
2	Meetings in Japan (Toyama City or Tokyo)		▼		▼		▼		▼	▼	
3	Final report								→	→	▼

Source: Nippon Koei

Figure 1-5 Project schedule

1.7 OVERVIEW OF THE SURVEY IN CHILE

Since there was a possibility of cancellation of the survey from Japan to Chile due to the pandemic of COVID-19, implementation structure to subcontracts to local companies was established for smooth implementation of the activities in Renca Municipality.

After confirming that the pandemic diminished compared to the previous year, the first travel to Chile was realized in November 2022. The city-to-city collaboration project team including the delegation of Toyama city had discussion on the progress and future work plan with the mayor and personnels of Renca municipality, reported the progress to the embassy of Japan, and had interview survey with the private companies in Renca to formulate new JCM projects.

The outline of the activities in Chile is shown in the following table.

Table 1-4 Outline of the Activities in Chile

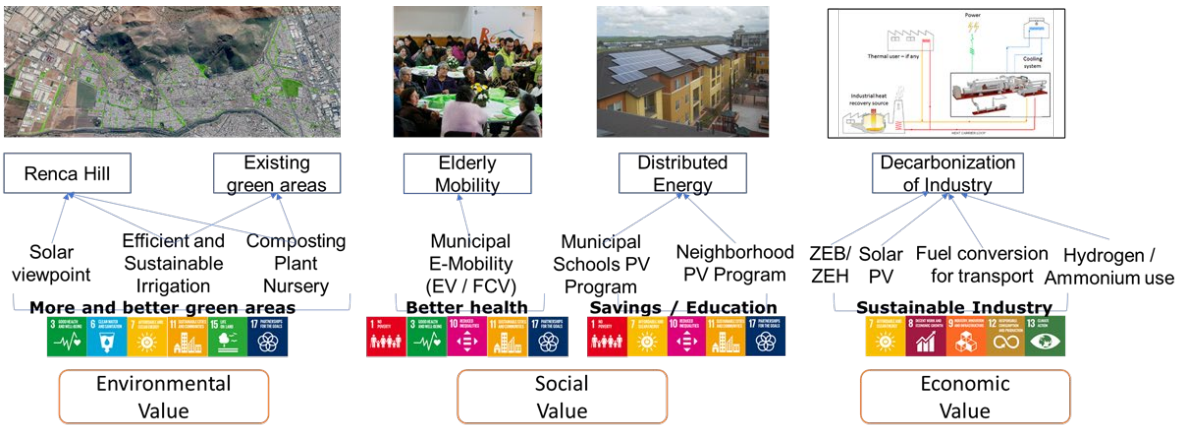
Date	Interviewee/ meeting participants	Summary of the meetings
21 Nov.	Cmpany G	Discussion for formulation of hydrogen mobility project to apply for the Co-innovation program/ program to demonstrate hydrogen technology.
22 Nov.	Company C	Report of the application of the JCM model project and site visit for confirmation of the buildings where the facility is to be installed. Discussion for formulation of a new JCM model project.
	Renca municipality	Report of the application of the JCM model project and site visit for confirmation of the buildings where the facility is to be installed. Report of the progress of city-to city collaboration programme, and exchange ideas on the phase 2 project to continue city-to-city programme between Renca municipality and Toyama city. Discussion for formulation of a new JCM model project.
23 Nov.	Company E	Report of the application of the JCM model project and site visit. Discussion for formulation of a new JCM model project JCM by installation of batter and PV panel on the wall of buildings etc.
	Company C	Discussion for formulation of a new JCM model project by improvement of the efficiency of the equipment installed and installation of new technology such as CCU etc.
24 Nov.	Company P	Discussion for formulation of a new JCM model project by using CCU and other technology, and site visit.
	Embassy of Japan in Chile	Explanation about the outline and progress of this city-to-city programme
	Company B and E	Discussion for formulation of a new JCM model project by waste-to-energy etc in Renca municipality.
25 Nov.	Company F	Discussion for formulation of a new JCM model project

Source: Nippon Koei

CHAPTER 2. ACTIVITIES RELATED TO ENERGY CONSERVATION, RENEWABLE ENERGY, TRANSPORTATION INFRASTRUCTURE, AND HYDROGEN

2.1 NEEDS OF RENCA MUNICIPALITY FROM VIEWPOINTS OF ENVIRONMENTAL, SOCIAL AND ECONOMIC VALUES

The needs of Renca Municipality identified in the first and second year of CtC collaboration project is shown in the following figure. The needs were categorized into environmental, social and economic values related to SDGs, which refer to the "Toyama City SDGs Future City Plan". Needs by category are outlined in the next section.



Source: Nippon Koei

Figure 2-1 Direction of project formation based on the needs of Renca Municipality

2.1.1 Needs related to environmental values

(1) Reforestation of the Renca hill and urban green space

Renca has a hill with an altitude of about 900m in the north, and occupies about 20% of the municipality's area. Reforestation and park development of the hill are listed as one of the measures in the Renca Municipality Climate Change Plan (2019). Renca developed the Master Plan for the area of 207 ha owned by the municipality in the hill in a participatory manner for involvement of the inhabitants. The plan includes activities such as plantation of native tree species, development of park facilities (parking lots, walkways, sightseeing platforms, gymnasium, etc.). Renca has started implementation of the Master Plan since 2017 together with contractors and residents. Technical needs related to implementation of the plan are presented by Renca as follows: i) development of sustainable irrigation facilities for tree plantation, and ii) introduction of solar power generation systems and lighting equipment to the park facilities (seedlings nursery, parking lots, and lookouts, etc.). The image of some of the facilities is shown in the following figure.

In FY2022, based on the priority proposed by Renca Municipality,formulation of a JCM model project for installation of roof-top PV system to the car parking of Renca hill was promoted and the proposal was submitted to MOEJ for the 3rd call for proposal in FY 2022. The details of the proposed model project are shown in Section 2.2.1. Projects targeting urban green space were not advanced this year.

Renca Hill Foot

Renca Hill Overall

Image of eco-nursery of Renca hill

Image of lookout of Renca hill

Source: Renca Municipality, Nippon Koei

Figure 2-2 Example of facilities in Renca Hill

2.1.2 Needs related to social values

(1) Improvement of transportation for welfare of the elderly

In Chile, aging of population has progressed significantly in recent years, and welfare of elderly people has become an important issue. In June 2019, Japan and Chile signed a Memorandum of Understanding on Cooperation for an Aging Society, and it is of high interest to provide technical assistance from Japan, which has a wealth of experience in the welfare of the elderly. Approximately 15% of Renca municipality's population accounts for over 60 years of age, of which 65% receive basic solidarity pensions which are supposed to be provided to the elderly people with lower pension income. Since it was found that the cost of transportation to hospitals and government offices is a significant burden for elderly people, Renca started to develop free transportation for the elderly as a part of welfare services. In 2020, an electric vehicle was introduced as a part of CSR activities from a private company, and pilot activity of this welfare service was started. In the future, in order to increase the number of buses for expansion of the

target area and increase of circulation routes, introduction of electric/hydrogen vehicles was presented as a need by Renca.

In FY2021, Toyama Hydrogen Energy Promotion Council was subcontracted for technical proposals related to the introduction of hydrogen and fuel cell vehicles (FCV). The results of the study are summarized in 2.3.1.

(2) Development of off-grid power sources for schools and social houses

Renca has more than 10 municipality schools and some social houses for low-income people. In order to strengthen sustainability of the facility, Renca presented a need for development of off-gird power sources through introduction of PV (PV) power generation systems for backup power source and reduction of electricity costs.

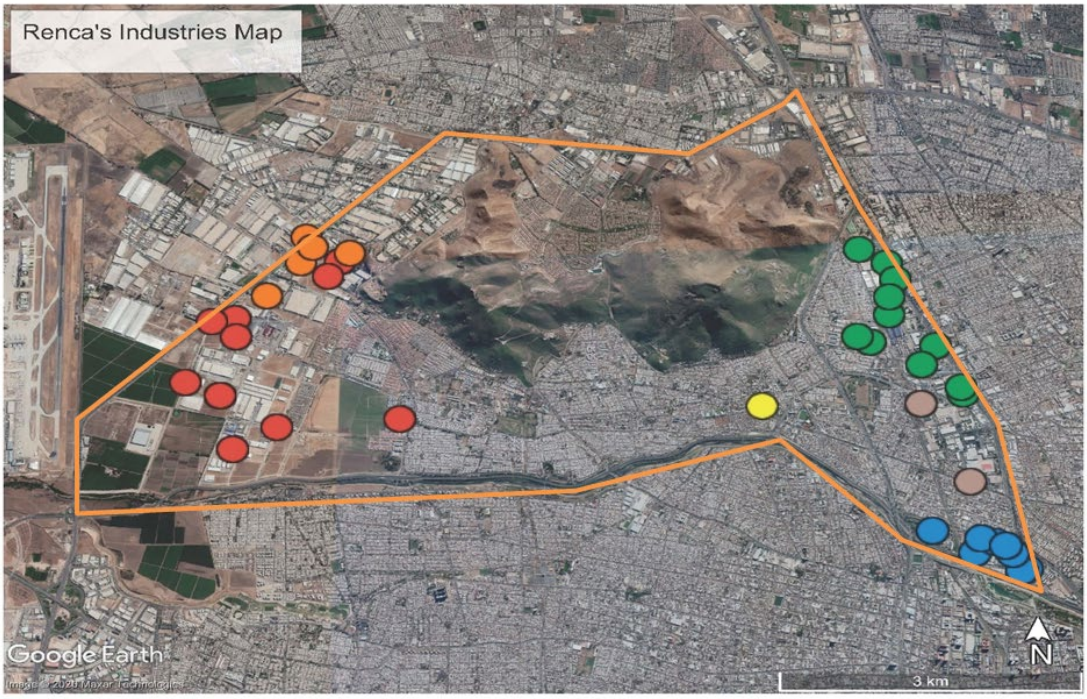
As a result of reviewing these needs, the feasibility of health centers and gym such as clinic and gymnasium was higher than that of schools and social houses. Thus, formulation of a JCM model project to install PV system to the prioritized facilities was promoted and its proposal was submitted to MOEJ in the 3rd call for proposal of FY 2022. The details of the project is shown in Section 2.2.1.

2.1.3 Needs related to economic value

(1) Decarbonization of Renca Municipality-related Companies

Since Arturo Merino BenIez International Airport is located just outside the western edge of Renca, there are many factories, warehouses, etc. of enterprises (e.g., beverage manufacturers, refrigerated warehouses, etc.) engaged in industrial activities within Renca for better access to distribution and transportation. These companies and facilities are the main sources of GHG emission of Renca, thus Renca presented its need for promotion of decarbonization of the companies/factories by formulation of JCM projects. As decarbonization technologies, the following potential technologies were presented: energy saving of factory buildings, energy saving in industrial processes (waste heat recovery power generation, etc.), and private power generation by PV system, etc.

Since the needs for the introduction of green hydrogen production equipment and the hydrogen mobility were identified this year, Hokusan Co. Ltd. was subcontracted to implement an overall study on the JCM model project formulation as a candidate for a representative company. In addition, Sherpas conducted coordination and discussions with local stakeholders. The results of the study are summarized in 2.3.1.



*Coloured circles: main industrial centres
Source: Renca Municipality
* The color of the circle is the geographical classification of factories by region as a cluster by Lenca Municipality.

Figure 2-3 Location of Main Industrial Facilities in Renca

(2) JCM model projects identified until the end of the 2nd year of the CtC collaboration project

The following table summarizes the results of preliminary study for identification of potential JCM model projects conducted in the 1st and 2nd year of the project. The identified potential JCM model projects are grouped into the following five categories: i) introduction of PV power generation system on the roof of the factory (private enterprise facilities and public facilities), ii) reduction in volume of industry waste which contributes to reduction of traffic load, iii) energy conversion of vehicles (forklifts, trucks, etc.) (conversion of fuel to DDF/natural gas/electrification), iv) introduction of hydrogen/electric bus, and v) wastewater treatment. Among these, application of two projects highlighted green color for JCM model projects in FY 2022 was conducted, and the outlines of the projects are described in the next section.

Table 2-1 Results of preliminary study for identification of potential JCM Model Projects conducted until the end of the 2nd year of the Project

	Company/Organization Name	Industries, products and services	Potential applicable technologies	Result of discussion
Economic Value (Decarbonization of Industrial Sector)	Company A	Chemical manufacturers	PV power generation (1-3 MW)	Interest in introducing PV system to facilities (warehouses) consuming 5 MW. Obtained information on the roof shape of the subject facility. Examined potential of expansion of the target facilities to the ones of group companies Started discussions with ESCO company and applied to the JCM model project FY 2022
	Company B	Warehouse	Rooftop PV system (max 0.3MWp)	Obtained drawings of warehouse to study the feasibility in the strength of the rooftop structure.
	Company C	Warehouse	PV power generation LED High-efficiency chiller Insulation material Improvement of efficiency of compression machine for waste cardboard Disposal of waste pallets	Discussion with company C for planning the details of the projects was made. Confirmed if there is a potential company in Toyama city which has technology on cardboard compression and waste pallet disposal
	Company D	Metal	Emission reduction from vehicles (forklifts, etc.) by conversion of fuel to natural gas, electrification, etc.	Internal discussion on model project in Company D was made. Under collection of information on the potential target vehicles

	Company/Organization Name	Industries, products and services	Potential applicable technologies	Result of discussion
Environmental value (Reforestation of Renca hill) Social value (provision of water resources)	Company E	Foods and beverages	Wastewater Treatment, Recycled Water, etc. (under discussion)	Interested in activities that contribute to social welfare as well as energy saving and emission reduction in its own manufacturing processes. It is necessary to formulate an activity plan for three years by the end of February. Another beverage manufacturer company has provided treated wastewater to the local communities free of charge. Similar activity for production of irrigation water for Renca hill reforestation is proposed and under discussion. Plantation of Renca hill will begin in May 2021 and terminate in FY 2021 as a memorial for those who passed away by Covid-19.
Social value (transportation for the elderly)	Company F	Energy	Fuel cell (FC) bus	1st year: Company F has donated an electric bus. Interested in donating a fuel cell bus as well. Internal discussion of the company for application to JCM scheme was made. 2nd year: Started discussion with the provider of FC vehicle and hydrogen refueling system to apply for Co-innovation programme.
Environmental value (Reforestation and development of Renca hill	Renca Municipality	Local governments	PV system (max 1MW)	Memorial monuments and forest parks are to be developed for those who have passed away by Covid-19. Installation of PV system to the roofs of parking lots for visitors, gymnasiums, and office etc was proposed. Generated power will be self-consumed, and surplus power is transmitted to the grid system.

Source: Nippon Koei

2.2 FEASIBILITY STUDY FOR FORMULATION OF JCM MODEL PROJECTS

Among the potential projects identified in the 1st year, feasibility study was conducted for the following two potential projects considering higher motivation of the potential participants to apply for JCM model projects: i) PV system installation to facilities owned by Renca Municipality and ii) PV system installation to the factories of Tehmco, a company in Renca Municipality. The initial plan was to integrate projects i) and ii), and apply for JCM Model Projects as one project since the scale of project i) is small.

However, in the 3rd year, it was decided to apply for two separate projects based on the request by Renca in order to avoid benefiting one particular company.

The above two projects were applied for the third round of JCM equipment subsidy projects in FY2022, and the project (2) to install photovoltaic power generation on the roof of Tehmco Group's factory in Renca District was selected. The following is a draft outline of the projects (1) and (2). See **Attachment-1** for detailed information.

2.2.1 Installation of rooftop PV system to the facilities of Renca Municipality and factories of a Renca-based company, Company A

(1) Overview of the project

This project is installing 0.4 MW rooftop solar power system to four municipal facilities in Renca: two health centers, municipal gymnasium, and Renca Metropolitan Park, and reducing GHG emissions by 289 t-CO2/year. Renca Municipality announced the participation in the Race-to-Zero campaign at COP26 in 2021, and this project was positioned as one of the new projects to achieve the Race-to-Zero target.

Due to the limited scale of solar power generation (0.4 MW) and the potential amount of GHG emission reductions, this project was not selected as a JCM Model Project in FY2022. However, the use of clean energy generated by photovoltaic power facilities at public facilities in Renca Muniicipality, especially at health centers and gymnasiums, which are used by a wide range of citizens, is highly significant for Renca’s efforts to achieve net-zero emissions by 2030. As Renca Municipality try to expand the introduction of solar power generation facilities, this project will continue to review the scale and structure and to be considered for reapplication in the next fiscal year.

Table 2-2 shows the overview of the project which applied to the 3rd selection in FY2022.

Table 2-2 Overview of a JCM model project (Introduction of 0.4 MW Rooftop Solar Power System to Municipal Facilities in Renca City)

Project title	Introduction of 0.4 MW Rooftop Solar Power System to Municipal Facilities in Renca City
Implementation structure	Representative participant: Asian Gateway Corporation Partner participants: (1) Enel X Chile (2) Renca Municipality
Background	Increase of renewable energy is one of the prior challenges for Renca Municipality to achieve Race-to-Zero target. Renca municipality would like to lead acceleration of introduction of renewable energy starting with the Municipality's public facilities.
Project outline	Power generation capacity: total 0.4 MWp Project power generation: total 435.6 kWh/year Estimated GHG emission reductions: total 289 t-CO_2/year

Source: Nippon Koei

(2) Target facilities

■ **Target facilities proposed by Renca Municipality**

Figure 2-4 shows the location and appearance of the target facilities in Renca Municipality: ① CESFAM Bicentenario (Health center 1), ②CESFAM Renca (Health center2), ③Gimnasio Poniente (Municipal gymnasium), ④PARQUEMET Cerro Renca (Renca Metropolitan Park).

①Health Center 1 -Location

①Health Center 1 -Appearance

②Health Center 2 -Location

②Health Center 2 -Appearance

③Municipal Gymnasium -Location

③Municipal Gymnasium -Appearance

④Renca Metoropolitan Park -Location

④Renca Metoropolitan Park -Appearance

Source: Nippon Koei

Figure 2-4 Location and overview of the target facilities in Renca Municipality

(3) Plan for installation of PV systems

■ **Plan for the installation of PV systems to the target facilities proposed by the Renca Municipality**

The plan for the installation of the PV system to the target facility is as follows.

