FY2021 Project for Ministry of the Environment Japan

FY2021

City-to-City Collaboration for Zero-Carbon Society

（Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City, Vietnam）

Commission Report

March 2022

Institute for Global Environmental Strategies

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1. Purpose and Outline of the Project

1.1. Purpose

This study aims to establish a zero-emission industrial park by promoting the concept of an eco-industrial park (a certification system promoted by UNIDO and the Ministry of Planning and Investment of Vietnam) through city-to-city collaboration between Hai Phong, the largest port city in northern Vietnam and a centrally-controlled city (along with Hanoi and Ho Chi Minh), and Hai Phong's sister city of Kitakyushu in Japan.

1.2. Outline

Specifically, this project attempts to transfer the expertise of Kitakyushu City, which is home to one of the largest eco-towns in Japan and has declared itself a zero-carbon city as it aspires to transform itself into a decarbonised society by 2050, in a form suitable for industrial parks in Hai Phong. Feasibility studies were conducted for a wide range of decarbonisation and low-carbonisation technologies, including (1) smart energy, (2) renewable energy, (3) energy recovery and utilization of liquid waste, and (4) energy-saving and high-efficiency equipment, targeting industrial parks that are promoting environmentally friendly practices in Hai Phong, in order to achieve both decarbonisation and advanced resource recycling systems.

In the short term, these efforts will be used as a tool to provide support to the target industrial parks in obtaining the Eco Industrial Park Certification. In the long term, the establishment of zero-emission industrial parks will go beyond the accepted standard of Eco-Industrial Parks and be used as a model throughout Vietnam to promote the SDGs in industrial cities (Figure 1.2).

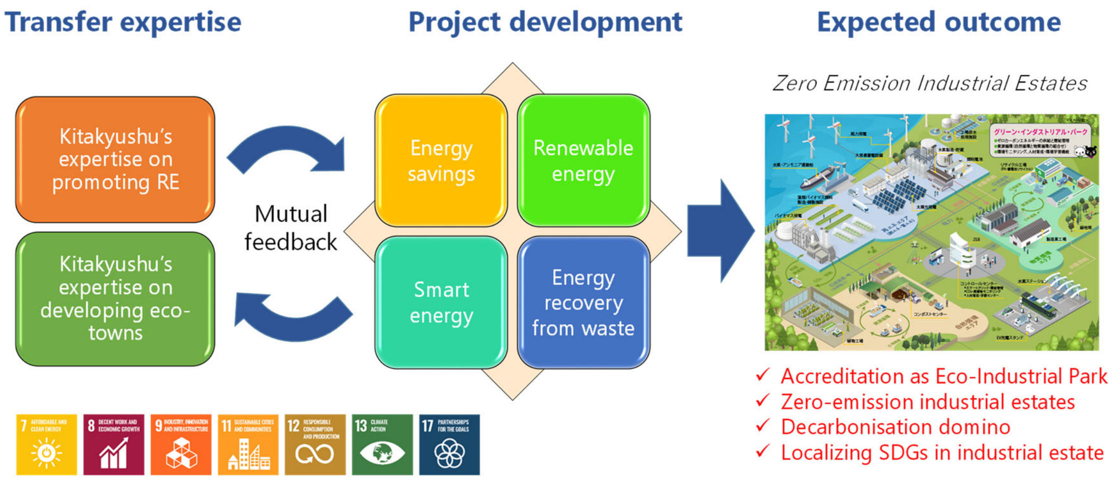


Figure 1.2. Concept of project.

1.3. Background

1.3.1. Relevant trends in Vietnam

Vietnam has been experiencing stable and high economic growth, recording real GDP growth rates in the 5% to 7% range every year from 2010 to 2019, although in 2020 and 2021, GDP growth rates were only in the 2% range due to the global spread of COVID-19. Both exports and imports reached record highs in 2021. Trade with Japan is also growing, hitting the USD 40 billion mark for the first time (In 2021, the country ranked fourth in exports to Japan and third in imports from Japan).[1,2,3]

As the economy has grown, energy consumption has also continued to increase steadily, with more than 50% of the country's power supply coming from coal-fired power plants (results for 2020). Rapid economic development has also led to the emergence of a number of environmental problems, notably the pollution caused by effluent from foreign-owned factories in 2016 and 2017, which has attracted public attention and led to tighter environmental controls.[4]

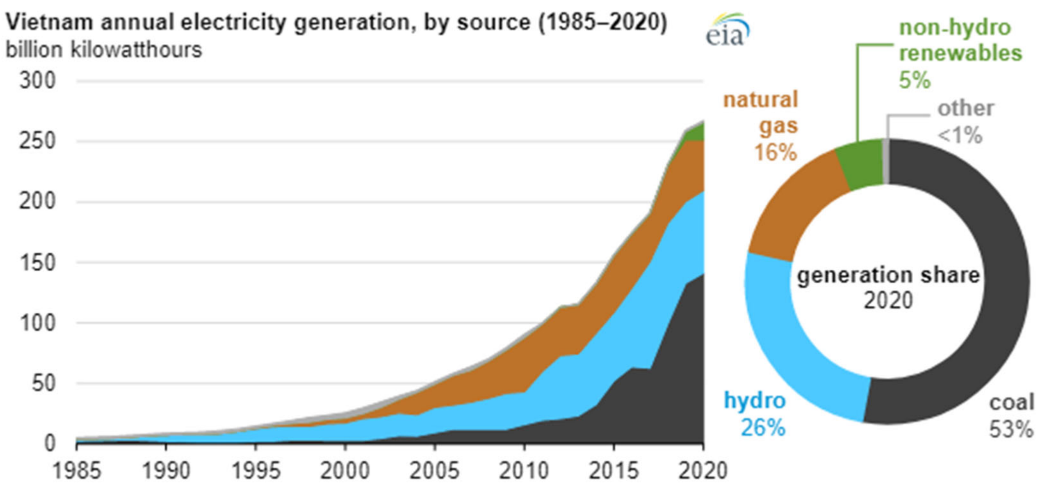


Figure 1.3.1. Power generation in Vietnam and the ratio of the power generation share.
(Source: U.S. Energy Information Administration[5])

Against this background, the Vietnamese government has launched a series of environmental measures in recent years to balance economic growth and environmental protection. In July 2020, it revised the Nationally Determined Contribution (NDC) under the Paris Agreement, setting a target of reducing greenhouse gas emissions by 9% by 2030 through domestic self-help efforts (27% with international assistance). In November 2020, the Environmental Protection Law was amended to expand the scope of environmental protection, strengthen information disclosure, and review environmental assessment procedures.[4] In October 2021, the Prime Minister issued Decision No. 1658/QĐ-TTg, the "National Green Growth Strategy for the period 2021-2030 with a view to 2050", which sets a target of reducing GHG emissions by 15% by 2030 and 30% by 2050 compared to 2014 levels. Furthermore, at the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (Glasgow, UK, 1 November 2021), Prime Minister Pham Minh Chin announced the aim of achieving virtually zero (carbon neutral) GHG emissions by 2050. In response, the National Climate Change Strategy (Prime Minister's Decision No. 2139/QD-TTg, December 2011), the National Action Plan to Address Climate

[1] JETRO "GDP growth of 2.6% in 2021, down from previous year" (12 January 2022): https://www.jetro.go.jp/biznews/2022/01/e7948ff8b1eb79ba.html
[2] JETRO "Trade, imports and exports to hit record highs in 2021" (1 February 2022): https://www.jetro.go.jp/biznews/2022/02/20fa2c39a1a43b32.html
[3] JETRO "Trade between Japan and Vietnam to hit $40 billion mark for first time in 2021" (2 February 2022): https://www.jetro.go.jp/biznews/2022/02/9d9e4542648709dd.html
[4] JETRO "Vietnam to reduce greenhouse gas emissions by 9% by 2030, focus on renewable energy (Vietnam)" (28 April 2021): https://www.jetro.go.jp/biz/areareports/special/2021/0401/95af12c1d66af1b4.html
[5] U.S. Energy Information Administration: https://www.eia.gov/todayinenergy/detail.php?id=48176

Change (Prime Minister's Decision No. 1474/QĐ-TTg, October 2012) and other relevant measures are being updated to align with the 2050 decarbonisation declaration at COP26.

The Ministry of Environment Japan has developed a low-carbon scenario for Hai Phong City with a 45% reduction in GHG emissions by 2050 in line with the Prime Minister's Decision No. 2068/2015/QD-TTg, "Renewable Energy Development Strategy in Vietnam until 2030 and Policy Outlook until 2050", using the Asia-Pacific Integrated Model (AIM). The results showed that the largest reduction potential could be found in the industrial sector, with the highest energy savings in factories (64%), followed by energy supply systems (27%).[6] Therefore, in order for Hai Phong to achieve decarbonisation, it is important to focus on the sectors with the greatest potential for reduction, and with this in mind, the study examined a menu of measures and technologies.

1.3.2. Background of city-to-city collaboration between Kitakyushu and Hai Phong

Hai Phong is a centrally-controlled city, along with Hanoi and Ho Chi Minh, and has a population of 1.9 million.[7] It is the largest port city in the north of Vietnam and is home to the international deep-water port of Lach Huyen (built with a JICA ODA loan).[8] It also has thriving industries (industry and construction account for 37.8% of GDP)[7] and many industrial parks. The city shares many similarities with Kitakyushu, which has developed into a port and industrial city in western Japan.

Since the signing of a friendship and cooperation agreement in 2009, Kitakyushu and Hai Phong have been engaged in technical exchange, mainly in the field of water supply and sewerage, as well as culture and the economy. Furthermore, in 2014, the two cities signed a sister city agreement and have been engaged in comprehensive cooperation in a variety of sectors, such as the water supply and sewerage fields, as well as in the waste and low-carbon technology fields. The ongoing relationship has matured into a solid partnership over the decade.

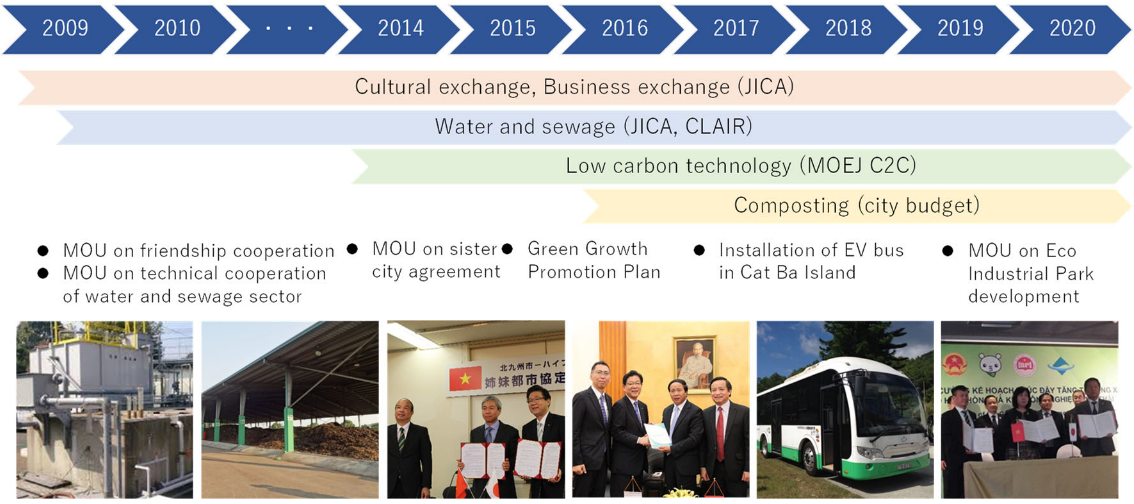


Figure 1.3.2. History of city-to-city collaboration between Kitakyushu and Hai Phong.

6 Institute for Global Environment Strategies, Mizuho Information & Research Institute, Inc (2021) FY2020 Supporting the establishment of systems for the diffusion and deployment of superior decarbonisation and low-carbon technologies in developing countries. Ministry of the Environment.

7 Hai Phong City People's Committee "Socio-Economic Information" (updated as of 31 October 2017): http://haiphongdpi.gov.vn/japan/gioi-thieu/tinh-hinh-kinh-te-xa-hoi/

8 JICA News "Opening of Lach Huyen International Port" (27 June 2018): https://www.jica.go.jp/vietnam/office/others/ku57pq0000224s7k-att/monthly1806.pdf

1.3.4. Industrial parks surveyed in this study

The two industrial parks surveyed in this study signed memorandums of understanding (MOUs) with Kitakyushu in 2019.

Nam Cau Kien Industrial Park was established in 2008 by Shinec Joint Stock Company, with about 60 companies occupying 263 ha of land. About 50% of these companies are Japanese or otherwise foreign-owned. The park is actively involved in environmental initiatives and is aiming to be accredited as an Eco Industrial Park.

The DEEP C Industrial Zones, the largest industrial park in Hai Phong, was established in 1997 and is located next to the largest port in the north, Lach Huyen. It is operated by Rent-A-Port, a Belgian company, and Dinh Vu Industrial Zone, whose shareholders include the Hai Phong City People's Committee. Covering an area of 3,400 ha, the park consists of five industrial parks spread across Hai Phong and Quang Ninh Province. More than 100 companies, including 14 Japanese companies, have moved into the park. The industrial park has been selected as a model Eco Industrial Park by the Ministry of Planning and Investment and UNIDO, and is working to increase the share of renewable electricity to 50% by 2030.

1.3.5. Past city-to-city collaboration projects between Hai Phong and Kitakyushu

Kitakyushu and Hai Phong were selected to participate in the city-to-city collaboration project, and have been actively involved for a total of six years, from FY2014 to FY2019. Both cities have provided support for institutional development and conducted project formation studies (Table 1.3.5). In the first year of the project in fiscal 2014, the two cities jointly formulated the Hai Phong City Green Growth Promotion Plan, and among the 15 pilot projects identified in the plan, specific project formulation studies were carried out from fiscal 2015 onwards in the energy and waste sector, as well as on the conservation of Cat Ba Island. A project identified through city-to-city collaboration (introduction of EV bus on Cat Ba Island) has been linked to the introduction of equipment through the "Low carbon technical innovation project for developing countries" (FY2017).

The promotion of Eco-Industrial Parks and the establishment of zero-emission industrial parks in this study are new directions set out with the aim of formulating a decarbonised society in the future, based on the achievements of cooperation between the two cities through the Green Growth Promotion Plan to date.

Table 1.3.5. Overview of the implementation of city-to-city collaboration projects between Hai Phong and Kitakyushu between 2014 and 2019.

Area of Activity	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019
Support for institutional development	• Support for the development of Hai Phong's Green Growth Promotion Plan					• Advice on environment al education centres in industrial estates
Energy	• Basic research	• Promotion of energy saving in factories and buildings	• Introduction of electric furnaces in foundries • Cogeneration • CNG Taxis			• Introduction of high-efficiency equipment in industrial parks
Waste	• Basic research	• Sewage sludge solid fuels • Waste-to-energy • Waste heat recovery power generation in cement plants • Raw materials and fuel for cement	• Waste heat recovery power generation in cement plants • Waste-to-energy	• Waste heat recovery power generation in cement plants • Waste-to-energy	• Waste heat recovery power generation in cement plants • Waste-to-energy	• Advice on wastewater treatment facilities in industrial estates
Conservation for Cat Ba Island	• Basic research	• Energy saving, renewable energy and introduction of EV buses on remote islands	• Incorporation of tourism fees for the introduction of EV buses to remote islands	• Low carbon projects combined with financing mechanisms in remote islands		
Specific results				• Introduction of EV buses to Cat Ba Island (Low carbon technology innovation project for developing countries)		

1.4. Implementation system for project

1.4.1. Implementation system

Kitakyushu and Hai Phong have assembled the right team in the right place for the implementation of this project, based on the trust and networks that the two cities have built up over the past 10 years. The Department of Foreign Affairs (DOFA) in Hai Phong and the International Environmental Strategies Division of the Environment Bureau in Kitakyushu took the lead in this study. Under the collaborative partnership between the two cities, IGES was charged with coordinating the entire project and providing support for transferring knowledge. In addition, a research system was established according to each research theme with the participation of the most appropriate companies and institutions in both Japan and Vietnam (Figure 1.4.1).

In response to the global spread of COVID-19, this year's survey was conducted without travelling to the field. Therefore, an implementation system was established to facilitate the survey remotely, making effective use of local consultants in line with the survey content.