Table 2-3 Draft plan for the installation of PV system to the facilities in Renca Municipality

No.	Target Facilities	Power generation Capacity (kWp)	Amount of Electricity Generated (kWh)
1	Health Center 1	166.1	304.6
2	Health Center 2	67.1	85.6
3	Municipality Gymnasium	86.9	115.2
4	Renca Metoropolitan Park	115.5	210.6
	Total	435.6	716

Source:Nippon Koei

The layout of the rooftop PV panels on the target facilities was reviewed by Enel X Chile, a ESCO companies. (The details are not included in this report for confidentiality.)

(4) Calculation of estimated GHG emission reduction

The GHG emission reductions from this project were estimated by using the JCM methodology CL_AM001 "Installation of Solar PV System" as shown below.

$ER_p = RE_p - PE_p$
$= RE_p$

ER_p : Emission reductions during the period p [tCO/p_2].
RE_p : Reference emissions during the period p [tCO/p_2].
PE_p : Project emissions during the period p [tCO/p_2] = 0

$$RE_p = \sum_i \left(EG_{i,p} \times EF_{RE,i}\right)$$

RE_p : Reference emissions during the period p [tCO/p_2].
$EG_{i,p}$: Quantity of the electricity generated by the project solar PV system i during the period p [MWh/p].
$EF_{RE,i}$: Reference emission factor of the project solar PV system i [tCO/MWh_2].

Parameters	Description of data	Source
$EF_{RE,i}$	Reference emission factor of the regional grid and/or captive power generator which is displaced by the project solar PV system *i*. The value for $EF_{RE,i}$ is selected from the list of emission factors in the following manner: <u>PV Case 1:</u> In case the solar PV system(s) in a proposed project activity is connected to a regional grid including through internal grid which is not connected to a captive power generator, $EF_{RE,i}$ is set as follows per the connected regional grid: Regional grid name: — Emission factor for PV Case 1: SEN (National System) — 0.404 tCO/MWh_2 Aysén System — 0.176 tCO/MWh_2 Magallanes System — 0.361 tCO/MWh_2 <u>PV Case 2:</u> In case the solar PV system(s) in a proposed project activity is connected to an internal grid connected to both a regional grid and a captive power power generator, $EF_{RE,i}$ is set as follows per the connected regional grid: Regional grid name: — Emission factor for PV Case 2: SEN (National System) — 0.404 tCO/MWh_2 Aysén System — 0.176 tCO/MWh_2 Magallanes System — 0.361 tCO/MWh_2 <u>PV Case 3:</u> In case the solar PV system(s) in a proposed project activity is connected to an internal grid which is not connected to the regional grid, $EF_{RE,i}$ is set at 0.533 tCO/MWh_2.	The default emission factor is obtained from a study of electricity systems in Chile and the most efficient diesel power generator (49% heat efficiency). The default value is revised if deemed necessary by the JC.

Source: JCM Methodology CL_AM001 "Installation of Solar PV System".

The following table shows the estimated GHG emission reductions from the installation of PV systems to facilities of Renca Municipality based on this methodology.

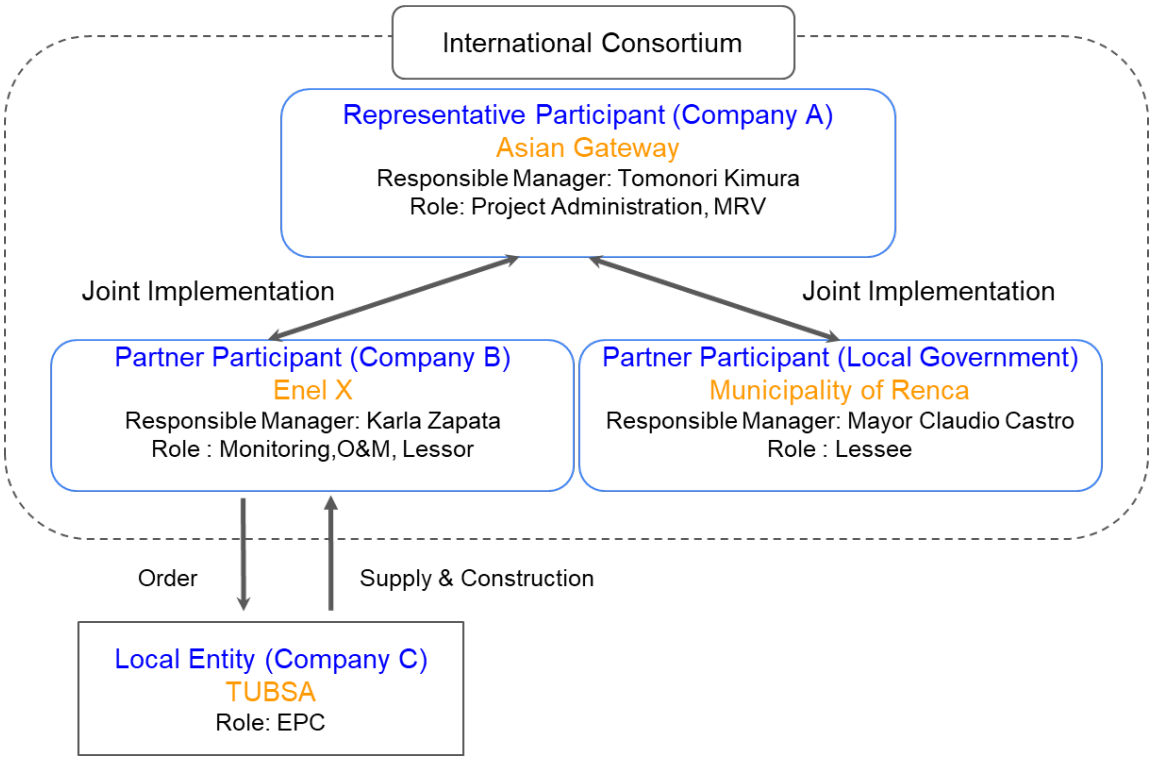
Table 2-4 Estimated GHG emission reductions from installation of PV system to facilities of Renca Municipality

No.	Target Fanilities	Amount of Electricity Generated (kWh/yr): EG	Emission Factor (tCO_2/MWh): EF	Emission Reductions (tCO_2/year)
1	Health Center 1	304.6	0.404	123
2	Health Center 2	85.6		34
3	Municipality Gymnasium	115.2		47
4	Renca Metoropolitan Park	210.6		85
Total		716		289

Source: Nippon Koei.

(5) Implementation structure

The international consortium will be formed by Asia Gateway Corporation, the representative participant, and Enel X Chile and Renca Municipality, the partner participants. The implementation structure of the project and the main roles of each member are shown in the following figure and table.



Source: Nippon Koei

Figure 2-5 Implementation structure

Table 2-5 Major roles of the members of the international consortium

Members	Major roles
Representative participant (Asian Gateway Cooperation)	Responsible for the management of the JCM Model Project, payment of subsidies to Partner participants and report credits based on the data provided by the partner participants.
Partner participant (Enel X Chile)	Responsible for the procurement of the PV system and O&M. Maintain the equipment for an initial 7 years, and will outsource maintenance and management to TUBSA, the EPC company.
Partner participant (Renca Municipality)	After 7-year lease contract for the PV system, the equipment will be transferred to Renca Municipality, which will own the equipment from 8 years to 17 years. Maintenance and management will continue to be outsourced by Renca Municipality to TUBSA.

Source: Nippon Koei

(6) Project schedule

The project was scheduled to start in January 2023, the lease and EPC contracts were to be signed in February, and the operation was to start in September. However, the schedule for the next fiscal year will be reconsidered to reconfirm all of its components.

2.2.2 Installation of rooftop PV system to the factories of a Renca-based company, Tehmcorp

(1) Overview of the project

A new JCM model project to install rooftop PV systems to the factories of Tehmcorp, chemical manufacturer, based in Renca municipality, was proposed to MOEJ in the 3rd call for proposal in FY 2022 and adopted. Partner participant, namely Solarity SpA, ESCO company, supplies electricity generated by the PV system to Tehmcorp at lower price to contribute to its decarbonization. The overview of the project is shown in the following table.

Table 2-6 Overview of the JCM model project

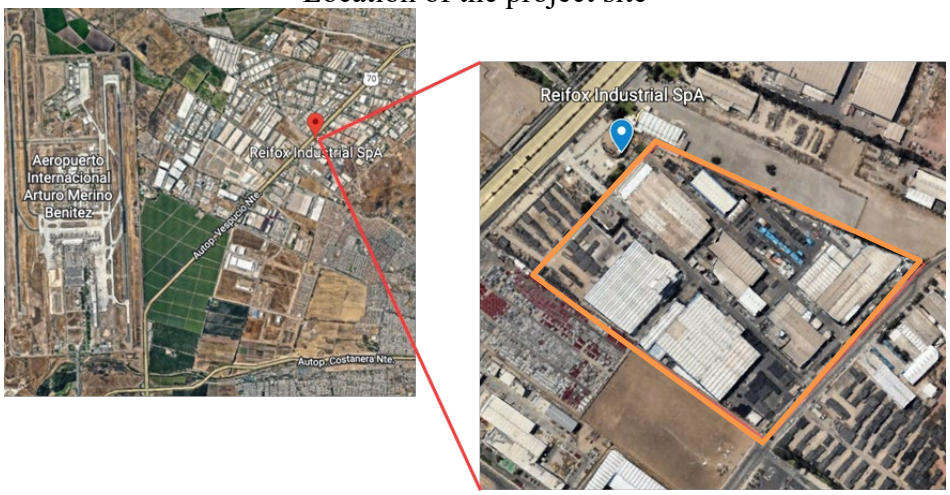
Project title	Introduction of 2.0 MW Rooftop Solar Power System to Industrial Plastic Plant in Renca City
Implementation structure	Representative participant: Asia Gateway Corporation Partner participants: Solarity SpA
Background	Increase of renewable energy is one of the prior challenges for Renca Municipality to achieve Race-to-Zero. Renca municipality would like to lead acceleration of introduction of renewable energy starting with the Municipality's public facilities. Needs of decarbonization in energy of the private sector
Activities	Power generation capacity: total 2.002 MWp Project power generation: total 25 GWh/year Estimated emission reductions: 1,105 tCO_2

Source: Compiled by Nippon Koei based on ESCO operators' proposals

(2) Target facilities

The following photos show the location and appearance of the target facilities proposed by Tehmcorp, which started its business in the field of polymer production about 40 years ago and currently operates 24 group companies providing polymer and metal products and services to major mining and construction companies in Chile and abroad. Tehmcorp proposed to install rooftop PV system to some factories operated by CAINSA, one of the group companies, manufactures rubber products and plastic pipes for mining industry, and window frame of buildings.

Location of the project site



Target facilities for installation of rooftop PV system (area surrounded by orange frame)

Roof of one of the target factories

Roof of one of the target factories

Source：Nippon Koei

Figure 2-6 Location of the Project site and target facilities

(3) Calculation of estimated GHG emission reduction

The GHG emission reductions from this project were estimated by using the JCM methodology CL_AM001 "Installation of Solar PV System" as shown below.

$ER_p = RE_p - PE_p$
$= RE_p$

ER_p : Emission reductions during the period p [tCO/p_2].
RE_p : Reference emissions during the period p [tCO/p_2].
PE_p : Project emissions during the period p [tCO/p_2] = 0

$$RE_p = \sum_i \left(EG_{i,p} \times EF_{RE,i}\right)$$

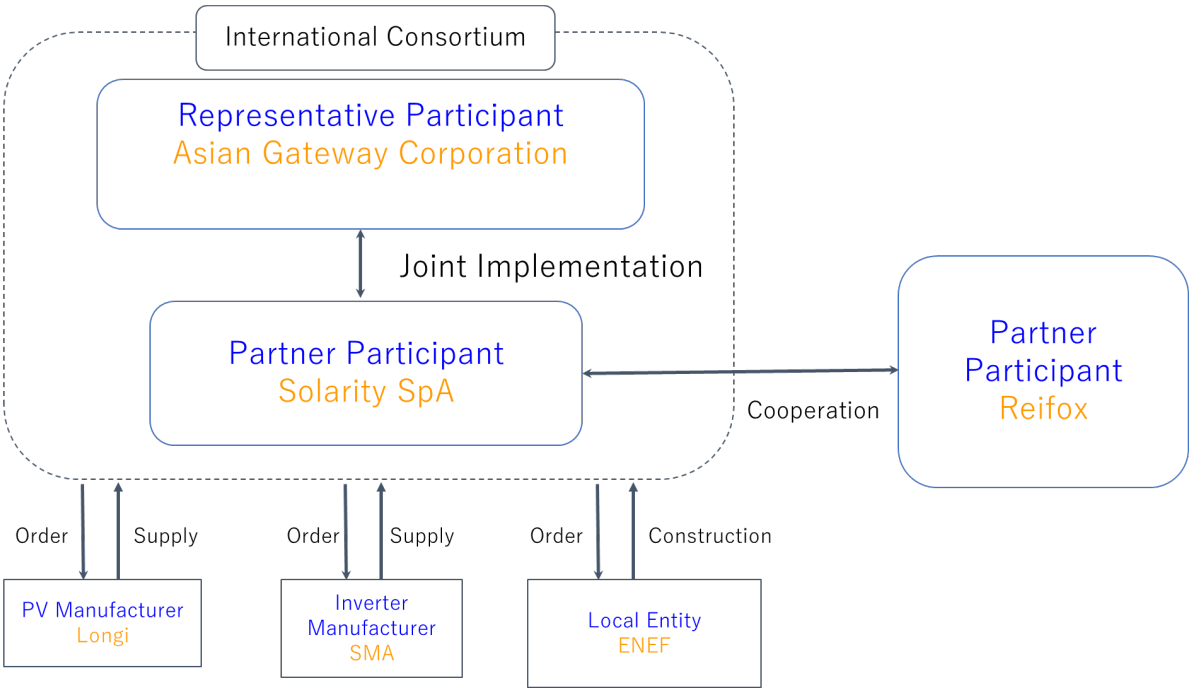
RE_p : Reference emissions during the period p [tCO/p_2].
$EG_{i,p}$: Quantity of the electricity generated by the project solar PV system i during the period p [MWh/p].
$EF_{RE,i}$: Reference emission factor of the project solar PV system i [tCO/MWh_2].

Parameters	Description of data	Source
$EF_{RE,i}$	Reference emission factor of the regional grid and/or captive power generator which is displaced by the project solar PV system *i*. The value for $EF_{RE,i}$ is selected from the list of emission factors in the following manner: <u>PV Case 1:</u> In case the solar PV system(s) in a proposed project activity is connected to a regional grid including through internal grid which is not connected to a captive power generator, $EF_{RE,i}$ is set as follows per the connected regional grid: Regional grid name: — Emission factor for PV Case 1: SEN (National System) — 0.404 tCO/MWh_2 Aysén System — 0.176 tCO/MWh_2 Magallanes System — 0.361 tCO/MWh_2 <u>PV Case 2:</u> In case the solar PV system(s) in a proposed project activity is connected to an internal grid connected to both a regional grid and a captive power power generator, $EF_{RE,i}$ is set as follows per the connected regional grid: Regional grid name: — Emission factor for PV Case 2: SEN (National System) — 0.404 tCO/MWh_2 Aysén System — 0.176 tCO/MWh_2 Magallanes System — 0.361 tCO/MWh_2 <u>PV Case 3:</u> In case the solar PV system(s) in a proposed project activity is connected to an internal grid which is not connected to the regional grid, $EF_{RE,i}$ is set at 0.533 tCO/MWh_2.	The default emission factor is obtained from a study of electricity systems in Chile and the most efficient diesel power generator (49% heat efficiency). The default value is revised if deemed necessary by the JC.

Source: JCM Methodology CL_AM001 "Installation of Solar PV System".

(4) Implementation structure

The implementation structure of the project is shown in the following figure. The representative participants, namely Asia Gateway corporation will form a JCM international consortium with the partner participant, Solartiy SpA, and implement the project in coordination with an off-taker, Reifox. Considering the concern of Tehmcorp/CAINSA for the payment of Capex, Solariy SpA, an ESCO company was involved to the international consortium to supply clean energy without initial cost to its client, Tehmcorp. The PV system is installed on the roofs of the factories of CAINSA, while Solarity SpA charges only the cost of electricity consumed by them.



Source: Nippon Koei

Figure 2-7 Implementation structure

The main roles of the international consortium members are shown in the following table.

Table 2-7 Major roles of the members of the international consortium

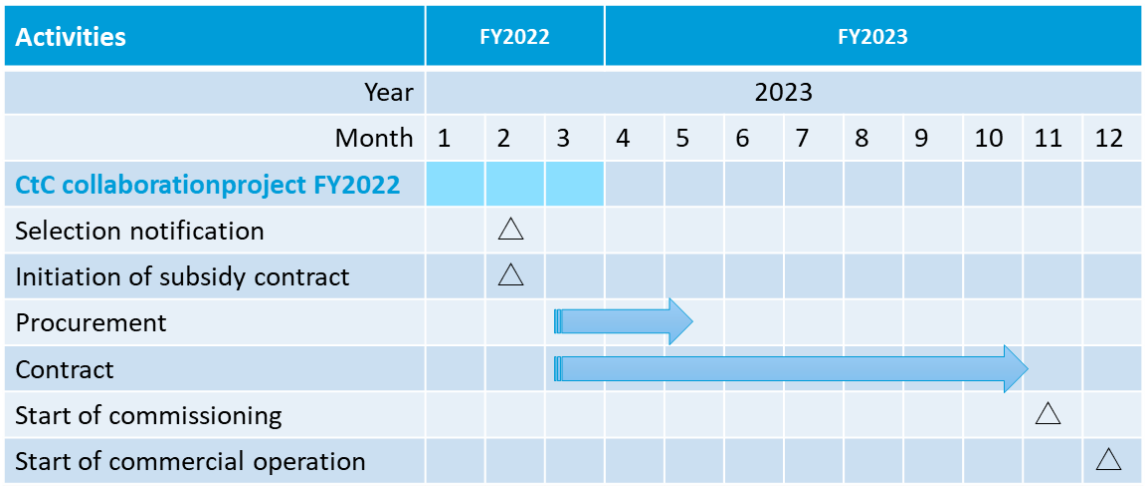
Members	Major roles
Representative participant (Asia Gateway Corporation)	Supervise installation and operation of the equipment, transfer subsidy to the Partner Participant, submit credit reports to MOEJ, submit necessary information for audits based on the data provided.
Partner Participant (Solarity SpA)	Fund raising, design of the system, selection and procurement of the equipment, O&M of the installed system. Provide the representative company with the date necessary for MRV.

Source: Nippon Koei

(5) Project schedule

The following figure shows the schedule of the project from January FY 2022 to the end of FY 2023.

Once adoption is announced in February 2023, a contract on subsidy will be started, and procurement will be completed in about 2 months, installation will be completed within eight months, and operation of the installed equipment will be started in December 2023.



Source: Nippon Koei

Figure 2-8 Proposed implementation schedule

2.3 FEASIBILITY STUDY FOR FORMULATION OF FINANCING PROGRAMME TO DEMONSTRATE DECARBONIZATION TECHNOLOGY FOR REALIZING CO-INNOVATION/ HYDROGEN TECHNOLOGY

2.3.1 Project to introduce hydrogen technologies in Renca complex for energy transition in the Republic of Chile

(1) Overview of the project

Among the potential projects identified in the first and second year, feasibility study for formulation of the project to introduce hydrogen technologies in Renca complex for energy transition in the Republic of Chile, was continued in this 3rd year with Renca municipality and the company in Renca, which proposed the project idea (herein after called Company F).

In the 1st year of the CtC programme, Company F advanced internal discussion, and proposed the concept of this project, which utilize advanced technologies such as the production and use of green hydrogen. Considering the characteristics of the project, in consultation with the Ministry of the Environment, it was confirmed that this project fits more to the scheme "Financing Programme to Demonstrate Decarbonization Technology for Realizing Co-Innovation" (hereinafter called "Co-innovation project") than JCM model project. In the 2nd year of the programme, a feasibility study for formulation of Co-innovation project was conducted with the proponent company "Company F", Renca Municipality, and Company A, a company based in Toyama city. Originally, introduction of FC bus for mobility of the elderly people in Renca was proposed by Company F and Renca municipality to address the social problem, namely luck of circular local mobility service at lower price/free of charge for the elderly people for their access to clinics etc. However, based on the discussion with the FC Vehicle (FCV) provider, it was agreed that Company F leases one FC sedan under this demonstration project as its 1st step. Through discussion with Company F and providers, the expected specifications of the equipment to be installed (water electrolyser, hydrogen station, fuel cell vehicle) were determined. Based on such expected specification, possibility of procurement of equipment satisfying the needs, schedule, and cost were confirmed.

In this year, implementing structure such as technical advisor, roles between the representative participants and partner participants, were discussed, aiming at application to the new scheme of MOEJ focusing on demonstration of hydrogen technology. The proposed project outline is shown in the following table.

Table 2-8 Draft outline of the project studied for formulation of Financing Programme to Demonstrate Decarbonization Technology for Realizing Co-Innovation/ Hydrogen Technology

Project title	Project to introduce hydrogen technologies in Renca complex for energy transition in the Republic of Chile
Structure	Representative participant: Company A of Toyama city Partner participants: Company F (Company operated jointly by a Chilean company and a French company)

Background	National policy [Chile] Government of Chile developed national green hydrogen strategy in 2020, in which it announced that it aims to become a green hydrogen exporting country by 2040. [Japan] Government of Japan promotes international collaboration to realize a hydrogen society. It considers hydrogen procurement from Latin America. Needs [Renca Municipality] In step with the aging of the population, welfare services need to be improved and strengthened. It needs expansion of mobility services for the elderly (e.g. circulating buses/ sedan). Based on participation in the Race to Zero campaign, Renca municipality is accelerating decarbonisation to achieve the plan announced for Race to Zero. [Partner participant: Company F] Thermal power generation company in Renca Municipality. Company F is interested in hydrogen mixed-combustion and hydrogen burning plant for decarbonization. In order to learn about the technologies and regulations related to hydrogen production and use, Company F is interested in producing green hydrogen and use for FCV as a first step. As a company based in Renca Municipality, Company F would like to contribute to Renca Municipality through its CSR activities likewise its experience in the past, contribution to Renca by donation of an electric bus for mobility for the elderly. [Representative participant: Company A] Toyama City company participating in the project. It is interested in participating in the hydrogen import business in the future.
Activities	Installation of one unit of 1 MW on-site hydrogen refuelling system, which is composed of water electrolysis for hydrogen production and hydrogen station, and rooftop PV panel in Company F's facility in Renca Municipality. Company F makes a lease agreement of one FC sedan car with a provider, Toyota Chile. (In the future, in addition to the FC sedan, installation of FC folk lift and FC bus would be planned)

Source: Nippon Koei

(2) Target facilities where the equipment will be installed

■ Water electrolysis hydrogen production equipment and filling equipment (hydrogen station)

The water electrolysis hydrogen production unit and the hydrogen station will be installed in Company F's thermal power plant located in the south-eastern part of Renca Municipality.

■ Fuel cell vehicles

One FC sedan, Mirai, will be leased from Toyota Chile to Company F. In principle, the staff of Company F drives it in Santiago, for example airport transfer etc., following the conditions on the usage to be defined by Toyota Chile. In order for demonstration of hydrogen mobility to the public, the personnel of Renca municipality could be also the users of the FC sedan.

(3) Overview of equipment for installation

■ **Water electrolysis hydrogen production equipment and filling facility (hydrogen station)**

As the equipment for hydrogen production and filling, on-site hydrogen station including electrolyzer called "Simple Fuel" of PDC machines was proposed by Company A, and the outline of this proposed project for co-innovation scheme was explained to the Japanese representative of PDC machines. The company expressed interest in the project and the introduction of hydrogen stations in Chile, and began to confirm the requirements of the fuel cell vehicles/buses to be introduced, to adjust specifications as appropriate, and to prepare a quotation. Simple Fuel was introduced as a reference by the Ministry of Economy, Trade and Industry (METI) at the Hydrogen and Fuel Cell Strategy Committee meeting held in August 2021[3]. The following table gives an overview of PDC Machines.

Table 2-9 Overview of PDC Machines Ltd.

Foundation	1977
Employee	About 180
Production base	USA Pennsylvania (ISO 09001 certified factory, ASME Section VIII, Division 1 certified factory)
Sales base	USA, China, Korea, Japan, Germany
CEO	Kareem Afzal
Product	diaphragm compressors/ hydrogen station
Delivery record	In total of 4,000 units of compressors sold all over the world. In total of 520 units of hydrogen station installed (share 60% of the market)
Certification/Standard-compliance	ASME, ANSI, AWS, CSA, CE< SQL.KGS, KOSHA, NEC, NFPA, OSHA, KHK, UL

Source: https://www.meti.go.jp/shingikai/energy_environment/suiso_nenryo/pdf/027_03_00.pdf (accessed on 20 Feb 2023)

The following table gives a basic specification of Simple Fuel introduced by the Ministry of Economy, Trade and Industry in its meeting for hydrogen-FC strategy committee.

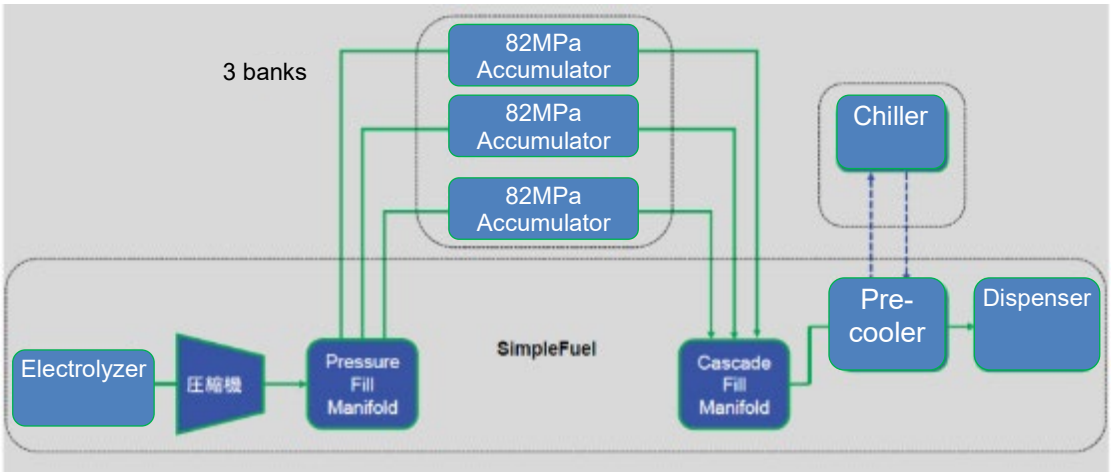
Simple fuel is package-type station containing water electrolyzer, developed by PDC machines, a company of USA. Although the capacity of hydrogen dispense is limited and dispense rate is slower, since it is small and can save space, it has possibility to be installed in distribution outlets of vehicles. It also can save cost of installation and O&M as well. It can function as initial station for smaller demand, and will function as backup station in remote areas where current ST has not yet been installed.		
	Type	SF70-10/20
	Capacity	10kg/day・20kg/day
	Dispense pressure	70MPa
	Accumulator capacity	25kg
	Dispense rate	10-15 mins (3kg)

[3] https://www.meti.go.jp/shingikai/energy_environment/suiso_nenryo/pdf/027_02_00.pdf


（出典）FCエキスポHP、PDCマシンズ日本法人より資源エネルギー庁作成

Electrolyzer	PEM (purified water)
Size	3m x 1.5m x 2.5m (for 1 FCV)
Durability	10 years
Remark	3 units of smaller station were installed for forklift in Japan

Simple Fuel have been installed in Japan for forklift, and in Europe for Caetano's FC bus. Caetano's FC bus is considered as one of the proposed FC buses for the project. The hydrogen station for FC buses installed in Europe has a hydrogen dispenser facility only, does not have water electrolyzer. Thus, the size of the hydrogen tank and other factors will have to be adjusted in case of introduction as package type station to Chile for FC bus. The system configuration of Simple Fuel is shown in the following diagram.



Source: Nippon Koei

Figure 2-9 Structure of simple fuel system

The water electrolysis hydrogen generator, diaphragm compressor, pre-cooler, dispenser section and control system are integrated in the main unit, while the control panel, accumulator, chiller and water purification system (optional) are located separately.

Regular maintenance is to be conducted by the staff of Company F trained by PDC.

■ **Fuel cell vehicles**

The outline of this proposed project for co-innovation scheme was explained to Toyota Motor Corporation and Toyota Chile (Mitsui & Co., Ltd.) and possibility of delivery of FC bus and FCVs for this project was confirmed.

Toyota Motor Corporation has confirmed that it is possible to introduce to Chile some “Mirai” fuel cell vehicles manufactured by Toyota Motor Corporation and a FC bus manufactured by Caetano SA equipped with Toyota Motor Corporation's fuel cell system. On the other hand, Mitsui & Co. expressed concern about the impact of this project on the development of the fuel cell vehicle market in Chile and the future prospects of the fuel cell vehicle market in Chile. Information related to the expected market impact and the market of FCV and bus in Chile were provided.

In this year, it was agreed by Company F and Toyota Chile that Company F makes a lease agreement of one FC sedan, Mirai under this demonstration project.

Toyota Mirai FCV

Caetano FC bus

Source: Mirai: https://toyota.jp/mirai/grade/equipment/ (accessed on 20 Feb 2023)
Caetano:https://www.sustainable-bus.com/fuel-cell-bus/barcelona-receives-first-caetano-hydrogen-bus/

Figure 2-10 FCVs proposed and studied in the project

The following table shows the main characteristics of fuels of fuel cell vehicles studied.

Table 2-10 Specification related to hydrogen fuels of FCV and FC bus studied

Item	Mirai	Caetano fuel cell bus
Fuel	Compressed hydrogen	
Storage method	High-pressure tank (3 tanks)	High-pressure tank (4 tanks)
Tank capacity L	141	312 (max. 37.5 kg: 350 bars)
Operation pressure MPa	70	35
FC stack model and type	FCB130 polymer electrolyte fuel cell	polymer electrolyte fuel cell
Maximum output kW (PS)	128(174)	60
Cruising range per full hydrogen charge km	750-850 (depending on grade, environment and method of operation)	400
Fuel consumption km/kg	105	16.7

Source: Compiled by Nippon Koei based on the following websites (accessed on 20 Feb 2023)
Mirai: https://toyota.jp/mirai/grade/equipment/ https://toyota.jp/mirai/station/faq/index.html
https://www.meti.go.jp/committee/kenkyukai/energy/nenryodenchi_fukyu/pdf/005_04_02.pdf
Caetano :https://caetanobus.pt/en/buses/h2-city-gold/ https://caetanobus.pt/en/esta-ai-o-h2-city-gold-o-novo-autocarro-caetano-a-hidrogenio/

(4) Permissions and safety regulations in Chile relevant to the project

■ Permission procedures

In Chile, the implementing institution of hydrogen-related projects are required to submit an application for project permission to the Superintendencia de Electricidad y Combustibles (SEC)[4].

■ Safety regulations

In Chile, hydrogen is classified as a flammable gas and a hazardous substance, and the Ministry of Public Health regulates the environment in which it is stored and used. The Ministry of Economic Development and Construction regulates the use of liquid and gaseous fuels for energy, but at present there is no safety regulation specific to hydrogen energy. A summary of the safety regulations for hazardous substances, including hydrogen, enacted by the Ministry of Public Health's is given in the table below. According to the Government of Chile, the safety regulation of Chile to be developed would comply with the ones developed by the countries with advance in hydrogen energy production and use such as EU, USA, Japan etc.

Table 2-11 List of hydrogen-related safety regulations in Chile

Provisions	Outline of the contents
Supreme Decree N° 43	Regulations for the storage of dangerous goods. Specific provisions on the maximum storage volume and the distance between dangerous goods and combustion equipment.
Supreme Decree N° 594	Regulations on health and the environment at work governing the handling of flammable substances, including hydrogen, in the workplace and fire prevention.
Exempt Resolution N° 408	List of designated dangerous goods. Designation of liquids and compressed hydrogen gas as dangerous goods.

Source: Nippon Koei

[4] https://energia.gob.cl/sites/default/files/guia_proyectos_especiales_hidrogeno_2021.pdf

(5) Approach for estimation of GHG emission reduction

Estimate of GHG emission reduction will be made after determination of the number of FCVs/FC buses to be introduced, and their conditions of use. A draft approach for estimation of GHG emission reduction is shown in the table below.

Table 2-12 Approach for estimation of GHG emission reduction

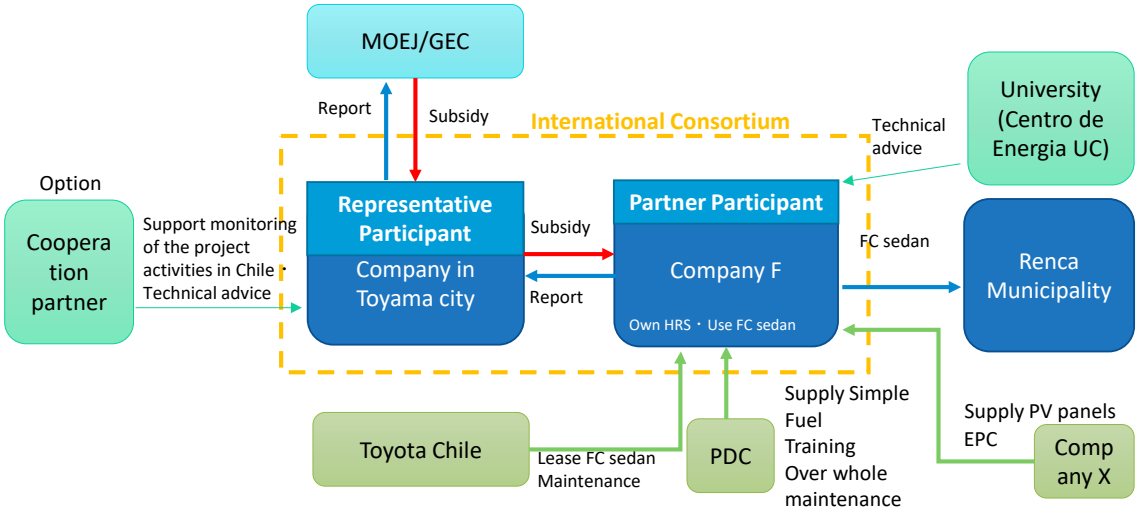
Calculation of reference emissions	Setting of reference emissions:. Emissions from the operation of vehicles (fossil fuel vehicles/electric vehicles) that would have been used for services of Company F. Calculation of reference emissions:. $\boldsymbol{RE_y = \sum_i (SFC_i \times NCV_{RF,i} \times EF_{RF,i} \times DD_{i,y} \times N_{RF,i,y})}$ RE_y Total reference emissions in year y (tCO_2/year) SFC_i Specific fuel consumption of reference vehicle category i (l/km) $NCV_{RF,i}$ Net calorific value of fossil fuel consumed by reference vehicle category i (MJ/l) $EF_{RF,i}$ Emission factor of fossil fuel consumed by reference vehicle category i (tCO_2/MJ) $DD_{i,y}$ Annual average distance travelled by project vehicle category i in the year y (km/year) $N_{RF,i,y}$ Number of reference vehicles in category i in year y
Calculation of project emissions	Calculate the fossil fuel consumption in the water electrolysis production of green hydrogen consumed in the project operation. (e.g. fuel consumption of vehicles for transporting water resources needed for hydrogen production, etc.) However, this will be based on the green hydrogen production process to be detailed in the future.

Source: Compiled by Nippon Koei based on the results[5] of the feasibility study of JCM for 25adults commissioned by GEC

(6) Implementation structure

The proposed implementation structure of the project is shown in the following figure. Renca Municipality and Company F will form an international JCM consortium with a representative partner, a company of Toyama City.

[5] https://gec.jp/gec/jp/Activities/fs_newmex/2013/2013ds01j_PM.pdf



Source: Nippon Koei

Figure 2-11 Draft implementation structure

The major roles of the members of the international consortium are shown in the following table.