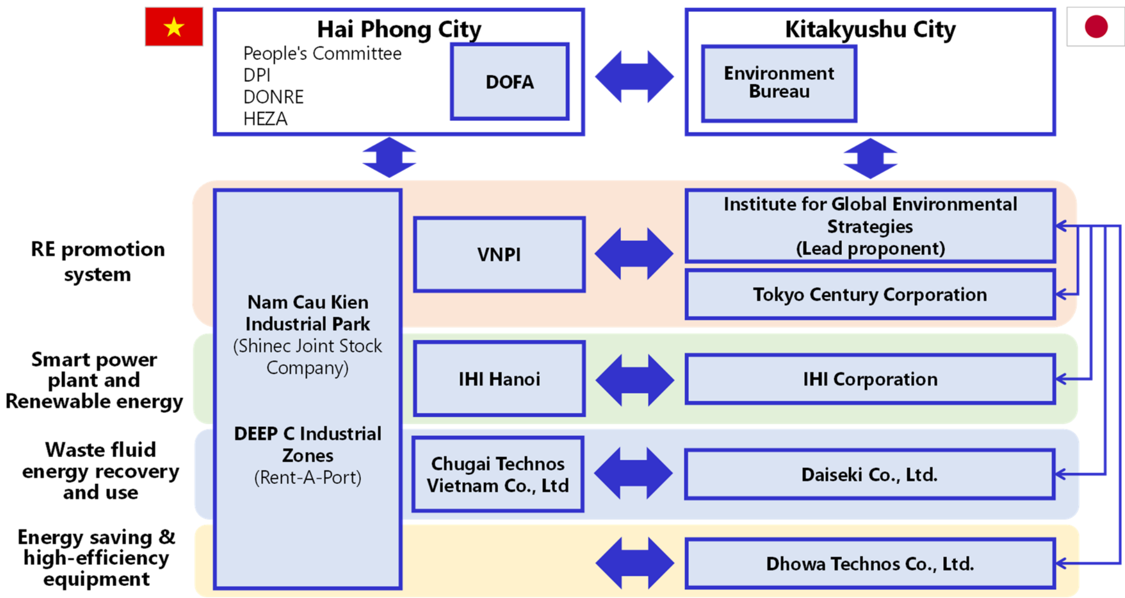


Figure 1.4.1. Project implementation structure.

1.4.2. Methodology and timetable

This survey mainly targeted two industrial parks. Since the format of the survey was to be a complex survey according to the situation and needs of each individual industrial park, adjustments were made to synchronise the survey as a whole in order to reduce the burden on the industrial park in handling the survey and to improve the efficiency of the survey. Specifically, a kick-off meeting and a final meeting were held separately, during which the participants filled in and answered questionnaires, held individual meetings, attended site visits, and conducted evaluations and discussions. In addition, surveys targeting areas other than industrial parks (interviews with cement companies, local banks, etc.) were conducted in parallel (Figure 1.4.2).

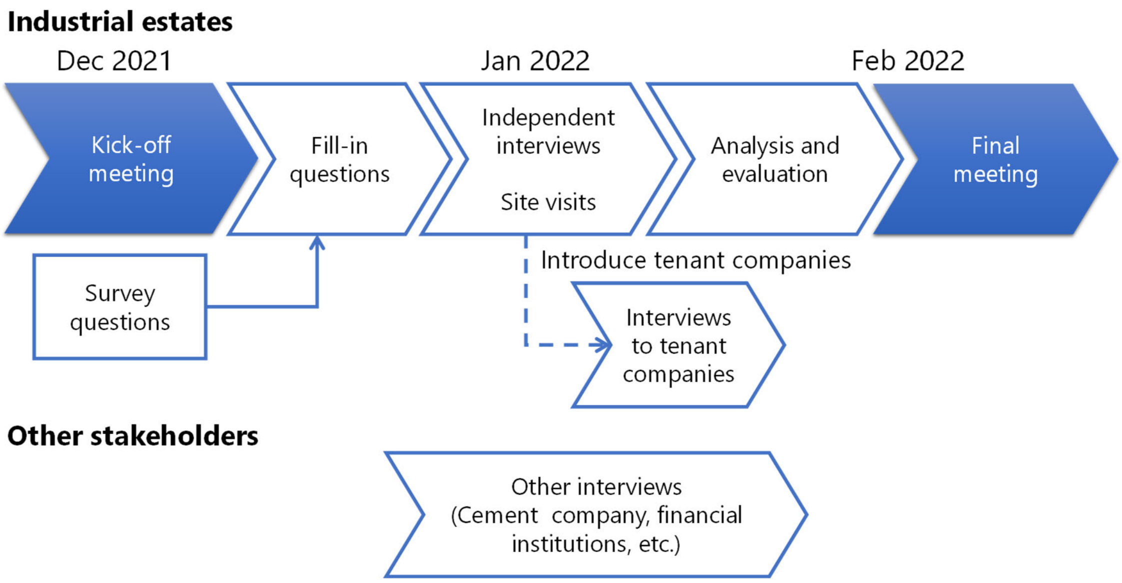


Figure 1.4.2. Image of the overall process of the survey.

The overall timetable for this study is shown in Table 1.4.2 in the form of an update to the Gantt chart provided in the application.

Table 1.4.2. Overall schedule of this survey (Gantt chart). The black bands indicate the approximate period of implementation and the numbers indicate the dates of the event.

Implementation	Person in Charge	2021		2022		
		Nov	Dec	Jan	Feb	Mar
System to enhance renewable energy installations						
4-1. System to enhance renewable energy installations	IGES Kitakyushu City					
(1) Interviews with industrial park management companies, etc.				21		
(2) Individual interviews with related companies				18, 20		
(3) Study on the proposed framework for promoting renewable energy				■	■	
Feasibility study						
4-2. Survey on smart power plants and renewable energy	IHI					
(1) Interviews with industrial park management companies, etc.				21		
(2) Survey on relevant legal systems, etc.		■	■			
(3) Review and adjustment of concept proposal and business feasibility evaluation				■	■	
4-3. 2. Survey on recovery and utilisation of waste liquid energy	Daiseki					
(1) Interviews with industrial park management companies, etc.		17		21, 26		
(2) Survey on relevant legal systems, etc.		■	■			
(3) Review and adjustment of concept proposal and business feasibility evaluation				■	■	
4-4. 3. Survey on energy-saving and high-efficiency equipment	Dhowa Technos					
(1) Discussions with companies considering equipment installation		10		21		
Meetings, reports, presentations, etc.						
4-5. Meetings, reports, presentations, etc.	IGES Kitakyushu City					
(1) Workshops with industrial parks			10, 15		16	
(2) Briefing for Ministry of Environment				6		
(3) Presentation at a conference designated by the Ministry of the Environment			17			
(4) Report writing					■	
(5) Reconsignment contracts and preparation of financial report		■				

2. Implementation of study

2.1. Development of a framework to promote the introduction of renewable energy in industrial parks

2.1.1. Background and purpose

Kitakyushu City is implementing the "Kitakyushu Model for 100% Renewable Energy", in which all public facilities (about 2,000) will be powered by renewable energy as a key measure in the city's aim to achieve carbon neutrality by 2050. This study examines ways to promote the introduction of renewable energy (especially solar power) in industrial parks by sharing Kitakyushu's expertise in a form suitable for industrial parks in Hai Phong City. In this fiscal year, a basic survey was conducted on existing financing schemes to promote the introduction of renewable energy.

2.1.2. Survey targets and methods

In this basic survey, a desktop survey was conducted on measures to introduce renewable energy in Vietnam, and an interview was held with the Renewable Energy Promotion Division in the Environment Bureau of Kitakyushu City, which is responsible for the implementation of the "Kitakyushu Model for 100% Renewable Energy", to increase understanding of the system (interview date: 14 October 2021). Individual meetings were also organised with each of the two target industrial parks to learn about electricity supply and demand mechanisms and their views on the introduction of renewable energy (interview date: 21 January 2022), as well as with local financial institutions to gather information on financial schemes and challenges faced in promoting the introduction of renewable energy in Vietnam. Discussions also took place on what expertise could be provided to industrial estates in Hai Phong.

2.1.3. Results of the survey

2.1.3.1. Trends in renewable energy introduction policies in Vietnam

Feed-in tariff (FIT) schemes[9]

The feed-in tariff (FIT) scheme for PV power in Vietnam has been put in place with a set time limit, in contrast to the permanent system in Japan. The first programme (FIT-1) applied to PV power projects that started commercial operation in the period leading up to 30 June 2019 with the Prime Minister's Decision No. 11/2017/QD-TTg (11 April 2017). The second programme (FIT-2) applied to rooftop PV power systems that commenced commercial operation between 1 July 2019 and 31 December 2020, and for which meter readings were verified (applicable period: 20 years) with the Prime Minister's Decision No. 13/2020/QD-TTg (6 April 2020).

The introduction of FIT-2 led to a surge in rushed installations and connections by December 2020, with 101,029 rooftop PV power projects (up to 9,296 MWp) connected to the grid power system and in commercial operation by 31 December.[10]

Tax incentives

Table 2.1.3.1. Tax incentives for solar power projects in Vietnam
(Source: Prepared based on VIETJO (2021)[11] and JICA (2020)[9]).

Tax type	Summary of preferential treatment
Corporate tax	Preferential tax rate of 10% to be applied for 15 years (standard tax rate is 20%). Additional tax exemptions to be applied for four years and 50% reduction in tax for nine years.
Import tax	Products used as the fixed assets in the project to be exempted from import duties, as well as equipment and parts for the project that cannot be produced domestically within five years.
Land lease tax	Projects to be exempt from land lease taxes, depending on the region or province, during construction (up to 3 years from the date the lease is signed) and for an additional 11 to 15 years after construction is completed, depending on conditions.
Value Added Tax (VAT)	Purchase VAT on costs incurred during the construction of the project to be refunded after the power plant starts commercial operation.

[9] JICA (2020) Report on the Completion of the Preparatory Survey for the Rooftop Solar Power Generation Project (PPP Infrastructure Project) for the National Textile Company of the Socialist Republic of Vietnam.
[10] VIETJO (2021/02/13) [No. 49] Vietnam, a Renewable Energy Powerhouse: Rapid Growth in Rooftop Solar Power Generation [Vietnam Business: Creating the Future]: https://www.viet-jo.com/news/column/210209105134.html
[11] VIETJO (2020/11/28) [Vol. 30] Vietnam's Renewable Energy Market: Preferential Tax Rates as an Investment Incentive Policy [Vietnam Business for the Future]: https://www.viet-jo.com/news/column/201126171321.html

Rooftop PV power generation projects

Prime Minister's Decision No. 13 permits PPAs (Power Purchase Agreements) to be signed with private companies for rooftop PV power generation projects without the involvement of Vietnam Electricity (EVN), paving the way for companies to take part in renewable energy power generation projects.

- PPA: After a power plant has been constructed, the Electricity Regulatory Authority of Vietnam (ERAV) or the People's Committee where the power plant is located will grant a power generation license to allow the plant to start operation.
- Private PPA: In this model, a power producer installs a rooftop PV power generation facility and sells the electricity to consumers (non-EVN). There are two sub-models in this model:[9]
  - Electricity sales model: A power producer owns a PV power generation facility, installs the facility on the rooftop of an electricity consumer, and sells the generated electricity directly to the consumer. General electricity consumers pay the power producer for the electricity they consume.
  - Equipment leasing model: In this model, a PV power generation facility is installed by a power producer on the rooftop of an electricity consumer, and the equipment is leased so that the consumer can consume the electricity generated. The electricity consumer pays a leasing fee to the power producer.

Prime Minister's Decision No. 13 defines rooftop PV power as a system with solar panels owned by the power purchaser installed on the rooftop of a building with a capacity not exceeding 1 MW and that is connected directly or indirectly to a grid with a voltage level of 35 kV or lower. In this model, some or all of the electricity produced can be sold to EVN or organisations/individuals. The unit sales price for electricity can be freely negotiated between the power producer and power purchaser, and no PV license is required (Circular No. 18/2020). The 1 MW limitation is applied on a per-facility basis, not a per-project basis. Even if a PV power project has multiple rooftop PV power generation facilities in one location with a total installed capacity exceeding 1 MW, if the installed capacity of each power generation facility does not exceed 1 MW, a license is not required.

2.1.3.2. Kitakyushu Model for 100% Renewable Energy

Objectives and features of the Kitakyushu Model for 100% Renewable Energy

The Kitakyushu Model for 100% Renewable Energy aims to (1) establish a system that enables the stable and inexpensive introduction of 100% renewable energy through the introduction of renewable energy, energy savings, and optimal operation and maintenance of equipment, (2) strengthen the competitiveness of small and medium-sized enterprises that require 100% renewable energy, and (3) realize a "virtuous cycle between the environment and economy".

The Kitakyushu Model for 100% Renewable Energy is also a mechanism that can be used to reduce the price of renewable electricity, applying value created by the elements of the circular economy, and specifically refers to five elements of the circular economy: (1) products as services, (2) extended product life, (3) sharing platforms, (4) collection and recycling, and (5) regenerative supply.[12]

Three steps

The Kitakyushu Model for 100% Renewable Energy breaks down the introduction of renewable energy into three steps.[12]

- Step 1: Switch to 100% renewable energy sources generated by Kitakyushu Power Co., Ltd. and other electricity producers to power public facilities.
- Step 2: Install PV power generation systems for self-consumption, electric vehicles (EVs), and storage batteries in a third-party ownership model.
- Step 3: In addition to the systems installed in Step 2, install energy-saving devices such as air conditioners and LEDs under a third-party ownership model.

Role of Kitakyushu Power Co., Ltd.

Kitakyushu Power Co. Ltd. (hereinafter referred to as "Kitakyushu Power") is a local electricity retail company established in 2015 by the City of Kitakyushu, local companies, financial institutions, and other investors. The company supplies 100% renewable energy (wind, solar, incineration) from renewable energy power plants as in Step 1 to public facilities in the city, as well as services to install PV power generation equipment, storage batteries, EVs, energy-saving devices, and other devices in a third-party ownership model in cooperation with financial institutions (that correspond to "equipment installation companies" in Figure 2.1.3.2.2), as indicated in Steps 2 and 3.

Kitakyushu Power is also expected to play a role in distributing surplus electricity generated by the renewable energy equipment installed in Step 2 to other public facilities. In this way, Kitakyushu Power is playing an indispensable key role in the Kitakyushu Model for 100% Renewable Energy. In addition, Kitakyushu Power is backed by a local government (Kitakyushu City), which positions it as a highly creditworthy company, giving it an advantage over ordinary private companies when working with financial institutions. The Kitakyushu Model for 100% Renewable Energy was initially intended for public facilities, but is now being considered for installation in private facilities that are interested.