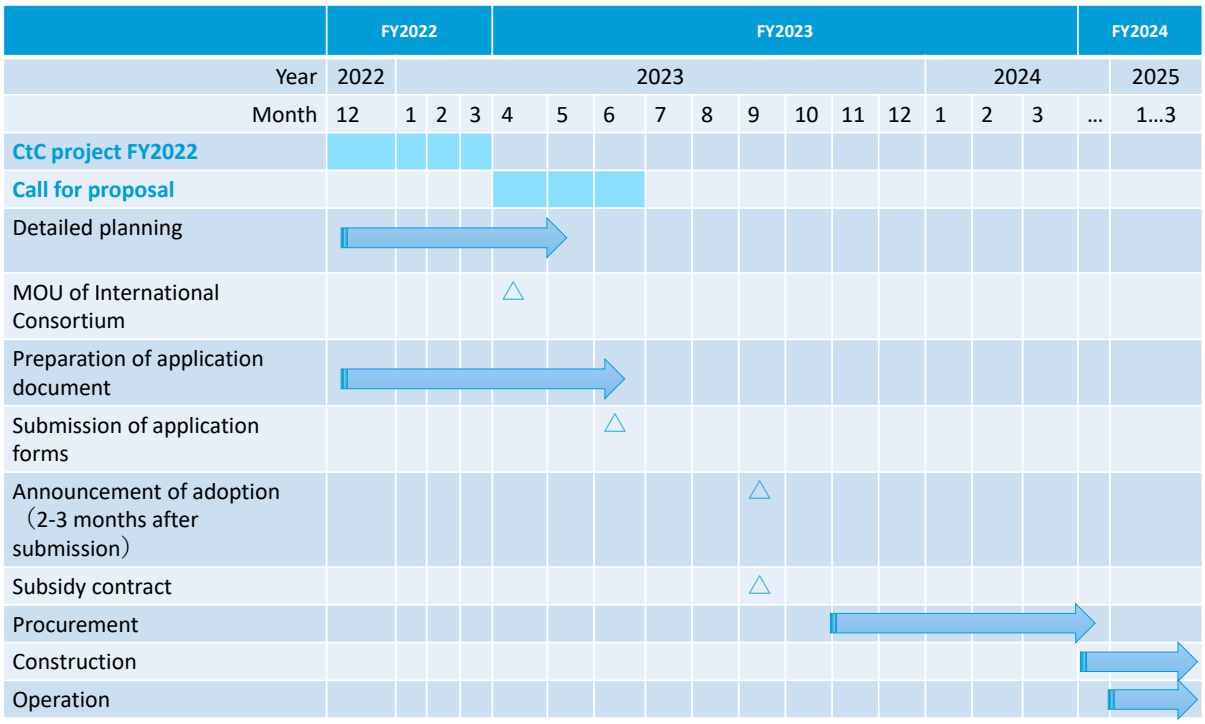
Table 2-13 Major roles of the members of the international consortium

Members	Major roles
Representative participant	Supervise installation and operation of the equipment, transfer subsidy to the partner participants, and submit reports to MOEJ and provide necessary information for audit based on data provided by the partner participants.
Company F	Install an electrolyser for hydrogen production and a hydrogen station in its premises, and as the owner of the installed equipment, operate and monitor the operational status such as amount of hydrogen produced and filled to FCVs, and report to the monitored results to the representative participant. Under the guidance of the equipment manufacturer, responsible for the maintenance of the equipment installed. Request necessary permit to the government of Chile, promote public awareness raising on the hydrogen mobility for dissemination of FCV in Chile.

Source: Nippon Koei

(7) Project schedule

The following figure shows a proposed schedule of the project from January FY 2023 to the end of FY 2024. Although the implementation period of the project for Financing Programme to Demonstrate Decarbonization Technology for Realizing Co-Innovation/Hydrogen Technology is not disclosed yet, the proposed schedule shows until the end of FY2025 according to the budget period of MOEJ for this scheme. This shorter project period is one of the concerns of the project, since procurement, construction and starting operation might not be able to be completed within this shorter project period. In the course of preparation for application to the scheme, discussion with MOEJ will be continued.



Source: Nippon Koei

Figure 2-12 Proposed implementation schedule

2.4 POTENTIAL OTHER PROJECTS IDENTIFIED DURING THE SURVEY IN CHILE

As described in Section 1.7 of Chapter 1, interviews with some companies in Renca were conducted and several potential JCM model projects were identified as summrized in the table below. More companies have started i) setting its own target for energy saving and decarbonization, and ii) studying the relevant technology to achieve their targets. Among the technology for energy saving and decarbonization, new technology such as CCU and FC folk lift attract their attention.

Table 2-14 Potential Projects Identified in the Interview with the Companies in Renca

Company/organization	Business/Service	Technology interested by the companies	Outline
Company a	Manufacture of chemical products, metallic equipment for machinery	➢ Electrification of the process with natural gas	This company uses natural gas in some parts of their manufacture process, such as steam production and cut and shape of metals. Due to escalation of the price of natural gas and for contribution to GHG emission reduction, this company showed interest in electrification of these process.
Company b	Manufacture of beverage	➢ FC/EV folk list ➢ CCU of discharged gas and produce E-fuel ➢ Improve chiller system ➢ Improve flow of boiler steam ➢ Other high efficiency facilities	This company identified the process with high energy consumption by its own energy management system. In order to improve the efficiency of the identified process.it started study on the technology for energy saving including that of Japan. In addition to the improvement of the existing system, this company showed its interest in application of JCM model project for installation of higher efficiency equipment to its new facility, which is under construction. It also showed its interest in CCU to produce carbonated beverage. This company will prioritize the technology and prepare a timeframe to apply for the JCM model project.
Company c	Manufacture of cement, concrete	➢ Fracture ➢ CCU etc.	This company pledged the Race-to-Zero campaign. It uses cokes and alternative energy, namely mixture of wastes for manufacture of cement to reduce the amount of fossil fuels used. Since 25 % of the total alternative energy is tire, technology of fracture of the tires are the key to improve the energy efficiency. In order to achieve the goal pledged in the Race to Zero campaign, company c started to study CCU technology, and showed its interest in the technology of Japan, and asked for cooperation from the CtC programme.
Company d	Construction, Waste management	➢ Install a waste management facility in/near Renca ➢ Waste to energy	Waste generated in Renca is transported to a landill area about 60 km away from Renca municipality. This company proposed a plan to construct a new facility for waste management, recycle, and waste-to-energy in/ near Renca to reduce the GHG emission from the transportation and landfill.
Renca municipality	Local government	➢ Zero Emission Building (ZEB) ➢ LED	Construction of a new municipality hall is under planification. Renca municipality interests in installation of PV panels, and ZEB of the building. It also interests in replace the streetlamps to LED.

Source: Nippon Koei

CHAPTER 3. SUPPORT FOR INSTITUTIONAL DEVELOPMENT

3.1 SHARING EXPERIENCES OF SDGS AND ZERO CARBON CITY DECLARATION

The project aims to promote SDGs and decarbonization efforts by sharing information and knowledge related to SDGs and Zero Carbon City declaration of Toyama City with Renca Municipality, Santiago City.

In June 2018, Toyama City was selected by the Japanese Cabinet Office as both a "SDGs Future City" and a "Local Government SDGs Model Project." "SDGs Future Cities" are local governments that propose excellent approaches to achieve SDGs among Japanese municipalities. In the first year of 2018, 29 local governments, including Toyama City, were selected. In addition, the "municipal SDGs model project" refers to a project that is making particularly leading SDGs efforts, and 10 projects were selected in the first year of FY2018, including the project of Toyama City.

For this reason, Toyama City, which is actively engaged in SDGs among Japanese municipalities, can provide information and innovations on actual initiatives from SDGs planning through city-to-city collaboration. Therefore, sharing activities of Toyama City is considered to be very useful for Renca Municipality, which is also considering the promotion of SDGs.

For Toyama City, SDG actions are a good example not only for Toyama City, but also for overseas cities, and that they are positioned as one of the initiatives for international cooperation is in line with SDGs's goals. Therefore, the promotion of SDGs has significant merits for both cities.

Toyama City declared Zero Carbon City as the fifth city in Toyama Prefecture in March 2021, in response to the growing momentum toward carbon neutrality by 2050 in Japan. In order to achieve the goal of carbon neutrality, Toyama City has established the "Toyama Regional Circular and Ecological Sphere Model Formation Platform" with local energy companies, universities, financial institutions and local government since 2019. Through this platform, they have been discussing measures to be taken by the public and private sectors. In March 2021, “Toyama City Energy Vision” was published, which sets out policies and reduction targets for achieving carbon neutrality. In November 2022, Toyama city developed Toyama City Vision for Smart City Promotion and started planning of EV sharing system for decarbonization. These Toyama City's efforts through the public-private partnership can be helpful for Renca Municipality, which has interest in decarbonisation and announced its participation in the Race to Zero campaign at COP26.

In FY 2022, Toyama City will share information about Toyama City's efforts on SDGs and collaboration with private companies in the final workshop to be held on 28 February.

3.2 OVERVIEW OF SDGS FUTURE CITY PLAN

In recent years, plans formulated by local governments based on national guidelines require the establishment of key performance indicators (Key Performance Indicators, hereinafter referred to as KPIs). For this reason, KPIs have been established in the Toyama City SDGs Future City Plan since the first version. First of all, Toyama City has set three values, namely "economy", "society" and "environment" as its ideal vision for 2030, and shows KPI and priority goals and targets for each value.

The project also promotes initiatives that contribute to the promotion of municipal SDGs in five areas: urban shapes, citizens' livelihoods, energies used, industries, and cities and regions. These initiatives are aimed at deepening the content that Toyama City has been working on to date and creating an autonomous virtuous cycle of the Compact City strategy by promoting cross-sectoral and complex initiatives in collaboration with diverse stakeholders for the value of each area of the economy, society, and the environment.

Table 3-1 Key points of Toyama City's initiatives contributing to the promotion of SDGs

#	Item	Overview
1	Shape of the city	Realization of compact city development based on the public transportation
2	Daily lives of the citizens	Building a healthy and transportation city and establishing a high-quality lifestyle
3	Energy	Building a safe and environmentally friendly smart city and a self-supporting distributed energy system
4	Industry	Building technological and social innovation by improving industrial vitality
5	Cities and regions	Enhancing urban branding through collaboration with various stakeholders

Source: 2nd Toyama City SDGs Future City Plan

3.3 OUTLINE OF TOYAMA CITY ENERGY VISION

Toyama City Energy Vision, which was formulated in March 2021, is a vision to realize carbon neutrality by 2050 and SDGs targets, and is positioned as a plan to promote efforts in the energy sector among the 5 promotion sectors in Toyama City SDGs Future City Plan. Toyama City Energy Vision aims to promote comprehensive energy policy in collaboration with various stakeholders by promoting renewable energy and energy saving business to encourage local production and local consumption of energy. The target period is 10 years from 2021 to 2030 with a vision to 2050.

In order to set targets in this vision, the potential of renewable energy in Toyama City was firstly assessed. The potential for the introduction of renewable energy in Toyama City is estimated to be 4.09 billion kWh, which is about double the actual amount of 2.01 billion kWh introduced in 2019. Among the renewable energy, the main source is PV power generation, and there is also potential for medium hydraulic power generation using agricultural water, and

biomass power generation using forest resources. The following table compares the actual and potential amount of renewable energy introduced in Toyama City.

Table 3-2 Amount of the renewable energy introduced as of 2019 and the potential amount to be installed in Toyama City

Renewable energy type	Installed amount (FY2019)	Potential amount
Solar power generation (Housing) (Non-housing)	125,116,000 kWh 27,347,000 kWh 97,769,000 kWh	1100,000,000 kWh kWh kWh
Small and medium scale hydropower generation Large scale hydro power generation	70,991,000 kWh 1811,568,000 kWh	760,000,000 kWh 1810,000,000 kWh
Wind power generation (onshore)	0.0 kWh	100,000,000 kWh
Biomass power generation (Wood) (Digestive gas)	3281,000 kWh 0.0 kWh 3281,000 kWh	320,000,000 kWh 310,000,000 kWh 8460,000 kWh
Total (*excluding large hydro)	21,010,000,000 kWh	41,090,000,000 kWh

Source: Prepared by Nippon Koei from Toyama City Energy Vision

3.4 SETTING KPIS IN TOYAMA CITY ENERGY VISION

Based on the above renewable energy introduction potential, Toyama City Energy Vision sets the mid-term targets of renewable energy introduction to double the current level by 2030 (2.21 billion kWh, about 47% of electricity consumption) and increase by 5 times the current level by 2050 (2.81 billion kWh, about 65% of electricity consumption). This milestone aligns with the target figure set in the national Green Growth Strategy, which is 50%-60% of renewable energy in 2050.

In order to achieve the renewable energy introduction target, Toyama City Energy Vision sets out 16 measures based on 4 policies. The details of the measures are as follows.

Table 3-3 Policies and measures in Toyama City Energy Vision

Policies	Measures
Policy1: Renewable energy Expanding the introduction of renewable energy	(1) Expanding PV using PPA model (2) Expanding micro- hydropower generation (3) Promoting biomass energy (4) Promoting EV sharing (5) Promoting hydrogen energy
Policy2: Promoting energy conservation	(6) Dissemination of energy-saving technologies and energy resources (7) Improving energy efficiency in private buildings (8) Improving energy efficiency in public buildings
Policy 3: Revitalizing the energy business	(9) Modelling of self-sufficient distributed energy system (10) Promoting green finance (11) Developing local production of local consumption model of RE (12) Expanding city know-how and companies' technology
Policy4: Collaboration with various stakeholders	(13) Promoting energy projects through PPP (14) Expanding energy project base (15) Human resources development for energy project s (16) Considering wide area collaboration in energy

Source: Prepared by Nippon Koei from Toyama City Energy Vision

Toyama City aims to reduce greenhouse gas emissions by 850,390 t-CO_2 by 2030 and 3,504,142 t-CO_2 by implementing 16 measures based on 4 policies, and to steadily develop measures to achieve carbon neutrality by 2050.

3.5 SPECIFIC MEASURES BASED ON TOYAMA CITY ENERGY VISION

Among the 16 measures in the Toyama City Energy Vision, 2 measures, which are particularly important, were shared with Renca Municipality.

1) Expanding PV using the Power Purchase Agreement (PPA) model

Though Toyama City has promoted support for the introduction of solar power generation through subsidy schemes, the number of new installations of solar power generation equipment has been decreasing due to the decline in the feed-in tariff (FIT) purchase price. Therefore, Toyama City has promoted the switch from the power sales model to the self-consumption model and the use of PPA models in public facilities. In addition, Toyama City aims to supply energy to municipal elementary and junior high schools, which are designated as evacuation sites in the regional disaster prevention plan, so that the generating energy can be used as emergency power sources. Toyama City aims to expand the introduction of solar power generation equipment in public and private facilities by utilizing the PPA model, and it will be double by 2030 and five times the current situation by 2050. KPI's targets are as follows.

Table 3-4 KPIs for the expansion of solar power

Item	March 2021	FY2030	FY2050
Solar power installations	125,120,000 kWh	250,240,000 kWh (Double the current level)	625,600,000 kWh (Five times the current level)

Estimated GHG reductions	-	101,844 t-CO_2	254,611 t-CO_2

Source: Prepared by Nippon Koei from Toyama City Energy Vision

2) Promoting EV sharing

In Toyama City, obtaining local mobility has become an issue due to the declining birth rate and ageing population and declining population in the suburbs. Therefore, Toyama City has installed EV charging stations in suburban administrative centers and 25 EV vehicles to enhance mobility. In the national road map, the target of introduction of EV is 90% by 2050, Toyama City also aims to increase EV 30% by 2030 and 90% in 2050 by promoting EV sharing. The KPIs for promoting EV sharing as follows.

Table 3-5 KPIs for promotion of EV sharing

Item	March 2021	FY2030	FY2050
EV introduction rate	-	30%	90%
Estimated GHG reductions	-	241,783 t-CO_2	725,329 t-CO_2

Source: Prepared by Nippon Koei from Toyama City Energy Vision

Image of EV

Source: https://kuruma-news.jp/post/99303 (accessed on 20 Feb 2023)

Figure 3-1 Photograph of EV vehicle

3.6 OUTLINE OF TOYAMA CITY VISION FOR SMART CITY PROMOTION

In November 2022, Toyama city published “Toyama City Vision for Smart City Promotion” to improve quality of life of the citizens and convenience for well-balanced development across the city. This vision proposed the approach of industry-academia-government collaboration to address the regional issues, and proposed activities to visualize the environmental burden in consideration for the next generations to realize the vision “Life sharing the regional enchantment and mutual support”. This new vision proposes activities for decarbonization such as, local energy generation and management system and EV sharing system.

3.7 EXAMPLES OF SDGS AND DECARBONISATION ACTIONS THROUGH

PUBLIC-PRIVATE PARTNERSHIPS

The realization of a decarbonized society cannot be achieved only by the efforts of the local government itself, it is important to strengthen collaboration with the private sector, including businesses and citizens. Toyama City Energy Vision also states that collaboration with various stakeholders including the private sector is one of the basic policies, and aims to promote measures through public-private partnership. Therefore, in this city-to-city collaboration project, Toyama City introduced some examples of public-private partnerships to Renca Municipality.

1) Registration of SDGs supporters

Toyama City recruits “SDGs supporters” who promote SDGs for companies, citizen groups and individuals above high school students, and introduces examples of their efforts in the newspapers and the city website. As of 2022, about 1,000 individuals and 300 organizations and companies have registered as SDGs supporters.

2) Toyama City SDGs Promotion Communicator Training Project

Toyama City has been training "Toyama City SDGs Promotion Communicators" who promote SDGs in their communities and workplaces and implement activities by themselves since 2020. The number of certified communicators is over 100 people, and Toyama City prepares the opportunities for training courses and presenting their activities.

3) Toyama City SDGs Week / Forum

Toyama City holds SDGs week and forum every year to raise awareness of SDGs among citizens and companies. In the SDGs week and forum, there are various events such as workshops, classes for elementary schools, and experience-based events at various locations in the city.

4) Formation of Autonomous Decentralised Energy System Model Project

Toyama City and Hokuriku Electric Power Company in Toyama City have introduced PV facilities, storage batteries, EV and EV chargers/dischargers, and energy management system into the city gymnasium, which has been designated as an evacuation site during disasters to promote "energy saving and CO_2 reduction" and "BCP function" of energy. They have also considered the introduction of EV sharing to the gymnasium to utilize EV by offering EV to city staff and local residents during normal periods.

3.8 DECARBONIZATION LEADING AREA INITIATIVES

3.8.1 Regional Decarbonization and Regional Decarbonization Roadmap

In October 2020, Japan declared its goal of becoming a decarbonized society by 2050, and on May 26, 2021, a partial amendment to the Law Concerning the Promotion of the Measures to Cope with Global Warming was enacted, which clearly states this goal. The aim of the amendment to the law is to require local governments to set targets for the introduction of renewable energy and to accelerate the movement toward local decarbonization.

Since collaborative and co-creational efforts between the national government and local governments are essential to achieve these goals, a "National-Local Decarbonization Council" chaired by the Chief Cabinet Secretary was established, with the aim of realizing regional decarbonization that contributes to local development to improve the attractiveness and quality of local communities. In addition, a "Regional Decarbonization Roadmap" was formulated at the third meeting of the National and Regional Decarbonization Conference on June 9, 2021, which outlines a process and concrete measures, focusing on initiatives and measures to be concentrated by 2030.

The "Regional Decarbonization Roadmap" sets the next five years as a concentrated period to mobilize all measures in order to start a "decarbonization domino of implementation" in which regional decarbonization spreads to other regions, starting with those with the highest willingness and feasibility. It also aims to expand regional decarbonization efforts nationwide after 2030, so that by 2050, many regions will have achieved decarbonization and will have solved their local problems to move into the next era of strong and vibrant local communities.

3.8.2 Decarbonization Leading Area

Decarbonization Leading Area is a region that achieves virtually zero CO_2 emissions from electricity consumption in the consumer sector (household and business and other sectors) toward carbon neutrality in 2050, and also achieves reductions in other greenhouse gas emissions, including transportation and heat utilization, consistent with Japan's 2030 target for the country as a whole, depending on regional characteristics.

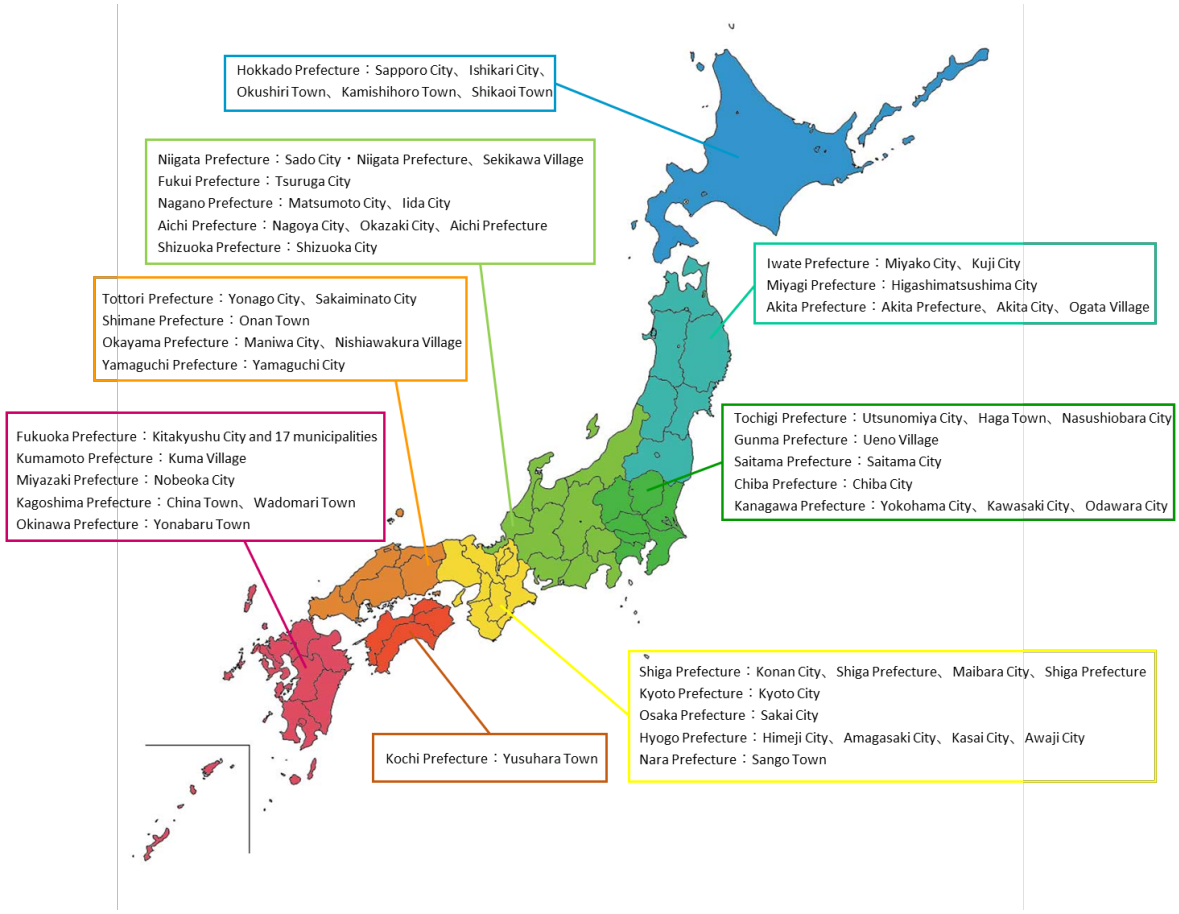
At least 100 Decarbonization Leading Areas, led by local governments, local businesses, and financial institutions, and with active support from the national government, led by the Ministry of the Environment, will implement initiatives to move toward decarbonization in accordance with regional characteristics and other factors, and will provide direction for initiatives to move toward decarbonization while solving regional issues and improving the quality of life of residents.

3.8.3 Status of selection of Decarbonization Leading Areas

Twenty-six Decarbonization Leading Regions were selected from 79 planning proposals at the first call for proposals, 20 were selected from 50 planning proposals at the second call for

proposals, and by the second call, 46 proposals from 66 municipalities in 29 prefectures across Japan had been selected. In addition, the Decarbonization Leading Areas are unique in that they allow multiple local governments to work together, as well as private companies, universities, and other organizations to work in partnership with local governments.

The third round of applications is scheduled to be accepted from Tuesday, February 7, 2023 to Friday, February 17, 2023, and the fourth and subsequent rounds will be held twice a year with the aim of selecting at least 100 decarbonized areas by 2025 to achieve carbon neutrality in 2050.



Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://policies.env.go.jp/policy/roadmap/assets/preceding-region/2st-DSC-kekka.pdf

Figure 3-2 Status of selection of Decarbonization Leading Areas

3.8.4 Commitments to Renca Municipality

The commitments made by the Renca Municipality toward the realization of a decarbonized society are as follows.

Based on these commitments, the next section summarizes the efforts of Japan's Decarbonization Leading Areas that could serve as a reference for the Renca Municipality.

Table 3-6 List of commitments of Renca Municiaplity

No.	commitment
1	Building a society that excludes no one
2	Creating green and healthy streets
3	Reduce air pollution and ensure clean air
4	Development of Zero Carbon Buildings
5	Transition to a strong and sustainable energy system
6	Progress Toward Zero Waste
7	Building a sustainable food system
8	Divest from fossil fuels and invest in a sustainable future
9	Aiming for strong and sustainable construction

Source: Prepared by Nippon Koei based on the following Renca Municipality presentation material
Cities towards carbon neutrality" Toyama-Renca

3.8.5 Possible references for Renca Municipality in Decarbonization Leading Areas

Based on the Renca Municipality's commitments, the following Japanese Decarbonization Leading Areas were selected to serve as a possible reference for the Renca Municipality.

The efforts of five municipalities (Sapporo City, Hokkaido; Shikaoi Town, Kato County, Hokkaido; Yokohama City, Kanagawa Prefecture; Konan City, Shiga Prefecture; and Sakai City, Osaka Prefecture) were considered as potential references for future efforts to decarbonize the Renca Municipality. The details of these municipalities' efforts are presented in the next and subsequent sections.

Table 3-7 Decarbonization Leading Areas and initiatives serve as a reference for Renca Municipality

No.	Municipality name	Main Initiatives	Commitments of Renca Municipality that fall under the initiative of Decarbonization Leading Areas. *Related Decarbonization Leading Areas in parentheses
1	Hokkaido Sapporo City	・ Realization of a Hydrogen Society through the Establishment of a Hydrogen Supply Chain ・ Decarbonization of electricity and heat through the utilization of cogeneration systems (CGS)	2. creating green and healthy streets (Promotion of FC buses and FC trucks)
			3. reduce air pollution and ensure clean air (Reduction of air pollutants through the realization of a hydrogen society)
			4. development of zero-carbon buildings (Decarbonization of electricity and heat by converting a group of private facilities to ZEB)
			5. transition to a strong and sustainable energy system (Establishment of a hydrogen supply chain)
			8. Divest from fossil fuels and invest in a sustainable future (Moving away from fossil fuels through the realization of a hydrogen society)
2	Hokkaido Kato County Shikaoi Town	・ Decarbonization of the town through the use of biogas ・ Maximize the use of renewable energy by building a	2. creating green and healthy streets (Widespread use of decarbonized vehicles that utilize biogas-derived energy)
			3. reduce air pollution and ensure clean air (Reduction of air pollutants through the use of biogas)
			5. transition to a strong and sustainable energy system (Construction of own line network and heat source network)
			8. Divest from fossil fuels and invest in a sustainable future (Breaking away from fossil fuels through the use of biogas)

		network of self-owned lines	
3	Kanagawa Yokohama City	・ Installation of solar power generation equipment through on-site PPA and off-site PPA ・ Reduce waste by using food residues for biomass power generation and composting.	5. transition to a strong and sustainable energy system (Utilization of excess power from on-site PPAs)
			6. progress toward zero waste (Use of food residues for biomass power generation, composting)
			7. building a sustainable food system (Composting of food residues)
			8. Divest from fossil fuels and invest in a sustainable future (Active installation of solar power generation equipment)
4	Shiga Konan City	・ Energy efficiency audits for factories and warehouses to replace LED and air conditioning. ・ Matching services for PPA and energy conservation service projects	3. reduce air pollution and ensure clean air (Reduction of air pollutants by promoting energy conservation in factories and warehouses)
			4. development of zero-carbon buildings (decarbonization of factories and warehouses)
			5. transition to a strong and sustainable energy system (Utilization of surplus electricity through integrated energy management)
			8. Divest from fossil fuels and invest in a sustainable future (Financing in collaboration with regional banks)
5	Osaka Sakai City	・ Energy conservation and VPP (virtual power plant) for the entire area through district heating and cooling ・ Conversion from private cars to public transportation through the use of advanced technology	1. building a society that excludes no one (Formation of urban space dominated by public transportation)
			2. creating green and healthy streets (Utilization of next-generation mobility)
			5. transition to a strong and sustainable energy system (Energy conservation and toughening of the entire area through VPP)

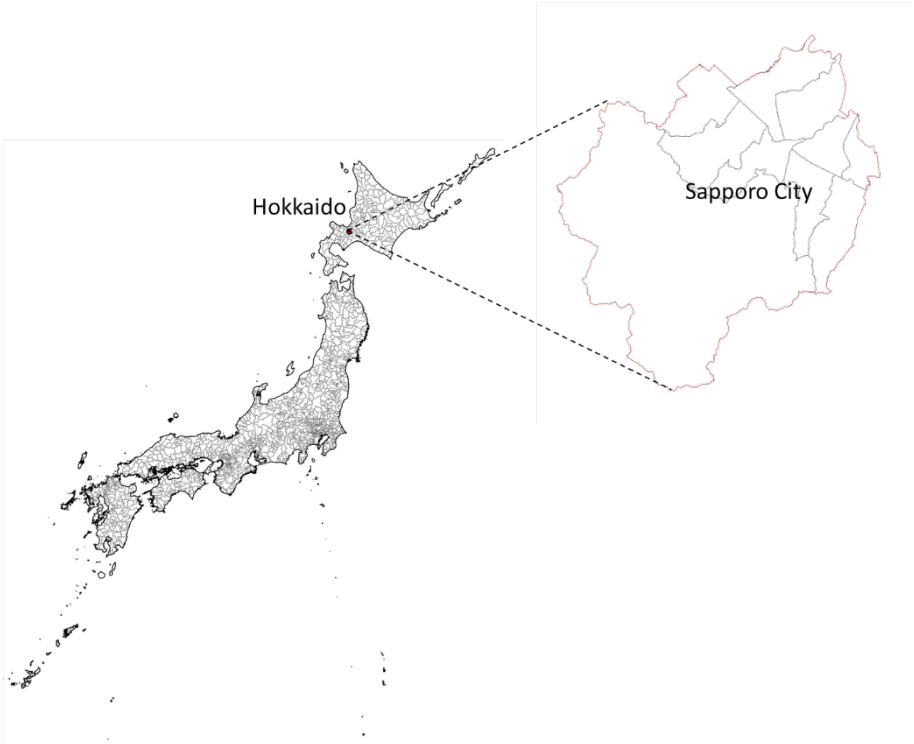
Source: Nippon Koei

(1) Sapporo City, Hokkaido

1) Area Overview

Located in the southwestern part of the Ishikari Plain, Sapporo, Hokkaido, is a large city with an area of 1,121.26 km2 and a population of 1,971,225 (as of January 1, 2023). The industrial structure of Sapporo, in terms of both the number of establishments and the number of employees, is dominated by tertiary industries such as wholesale and retail trade and food and lodging services, with a lower percentage of secondary industries such as manufacturing than the rest of Japan.

Sapporo's greenhouse gas emissions in FY2016 were approximately 11.93 million t-CO_2. The city's three sectors (household, business, and transportation) accounted for about 90% of the city's CO_2 emissions. The background is the high heating energy consumption of households in snowy and cold regions, an industrial structure centered on tertiary industries, and high dependence on automobiles in daily life.



Source: Created by Nippon Koei using a map of global Japan from the website of the Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism.

Figure 3-3 Location of Sapporo City, Hokkaido

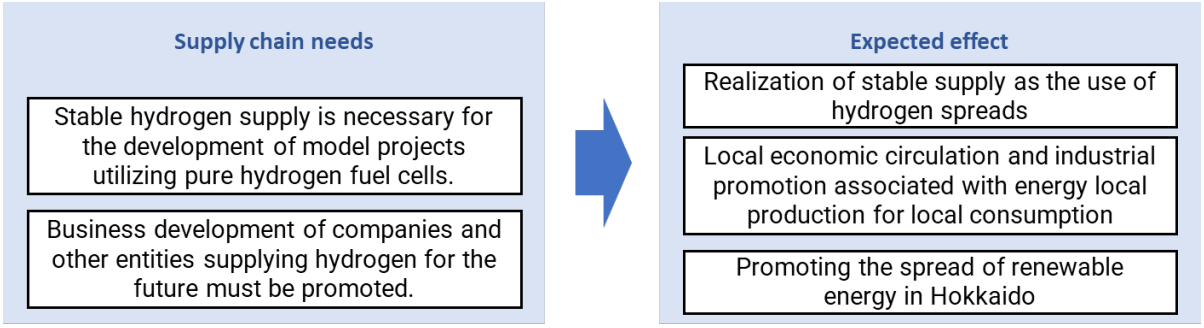
2) **Main Initiatives**

■Achieving a hydrogen society through the establishment of a hydrogen supply chain (Renca Municipality Commitment_2, 3, 4, 8)

In order to realize a model project for utilizing pure hydrogen fuel cells, it is necessary for "suppliers" to develop their business to provide a stable supply of hydrogen, and to deliver hydrogen to consumers through hydrogen production, storage, and transportation.

Specifically, green hydrogen produced from surplus electricity in renewable energy generation areas and hydrogen produced as a byproduct of industrial processes is stored at hydrogen storage facilities, and then supplied to hydrogen stations and temporary storage facilities in demand areas using transportation methods such as high-pressure gas hydrogen, liquefied hydrogen, and organic hydrate that are appropriate for the cost and application. The hydrogen is then supplied to hydrogen stations or temporary storage facilities in demand areas using transportation methods that are appropriate for the cost and purpose.

In light of the characteristics of large cities where energy demand exceeds supply capacity, a hydrogen supply chain that is easy to store and transport will be constructed to realize a hydrogen society. In addition, in anticipation of the arrival of a hydrogen society in Hokkaido, which has high renewable energy potential, develop stationary hydrogen stations that can accommodate large vehicles such as FC buses and trucks will be planned.



Source: Sapporo City Hydrogen Utilization Policy (accessed on 20 Feb 2023)
https://www.city.sapporo.jp/kankyo/energy/documents/honsyohenn.pdf

Figure 3-4 Necessity and expected effects of Hydrogen Supply Chain

■Decarbonization of electricity and heat through the use of CGS (cogeneration systems) (Renca Municipality Commitment_3, 4, 5, 8)

A CGS (cogeneration system) is a system that simultaneously uses the "heat" generated when "electricity" is produced by a generator as "hot water" or "steam".

In addition to the energy network being built in the Sapporo City center area using CGS, the project aims to decarbonize electricity and heat by converting to ZEB at a group of private facilities, using renewable energy from woody biomass as a heat supply reduction, and switching to CN gas.

Source: Sapporo City HP (accessed on 20 Feb 2023)
https://www.city.sapporo.jp/kankyo/energy/shokai/biomass.html#s01

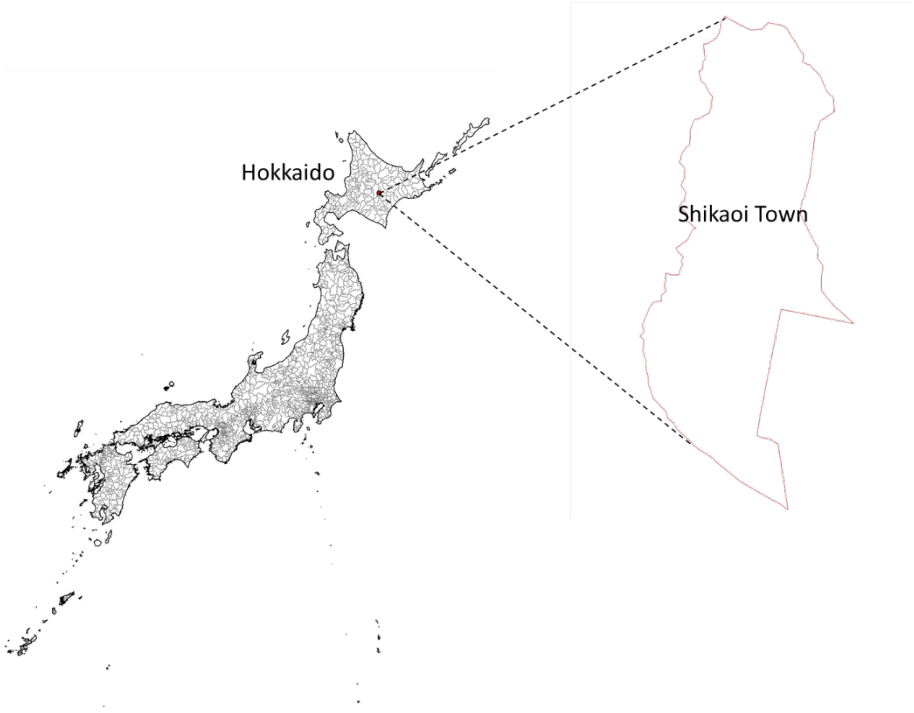
Figure 3-5 Wood pellets of woody biomass fuel

(2) Shikaoi Town, Kato County, Hokkaido

1) Area Overview

Shikaoi Town, Kato County, Hokkaido, is located in the northwestern part of the Tokachi Plain, with an area of 404.70 km2 and a population of 5,135 (as of January 2023). Agriculture is the town's main industry, accounting for the largest share of production by industry, with dairy cattle accounting for 2/3 of the total.