[12] Efforts to convert to 100% renewable energy in the Kitakyushu metropolitan area: https://kankyo-kitakyushu.hub.arcgis.com/

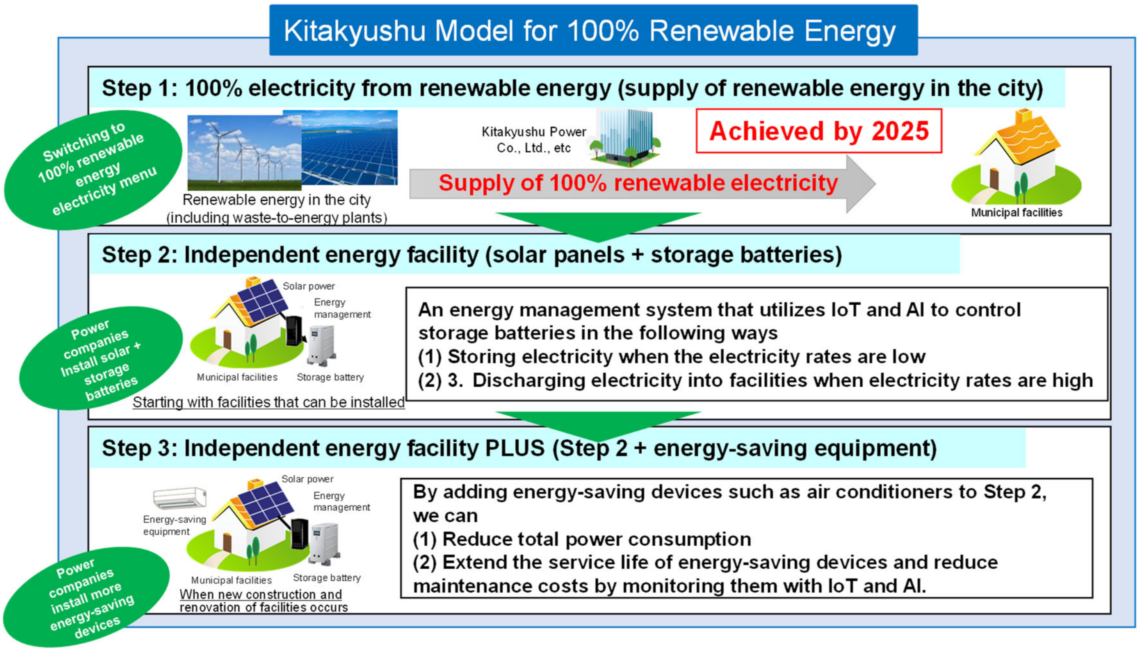


Figure 2.1.3.2.1. Three steps in the Kitakyushu Model for 100% Renewable Energy. (Source: Kitakyushu City[9])

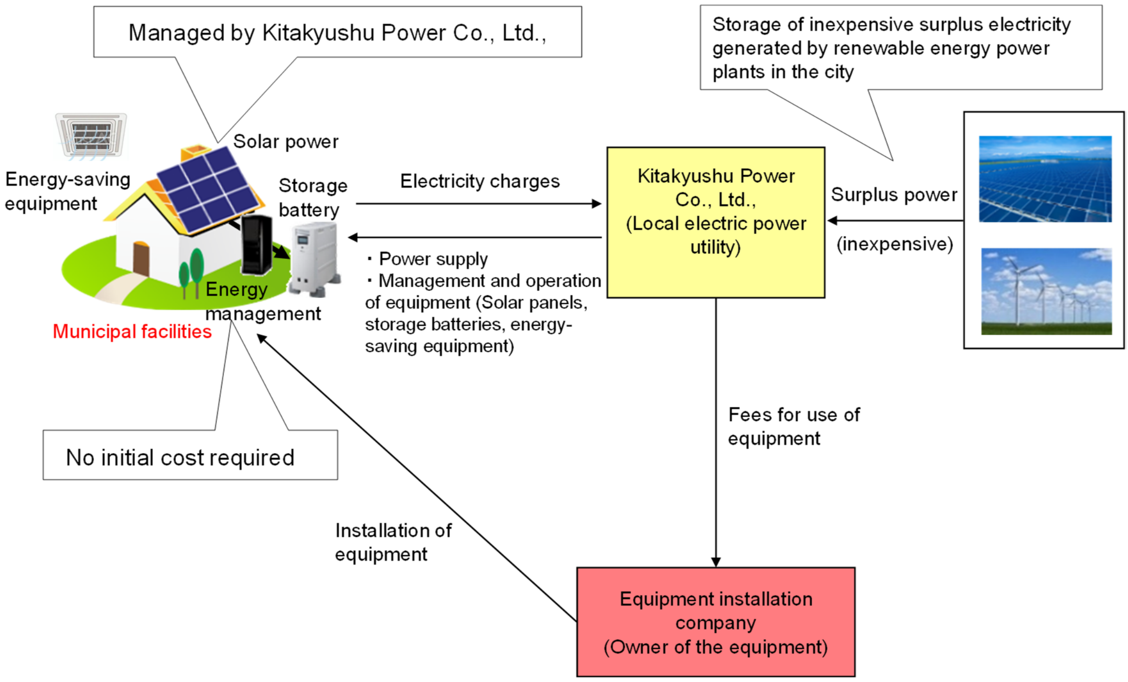


Figure 2.1.3.2.2. Conceptual diagram of the Kitakyushu Model for 100% Renewable Energy. (Source: Kitakyushu City)

<u>Third-party ownership system</u>

Conventionally, when equipment is purchased by local governments, the local government owns the equipment itself, but the number of installations per year is limited for equipment with a large initial investment, such as PV power generation equipment. Therefore, Kitakyushu City is switching to a "third-party ownership system" (third-party ownership model or subscription system) as a means of introducing renewable energy and other equipment as early as possible and in greater numbers.

In general, the third-party ownership system refers to the "PPA model" in which a power producer installs PV power generation equipment at a consumer's facility and supplies the generated electricity to the consumer under a power purchase agreement (PPA). In this model, equipment can be installed with no initial investment, and the consumer pays a monthly electricity fee during the contract period. A "leasing model" is one in which the consumer pays a monthly fee in exchange for a leasing company to install and maintain the PV power generation equipment at the consumer's facility. Kitakyushu refers to this type of system, where equipment is owned by a third-party other than the customer and the equipment can be installed without any initial investment, as a "third-party ownership system". Kitakyushu is experimenting with various financing models that can be used with this third-party ownership system, and is testing out variable and fixed monthly payments to find the best option.

Table 2.1.3.1 compares and summarises the financing models used in Japan to install PV power generation equipment. The PPA and leasing models are the only third-party ownership models, but there are also a number of other options, such as roof rental and solar loans that can be used without initial costs.

Table 2.1.3.1. Comparison of financing models for PV power generation in Japan (prepared by the study team).

	Roof rental	PPA	Lease	Solar loan	Self-owned
Property owner	Power generation company	PPA provider (self-owned after PPA term)	Lease provider (self-owned after PPA term)	Customer	Customer
Initial costs	—	—	—	— (can be set to none)	YES
O&M costs	—	—	—	YES	YES
Owner of generated electricity	Power generation company	PPA provider	Customer (can choose either self-consumption or sale of electricity)	Customer	Customer
Other expenses	—	Payment for self-consumed electricity	Lease payments (even when electricity is not generated)	Loan repayment	—
Income from electricity sales	—	—	YES (no charge for self-consumption)	YES (no charge for self-consumption)	YES (no charge for self-consumption)
Other income	Roof usage fees	—	—	—	—

<u>Use of IoT and AI to extend the service life of equipment</u>

In Step 2 and Step 3, facilities and equipment are not only installed using a third-party ownership system, but an energy management system that utilises IoT and AI can be used to save energy and extend the service life of these facilities and equipment. For example, the storage batteries in Step 2 store electricity when electricity rates are low and discharge electricity into facilities when rates are high, thereby providing a stable supply of renewable energy sources and helping reduce output control. For air conditioners in Step 3, monitoring systems using IoT and AI are being introduced to detect signs of failure and repair defective parts before they fail, reducing maintenance costs by eliminating periodic inspections and extending the service life of equipment. With LEDs, sensors and management systems connected to networks are used to reduce lighting time, extend warranty periods, and further promote energy savings. These efforts are being implemented to reduce the total amount of electricity used, and lower annual payments at the same time by extending warranty periods for equipment and facilities with longer service lives.

Sharing and recycling of storage batteries

Because storage batteries are still expensive and the hurdles to their widespread use are high, studies are being conducted into the multiple use (sharing) of EV vehicles that have been introduced under a third-party ownership system, not only for use as public vehicles but also as storage batteries for electricity generated by renewable energy at public facilities. The establishment of a used storage battery market is also being considered so that the storage batteries in EV vehicles can be replaced with new ones after five to seven years, collected and recycled in cooperation with automobile manufacturers, and then reused as stationary storage batteries. These, together with the introduction of products by subscription (products as a service) and the extension of the service life of products, are elements of the circular economy that are being applied.

2.1.3.3. Status of introduction of renewable energy in industrial parks

The survey team collected information from Nam Cau Kien Industrial Park (NCK) and DEEP C Industrial Zones (DEEP C) about the structure of electricity supply and demand, as well as their ideas and needs regarding the introduction of renewable energy through a questionnaire and subsequent interviews (both conducted on 21 January 2022).

Nam Cau Kien Industrial Park

Two electricity retail companies are in operations in NCK: Lam Thinh Joint Stock Company, which specialises in retailing grid electricity from EVN, and Vung Duyen Hai Joint Stock Company, a newly established electricity retail company specialising in PV power, which play the role of private PPA providers (Figure 2.1.3.2.1).

Currently, solar panels with a capacity of 100 kW are being installed on the roof of NCK's office building on a trial basis. PV power generation equipment with a capacity of 1 MW or less will be installed on the roof for self-consumption in the industrial park, and supplied to tenants in the industrial park through Vung Duyen Hai Joint Stock Company, rather than for self-consumption at the factory leasing the roof. Electricity not expected to be sold to EVN.

The total area of the roofs of factories and other buildings in NCK is 34 ha, of which 3.5 ha are owned by NCK. This area will increase to 6.1 ha, including 2.6 ha under development.

About 70 factories are located in NCK, including about 20 companies that have already agreed to install PV panels on their roofs. A number of these companies have requested the installation of PV panels. There are two ways to invest in PV power generation facilities, either through Vung Duyen Hai Joint Stock Company alone or jointly with other companies. Shinec Joint Stock Company is expected to participate in investment as appropriate.

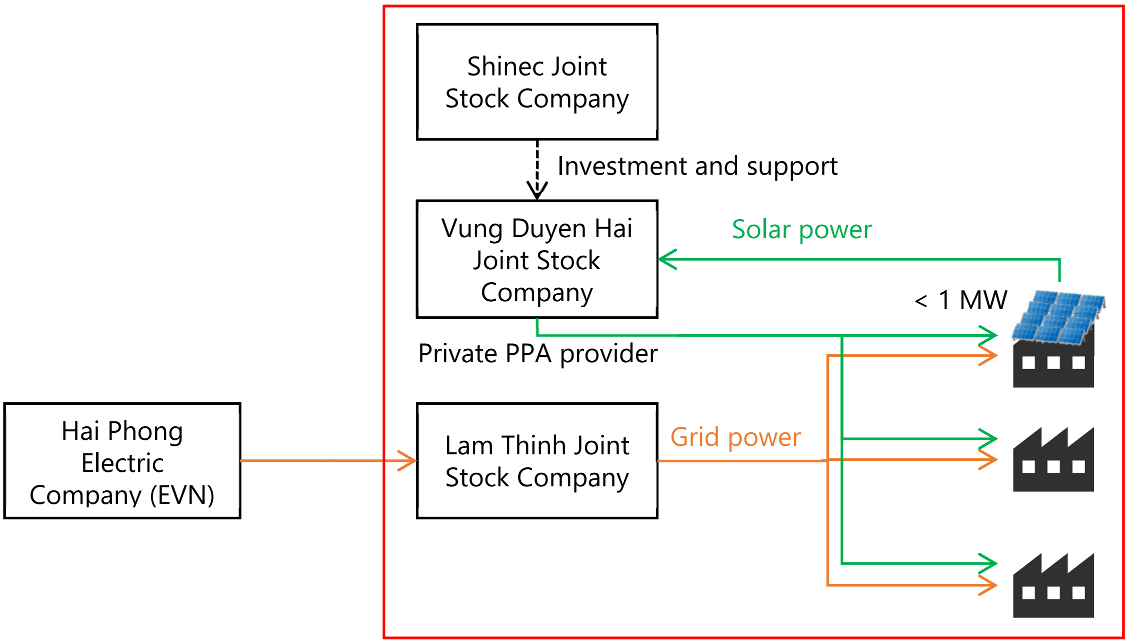


Figure 2.1.3.2.1. Conceptual diagram of the power distribution system including renewable energy in Nam Cau Kien Industrial Park (based on interviews by the survey team).

<u>DEEP C Industrial Zones</u>

DEEP C Management manages four subsidiaries by sector in DEEP C. In the energy sector, DEEP C Green Energy (50% owned by Tokyo Electric Power Company), an electricity retail company, receives electricity from EVN's grid and distributes it to tenant companies. Rent-A-Port is a Belgian company, and DEEP C has been an early adopter of renewable energy, as investors in Europe and the U.S. consider investment in renewable energy as a factor in their decision-making process. In addition to PV power generation, DEEP C has already installed a wind power system, and is also considering waste-to-energy. DEEP C itself invests in the installation of renewable energy facilities, and will commission DEEP C Green Energy to install facilities.

In terms of PV power generation, the company basically installs rooftop PV systems on the roofs of tenant companies, but has not yet had experience with ground-mounted PV systems. The electricity generated by roof-mounted PV systems is redistributed to tenant companies through DEEP C Green Energy, instead of being consumed by the factories where the systems are installed. Electricity from EVN and renewable energy power are mixed and supplied to tenants, and it is possible to provide a certificate indicating the percentage of the power from renewable energy. However, some tenants have installed roof-mounted PV systems to generate power for their own consumption.

The number of tenants seeking to install and use renewable energy power is also increasing at DEEP C. One reason for this is that the power environment in Vietnam is unstable and has a poor outlook. Based on the existing plan to achieve 50% renewable energy by 2030, DEEP C intends to continue to promote the introduction of renewable energy sources, especially solar and wind power.

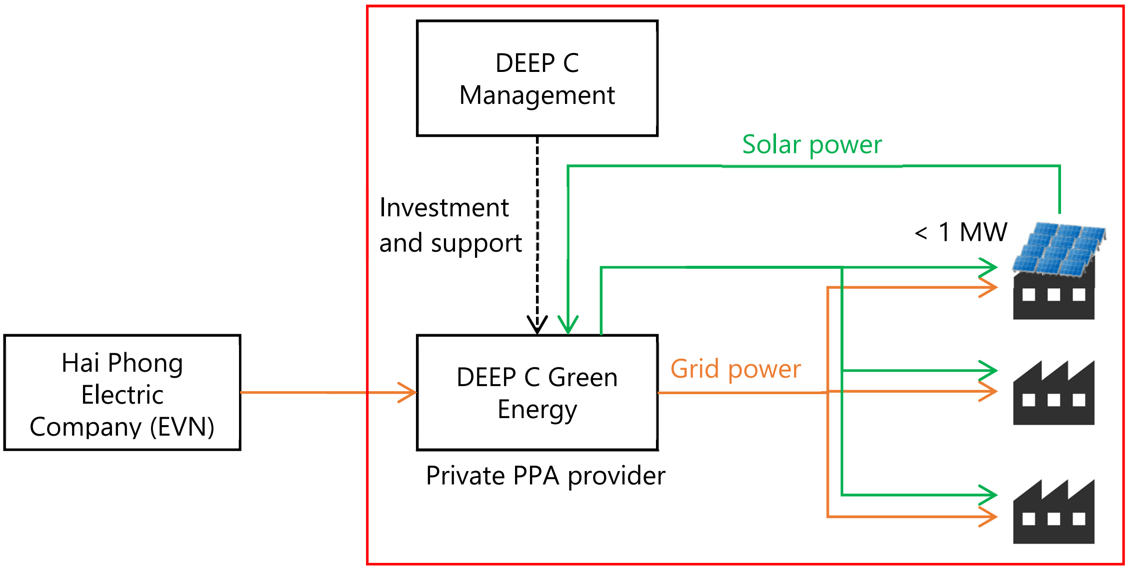


Figure 2.1.3.2.1. Conceptual diagram of a power distribution system including renewable energy in DEEP C Industrial Zones (based on interviews by the survey team).

2.1.3.4. Interviews with local financial institutions

Until 1988, Vietnam had adopted a monobank system in which the State Bank of Vietnam (SBV) served as both the central bank and a commercial bank. Since then, state-owned commercial banks with commercial banking functions have become independent, and three of the largest banks (Vietcombank, VietinBank, and BIDV) are listed on the stock exchange. These banks differ from other private commercial banks in that they are heavily influenced by the Vietnamese government, as SBV remains the largest shareholder even after privatisation.[13]

In this study, we interviewed two of the largest state-owned commercial banks, Vietcombank (interview date: 20 January 2022) and VietinBank (interview date: 21 January 2022). Vietcombank was interviewed together with an employee seconded from Mizuho Bank, which holds a 15% stake in Vietcombank, and the Hanoi branch of Mizuho Bank. The following is a summary of the information gleaned from the interviews with the two banks.

<u>Trends in the PV power generation business in Vietnam</u>

- With the promulgation of Prime Minister's Decision No. 13/2020, which deregulates the private PPAs that allow private power producers and electricity consumers to buy and sell renewable electricity without going through EVN, the number of financing projects for rooftop PV systems with a capacity of 1 MW or less and a voltage of 35 kV or less is increasing. There are many players in the business, including major Japanese trading companies and multinational corporations.
- For rooftop PV systems with a capacity of 1 MW or less, it is common for power providers to procure equipment (and the bank to finance it), and for the plant owner who leases the roof to sign a contract to pay over a 10- to 15-year period under a power purchase agreement, with no initial investment. There

[13] Daiwa Institute of Research Ltd. (2015) Report on a Basic Study to Support the Development of Financial Infrastructure in Vietnam. Financial Services Agency.

are also models in which electricity is sold to EVN, but because of the cost burden of distribution lines and other equipment, many of these systems are installed for self-consumption.

- The main challenges in the PV solar business in Vietnam are a shortage of grid power lines due to a rapid increase in PV projects, fixed and low power purchase prices, and the possibility that the power purchase contract is closer to EVN and EVN may not be able to purchase the power for its own reasons.

Financing solar power in Vietnam

- Decision: Financing decisions are made based on the type of project, such as a rooftop PV, wind power, or offtaker (entity purchasing electricity).
- Loan conditions for Japanese banks: It is difficult for foreign banks such as Japanese banks to finance large projects in Vietnam due to the risk of fluctuations in the exchange rate. Japanese banks can only finance PV models in industrial parks if the power producer is a Japanese trading company, or if the tenant is a listed, creditworthy Japanese company with a long-term contract.
- Financing conditions of local banks: When a power producer or end user is a local company in Vietnam, the local bank in Vietnam comes into play. If an industrial park management company is a power producer and finances a PV power project, it is common to take real estate as collateral (land and buildings) to back the payment of the loan for 10 to 15 years. Local banks generally rely on the risk of a power generation project rather than the creditworthiness of the end user (tenant company).
- Power producers: The power producer must take on the investment risk. Japanese trading companies cannot take on the long-term credit risk of local tenants, so it is difficult to work with Japanese trading companies unless the tenants are listed Japanese companies or the industrial park is filled mostly with Japanese companies. Therefore, if the industrial park has a large number of local tenants, a local power producer will take on the risk of the end user and the local bank will take on the risk of the local power producer.
- Electricity retail price and payback period: Due to EVN's low electricity retail price, end users will seek to procure electricity at a lower price, resulting in a longer payback period. If the end-user is a Japanese company, it may be difficult to obtain approval from the head office because the PPA period is too long (15-20 years).
- Sunlight conditions: Sunlight conditions in the northern part of Vietnam where Haiphong is located are generally poor, which makes PV power projects less profitable. Therefore, large-scale ground-mounted PV projects are concentrated in the south where sunshine conditions are better. In the north, rooftop models are the norm in industrial parks, and financing is mainly based on risk analysis and collateral value of the company (corporate finance). Sunlight conditions are treated only as reference. On the other hand, in large-scale PV projects in the south, financing decisions are based more on risk analysis of the project itself (project finance view), with data from external organisations used for feasibility assessments.
- Lease: There are some finance models for third-party ownership leases of power generation equipment and roofs, but there are few examples of such leases because contracts are only available with a license.

Promoting PV from a finance perspective

- The most effective and realistic way to promote the installation of PV systems in industrial parks under the current system is to focus on rooftop models with a capacity of 1 MW or less that do not require licenses and have lower barriers to entry.
- Under Vietnam's legal system, it is unlikely that the national government or local governments will provide debt guarantees for PV power generation projects. Therefore, the involvement of the local government is unlikely to lead to improved credit.
- It would be easier for banks to provide loans and more economically rational to shorten the contract period from 15 to 8 years, for example, by including initial cost.

2.1.4. Summary and potential for future development

In summarising the results of the above survey, the only mechanism found for promoting PV power generation projects in Haiphong, a city with poor sunshine conditions, is a scheme in which private PPAs with a capacity of 1 MW or less are installed on rooftops, and the electricity retail company of the industrial park becomes the PPA provider, supplying renewable power to tenant companies.

Of the various elements under the Kitakyushu Model for 100% Renewable Energy that Kitakyushu can offer to Haiphong and local industrial parks from its experience in promoting renewable energy, those circled in bold in Table 2.1.4 (i.e., (1) subscription, (2) optimal use of products using IoT and AI, and (3) sharing (multi-use)) were considered to be helpful. These findings were shared at the final meeting (see 3.1.2. "Final Meeting").

Table 2.1.4. Main elements and expected effects from the Kitakyushu Model on 100% Renewable Energy. Bold box indicates elements that were considered to be helpful to Haiphong City and local industrial parks (prepared by the survey team).

Key elements of the Kitakyushu Model on 100% Renewable Energy	Expected results				
	Promoting introduction	Energy savings	Longer service life	Lower cost	Improved credit
Establishment of a local power company (Kitakyushu Power)	√				
Shift from ownership to use (subscription)	√				
Optimal use of products using IoT and AI		√	√	√	
Sharing (multi-use)	√			√	
Collection and recycling of batteries	√				
Supply of recycled batteries	√				
Kitakyushu City's involvement and commitment					√

There were four similar PV power generation projects adopted as JCM Model Projects in Vietnam at the time of the FY 2021 call for proposals.[14] According to JCM rules, if there are five or more JCM Model Projects in the same partner country using similar technologies selected at the time of the open call for proposals, the cost-effectiveness of the subsidy amount required to reduce GHG emissions by one tonne will

[14] GEC(2021) Public Offering of Subsidies for Projects to Reduce Carbon Dioxide Emissions (Model Projects within Joint Crediting Mechanism) for FY2021 through FY2023. https://gec.jp/jcm/jp/kobo/r03/mp/jcmsbsdR3_koboyoryo.pdf

be gradually lowered from JPY 4,000/tCO_2eq which is the general cost-effectiveness standard for JCM to JPY 3,000/tCO_2eq. If there are 10 or more subsidised projects, the cost-effectiveness will be lowered to JPY 2,500/tCO_2eq. In Vietnam, five solar power projects were added in fiscal 2021, so there will be a total of nine projects at the time of the open call for proposals next year.[15] As a result, a cost-effectiveness of JPY 3,000/tCO_2eq will be applied next year, but if even one project is adopted during the next fiscal year, it is expected to drop to JPY 2,500/tCO_2eq the year after, which will reduce the benefits of the subsidy considerably.

When utilising the JCM Model Project scheme for the installation of PV power generation equipment in an industrial park, a shortcut would be to consult with Japanese companies currently located in the industrial park and ask them to take on the role of representative of an international consortium. In this case, it would be possible to enjoy the economies of scale if the industrial park management company could collaborate on the installation of several 1-MW units not only on the rooftops of factories, but also on the rooftops of other factories nearby.

2.2. Study on the Introduction of Smart Power Plants and Renewable Energy

2.2.1. Background and purpose

This study aims to achieve the creation of a zero-emission industrial park through city-to-city collaboration between Hai Phong and Kitakyushu with the introduction of an Eco-Industrial Park that promotes the reduction of GHG emissions. Hai Phong City is actively supporting the certification of Eco-Industrial Parks, with Nam Cau Kien Industrial Park and DEEP C Industrial Zones, two of several industrial parks in Hai Phong that have taken a proactive stance in reducing GHG emissions and introducing renewable energy, positioned as candidates for Eco-Industrial Parks.

IHI has been working on the introduction and application of Smart Power Plants, which combine natural gas-fuelled engines and PV power generation equipment and that are optimally controlled by an Energy Management System (EMS), mainly in the Southeast Asian market. Smart Power Plants conserve energy by optimising operations and effectively using renewable energy.

To elaborate, a Smart Power Plant, which is optimally controlled and operated with an EMS, combines energy supply equipment that uses renewable energy to meet electricity demand. The plant maximises the use of renewable energy by storing excess energy in storage batteries. Surplus energy stored in batteries ensures that other energy supply equipment is also operating at maximum efficiency, thereby maximising the effective use of fossil fuels. Using the EMS to optimise control and operations at the entire power plant, including energy supply equipment, to meet electricity demand makes it possible to maximise the use of both renewable energy and fossil fuels, and as a result, reduce CO_2 and other GHG emissions.

Smart Power Plants, which are optimally controlled and operated by an EMS, are highly compatible with a wide range of equipment. Even if there is a change in the configuration of energy supply equipment, GHG emissions such as CO_2 can be reduced by operating and controlling components and equipment at maximum efficiency while storing surplus power in storage batteries.

This survey has investigated the feasibility and potential of introducing smart power plants, as well

[15] GEC: Joint Crediting Mechanism Case Studies: https://gec.jp/jcm/jp/projects/

as review conditions and assess intentions at target industrial parks with the aim of achieving both energy savings and the effective use of renewable energy.

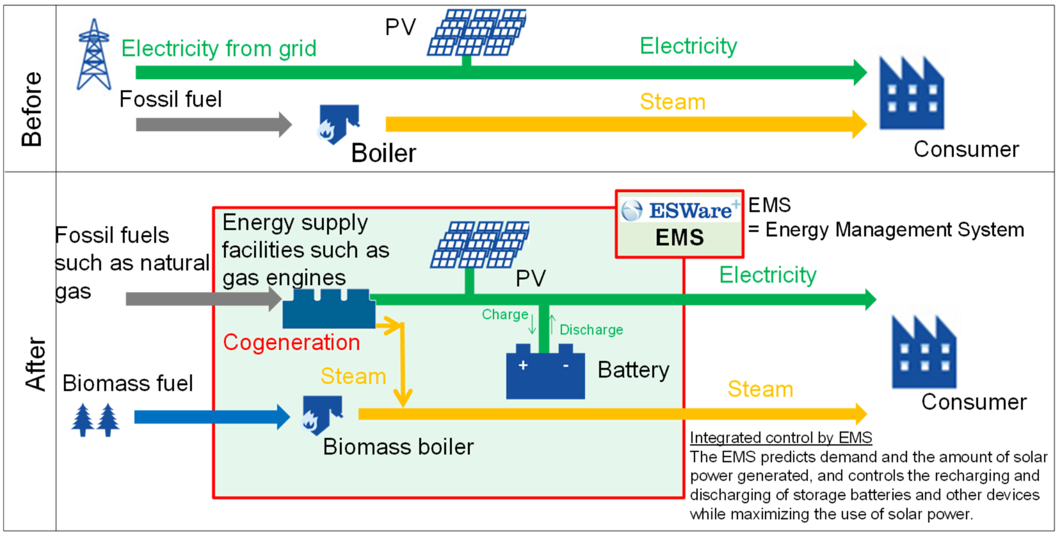


Figure 2.2.1. Conceptual diagram of a smart power plant.

2.2.2. Survey targets and methods

The target areas covered in this survey are Nam Cau Kien Industrial Park and DEEP C Industrial Zones.

(Ref) Websites:

(1) Nam Cau Kien Industrial Park: https://namcaukien.com.vn

(2) DEEP C Industrial Zones: https://deepc.vn/en

First, basic information on the scale and electricity demand of both industrial parks were collected. In addition, inquiries were made into the intentions of each industrial park, focusing on how to reduce GHG emissions in line with the conditions and intentions of each industrial park.

2.2.3. Survey on grid electricity rates and gas prices in industrial parks

A survey was conducted on the grid electricity rates of EVN (Vietnam Electricity) and gas prices of PVgas (PetroVietnam Gas), both required conditions for this study.

2.2.3.1. Electricity rates

Below are EVN’s grid electricity rates for supplying power to the industrial parks. The survey confirmed that electricity rates in NCK Industrial Park were the same as those below. The unit price in the DEEP C Industrial Zones is the same as that of EVN, with slight variations in unit price depending on power supply conditions. Since EVN's electricity rates for industrial parks (voltage level of 22kV to 110kV) are the same as those in NCK Industrial Park, the following electricity rate units were used in this study.

a) Standard hour: VND 1,526/kWh (approximately JPY 7.6)

b) Off-peak hour: VND 989/kWh (approximately JPY 4.9)

c) Peak hour: VND 2,817/kWh (approximately JPY 14.1)

VIETNAM ELECTRICITY
Enlightening Trust
EVN

Introduction | Cooperation Information

Electricity Price

WHOLESALE ELECTRICITY TARIFF

d) Industrial zone

2	*Wholesale tariff for medium-voltages electricity at the 110/35-22-10-6kV substations*	
2.1	*Voltage levels from 22kV to below 110kV*	
	a) Standard hour	1,526
	b) Off-peak hour	989
	c) Peak hour	2,817

Figure 2.2.3.1.1. EVN (Vietnam Electricity) grid electricity rates.

(Ref) Website: https://en.evn.com.vn/d6/news/WHOLESALE-ELECTRICITY-TARIFF-9-28-260.aspx

TIME – OF – USE ELECTRICITY CHARGE

a) Definition of hours:

+ Standard hour

From Monday to Saturday

- From 4.00 a.m. to 9.30 a.m. (5 hours and 30 minutes);
- From 11.30 a.m. to 5.00 p.m. (5 hours and 30 minutes);
- From 8.00 p.m. to 10.00 p.m. (2 hours).

Sunday

From 4.00 a.m. to 10.00 p.m. (18 hours).

+ Peak hour

From Monday to Saturday

- From 9.30 a.m. to 11.30 a.m. (2 hours);
- From 5.00 p.m. to 8 p.m. (3 hours).

Sunday: No peak hours.

+ Off-peak hours:

All days: from 10 p.m. to 4 a.m. of the following day (6 hours).

Figure 2.2.3.1.2. EVN's definition of TOU (Time Of Use)

(Ref) Website: https://en.evn.com.vn/d6/news/TIME-OF-USE-ELECTRICITY-CHARGE-9-28-264.aspx

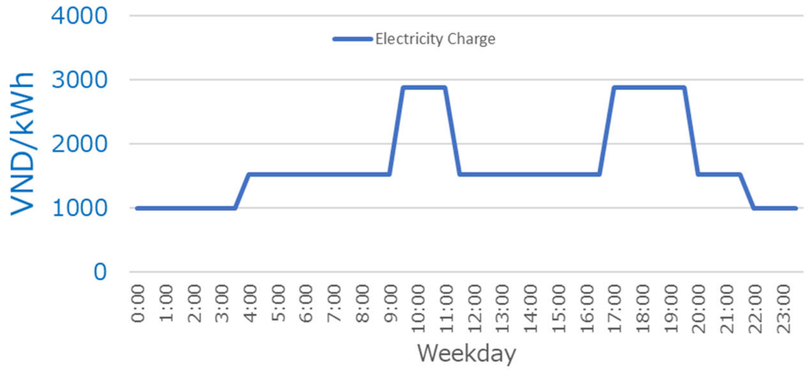


Figure 2.2.3.1.3. Example of EVN's electricity rates by hour on weekdays.

2.2.3.2. Gas price

The price of gas supplied to the two industrial parks is as follows.

Retail gas price in Hai Phong City: VND 34,500/kg (approximately JPY 173/kg)

(Ref) Website: http://pvgaslpg.vn

2.2.4. Field survey results

2.2.4.1. Review of conditions in both industrial parks and confirmation of intentions

Web conferences were held individually with both industrial parks to review conditions in the industrial parks and their individual intentions. In addition, the following measures were presented as options for reducing CO_2 and other GHG emissions, and ideas were collected on the measures the industrial parks would like to see considered.

- Option 1: Peak shift with PV power generation + storage battery system
- Option 2: Smart power plant (mono-generation without the use of waste heat)
- Option 3: Smart power plant (co-generation with the use of waste heat)

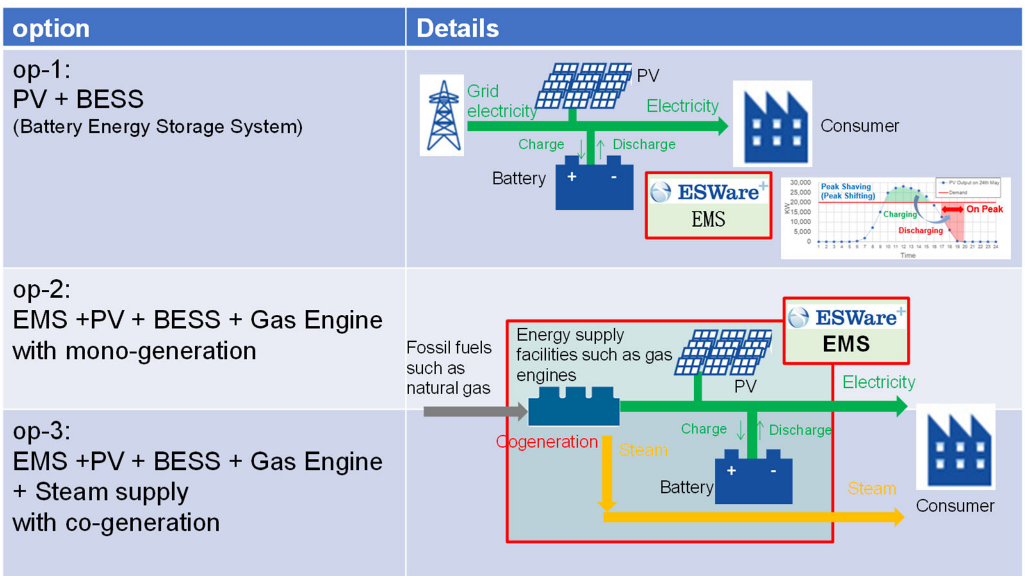


Figure 2.2.4.1. Proposed measures to reduce GHG emissions.