In FY 2019, the greenhouse gas emission in Shikaoi Town was approximately 62,000 t-CO_2, with agriculture, forestry, and fisheries, business, households, and freight vehicles each accounting for about 20% of the total emissions. In addition, emissions from the use of electricity and gasoline, diesel, and kerosene account for about 30% and 50% of the total, respectively. The region is characterized by its heavy use of fossil fuels due to the heavy heating load in this snowy and cold region and its dependence on automobiles due to the scattered settlements and the lack of adequate public transportation systems.



Source: Created by Nippon Koei using a map of global Japan from the website of the Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism.

Figure 3-6 Location of Shikaoi Town, Kato County, Hokkaido

2) Main Initiatives

■Decarbonization of the town through the use of biogas (Renca Municipality Commitment_2, 3, 5, 8)

In addition to meeting the town's electricity demand with renewable energy, a third biogas plant will be built to provide a power source capable of meeting electricity demand within the town

in order to both develop the dairy farming industry, which is a key industry in the region, and to take environmental measures.

As a mechanism to handle this power locally, a "regional energy company" will be established, and a system will be set up to enable local production and local consumption of energy so that the company can conduct power distribution business in the future. In addition, by 2030, the company will introduce stations mainly for EV and FCEV that use biogas-derived energy, and through sharing, educate the public and reduce the number of vehicles in its fleet, aiming for the future diffusion of decarbonized vehicles in the town.

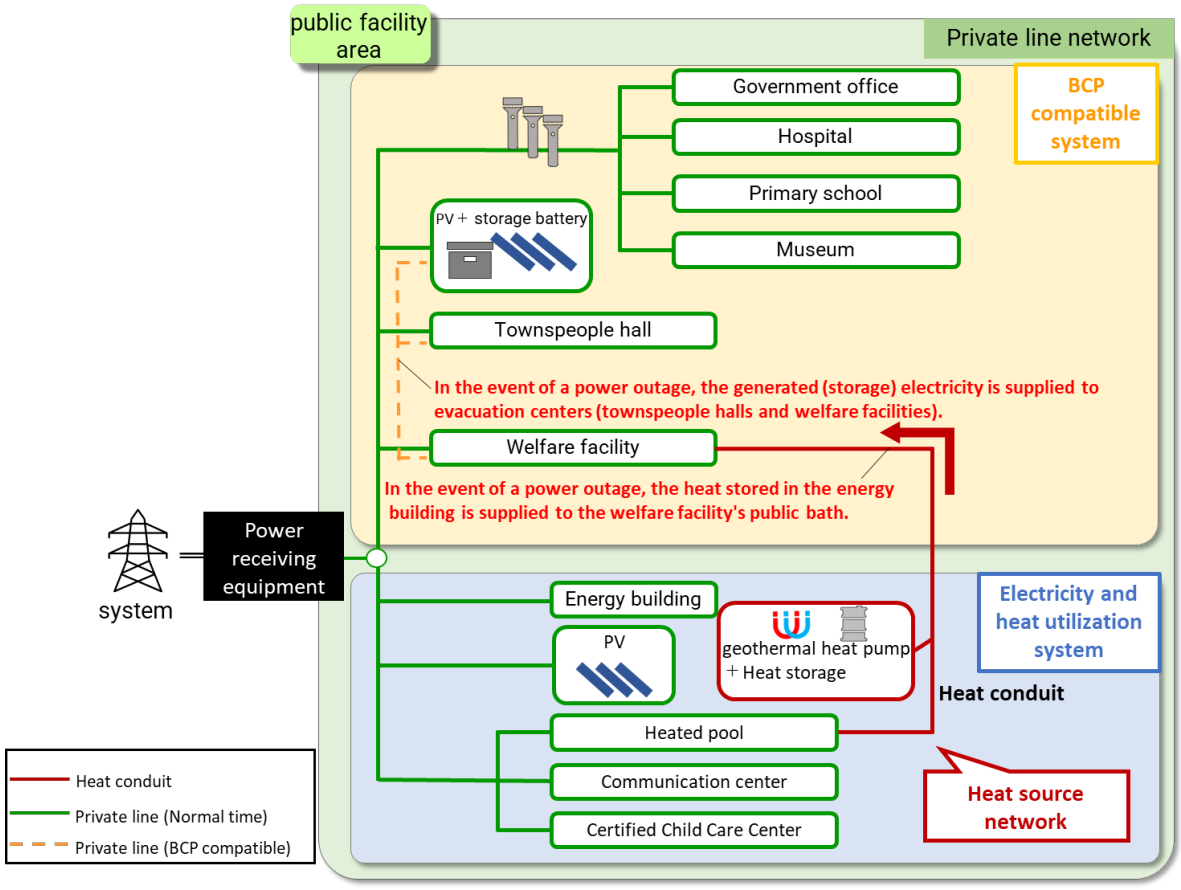
Source: Shikaoi Town HP (accessed on 20 Feb 2023)
https://www.town.shikaoi.lg.jp/work/biogasplant/

Figure 3-7 Shikaoi Town Environmental Conservation Center (Biogas Plant)

■Maximize the use of renewable energy by building a network of self-owned lines (Renca Municipality Commitment_5, 8)

Targeting areas where groups of public facilities are concentrated, the project aims to reduce the reverse power flow to the grid by using the heat source network while enabling the introduction of renewable energy sources using the self-owned line network.

In the heat source network, the electrification of fossil fuel boilers and the active introduction of electric heat pump air conditioning are planned. In addition, V2H and FCEV will be deployed to establish a system capable of supplying electricity in case of emergency. Hydrogen fuel cells will be installed in the area surrounding the town hall, and methane gas cogeneration systems will be installed in the Urimaku area to use biogas for electricity and heat, thereby increasing energy self-sufficiency.



Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://www.town.shikaoi.lg.jp/file/contents/1370/16824/shikaoi_jieisen_ppt.pdf

Figure 3-8 Image of Utilization of Own Line Network

(3) Yokohama City, Kanagawa Prefecture

1) Area Overview

Yokohama City, Kanagawa Prefecture, is the largest basic municipality in Japan, located in the eastern part of Kanagawa, with an area of 437.71 km2 and a population of 3,766,999 (as of February 1, 2023). The city has a role as a port city that has driven active trade, commerce, shipping, and shipbuilding. In addition, a world-class industrial zone stretches from the northern part of Tokyo Bay to the eastern part of the city and is home to a diverse range of manufacturing industries, including electronics, machinery, and automobiles.

Greenhouse gas emissions from the city area in FY 2019 were 17.72 million t-CO_2, a decrease for the sixth consecutive year after peaking in FY 2013. Factors contributing to the decrease include a decrease in energy consumption due to energy conservation efforts and an improvement in the emission factor for electricity. In addition, emissions from the consumer sector (household and business) are larger than the national rate.

Source: Created by Nippon Koei using a map of global Japan from the website of the Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism.

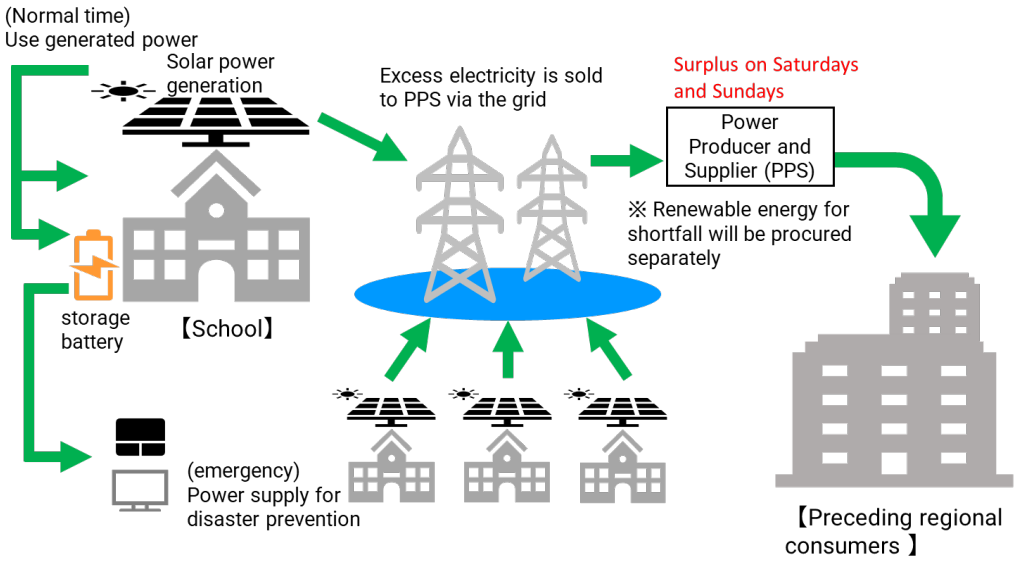
Figure 3-9 Location of Yokohama City, Kanagawa Prefecture

2) **Main Initiatives**

■Installation of photovoltaic facilities through on-site PPA and off-site PPA (Renca Municipality Commitment_5, 8)

Since the target area has low potential for introducing renewable energy, we will promote the installation of photovoltaic power generation equipment not only on rooftop spaces, but also on walls and other surfaces, taking into account the characteristics of many high-rise buildings located in the area.

Yokohama City is also promoting the installation of solar power generation equipment through on-site PPA at 65 elementary and junior high schools from FY2021 to FY2022. Since schools generate surplus solar power during holidays and summer vacations, the city plans to supply this surplus power to other public facilities through self-commissioning to achieve 100% self-consumption of renewable energy power from FY2022. After installing and self-consuming solar power generation equipment in on-site PPA, the surplus power will be utilized within the target area to consume 100% of the renewable energy power.



Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://www.env.go.jp/content/000064728.pdf

Figure 3-10 Image of utilization of surplus power from on-site PPA at elementary and junior high schools

■Reduction of waste by using food residues for biomass power generation and composting (Renca Municipality Commitment_6, 7)

As an initiative to both improve the recycling rate of food residues and supply renewable electricity, food residues are methane fermented by a city business to generate biomass power, and part of the electricity generated is used to light in the parks of the target area.

EV packer trucks are used to collect food residues, and their electricity is also charged from biomass-generated electricity, creating a resource cycle in which food residues are returned as renewable electricity. Composting of digested liquid after methane fermentation is also currently under consideration.

As other food residue initiatives, a scheme to recycle food residues into fully matured compost and soil conditioner, and provide and sell them to farmers is being considered and implemented in the district. A resource recycling model will be established in which composted food residues are used by farmers in the suburbs of the city, and vegetables grown there are locally produced and consumed in the target district and in Yokohama City.

Source: Pacifico Yokohama HP (accessed on 20 Feb 2023)
https://www.pacifico.co.jp/pacifico/press/release/tabid/341/Default.aspx?itemid=761&dispmid=926

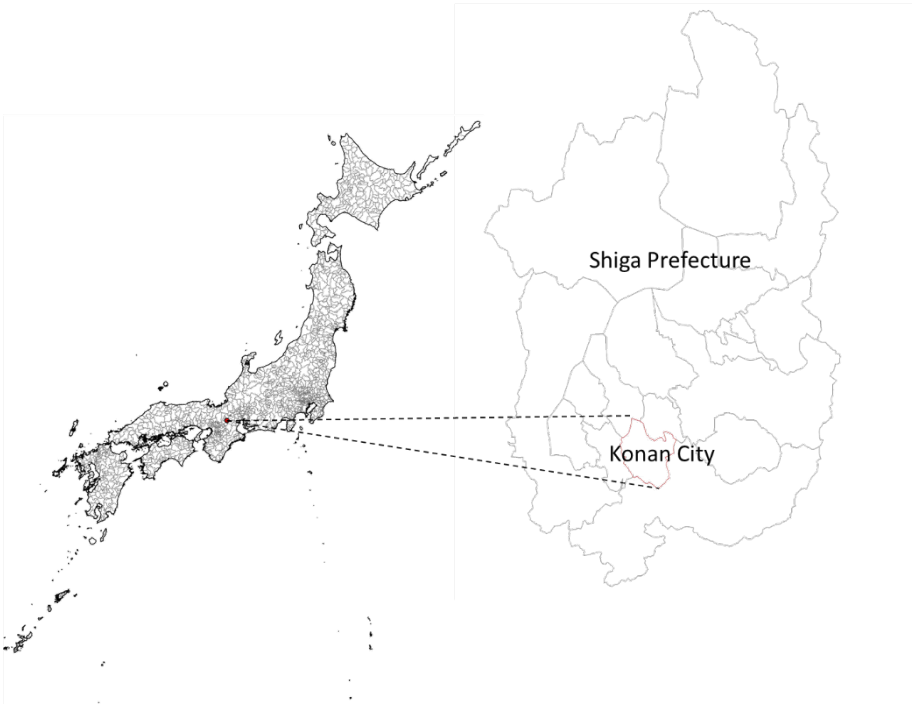
Figure 3-11 Battery-replaceable EV packer truck

(4) Konan City, Shiga Prefecture

1) Area Overview

Konan City, Shiga Prefecture, is located in the southern part of Shiga, with an area of 70.40 km2 and a population of 54,553 (as of January 31, 2023). The city is home to the largest industrial park in the prefecture, the Konan Industrial Park, and many manufacturing companies. In addition, as a major transportation hub, the transportation industry is concentrated in the city, with distribution centers and warehouses located in the area, and further corporate expansion is also expected.

Greenhouse gas emissions in the city area decreased from 660 thousand t-CO_2 in 2013, the base year, to 433 thousand t-CO_2 in 2019, a decrease of 34.4%. In particular, greenhouse gas emissions from the industrial sector are 11% higher than the sector's share (39%) in the prefecture's greenhouse gas emissions, and further measures are needed.



Source: Created by Nippon Koei using a map of global Japan from the website of the Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism.

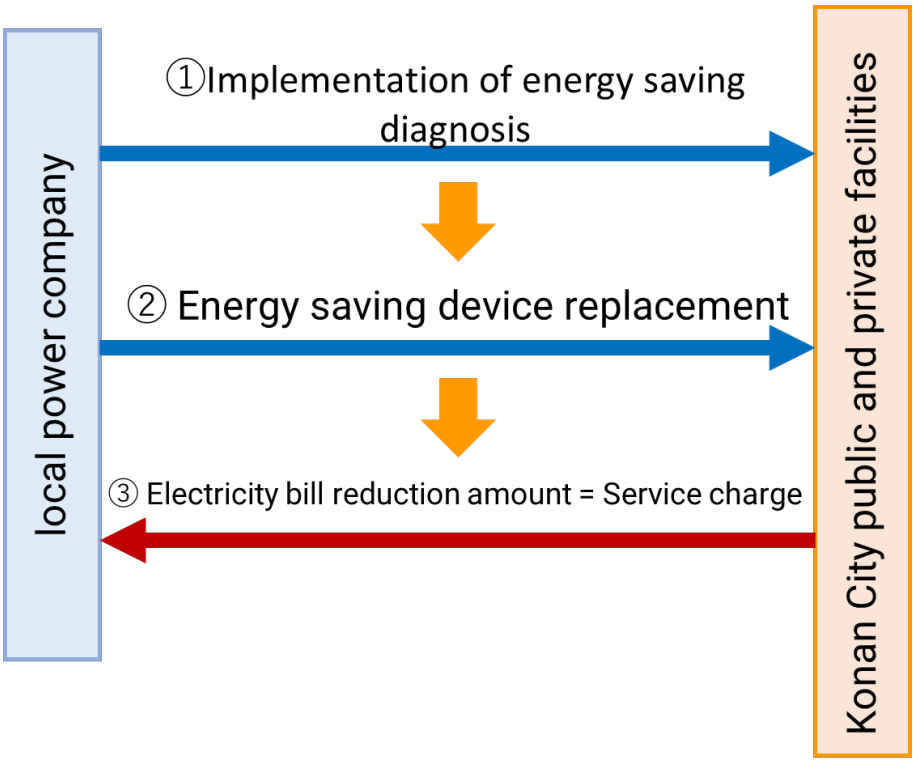
Figure 3-12 Location of Konan City, Shiga Prefecture

2) **Main Initiatives**

■Renewal of LED and air conditioning through energy efficiency audits to factories and warehouses (Renca Municipality Commitment_3, 4, 5, 8)

Currently, based on the results of an energy conservation audit conducted by a local electric power company, the company is implementing LED lighting in school gymnasiums and staff rooms and replacing air conditioning equipment in libraries and other public facilities as an energy conservation service project. In the future, the company will newly introduce natural energy facilities and energy-saving equipment to welfare facilities and enterprises in the transportation and industrial sectors to decarbonize and promote local production for local consumption of energy.

Specifically, the project will implement on-site and PPA projects utilizing warehouse roofs, factory roofs in the industrial sector, and adjacent unused land, as well as upgrading LED and air conditioning systems to factories. In addition, the factories and other facilities will consume their own electricity to decarbonize outside of the consumer sector, and during times when the factories are not in operation, etc., the surplus will be controlled to be used up by welfare facilities in the prior decarbonization areas that have electricity demand even during those times, thereby contributing to the decarbonization of the consumer sector.