2.2.4.2. Results of field survey at Nam Cau Kien Industrial Park

The current situation is as follows.

- It is possible for the industrial park to cover electricity demand up to 189 MVA (The industrial park has three substations with a capacity of 63 MVA, and a maximum capacity of 189 MVA). Assuming a power factor of 0.9, this is equivalent to about 170 MW, which is a considerably large power demand.

NCK Industrial Park's intentions for reducing GHG emissions are as follows.

- Among options 1, 2 and 3, NCK would like to consider option 1: PV power generation + storage battery system. Options 2 and 3 on the introduction of a Smart Power Plant were excluded from the list of candidates because although renewable solar energy is included, these options also require a generator, such as a gas engine that uses fossil fuels. The results of this field survey confirmed that the industrial park has a strong desire to increase the ratio of renewable energy used, rather than reduce CO_2 and other GHG emissions.
- There are about 70 tenants in the industrial park, and negotiations are ongoing with about 20 companies to have them install PV power generation on the roofs of their buildings. The industrial park leases the roofs from the tenants and installs PV power generation equipment to generate electricity, which is then returned to the electricity management company that has jurisdiction over electric power in the industrial park before it is sold to the tenants.
- Steel, machining, and plastic processing companies, which have a high demand (usage) for electricity are proactively considering the installation of PV power generation on the roofs of their buildings.
- The roofs of factories owned and leased by NCK Industrial Park itself alone cover an area of approximately 3.5 ha. Furthermore, the potential area available for installing PV power generation on the roofs of tenants who are considering leasing out space to the industrial park (roof rental) is 34 ha.

2.2.4.3. Results of field survey at DEEP C Industrial Zones

The current situation is as follows.

- Electricity demand in the entire industrial park is 626 MVA at maximum, which is purchased from EVN. Assuming a power factor of 0.9, this is equivalent to about 560 MW, which is a considerably large power demand.

DEEP C's intentions for reducing GHG emissions are as follows.

- Among options 1, 2 and 3, DEEP C would like to consider applying option 1: PV power generation + storage battery system. Options 2 and 3 on the introduction of a Smart Power Plant were excluded from the list of candidates because although renewable solar energy is included, these options also require a generator, such as a gas engine that uses fossil fuels. The industrial park is aiming to increase the use of renewable energy to 50% by 2030, and Hai Phong, which is promoting the creation of Eco-Industrial Parks, is reluctant to propose new equipment that uses fossil fuels, opting instead for option 1 which uses only renewable energy. The results of this field survey reconfirmed that the industrial park has a strong desire to increase the ratio of renewable energy used, rather than reduce CO_2 and other GHG emissions.

- DEEP C Industrial Zones is funded with European capital. Since European investors use the level of renewable energy as a criterion for deciding whether to invest, it is essential to promote the introduction of renewable energy.
- DEEP C has already installed and is operating PV power generation equipment, albeit on a smaller capacity. They are already aware of the fact that the northern region of Vietnam, including Hai Phong, tends to have weak solar radiation (which, in turn, reduces the amount of solar power generated). Considering the diversification of renewable energy sources, they have also introduced and are confirming the potential of wind power generation systems.
- Due to the unstable supply of electricity in the northern part of Vietnam, including Hai Phong, DEEP C is willing to consider the use of solar power even if solar radiation is slightly weak. They believe that the industrial park as a whole has vast potential due to its extensive area, and want to work steadily towards the introduction of solar power. DEEP C is also considering the introduction and use of renewable energy, including wind power generation, and has a strong desire to further promote the introduction and use of renewable energy as a basis for investment decisions by European investors.
- PV power generation equipment in the industrial park will not be installed on the ground (out in the open), but on roofs. Although some companies that have been in the park for years have installed PV power generation equipment on their own roofs for their own consumption, there are very few examples of this. For the past few years, DEEP C has requested tenant companies to lease out their roofs so that the industrial park can install PV power generation equipment. All the electricity generated will be returned to the electricity management company that has jurisdiction over the industrial park before it is sold to tenant companies. This offers an incentive to tenant companies to reduce occupancy rent by an amount equivalent to leasing the roof. In addition, the electricity generated from solar power is combined with grid power and supplied to each tenant. Green certificates are issued to tenants to show the percentage of renewable energy in the electricity supplied.

2.2.4.4. Summary of results of field surveys in NCK and DEEP C industrial parks

The results of these surveys, which mainly focused on the intentions of the two industrial parks through interviews and discussions, are compiled below.

- Rather than aiming to reduce CO_2 and other GHG emissions, the two industrial parks have expressed a strong desire to promote the use of renewable energy. Since European investors use the level of renewable energy as a criterion for deciding whether to invest, promoting the use of renewable energy is absolutely essential.
- The survey confirmed that neither industrial park intends to introduce new equipment for use in a smart power plant, which combines PV power generation equipment, storage battery systems, gas engines, and other equipment, and is operated via an integrated EMS, because gas, a fossil fuel, is used.

Although the initial scope of the study was to investigate the use of Smart Power Plants, based on the results of the field surveys of both industrial parks, the focus shifted to targeting a combination of primarily PV power generation, which is a renewable energy source, and storage battery systems, which contribute to the effective use of stored energy.

2.2.5. Proposal concept

2.2.5.1. Proposal details

The results of the survey of the two industrial parks demonstrated a strong demand for a plan using only renewable energy rather than a smart power plant using fossil fuels, so the concept proposed was the use of PV power generation and a storage battery system.

Although proposals focused on options combining PV and storage battery systems, proposals for PV power generation alone should also be considered as a way to verify the effectiveness of storage battery systems.

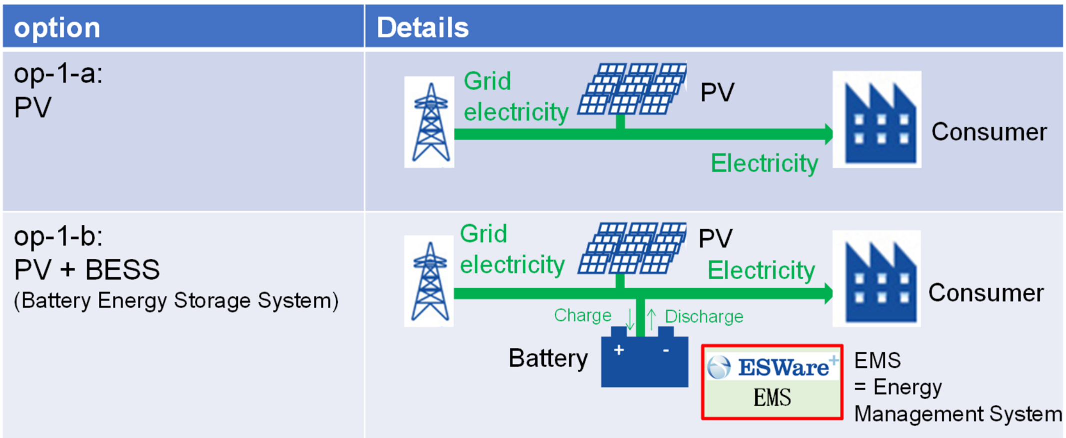


Figure 2.2.5.1. Conceptual diagram of the proposed introduction of renewable energy.

2.2.5.2. Conditions for consideration: PV power generation

Solar radiation data used in the PV power generation study will be obtained from the Database for Solar Radiation in Asia, a design support tool for PV power generation systems published by the New Energy and Industrial Technology Development Organization (NEDO). Solar radiation data from METPV-ASIA was used for northern Vietnam (Station: PHU LIEN), a system that collects data hourly over a 24-hour period, 365 days a year. PHU LIEN is located in the suburbs of Hai Phong, quite close to the NCK and DEEP C industrial parks. The solar radiation data used in METPV-ASIA is not taken directly from the average year, but is artificially created by selecting the most average year for each month within the statistical period and smoothing the data at the beginning and end of each month.

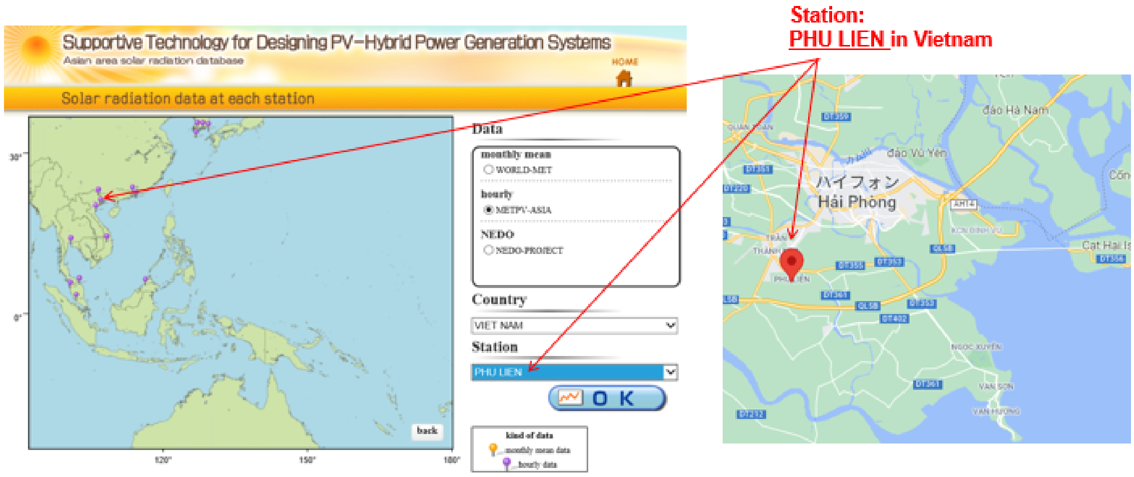


Figure 2.2.5.2. NEDO Database for Solar Radiation in Asia and solar radiation data point.

(Ref) Website: https://appww1.infoc.nedo.go.jp/appww/main.html?lang=1

2.2.5.3. Conditions for consideration: Storage battery system

The application of a storage battery system was examined, taking the following conditions into account.

- A loss of 15% of charged electricity was considered as the loss occurring in the charge and discharge of the storage battery. A 15% loss was considered as the total loss of the storage battery's round trip efficiency, inverter efficiency, transformers, cables, and other equipment. A 15% loss is the rate at which, for example, 85 kWh can be discharged when 100 kWh of electricity is charged into the storage battery.
- In order to ensure economic efficiency when installing and operating the storage battery system, it was assumed that the peak hours of the TOU (Time of Use), when grid electricity rates are high, would be covered either directly by electricity generated by solar power, or by discharging electricity from storage batteries. In other words, the EMS predicts the amount of electricity required during peak hours of the TOU (Time Of Use), and the electricity generated by solar power is stored in storage batteries during standard hours and off-peak hours of the TOU, when grid electricity rates are cheaper.
- It was assumed that the night-time power during off-peak hours of the TOU, when grid electricity rates are lowest, will not be charged and stored in storage batteries, and then discharged during the daytime when the demand is higher and grid electricity rates are more expensive, saving the equivalent of the difference in electricity rates. This study was conducted with a view to the eventual application as a JCM Model Project, and since the JCM application guidelines in fiscal 2021 stated that storage batteries should only be charged with electricity generated by solar modules, it was assumed that storage battery operations for energy shifting would not be conducted targeting the hourly difference in TOU rates for grid electricity.

2. Solar Power Plant with Battery

All the following conditions must be met.

- Photovoltaic module

The efficiency of photovoltaic modules must be 20% or higher.

- Battery

(1) A battery charges only the power generated by photovoltaic modules to be introduced, and the amount of power supplied from the battery can be measured.

(2) Regarding the installation necessity of a battery, one of the following requirements must be met.

1) Installation at off-the-grid areas

2) In case of supplying the generated power to grid, the installation of batteries is required by the laws or the regulations of the partner country, such as for the purpose of stabilizing the grid system.

3) All of the followings must be met for the self-consumption in the factory or the local power supply business.

(a) In principle, the battery should be charged and discharged every day.

(b) The battery capacity is 20% or larger than the wattage of photovoltaic modules installed and within the maximum daily chargeable amount of generated power.

Figure 2.2.5.3. Conditions for PV power generation + storage batteries in the JCM Model Projects (FY2021 application guidelines).

(Ref) Website: https://gec.jp/jcm/jp/kobo/r03/mp/jcmsbsdR3_koboyoryo.pdf

2.2.5.4. Conditions for consideration: Demand

The following conditions were confirmed when the industrial parks were requested to present information on 24-hour time-series demand (electric power load).

Table 2.2.5.4. Time-series demand (electric power load) for industrial parks.

Time difference	Demand
Standard hours (4h-9h30';11h30'-17h; 20h-22h)	70% of Peak Demand
Peak hours (9h30'-11h30'; 17h-20h)	100% of Peak Demand
Off-Peak hours (22h-4h)	30% of Peak Demand

Since the total maximum demand in each of the two industrial parks is different, and the demand of individual factories where renewable energy will be introduced has not yet been determined, a decision was made to examine optimal capacity for PV power generation equipment and storage battery systems per unit peak demand, assuming peak demand of 1 MW.

In both industrial parks, even if the scale of the factory where renewable energy will be introduced or the total capacity of the PV power generation equipment to be installed changes, the results of the study on a peak demand of 1 MW and the optimal capacity of the PV power generation equipment for this unit of demand (the relationship between demand for 1 MW and the optimal capacity of the PV power generation equipment) are proportional, and therefore, highly applicable.

2.2.5.5. Conditions for consideration: Grid electricity rates

Definition of grid electricity rates and TOU (Time Of Use) were considered to be the same as the electricity rates for industrial parks in section 2.2.3.1.

2.2.5.6. Evaluation details

Assuming a peak demand of 1 MW, the following cases were compared and examined to determine optimal capacity settings, including economic viability.

Table 2.2.5.6. Conditions and contents of a comparative study when peak demand is estimated at 1 MW.

Conditions	Contents
Base: Grid power	Assumes current use of grid power
Option-1-a： PV	If the amount of solar power generation exceeds the demand, the output will be throttled (the equivalent amount of solar power generated that exceeds demand will be wasted).
Option-1-b： PV+BESS	The amount of solar power generated at the time will be used to cover the amount of electricity needed during peak hours. If there is a shortage, the solar power generated during standard hours, etc., can be charged into storage batteries in advance and then discharged during peak hours to cover the shortage.

Under the conditions in Option-1-a (PV power generation only), optimal capacity was calculated considering the amount of PV power generated under solar radiation conditions in Hai Phong for a peak demand of 1 MW. In the combination PV and storage battery system shown in Option-1-b, optimal capacity was calculated when energy is shifted by discharging electricity from storage batteries during peak hours of TOU when electricity prices are high.

After calculating the optimal capacity of the PV power generation and storage battery system from a technical perspective, the feasibility of this option was also examined and evaluated from an economic perspective. To evaluate the economic viability of the project, GHG emission reductions were examined based on the guidelines for the JCM Model Projects, with the amount of potential subsidies estimated based on GHG emissions and cost-effectiveness. Based on the estimated subsidy amount, economic efficiency was evaluated by examining the initial CAPEX (Capital Expenditure) and the OPEX (Operating Expense), which takes into account savings in grid electricity rates.

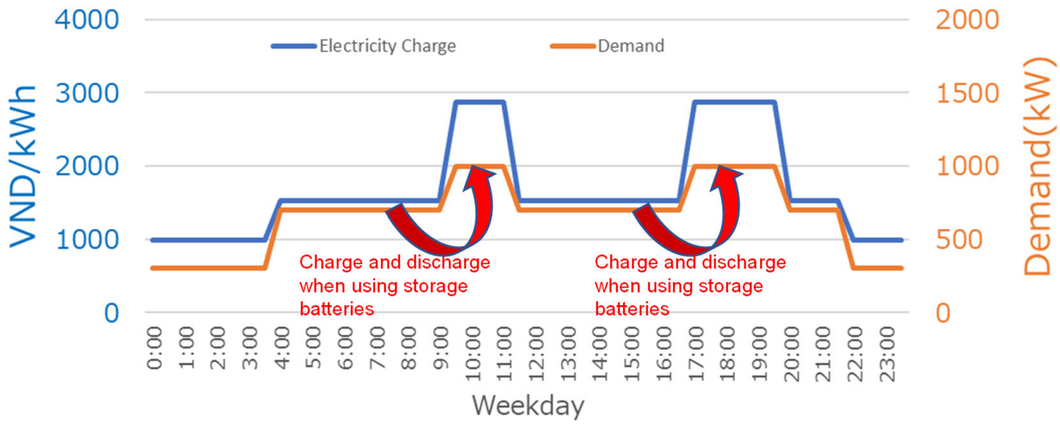


Figure 2.2.5.6. Comparison of changes in grid electricity rates and demand during a 24-hour period on weekdays.

2.2.6. Results of considerations on the proposed concept and GHG reduction effects

2.2.6.1. Results for PV power generation only

The amount of solar power generated was calculated based on solar radiation data for northern Vietnam from NEDO's Database for Solar Radiation in Asia (METPV-ASIA). The annual output using a system with a PV capacity of 3 MWp is shown in Figure 2.2.6.1.1. The strength (=height) of the solar power output for 365 days directly represents the strength of solar radiation over 365 days, and therefore, it is possible to determine monthly and daily variations in solar radiation by comparing the relative heights of the graphs over 365 days. It can be observed that, even within the same month, there are large variations from day to day.

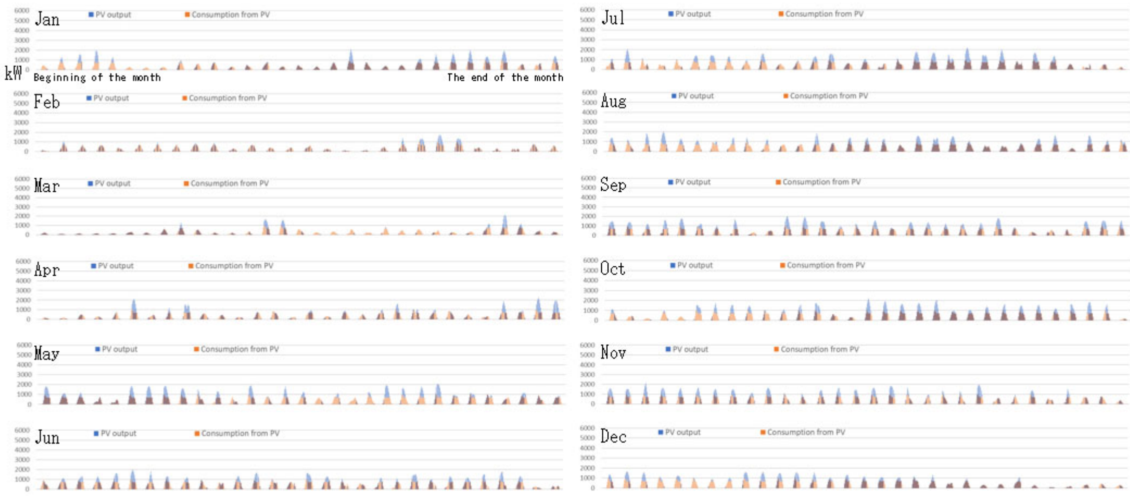


Figure 2.2.6.1.1. Variations in the amount of electricity generated by a system with a PV capacity of 3 MWp over 365 days.

Based on this data, the impacts of different PV capacities for a peak demand of 1 MW were examined. The conditions for considering this scenario are as follows.

- Demand: 1 MW peak, 0.7 MW standard, 0.3 MW off-peak (see 2.2.5.4)
- Grid electricity rates: see 2.2.3.1.1.
- PV power generation capacity: Varies by 1 MWp between 1 MWp and 5 MWp
- Other: Solar output is used as is; if output is unable to meet demand, grid power is purchased; if output exceeds demand, excess is lost (cannot be consumed).

The following can be ascertained when looking at Figure 2.2.6.1.2.

- Increasing PV capacity will not result in a linear increase in PV output. This is because even if PV capacity is increased to 3 MW, 4 MW, or 5 MW, any electricity output that exceeds demand will be lost.
- As a result, electricity prices will not decrease linearly even if PV capacity increases.

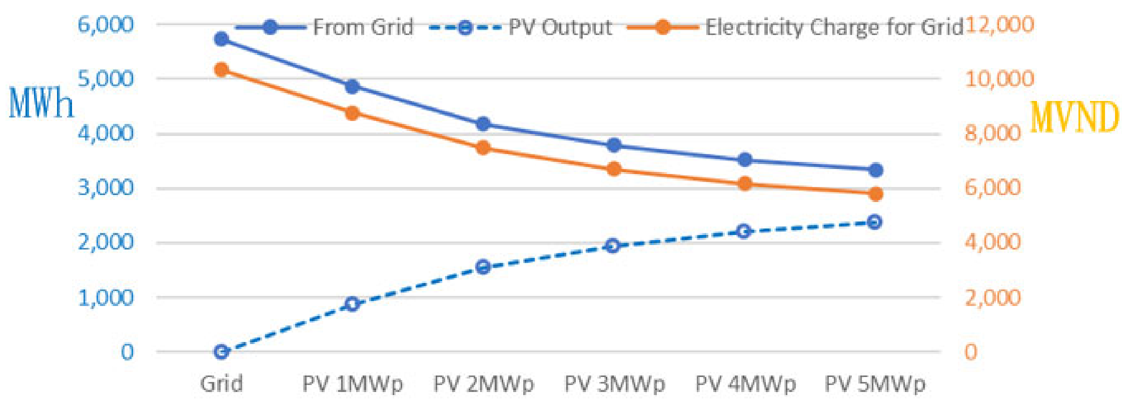


Figure 2.2.6.1.2. Correlation between PV output and electricity prices for peak demand of 1 MW.

2.2.6.2. Results for PV power generation + storage battery systems

Applying the same solar radiation data, the effects of different storage battery capacities were examined when the PV capacity was fixed at 3 MWp for a peak demand of 1 MW. The conditions for considering this scenario are as follows.

- Demand: 1 MW peak, 0.7 MW standard, 0.3 MW off-peak (see 2.2.5.4)
- Grid electricity rates: See 2.2.3.1.1.
- PV power generation capacity: Fixed at 3 MWP
- Storage battery capacity: Varies by 1 MWh between 1 MWh and 5 MWh
- Storage battery charge/discharge loss: The discharge amount is assumed to be 85% of the charge amount (15% loss considered).
- Other: During TOU peak time, solar power output is used as is or discharged from storage batteries, and grid power is not purchased; during TOU standard time, solar power output is used as is only if the equivalent demand of the peak time on the same day can be covered by discharging storage batteries, and if not, storage batteries are charged.

The following can be ascertained when looking at Figure 2.2.6.2.

- As the capacity of storage batteries increases, grid electricity rates fall, but not linearly.

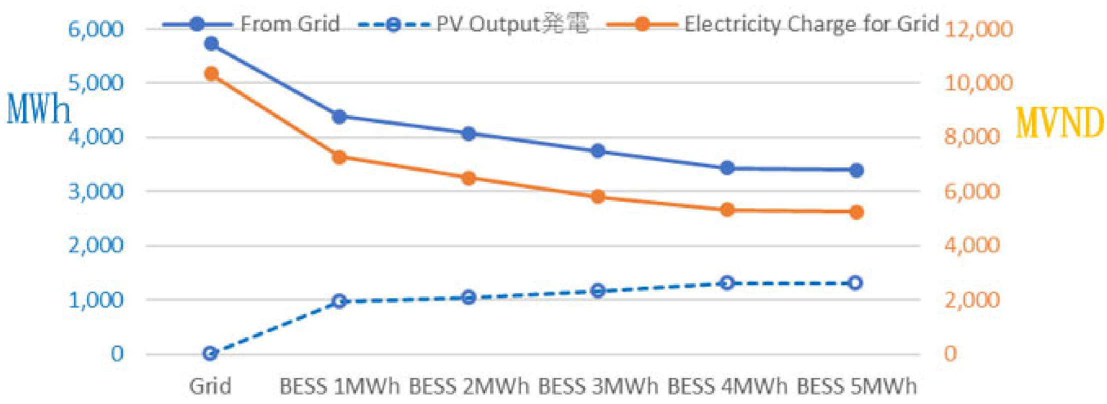


Figure 2.2.6.2. Correlation between storage battery capacity and electricity rates for peak demand of 1 MW.

2.2.6.3. Equation for calculating the GHG reduction effect for PV power only

The following equations were used to calculate CO_2 emission reductions.

Calculating reference emissions

$$RE_p = \sum_i (EC_{i,p} \times EF_{RE,i})$$

RE_p : Reference emissions during the period p [tCO_2/p]

$EC_{i,p}$: Quantity of electricity consumed from electricity generated by the project solar PV system i during period p [MWh/p]

$EF_{RE,i}$: Reference CO_2 emission factor for the project solar PV system i [tCO_2/MWh]

Calculating project emissions

$$PE_p = 0$$

PE_p : Project emissions during period p [tCO_2/p]

Calculating emissions reductions

$$ER_p = RE_p - PE_p$$
$$= RE_p$$

ER_p : Emission reductions during period p [tCO_2/p]

RE_p : Reference emissions during period p [tCO_2/p]

PE_p : Project emissions during period p [tCO_2/p]

(Ref) Approved Methodology: JCM VN AM007 ver01.0.pdf

Website: https://www.jcm.go.jp/vn-jp/methodologies/45/approved_pdf_file

2.2.6.4. Equation for calculating the GHG reduction effect when using a PV power generation system + storage battery system

The following equations were used to calculate CO_2 emission reductions.

Calculating reference emissions

$$RE_p = \sum_{i,j} \{EG_{i,p} - EC_{i,j,p} + ED_{j,p}\} \times EF_{RE}$$

RE_p : Reference emissions during the period p [tCO_2/p]

$EG_{i,p}$: Quantity of electricity generated by the project solar PV system i during the period p [MWh/p]

$EC_{i,j,p}$: Quantity of the electricity changed by the project solar PV system i to the project storage battery system j during the period p [MWh/p]

$ED_{j,p}$: Quantity of the electricity discharged from the project storage battery system j during the period p [MWh/p]

EF_{RE} : Reference CO_2 emission factor for the project system [tCO_2/MWh]

$$ED_{j,p} = EC_{i,j,p} \times (1 - LR_{j,p})$$

$LR_{j,p}$: Loss ratio of charge and discharge on the project storage battery system j during the period p [%]

Calculating project emissions

$$PE_p = 0$$

PE_p : Project emission during the period p [tCO_2/p]

Calculating emissions reductions

$$ER_p = RE_p - PE_p$$
$$= RE_p$$

ER_p : Emission reductions during the period p [tCO_2/p]

RE_p : Reference emissions during the period p [tCO_2/p]

PE_p : Project emissions during the period p [tCO_2/p]

(Ref) Approved Methodology: JCM ID AM017 ver01.0.pdf

Website: https://www.jcm.go.jp/id-jp/methodologies/78/approved_pdf_file

2.2.6.5. Legal durable years

In calculating CO_2 emissions for JCM Model Projects, the project period runs from the start of operation of the equipment or facility to be monitored to the end of its legal durable years. For information on legal durable years, refer to the "Ministerial Ordinance on Durable Years of Depreciable Assets (Ministry of Finance, Ordinance No. 15 of 1965)".

Website: https://elaws.e-gov.go.jp/document?lawid=340M50000040015

The legal durable years for a PV power generation system differs depending on whether the system is installed for private consumption or to generate electricity as a power producer. Figure 2.2.6.5.1 shows the outlook on the legal durable years of PV power generation equipment via Q&A with the National Tax Agency. If an automobile manufacturer consumes electricity generated from PV power for its own use, legal durable years are set at nine years. If a power producer uses electrical industry equipment, legal durable years are set at 17 years. The cumulative CO_2 emissions reduced over the years of the project period are calculated as the total CO_2 emission reductions. The difference between the legal durable years of nine and 17 years is the difference in total CO_2 emission reductions of 17÷9=1.9 times (or 9÷17=53%), which is double (or half) the difference.

According to both industrial parks that are the subject of this study (see section 2.2.4), power producers in these industrial parks install PV power generation equipment on the roofs of tenant companies. The electricity generated by solar power is not directly consumed by the tenant companies themselves, but is instead consolidated by power producers. Therefore, the legal durable years of the equipment can be considered to be 17 years, since it is sold by the power producer as electricity. Therefore, in this study, the legal durable years for PV power generation is assumed to be 17 years. (It should be noted that the official interpretation of whether solar power generated from roofs leased by tenant companies in an industrial park can be classified as an electric power generation facility, equipment or system depends on how the tax office assesses the situation, so confirmation is required.)

In addition to PV power generation equipment, the legal durable years of the combined storage battery system was also examined. According to the "Ministerial Ordinance on Durable Years of Depreciable Assets", the legal durable years for stand-alone storage battery power supply equipment is six years. Since this period is very short and the total estimated amount of CO_2 emissions reduced will be low, the team consulted with the Global Environment Centre (GEC), which is in charge of JCM Model Projects. The interpretation of legal durable years when PV power generation equipment and storage battery systems are combined follow.

- “When applying for a JCM Model Project with solar + storage battery technology, legal durable years are defined as 17 years for power sales projects. However, this varies for self-consumption projects depending on the business category of the tenant company. For details, please contact the tax office with jurisdiction over the company's head office.”

Therefore, in this study, the legal durable years for PV power generation equipment + storage battery systems shall be considered as 17 years. (It should be noted that the official interpretation of legal durable years for PV power generation equipment + storage battery systems depends on how the tax office assesses the situation, so confirmation is required.)

【照会要旨】

自動車製造業を営む法人が、自社の工場構内に自動車製造設備を稼働するための電力を発電する設備として設置した風力発電システム又は太陽光発電システムの耐用年数は何年ですか。

【回答要旨】

風力発電システム及び太陽光発電システムに係る耐用年数は、いずれも減価償却資産の耐用年数等に関する省令（以下「耐用年数省令」といいます。）別表第2「23　輸送用機械器具製造業用設備」の9年が適用されます。

（理由）

1　本件資産は、自家発電設備の一つであり、その規模等からみて「機械及び装置」に該当します。

2　本件設備のように、その設備から生ずる最終製品(電気)を専ら用いて他の最終製品(自動車)が生産される場合には、当該最終製品(電気)に係る設備ではなく、当該他の最終製品(自動車)に係る設備として、その設備の種類の判定を行うこととなります。

3　したがって、本件設備は、自動車・同附属品製造設備になりますので、日本標準産業分類の業用区分は、小分類(「311 自動車・同附属設備製造業」)に該当し、その耐用年数は、耐用年数省令別表第2「31 電気業用設備」の「その他の設備」の「主として金属製のもの」の17年ではなく、同別表第2「23 輸送用機械器具製造業用設備」の9年を適用することとなります。

Figure 2.2.6.5.1. Legal durable years for PV power generation equipment in factories producing power for self-consumption (Source: National Tax Agency).