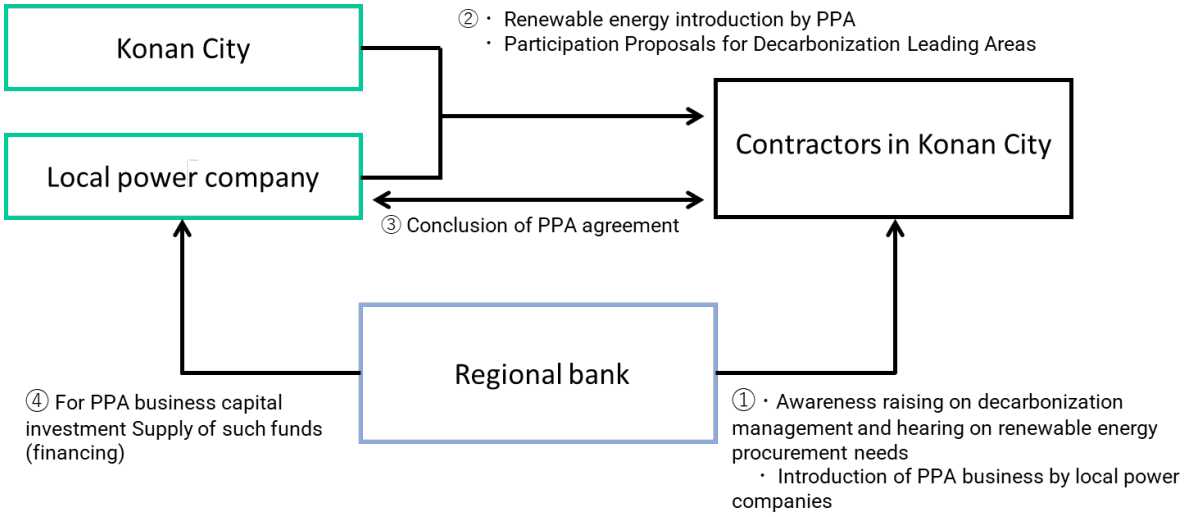
Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://www.city.shiga-konan.lg.jp/soshiki/kankyou_keizai/seikatsu_kankyo/5_1/3/6/3531.html

Figure 3-13 Flow of energy efficiency and conservation audit implementation

■Implementation of matching services for PPA projects and energy conservation service projects (Renca Municipality Commitment_5, 8)

Regarding the approach to companies in the Konan Industrial Park, they are currently working with regional banks and to provide matching services for PPA projects and energy efficiency and conservation service projects, and there is a high need for such services from companies in the city. Konan City will continue to work with the regional bank to explain the prior decarbonization projects to the companies in the Konan Industrial Park and expand the decarbonization efforts.

By centrally managing energy by local electric power companies, surplus power generated by public facilities and factories can be supplied to welfare facilities and other facilities that use a lot of electricity, creating a casual supportive relationship with energy.



Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://www.city.shiga-konan.lg.jp/material/files/group/11/datutanso.pdf

Figure 3-14 Overview of Matching Services for PPA Project and Energy Saving Project

(5) Sakai City, Osaka

1) Area Overview

Sakai City, Osaka, is an ordinance-designated city with an area of 149.83 km2 and a population of 819,235 (as of January 1, 2023), located in the south-central part of Osaka. Its main industry is manufacturing, and many small and medium-sized companies are currently concentrated in the city. In order to survive in domestic and international competition, the city has enhanced its unique technological capabilities and its own brand power, and boasts a high market share in the industry. The city is also characterized by a concentration of companies with high production capacity, advanced production technology that combines speed and precision, and product planning and development capabilities.

Greenhouse gas emissions from the city area in FY 2018 were 6.05 million t-CO_2, a reduction of 1.41 million t-CO_2 (18.9%) compared to FY 2013. By sector, the industrial sector accounts for the majority of emissions at 45.7% of the total, which is high compared to the national average.

Source: Created by Nippon Koei using a map of global Japan from the website of the Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism.

Figure 3-15 Location of Sakai City, Osaka

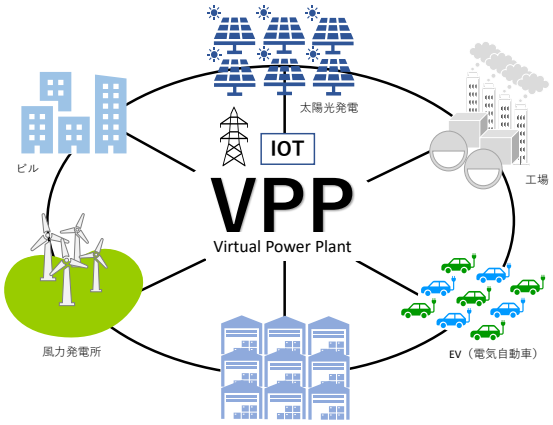
2) **Main Initiatives**

■Area-wide energy conservation and VPP (Virtual Power Plant) through district heating and cooling (Renca Municipality Commitment_5)

District heating and cooling is a system for cooling, heating, and hot water supply by supplying heat-transfer fluids such as chilled water, hot water, and steam from a heat supply facility (district heating and cooling plant) to a group of buildings in a certain area through local pipes. Advantages of district heating and cooling include energy savings from the use of unused energy, energy savings from the use of high-efficiency systems, and energy savings and stable supply through the use of advanced operating technologies.

In this city, as the district heating and cooling facilities are due for renewal, Sakai City will work with the renewal of district heating and cooling facilities to simultaneously decarbonize and strengthen the resilience of private and public facilities, and to further improve efficiency by introducing high-efficiency large-scale cogeneration systems, high-efficiency large-scale air conditioning heat source equipment, etc., utilizing district heating and cooling.

In addition to the demand response using district heating and cooling owned facilities, the system can realize VPP for the entire area by controlling the load of consumers and coordinating with distributed power sources and renewable energy on the consumer side, etc., contributing to large-scale power supply and demand adjustment at the time of mass introduction of renewable energy in the future.



Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://clh.jp/items/frontiersmart/technology/vpp/

Figure 3-16 Diagram of a VPP (Virtual Power Plant)

■Conversion of use from private cars to public transportation through the use of advanced technology (Renca Municipality Commitment_1, 2)

The Sakai Mobility Innovation (SMI) Project aims to shift the use of public transportation from private cars to public transportation and to create an urban space where people and public transportation play a central role by improving the convenience of public transportation through the use of advanced technologies such as ICT, the provision of charging facilities, and the creation of spaces where a variety of people can stay and interact.

The goal is to introduce the advanced rapid transit (ART) in urban centers based on flexible and expandable vehicles that are well-designed and have high environmental performance. Specifically, the ART system will provide a barrier-free environment that allows wheelchair users to safely get on and off the train without gaps or bumps, by using positive-arrival control technology to stop at ART stations without gaps or bumps, and automatic driving technology to enable smooth acceleration and deceleration. The system can also be linked to other modes of transportation.

Source: Compiled by Nippon Koei based on the following website (accessed on 20 Feb 2023)
https://www.env.go.jp/content/000060855.pdf

Figure 3-17 Overview of Sakai Mobility Innovation (SMI) Project

3.9 DEMONSTRATION EXPERIMENT OF TSUMUGI@: SDGS ASSESSMENT TOOL FOR LOCAL GOVERNMENT

Following efforts last year, Renca Municipality diagnosed the status of municipality's initiatives for SDGs by using the SDGs assessment tool named "TSUMUGI @" developed by Nippon Koei.

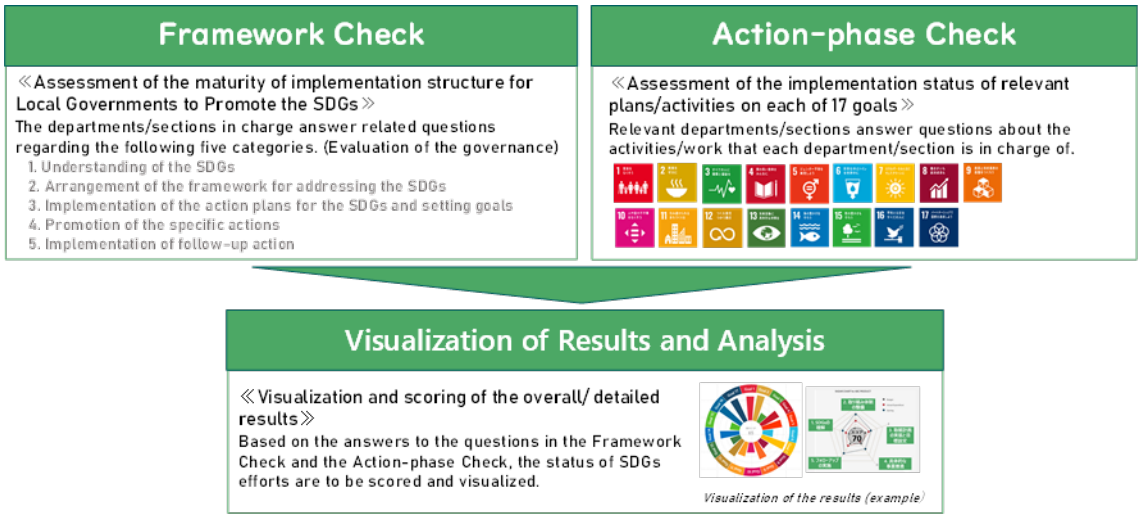
Last year, Renca Municipality diagnosed it by using the trial version of TSUMUGI@ as a demonstration and single department in each goal answered the set questions. After the demonstration, it was pointed out by the participants from Renca Municipality that it would be preferable to answer each question by single or multiple related departments which were actually in charge of the initiatives. This year, the beta version of TSUMUGI@ which has updated questions from the trial version was used and a series of interview was conducted for each goal in which single or multiple departments in charge got together to answer the set questions in the corresponding goal, in order to collect responses that reflect the actual status of Renca Municipality. Feedback on the results was shared with Renca Municipality in January 2023.

In addition, from November to December 2023, Toyama City also diagnosed the status of their initiatives by using the beta version of "TSUMUGI@". At the seminar scheduled to be held at the end of February 2023, the results of both, as well as each strength and challenges will be presented and specific activities and countermeasures for better initiatives will be discussed.

(1) Overview of TSUMUGI@

TSUMUGI@ is an online application tool that local governments can easily assess their status of the SDGs initiatives and their status of development of implementation structure, by answering a set of questions on the website. As shown in Figure 3-1, it consists of the Framework Check that assesses the status of construction of the implementation structure to promote SDGs, and the Action-phase Check that assesses the status of SDGs initiatives implemented by local governments for each of 17 goals. The assessment results can be displayed when all questions of each Checks are answered by the related departments and sections of the local government. See **Attachment-2** for detailed information.

At present, this online application of TSUMUGI@ is only available in Japanese. Therefore, the set questions were translated into Spanish to be asked verbally to the staff of Renca Municipality involved. The answers collected from Renca Municipality were put into the online system by the Japanese expert to get the assessment results.



Source: Nippon Koei

Figure 3-18 Overview of TSUMUGI@

(2) Demonstration Experiment of TSUMUGI@

1) Renca Municipality

After the kick-off meeting to explain about the beta version of TSUMUGI@ and the second trail to Renca Municipality, the departments which carry out activities in the field of each goal were identified through the discussion with Renca Municipality, and the identified single or multiple departments were interviewed to answer the set questions in each goal as shown in Table 3-8. Through this process, the result of this assessment could reflect the actual status of Renca Municipality's efforts, comparing to last year.

Table 3-8 Interview to relevant department on the TSUMUGI@ Demonstration

Goal	Relevant Directorate	Meeting date
Framework Check		
-	DIMAO	December 17, 2022, 15:00-16:00
Action-phase Check		
1	Social Department, and DIDECO	December 7, 2022, 11:00-12:00
2	Social Department, and DIDECO	December 7, 2022, 11:00-12:00
3	Health of the Municipal Corporation and DIDECO	December 7, 2022, 11:30-12:30
4	Education of the Municipal Corporation	December 12, 2022, 13:00-14:00
5	Inclusion and Gender Department	December 12, 2022, 10:30-11:30
6	DIMAO, and Operations and Emergencies Directorate	December 12, 2022, 10:30-11:30
7	DIMAO, DOM, and La Fabrica	December 12, 2022, 10:30-11:30
8	DEL, and La Fabrica	December 12, 2022, 11:00-12:00
9	DIMAO, DOM, and La Fabrica	December 12, 2022, 10:30-11:30
10	La Fabrica, DIDECO, Municipal Administration, and Legal Administration	December 13, 2022, 10:00-11:00
11	DIMAO, and La Fabrica	December 13, 2022, 11:00-12:00
12	DEL, and La Fabrica	December 12, 2022, 11:00-12:00
13	DIMAO, and La Fabrica	December 13, 2022, 11:00-11:30
14	DIMAO	December 17, 2022, 15:00-16:00
15	DIMAO, and SECPLAN	December 13, 2022, 11:30-12:30
16	La Fabrica, DIDECO, Municipal Administration, and Legal Administration	December 13, 2022, 10:00-11:00

Goal	Relevant Directorate	Meeting date
17	DIMAO, and La Fabrica	December 13, 2022, 11:00-11:30

Note：DIMAO: Directorate of Environment, Cleaning and Ornament
DIDECO: Directorate of Community Development
DOM: Directorate of Municipal Works
DEL: Directorate of Local Economic Development
SECPLAN: Communal Planning Secretary
Source: Nippon Koei

2) Toyama City

Toyama City also diagnosed by TSUMUGI@ during Noveomber to December 2022 with the cooperation of the Planning and Coordination Section of the Planning and Management Department which has jurisdiction over the SDGs. The Planning and Coordination Section responded to Framework Check, while a total of 41 departments responded to the Action-Phase Check on the online application.

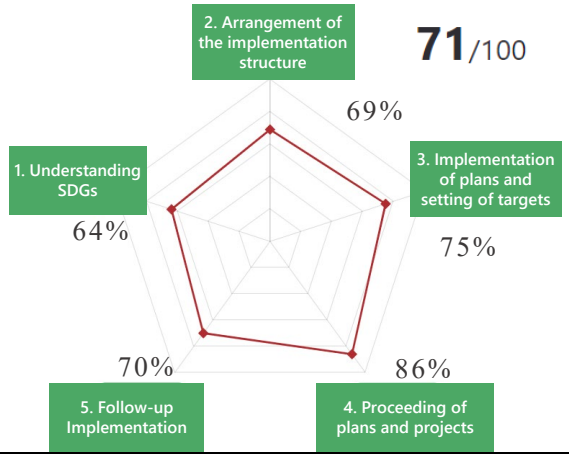
(3) Demonstration Experiment of TSUMUGI@

The assessment result of Renca Municipality is shown below. The overall assessment score was 71 points for the Framework Check and 72 points for the Action-Phase Check.

Result of Action-Phase Check shows relatively high scores on each of the 17 goals. In other words, although Renca Municipality doesn't formulate, implement or monitor the relevant plans of city development in line with the concept of SDGs, it does help by organizing them on the axis of SDGs through TSUMUGI@, the result showed that Renca Municipality has been conducting various initiatives comprehensively for realizing sustainable society. In particular, it can be said that Renca Municipality is actively working on Goal 10 (Reduced Inequalities), Goal 7 (Affordable and Clean Energy), Goal 2 (Zero Hunger), and Goal 16 (Peace, Justice and Strong Institutions), while more practical efforts are expected for Goal 15 (Life on land), Goal 8 (Decent Work and Economic Growth) and Goal 5 (Gender Equality), according to the result.

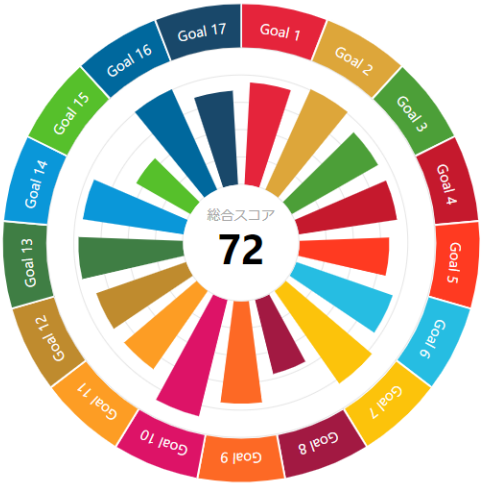
A feedback meeting was held on January 27, 2023 with Renca Municipality to share the comprehensive and detailed assessment results for each goal. A record of the meeting is shown in Table 3-9.

Overall Result of Framework Check（Renca Municipality）



Approach	Score
1. Understanding SDGs	64
2. Arrangement of the implementation structure	69
3. Implementation of plans and setting of targets	75
4. Proceeding of plans and projects	86
5. Follow-up Implementation	70

Overall Result of Action-Phase Check (Renca Municipality)



1	75%	7	83%	13	77%
2	81%	8	56%	14	75%
3	73%	9	75%	15	46%
4	73%	10	88%	16	81%
5	66%	11	70%	17	69%
6	75%	12	70%		

Top 3 Goals
Bottom 3 Goals

Source: Nippon Koei

Figure 3-19 Assessment Result of Renca Municipality (example)

Table 3-9 Feedback Meeting of the TSUMUGI@ assessment result

Date	January 27, 2023 9:00-10:30
Participant	Renca Municipality; In total 16 people from DIMAO, DIDECO, Municipal Administrator, SECPLAN, Operations and Emergencies, and Government Center Nippon Koei, Sherpas, and La Fabrica
Comments from Renca Municipality	Renca Municipality commented the following points after the explanation of the assessment results done by the Japanese expert team. ✓ This year, since the departments in charge answered the questions, the contents of the questions were more understandable, and it made a better diagnosis. ✓ Although Renca Municipality does not have any plans or management system that specifically coordinate with the SDGs, it is promoting efforts towards sustainability. It is very interesting to be able to evaluate and visualize the city progress with this tool. ✓ This tool can give an opportunity to learn about SDGs through the diagnose. ✓ It is desirable to use it continuously and check the progress. ✓ It is important for central governments as well as local governments to assess its progress on climate change and sustainability. From the Japanese expert team, the following points were summarized. ✓ Although Renca Municipality does not have a dedicated staff in charge or policy regarding the SDGs, this kind of cross-sectional self-evaluation would help the municipality understand that various efforts are being made. It would be great if Renca Municipality consider how to use this result for dissemination of your efforts. ✓ It is not intended to simply compare the results of Toyama City and Renca Municipality, as the central government of Japan has various support schemes for local governments. It is preferable if this assessment can utilize for them to learn from each other's efforts and strengths, and to provide an opportunity to consider improvement measures for their weaknesses. ✓ Since the mayor of Renca Municipality is the leader of a group called Municipality for Sustainability which is a discussion group on sustainability in neighbouring local governments, it may be possible for Renca to promote initiatives for the SDGs as a leader in the future. ✓ As the next step, it would be valuable for Renca Municipality to share the assessment results among the municipality as communication tool and consider how to take advantage of their strengths and how to work on their challenges.

Source: Nippon Koei

(4) Sharing the Results and Next Step

At the seminar scheduled for February 28, 2023, the assessment results of Renca Municipality and Toyama City will be presented to share the strengths and challenges of both local governments among the relevant parties. Also, the framework of the Decarbonization Leading Areas will be shared as one of Japan’s efforts.