(Ref) Website: https://www.nta.go.jp/law/shitsugi/hojin/05/12.htm

一　減価償却資産の耐用年数等に関する省令　別表

別表第二　機械及び装置の耐用年数表

3	繊維工業用設備	炭素繊維製造設備				
		黒鉛化炉	3	0.334	0.833	0.667
		その他の設備	7	0.143	0.357	0.286
		その他の設備	7	0.143	0.357	0.286
9	石油製品又は石炭製品製造業用設備		7	0.143	0.357	0.286
10	プラスチック製品製造業用設備(他の号に掲げるものを除く。)		8	0.125	0.313	0.250
11	ゴム製品製造業用設備		9	0.112	0.278	0.222
12	なめし革、なめし革製品又は毛皮製造業用設備		9	0.112	0.278	0.222
13	窯業又は土石製品製造業用設備		9	0.112	0.278	0.222
20	電子部品、デバイス又は電子回路製造業用設備	光ディスク（追記型又は書換え型のものに限る。）製造設備	6	0.167	0.417	0.333
		プリント配線基板製造設備	6	0.167	0.417	0.333
		フラットパネルディスプレイ、半導体集積回路又は半導体素子製造設備	5	0.200	0.500	0.400
		その他の設備	8	0.125	0.313	0.250
21	電気機械器具製造業用設備		7	0.143	0.357	0.286
22	情報通信機械器具製造業用設備		8	0.125	0.313	0.250
23	輸送用機械器具製造業用設備		9	0.112	0.278	0.222

31	電気業用設備	電気業用水力発電設備	22	0.046	0.114	0.091
		その他の水力発電設備	20	0.050	0.125	0.100
		汽力発電設備	15	0.067	0.167	0.133
		内燃力又はガスタービン発電設備	15	0.067	0.167	0.133
		送電又は電気業用変電若しくは配電設備				
		需要者用計器	15	0.067	0.167	0.133
		柱上変圧器	18	0.056	0.139	0.111
		その他の設備	22	0.046	0.114	0.091
		鉄道又は軌道業用変電設備	15	0.067	0.167	0.133
		その他の設備				
		主として金属製のもの	17	0.059	0.147	0.118
		その他のもの	8	0.125	0.313	0.250

Figure 2.2.6.5.2. Legal durable years of equipment by facility (industry) type

(Source: e-gov law search site)

付　録　二《耐用年数の適用等に関する取扱通達付表》

番号	設　備　の　種　類	細　　目	耐用年数
352	蓄電池電源設備		6

Figure 2.2.6.5.3. Legal durable years of power supply equipment for storage batteries

(Source: e-gov law search site).

2.2.6.6. Emission factors

The application of emission factors in JCM Model Projects depends on whether the technology falls under the category of energy efficiency or renewable energy. In the case of Vietnam, the emission factor is 0.8458t-CO_2/MWh for energy efficiency projects, while it is 0.333t-CO_2/MWh for renewable energy projects. Since CO_2 emission reductions are calculated by multiplying the amount of energy generated by the emission factor, the difference in emission factors is directly related to the difference in CO_2 emission reductions. If we simply compare the emission factor values, the total CO_2 emission reduction is 0.8458 ÷ 0.333 = 2.54 (0.333 ÷ 0.8458 = 39%), which is a difference of more than double.

The emission factor for renewable energy seems to be calculated based on the thermal efficiency of the most efficient natural gas-fired thermal power plant, and is conservative compared to the actual emission factor for grid power in Vietnam.

Website: https://www.jcm.go.jp/vn-jp/methodologies/45/approved_pdf_file

An emission factor of 0.333t-CO_2/MWh, which is set for renewable energies, was applied in this study because it only covers the use of PV power generation, or PV power generation + storage batteries.

令和3年度JCM設備補助事業　電力CO2排出係数(tCO2/MWh)一覧表　　令和3年4月7日(公募開始時点)

No.	パートナー国	省エネルギー				再生可能エネルギー(PV、風力、水力等)		
		全ての場合	右記以外の場合	所内自家発電のみを代替する場合		全ての場合	右記以外の場合	所内自家発電のみを代替する場合
				ディーゼル	天然ガス			
1	モンゴル	–	別表1参照	0.8	–	–	別表1参照	0.533
2	バングラデシュ	–	0.67	0.8	0.46	–	0.376	0.533
3	エチオピア	–	–	0.8	–	–	0.112	0.533
4	ケニア	–	0.2262	0.8	–	0.533	–	–
5	モルディブ	0.8	–	–	–	0.533	–	–
6	ベトナム	–	0.8458	0.8	0.46	–	0.333	0.533
7	ラオス	–	0.5595	0.8	–	–	0.319	0.533
8	インドネシア	–	別表2参照	0.8	–	–	別表2参照	0.533
9	コスタリカ	–	0.1	0.8	0.46	–	0.255	0.533
10	パラオ	0.8	–	–	–	0.533	–	–
11	カンボジア	–	別表3参照	0.8	–	–	0.353	0.533
12	メキシコ	–	0.528	0.8	–	–	0.434	0.533
13	サウジアラビア	–	0.654	0.8	0.46	0.533	–	–
14	チリ	–	0.611	0.8	–	–	別表4参照	0.533
15	ミャンマー	–	0.3	0.8	–	–	0.319	0.533
16	タイ	–	0.5664	0.8	0.46	0.319	–	–
17	フィリピン	–	別表5参照	0.8	–	–	別表5参照	0.533

Figure 2.2.6.6.1. List of emission factors for JCM Model Projects

(Source: FY2021 Application Guidelines).

(Ref) Website: https://gec.jp/jcm/jp/kobo/r03/mp/jcmsbsdR3_koboyoryo.pdf

分野	技術	JCM方法論
2. 再生可能エネルギー	太陽光発電	MN_AM003, BD_AM002, KE_AM002, MV_AM001, VN_AM007, LA_AM002, ID_AM013, CR_AM001, PW_AM001, KH_AM002, MX_AM001, CL_AM001, TH_AM001, PH_AM002
	太陽光発電＋蓄電池	MV_AM002, ID_AM017, CL_AM002
	小水力発電	KE_AM003, ID_AM019, ID_AM021, PH_AM001
	風力発電	
	地熱発電	
	バイオマス発電	ID_AM027, MM_AM004
	バイオガス発電	
	バイオマス燃焼ボイラー（固体）	
	バイオガス燃焼ボイラー	
	バイオマスコジェネレーション	ET_AM003

Figure 2.2.6.6.2. Classification of PV power generation + storage batteries in the JCM Model Projects (Source: FY2021 Application Guidelines).

2.2.6.7. Evaluation of subsidies for JCM Model Projects with GHG reduction effects

In order to carry out calculations for economic considerations as well, the initial assumed costs of the PV power generation equipment and storage battery system were set as follows.

- PV power generation equipment: As shown in Figure 2.2.6.7.1, prices are higher than JPY 100,000/kW. However, this information is dated and prices are falling, so prices are estimated to be JPY 100,000/kW (100 million yen/MW).
- Storage batteries: As shown in Figure 2.2.6.7.2, prices are about JPY 200,000/kWh. Although not a realistic figure, prices are estimated to be JPY 50,000/kWh (JPY 50 million/MWh), so that results can be achieved that will brighten the outlook for the future.

A feasibility study on economic viability, as well as reducing GHG emissions, was conducted under the following conditions.

- Legal durable years (Project period): 17 years
- Emission factor: 0.333 tCO_2/MWh
- Estimated initial cost: JPY 100 million/MWh for PV power generation, JPY 50 million/MWh for storage batteries
- Subsidy rate for JCM Model Project: 30% for PV power generation (four projects in Vietnam), 50% for storage batteries (new project in Vietnam)

As shown in Figure 2.2.6.7.3, when PV capacity varies for a peak demand of 1 MW, the CO_2 emission reduction increases. However, the payback period will be greater as electricity savings will have less effect in relation to an increase in initial costs. Therefore, for a peak demand of 1 MW, a PV capacity of 3 MWp is considered to be suitable under solar radiation conditions in Hai Phong City in northern

Vietnam.

If PV power generation capacity is set at a constant 3 MWp for a peak demand of 1 MW, and the storage battery capacity varies, the amount of CO_2 emissions reduced increases as shown in Figure 2.2.6.7.4. However, when the storage battery capacity exceeds a certain value, the amount of CO_2 emissions reduced also becomes constant. Economic efficiency is best achieved with a storage battery capacity of 3 to 4 MWh, as cost recovery is affected by savings in electricity rates with energy shifts to peak hours in response to an increase or decrease in initial costs. Therefore, for a peak demand of 1 MW, a PV capacity of 3MWp and a storage battery capacity of 4 MWh are considered suitable under the solar radiation conditions of Hai Phong City in northern Vietnam. However, even when the estimated cost of a storage battery is examined assuming an unrealistic cost of JPY 50,000/kWh, which is a quarter of the current cost of approximately JPY 200,000/kWh, the payback on investment will be longer at approximately 15 years.

The cost-effectiveness (cost-effectiveness of a subsidy required to reduce GHG emissions by one tonne) of all GHG emission reductions for both PV power generation only or a combination of PV power generation and storage battery systems is below.

- With PV power generation alone, the cost-benefit ratio ranges from about JPY 6,000 to over JPY 10,000/tCO_2. To reach an optimal capacity of 3 MWp, the cost-benefit ratio was JPY 8,197/tCO_2. (See Table 2.2.6.7.1)
- With a combined PV power generation and storage battery system, the cost-benefit ratio is approximately JPY 19,000 to JPY 23,000/tCO_2. To achieve an optimal combination of 3 MWp for PV power generation capacity + a 4-MWh storage battery capacity, the cost-benefit ratio was JPY 19,307 yen/tCO_2. (See Table 2.2.6.7.2)
- By simply comparing this cost-benefit ratio, it is clear that the PV power generation alone is more economically viable than the combination of PV power generation equipment and storage battery systems.

Furthermore, by only applying for subsidies for initial investment in a limited range of equipment that will directly contribute to reducing GHG emissions, the cost-benefit ratio in terms of total GHG emissions reduced may fall below JPY 4,000/tCO_2. The economic feasibility of the project was examined when considering the return on investment using a limited range of subsidies to achieve cost effectiveness of JPY 4,000/tCO_2.

表 2-3　主要国の太陽光発電システム価格　　　　[万円/kW]

国	系統連系型(< 10 kW)		系統連系型(> 10 kW)	
	2008 年	2012 年	2008 年	2012 年
日本	71	48	54	44
ドイツ	59～67	14～25	55	14～17
イタリア	84～99	21～29	64～84	11～26
米国	72～93	43	67	26～40

※：換算レートは，2008 年は 1 ドル=103 円，1 ユーロ=152 円，2012 年は 1 ドル=80 円，1 ユーロ 103 円を使用．
出典：TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2008，(2009，IEA PVPS)．28p
TRENDS 2013 IN PHOTOVOLTAIC APPLICATIONS Survey Report of Selected IEA Countries between 1992 and 2012，(2013，IEA PVPS)，64p より NEDO 作成

Figure 2.2.6.7.1. PV power system prices in major countries (Source: NEDO).

(Ref) Website: https://www.nedo.go.jp/content/100544817.pdf

Figure 2.2.6.7.2. Materials for the 4th Study Group on the Dissemination of Stationary Energy Storage Systems (Source: Ministry of Economy, Trade and Industry).

(Ref) Website: https://www.meti.go.jp/shingikai/energy_environment/storage_system/pdf/004_04_00.pdf

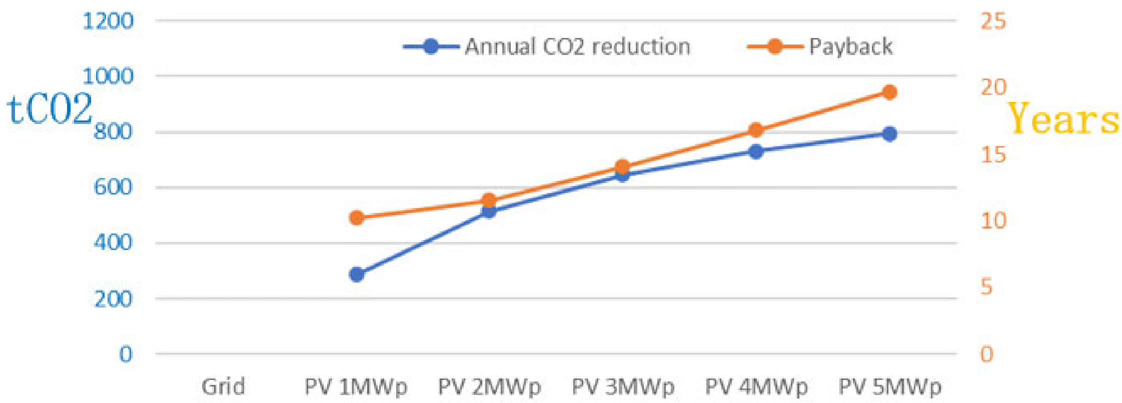


Figure 2.2.6.7.3. CO_2 emission reductions and payback period when PV capacity fluctuates with a peak demand of 1 MW.

Table 2.2.6.7.1. CO2 emission reductions and payback period when PV capacity fluctuates with a peak demand of 1 MW.

	PV 1MWp	PV 2MWp	PV 3MWp	PV 4MWp	PV 5MWp
Annual usable PV output (MWh)	862	1,546	1,940	2,199	2,384
annual saving cost (MVND)	1,571	2,860	3,641	4,163	4,536
CO2 reduction amount of JCM (tCO2/year)	287	515	646	732	794
Japanese legal durable years	17	17	17	17	17
CO2 reduction amount for project period of JCM (tCO2)	4,879	8,751	10,980	12,450	13,496
PV initial cost (JPY)	100,000,000	200,000,000	300,000,000	400,000,000	500,000,000
Percentage of JCM financial support	30%	30%	30%	30%	30%
cost effectiveness (JPY/tCO2)	6,149	6,856	8,197	9,639	11,115
Subsidy amount equivalent to 4000 yen as cost effectiveness (JPY)	19,515,540	35,004,014	43,919,208	49,798,962	53,982,510
Payback Year	10.2	11.5	14.1	16.8	19.7

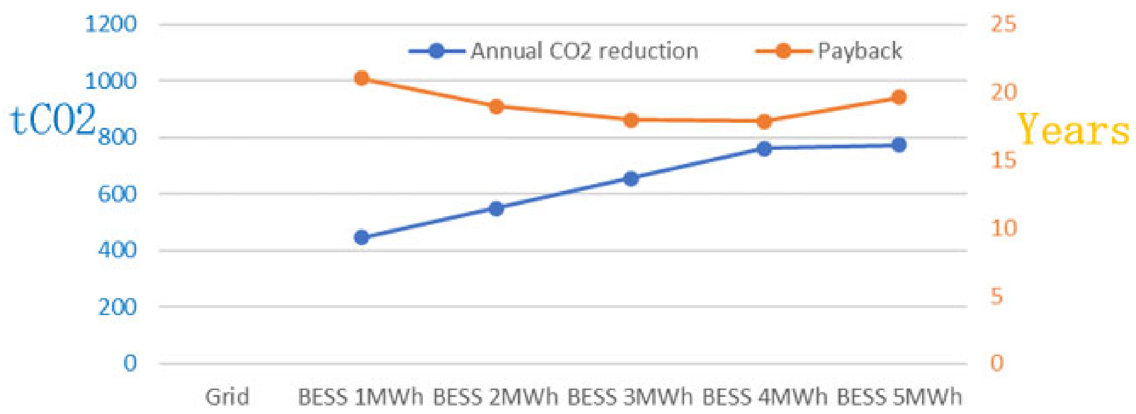


Figure 2.2.6.7.4. CO_2 emission reductions and payback period when storage battery capacity fluctuates with a peak demand of 1 MW

Table 2.2.6.7.2. CO_2 emission reductions and payback period when storage battery capacity fluctuates with a peak demand of 1 MW.

	PV 3MW				
	BESS 1MWh	BESS 2MWh	BESS 3MWh	BESS 4MWh	BESS 5MWh
Annual usable PV output (MWh)	982	1,047	1,155	1,310	1,310
annual saving cost (MVND)	3,042	3,820	4,511	5,012	5,066
CO2 reduction amount of JCM (tCO2/year)	445	550	657	762	773
Japanese legal durable years	17	17	17	17	17
CO2 reduction amount for project period of JCM (tCO2)	7,568	9,345	11,165	12,948	13,147
PV+BESS initial cost (JPY)	350,000,000	400,000,000	450,000,000	500,000,000	550,000,000
Percentage of JCM financial support	50%	50%	50%	50%	50%
cost effectiveness (JPY/tCO2)	23,123	21,403	20,152	19,307	20,917
Subsidy amount equivalent to 4000 yen as cost effectiveness (JPY)	30,272,555	37,378,481	44,660,195	51,793,452	52,588,602
Payback Year	21.0	19.0	18.0	17.9	19.6

2.2.7. Feasibility

A feasibility study was conducted for both options with the PV power generation equipment alone and a combined PV power generation and storage battery system, with the following points confirmed.