In addition, another roundtable between Renca Municipality and Toyama City is planned to be set up in order to share current initiatives and best practices for sustainability of each city. In addition, the information will be provided to Renca Municipality such as the status of efforts by local governments in Japan and the support scheme that the central government currently provides for local governments in order to accelerate their efforts on SDGS. Through these opportunities, in addition to consider any activities that Toyama City can support Renca Municipality from the perspective of SDGs and any efforts that can be coordinated between them, specific measures to lead to actual implementation will be examined.

3.10 RACE TO ZERO ACTIVITIES OF RENCA MUNICIPALITY

3.10.1 Outline of the Race to Zero Campaign

Race to Zero is a global campaign launched on June 5, 2020 (Environment Day) as an effort toward COP26, led by the High-Level Climate Champions for Climate Action – Nigel Topping, United Kingdom and Gonzalo Muñoz, Chile at the time. It aims to reduce GHG emissions by 50% by 2030 and achieve net zero emissions as soon as possible, and by 2050 at the latest, with the participation of non-state actors including companies, cities, financial and educational institutions. The number of participants is 8,296 companies, 52 sub-national regions, 1,136 cities, 1,125 educational, 593 financial, 64 healthcare institutions, and 29 other organizations (as of October 2022). The minimum criteria for participation in the Race to Zero campaign are shown below.

Table 3-10 Minimum criteria for participation in the Race to Zero campaign

No.	Item	Minimum Criteria
1	Pledge	- Pledge at the head-of-organization level to reach (net) zero GHGs as soon as possible, and by 2050 at the latest - Set an interim target to achieve in the next decade, which reflects maximum effort toward or beyond a fair share of the 50% global reduction in CO2 by 2030
2	Plan	- Within 12 months of joining, publicly disclose a Transition Plan, City/Region Plan, or equivalent which outlines how all other Race to Zero criteria will be met, including what actions will be taken within the next 12 months, within 2-3 years, and by 2030
3	Proceed	- Take immediate action through all available pathways toward achieving (net) zero, consistent with delivering the interim targets
4	Publish	- Report publicly progresses against both interim and longer-term targets, as well as the actions being taken, at least annually
5	Persuade	- Within 12 months of joining, align external policy and engagement, including membership in associations, to the goal of halving emissions by 2030 and reaching global (net) zero by 2050

Source: Prepared by Nippon Koei Co., Ltd. based on the UNFCCC HP "Race to Zero Criteria 3.0 (unfccc.int)"

3.10.2 Race to Zero Activities of Renca Municipality

Renca Municipality was the first Municipality of Chile to join Race to Zero campaign in October 2021. Renca Municipality is actively working to address climate change, and through this campaign, aims to be a model in urban, social and economic transformation, including a sustainable mark that incorporates different climate change adaptation and mitigation initiatives. See **Attachment-3 to 4** for detailed information.

CHAPTER 4. RESULTS OF SEMINARS AND MEETINGS

This chapter summarizes the results/plans of the various workshops and seminars. Through these meetings, the needs and issues of Renca Municipality were identified and discussed specific support by Toyama City from the perspective of Toyama City SDGs Future City. At the same time, it considered the possibility of JCM projects for existing projects and facilities with high potential for renewable energy and energy conservation.

4.1 KICK-OFF MEETING WITH MINISTRY OF THE ENVIRONMENT, JAPAN (24 OCTOBER 2022)

The kick-off meeting for FY2022 Toyama-Renca city-to-city collaboration project was held online. The summary and results of the kick-off meeting are shown in the table below.

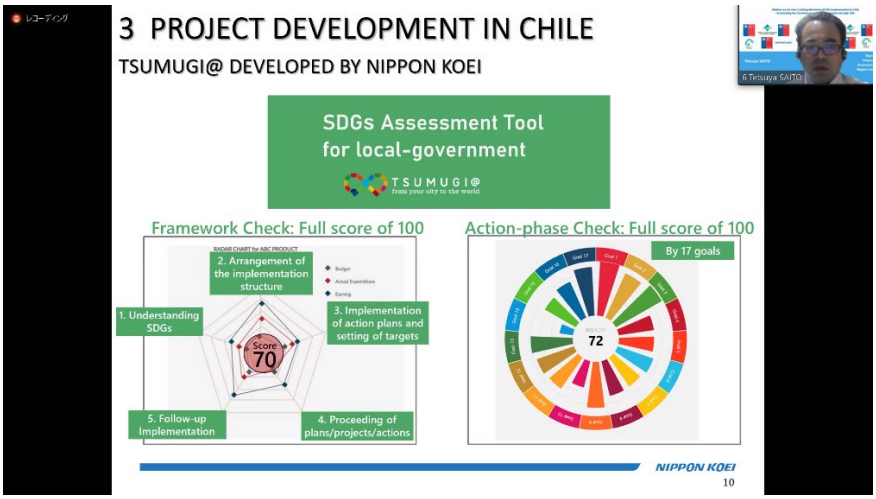
Table 4-1 Summary of the kick-off meeting with MOEJ

Item	Kick-off meeting with MOEJ
Implementation method	Online
Date and time	24 September 2021, 10:00-11:00
Overview	Kick-off meeting for city-to-city collaboration project between Toyama City and Renca Municipality
Objective	Explain the project outline to MOEJ and exchange opinions regarding the project implementation strategy.
Agenda	1.Overview of the project 2.Comments and questions on the outline of the project plan and implementation strategy
Participants	MOEJ (2 people) Toyama City (2 people) Nippon Koei (5 people)
Results	MOEJ stated that it expects that through this project, the knowledge/experience sharing of decarbonization with the other local governments are promoted.

Source: Nippon Koei

4.2 WEBINAR ON THE JCM IMPLEMENTATION IN CHILE – INNOVATION FOR CARBON NEUTRALITY THROUGH JCM (28 OCTOBER 2022)

The JCM Chile Webinar "Webinar on the Joint Crediting Mechanism (JCM) Implementation in Chile – Innovation for Carbon Neutrality through JCM", organized by the Global Environment Centre (GEC), was held on 28 October 2022. As a representative of city-to-city collaboration projects, Nippon Koei made a presentation titled " JCM Project Development in Chile ", which introduces the project outline, shared the knowledge on JCM project formulation, and explained the approach of the city-to-city collaboration project based on SDGs. The presentation material is shown in **Attachment-5**.



Presentation on the SDGs Assessment tool, TSUMUGI@, applied in the project
Source: Nippon Koei

4.3 ZERO CARBON CITY WORKSHOP (28 FEBRUARY 2023)

The online final workshop will be held in the end of February to share the result of the phase 1 (3-year city-to-city collaboration programme between Renca municipality and Toyama city), knowledge/experience on decarbonization of both cities, and have discussion on the plan of phase 2 of the project. The presentation materials are shown in **Attachment-6**, and the outline is shown in the following table.

Table 4-2 Outline of the online workshop

Title	Zero Carbon City Workshop
Implementation method	Online
Date and time	28 February 2023, 21:00-22:00
Overview	In addition to the introduction of Renca Municipality's activities for Race to Zero and Toyama City's activities for Zero Carbon City, companies from Renca Municipality and Toyama City make presentations as examples of collaboration activities with local governments to achieve decarbonized society.
Objective	Share the result of the phase 1 (3 years of the city-to-city project between Renca municipality and Toyama city) Share knowledge and experience on decarbonization of both cities Discussion on the plan for phase 2 of the project
Agenda	1. Opening Remarks (10 min) 2. Efforts and Results of Phase 1 of City-to-City Collaboration Project (10 min) 3. Achievements of City-to-City Collaboration Project on SDGs, Zero Carbon City (10 min) 4. Findings related to Decarbonization Leading Areas in Japan (10 min) 5. Evaluation results by TSUMUGI@ (10 min) 6. Carbon Neutrality vision and Art. 6 (10 min) 7. Collaboration in Renca Projects (10 min) 8. Needs of Renca Municipality regarding City-to-City Collaboration Project in the coming year, and findings related to Race-to-zero (10 min) 9. Panel Discussion on Phase 2 Initiatives (10 min) 10. Closing Remarks (10 min)
Participants	Ministry of Environment, Chile Toyama City and companies in Toyama City Embassy of Japan in Chile Embassy of Switzerland in Chile Renca Municipality (including mayor), companies and NGOs in Renca Municipality Other local governments near Renca municipality Nippon Koei, local staff Interpreters

Source: Nippon Koei

4.4 FINAL MEETING WITH MOEJ (24 FEBRUARY 2023)

The final meeting with MOEJ will be conducted to report the results of city-to-city collaboration project between Toyama City and Renca Municipality in FY2022 and the proposed activities for phase 2.

The summary of the final meeting is shown in the table below.

Table 4-3 Overview of final meeting with MOEJ

Item	Final meeting with MOEJ
Implementation method	Online
Date and time	24 February 2022, 13:00-13:30
Overview	Final meeting of the city-to-city collaboration project between Toyama City and Renca Municipality
Objective	Report to MOEJ on the results of this year's project and plans for next year.
Agenda	1.Report on the results of the project and explanation of the plans for next year 2.Comments and questions

Participants	MOEJ Toyama City Nippon Koei

Source: Nippon Koei

4.5 ZERO CARBON CITY INTERNATIONAL FORUM 2023 (1 MARCH 2022)

Zero Carbon City International Forum 2023 hosted by the Ministry of the Environment, Japan will be held on 1st March 2023. MOEJ together with the Office of the Special Presidential Envoy for Climate (SPEC), U.S. State Department organized the Forum as a part of the "Global Subnational Zero Carbon Initiative" launched by the in the Side Event at Japan Pavilion of the COP26.

In this forum, leading subnational climate policies and actions and city-to-city collaborations to expanding "Decarbonization Domino Effect" ware shared, and both Toyama City and Renca Municipality introduced their activities.

For this forum, presentation materials in Japanese and English, shown in **Attachment-7**, were submitted to MOEJ to share the result of this project with the participants of the forum.

CHAPTER 5. FUTURE PLAN

5.1 SUMMARY OF PHASE 1 INITIATIVES

In Phase 1, the two cities shared information on SDGs and decarbonization initiatives in accordance with the three-year plan outlined in Section 1.4, and submitted two proposals for JCM Model Projects, one of which was adopted. In addition, by conducting an evaluation of SDG initiatives in both cities using TSUMUGI@ developed by Nippon Koei, it was possible to visualize SDG initiatives in both cities and to help deepen discussions.

Since the start of the project in FY2020, activities have been restricted under COVID-19, so that only one trip to the site by the city of Toyama and consultants was made during Phase 1, and no trips by companies in Toyama were realized, but the combination of online discussions and close support by the local implementation structure (La Fabrica and Sherpas) led to the best possible results.

In addition, international information dissemination and sharing was also possible, as Mayor Renca spoke at the Ministry of Environment side event at the Japan Pavilion at COP26, and the Embassy of Switzerland, which supports bilateral emission reduction activities under Article 6 of the Paris Agreement, is scheduled to participate in the final seminar (in the planning stage).

Renca Municipality has announced its participation in Race-to-Zero in 2021 during the Phase 1 period, and this City-to-City Collaboration Project has contributed to its decision to participate in Race-to-Zero, and other organizations are expected to provide further support through JCM projects etc. for its future emission reduction activities. Through the JCM Model Project adopted above, the way for contributing to emission reductions in the private sector in Renca District was paved.

On the other hand, through this year's field trips, it is considered that the potential for project formation in the Renca District is still high. Since the remote location and budget restrictions limited the number of trips, it is considered that continued use of the program is necessary. It was felt that a visit to Toyama City from Renca Municipality should definitely be realized in the future.

5.2 POLICIES FOR CITY-TO-CITY COLLABORATION PROJECT IN THE COMING YEAR

In proposing City-to-City Collaboration Project for the coming year, it is planned to confirm the proposal through discussions at a seminar to be held in February and at regular meetings with Renca Municipality and Toyama City, but policy at this time, the followings were considered based on what has been discussed at regular meetings to date.

5.2.1 Major policies and novelty as Phase 2

In implementing Phase 2, the following four points are considered as the main policies.

1) Clarification of specific contributions to achieving Race to Zero: A plan will be developed to support the achievement of Race to Zero in Renca Municipality by 2030 through JCM Model Projects, etc.
2) Formation of JCM projects with high novelty: Projects to promote the use of green hydrogen in compliance with Chilean policies that are strongly oriented toward a hydrogen society will be planned and implemented. In addition, promote project formation related to CCU.
3) Implementation of the decarbonization and SDGs domino: The Mayor of Renca Municipality is leading a group of cities advancing sustainability in Chile, and the initiatives in Renca Municipality can be disseminated to neighboring municipalities as a decarbonization and SDGs domino. Through Phase 2, Renca Municipality's progressive initiatives in the areas of decarbonization and SDGs will be embodied in other municipalities.
4) Specific actions on SDGs: In Phase 1, TSUMUGI@ was used to visualize SDG initiatives. During the three years of Phase 2, based on the evaluation results, Renca Municipality and Toyama City will cooperate to take some specific actions (implementation of activities and formulation of policies). At this stage, with "collaboration" as the keyword, we are considering the implementation of activities and formulation of policies related to collaboration between citizens, the public, businesses, collaboration between municipalities, and collaboration between municipalities and the national government.

5.2.2 Policies for next fiscal year (policy level cooperation)

1) This year, Race to Zero plans and progress were organized through a re-commissioning to La Fabrica. For the next year - and the year after that, the Renca Municipality will need to take and report on tangible decarbonization actions in line with its participation in Race to Zero. From the perspective of this City-to-City Collaboration Project, it is important to organize how city-to-city collaboration and support schemes such as the JCM Model Project can contribute to the decarbonization of Renca Municipality, and to avoid duplication of support from other countries such as Switzerland and the UK, as well as to generate synergies. Therefore, it is planned to start to prepare a plan for Renca Municipality's contribution to Race to Zero in the next fiscal year. In the next fiscal year, it is planned to organize the details of Japan's contribution, and in the fiscal year after next, consider aligning the plan with the plans of other countries.
2) Also, this year, as indicated in Section 3.9, it is planned to visualize the SDG initiatives of Renca Municipality and Toyama City, and discussed the characteristics, strengths and weaknesses of their respective SDG initiatives. Through Phase 2, it is considered that it is

important to lead to concrete actions (setting policies and implementing activities) in the area of SDGs.

5.2.3 Strategy for next fiscal year (JCM Model project)

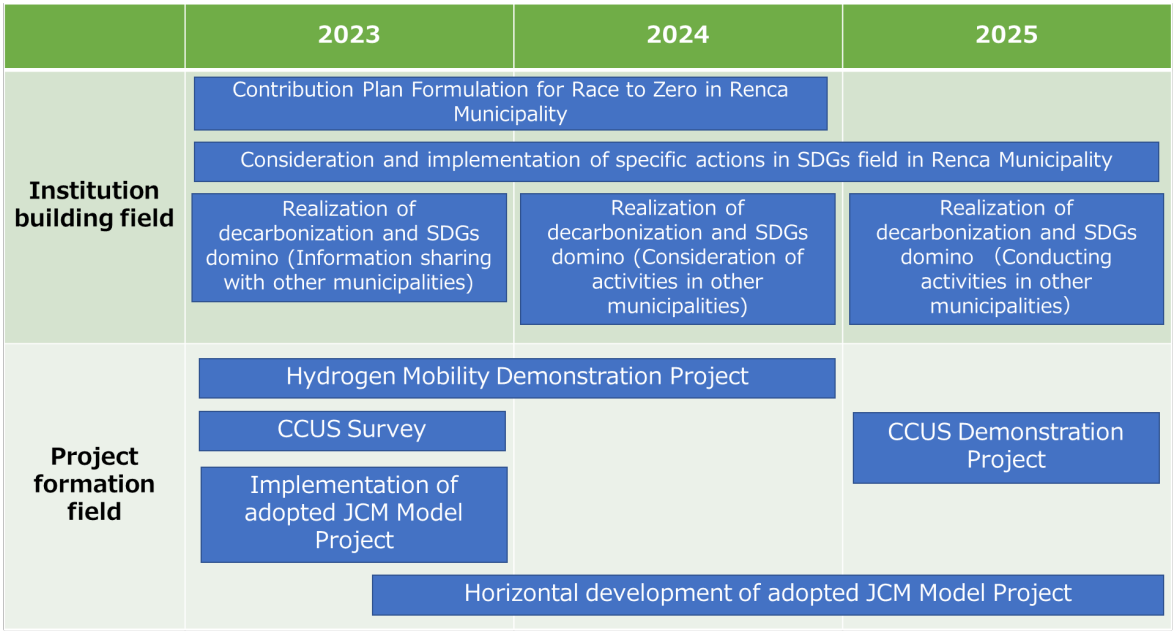
1) With participation in Race to Zero, the Renca Municipality will need to take and report on tangible decarbonization actions. The use of JCM Model Projects is increasingly expected as a concrete project.
2) An ESCO scheme for introducing solar power was informally adopted in FY2022 as JCM Model Project. If this project is successfully completed, we expect that many companies will be interested in the project and that there will be high potential for horizontal development. We will conduct activities for horizontal development by widely publicizing the project at the time of completion of construction, which is expected to take place during the next fiscal year. Although the solar power generation project in Renca District was not selected this year, it is considered learning through the site visit that the project can contribute to the decarbonization goal of Renca Municipality itself, and that the health center, which is visited by almost all residents, is also visited by many poor people, etc. Therefore, the project can directly contribute to the SDG goal of "providing clean energy to all. It is highly considered for continuing to apply for this project because it can directly contribute to the SDG goal of "delivering clean energy to everyone". Since a comment about the small scale of the project as a reason for rejection was given, it is considered grouping the application with other projects.
3) Through last year's survey, a local need for CO_2 recovery and fixation was identified and that there are Japanese companies willing to provide technology in this field, and this year, a study to investigate CCUS project was prepared. In the next fiscal year, we are considering applying for the METI-funded JCM-CCUS FS survey scheme, and if the survey is adopted, we can examine the possibility of JCM Model Project in conjunction with this City-to-City Collaboration Project.

5.2.4 Strategy for next fiscal year (Hydrogen project formation)

Since the introduction of hydrogen mobility explained in Section 2.3 is not suitable for JCM Model Project from the viewpoint of cost-effectiveness, it is considered proposing the project as a project for the introduction of hydrogen and other new technologies, which will be launched in the next fiscal year. The implementation and monitoring of this project will also be supported by this City-to-City Collaboration Project, and the plan is to disseminate the results widely through the Renca Municipality and Toyama City cooperation.

5.2.5 Concept of Phase 2 (Draft)

A draft concept for the three years of Phase 2, based on the above discussion, is shown in the figure below.



Source: Nippon Koei

Figure 5-1 Phase 2 Concept (Draft)