- In Southeast Asia, the northern part of Vietnam tends to have lower levels of solar radiation due to cloudy weather. Therefore, the amount of electricity generated by solar power tends to be lower compared to other countries in Southeast Asia. While the utilization rate (capacity factor) of PV power generation equipment is about 16% in Thailand and 14% in Japan, it is estimated to be about 10% in northern Vietnam.

- Although PV output can reduce grid electricity rates, savings (i.e., payback cost) tend to be small because grid power in Vietnam is inexpensive. Assuming that the initial cost of PV power generation equipment and the amount of power generated are the same, it is easier to recover investments in countries with higher grid electricity rates.
- Energy shifting, in which solar power output is charged into storage batteries over the less-expensive TOU (Time Of Use) standard hours during the daytime and discharged during the more expensive TOU peak hours in the evening, will lead to qualitative savings in electricity rates. However, since the initial cost of a storage battery system is already high, and grid electricity rates are inexpensive, the marginal difference in electricity rates between the TOU peak hour and standard hour itself will also be very low. As a result, the savings effect will be weaker, making it exceptionally difficult to ensure economic viability.
- When considering the use of subsidies under the JCM Model Project for the initial cost of capital investment to ensure economic viability, the use of PV power generation equipment, not a combination of PV power generation equipment and storage battery systems, is more effective in reducing the burden from initial costs. On the other hand, with a combination of PV power generation equipment and storage battery systems, although it is possible to achieve savings in electricity rates by shifting energy from less expensive daytime rates to higher evening rates, it is not possible to ensure economic efficiency because the initial cost of the storage battery system is much higher than that for PV power generation equipment. In addition, the storage battery system itself does not generate any additional power, it only shifts electric energy over time. For this reason, the initial cost of the storage battery system cannot be covered unless there is a difference in electricity rates between daytime and evening hours that is equivalent to the initial cost of adding a storage battery system to a stand-alone PV power generation system
- In both industrial parks in this study, electricity demand for the entire park is large, at a scale of several hundred MW. However, the area available for the installation of PV power generation equipment is limited. Even with the installation of the maximum amount of PV power generation equipment that can be installed at this time, it will still be possible for all of the output power to be consumed within the industrial park itself. Therefore, the most economical path to reducing CO_2 and other GHG emissions is to lower initial costs by installing PV power generation equipment without a storage battery system, and to use all of the electricity output to meet demand in the industrial park.

2.2.8. Potential for future development

As described in Section 2.2.7, when using renewable energy generated from solar power in the industrial parks near Hai Phong City, the easiest way to ensure economic viability is by consuming energy directly, since the industrial parks have a much higher demand for solar power (output), rather than by storing it in storage batteries and shifting the energy.

In order to examine the possibility of introducing the proposed systems in Southeast Asian countries, including in industrial parks near Hai Phong, a comparative study was conducted on dominant factors using Vietnam, Indonesia and Thailand as typical examples.

2.2.8.1. Comparison of grid electricity rates

Using renewable energy such as solar power as a substitute for fossil fuel or achieving energy savings with the installation of Smart Power Plants will reduce the amount of electricity purchased from the grid. These savings will reduce operating costs (OPEX improvement), which is expected to offer a faster return on initial investment. In order to enable a faster return on investment, cost savings from electricity generated by the grid must be increased, which is easier to achieve with a higher unit price for electricity from the grid. In Vietnam, grid electricity rates are lower than in other countries. In Indonesia, the government subsidises fuel under a national economic policy, which lowers the cost of electricity from the grid. However, in Thailand, grid electricity is comparatively higher, and in TOU peak hours, the price is equivalent to industrial electricity rates in Japan. Based on a comparison of electricity prices, Thailand is the most economically viable of the three countries when looking at maximising the effect of reducing operating costs (saving electricity).

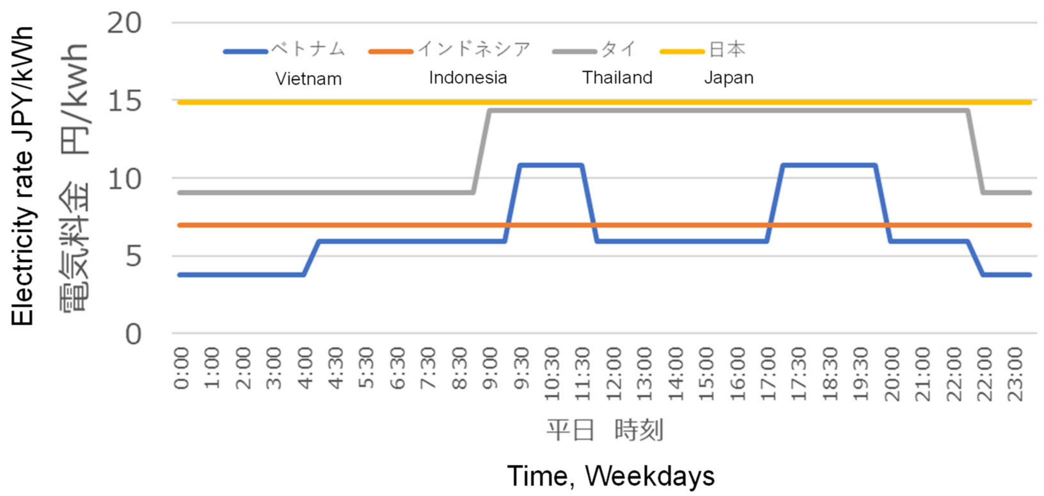


Figure 2.2.8.1. Comparison of electricity prices in select countries in Southeast Asia.

2.2.8.2. Comparison of gas prices

Achieving energy efficiency and energy savings in a smart power plant is expected to reduce the amount of electricity purchased from the grid, leading to lower operating costs (OPEX improvement) and faster recovery of initial investment. A comparison was also conducted on the cost of natural gas, which will be used as fuel for gas engines in the Smart Power Plant. There is no significant difference in the estimated price of gas in Southeast Asian countries, as they all tend to be located close to and have easy access to natural gas fields. Since gas prices are almost level in the three countries, a smart power plant is likely to be more economically efficient in countries with higher grid electricity prices, as shown in Section 2.2.8.1. In countries where the relative price difference between electricity and gas prices is large, it is easier to ensure economic feasibility, and among the three countries, Thailand demonstrated the highest potential.

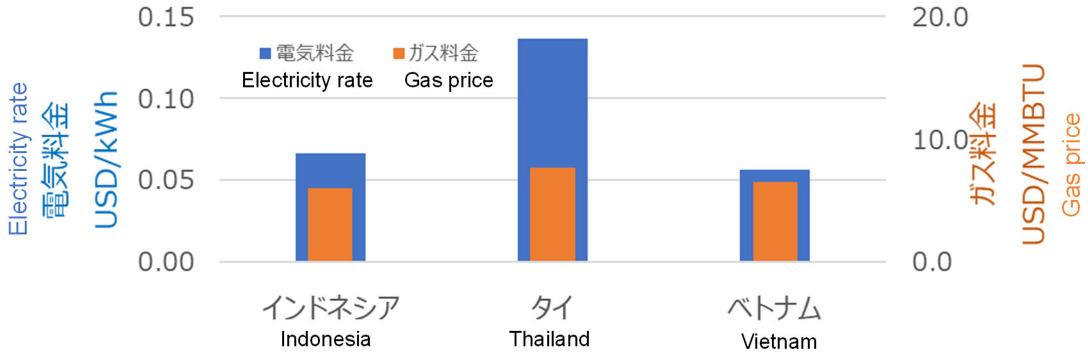


Figure 2.2.8.2. Relative comparison of electricity and gas prices in select countries in Southeast Asia.

2.2.8.3. Comparison of sunlight hours (solar power potential)

This study confirmed the potential of solar power generation, a candidate for renewable energy. As can be seen from the solar radiation potential map (Figure 2.2.8.3.1.), solar radiation in Thailand is strong, while solar radiation in Vietnam is strong in the south, but weaker in the north. In this figure, it is clear that solar radiation in northern Vietnam is generally weaker than Japan. The sky in northern Vietnam tends to be cloudy all year round, which is believed to be a reason for the area's weaker levels of solar radiation.

In addition, when examining the results of the use of solar power generation in each country listed in the open application guidelines for the JCM Model Projects, there were a significantly large number of cases in Thailand where solar power has been adopted. This may be due to the fact that Thailand has higher levels of solar radiation, which results in higher solar power output and more expensive grid electricity rates, making it more economically viable. In Vietnam, solar radiation tends to be stronger in the south, so most of the projects that have been adopted as JCM Model Projects are located there. One of the projects on bundling applications for multiple factories also partially included the Hanoi area. In Indonesia, although solar radiation is stable throughout the country, the number of installations has not increased, most likely due to the introduction of local content regulations (TKDN) that mandate the use of products and services from the home country (perhaps because these tend to be priced high, but are low quality).

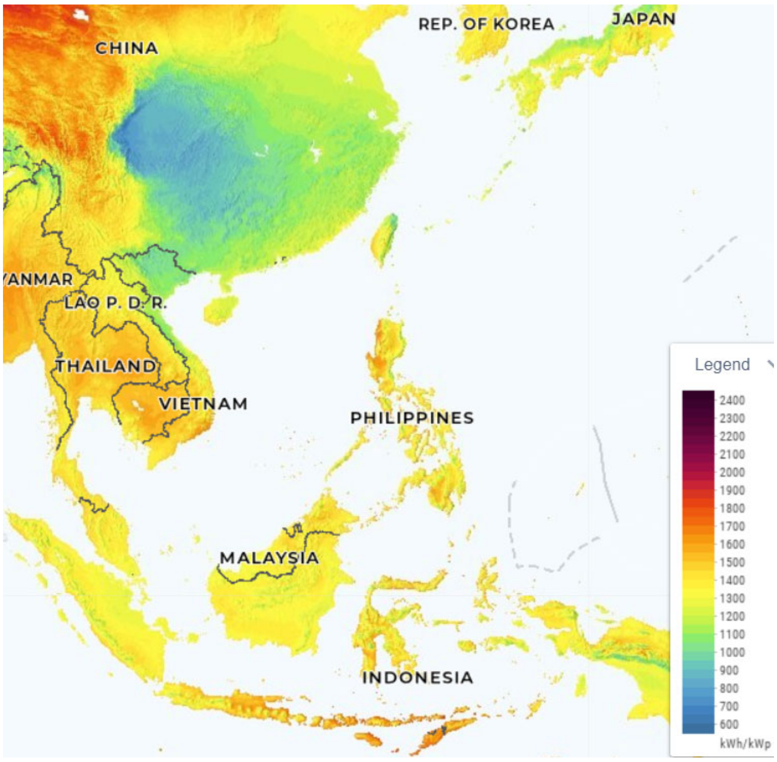


Figure 2.2.8.3.1. Potential distribution map of solar radiation.
(Ref) Website: https://globalsolaratlas.info

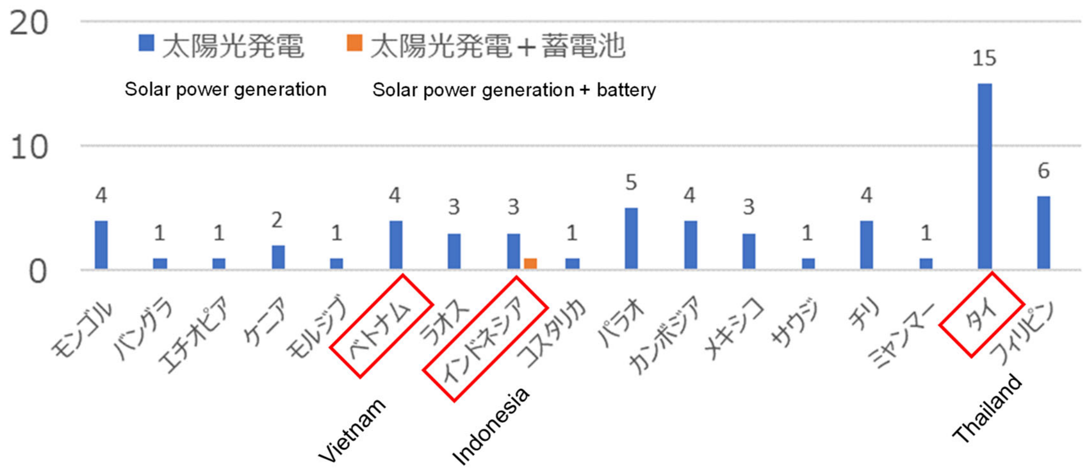


Figure 2.2.8.3.2. Number of applications of PV power generation equipment in JCM Model Projects (FY2021 application guidelines).
(Ref) Website: https://gec.jp/jcm/jp/kobo/r03/mp/jcmsbsdR3_koboyoryo.pdf

2.2.8.4. Comparison of grid emission factors (Comparison of potential application as JCM Model Projects)

From the viewpoint of ensuring economic viability, the JCM Model Project is a highly effective programme, as it provides subsidies based on GHG emission reductions for the initial cost of equipment, which is the largest investment required when installing equipment. The ability to reduce the burden of initial costs by utilising the JCM Model Project will have a significant impact on ensuring economic efficiency and business feasibility.

The cost of the subsidy is determined by the GHG emission reduction effect. One factor that affects cost is the emission factor of each country. If a CO_2 or GHG emission reduction project is carried out in a country with a high emission factor for grid electricity, the GHG emission reduction effect tends to be greater, and as a result, the project is likely to be able to utilise a larger subsidy for capital investment.

Countries with high emission factors, such as Vietnam and Indonesia, tend to have a higher percentage of electricity generated by coal-fired power plants, which are inexpensive and have large CO_2 emissions. However, countries with relatively small emission factors, such as Thailand, tend to generate a higher percentage of electricity from natural gas and other sources with relatively low CO_2 emissions.

Therefore, projects in countries with high emission factors tend to be able to reduce initial costs through JCM Model Projects.

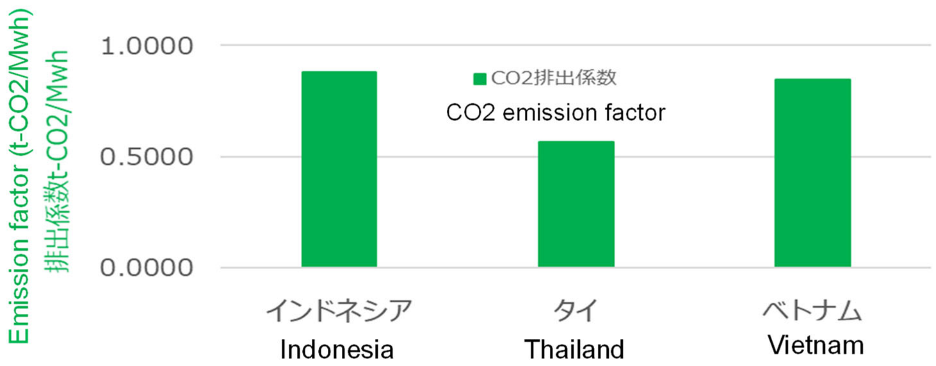


Figure 2.2.8.4. Comparison of emission factors in select countries in Southeast Asia.

2.2.8.5. Summary of potential developments in the future

In order to reduce CO_2 and other GHG emissions and further utilise renewable energy while simultaneously ensuring economic efficiency, the following points must be addressed.

- Countries and regions with stronger solar radiation potential should be targeted so that more renewable energy can be utilised.
- While countries with higher grid power emission factors are more likely to be able to reduce initial costs with the use of JCM subsidies, countries with relatively low grid power emission factors and high grid power rates tend to be able to improve operations by saving power during operation (securing economic efficiency). Emission factors, which affect initial costs, and grid electricity rates, which affect operational costs, tend to be in conflict from the viewpoint of ensuring economic efficiency.
- With this contradictory relationship, it will be an ongoing challenge to develop projects that can help reduce CO_2 and other GHG emissions, taking into account regional characteristics, ensuring economic efficiency, and utilising renewable energy.

2.3. Study on Recovery and Utilisation of Waste Liquid Energy

2.3.1. Background and purpose

The “Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City” aims to reduce greenhouse gas emissions in Hai Phong City, Vietnam through city-to-city collaboration with its sister city, Kitakyushu in Japan. The purpose of the project is to establish a zero-emission industrial park that takes resource recycling into consideration.

This study investigated the feasibility of a project to reduce greenhouse gas emissions by collecting, treating and processing high-concentration waste liquid and sludge discharged from industrial parks for use as alternatives to fossil fuels in cement plants, boilers, and other facilities.

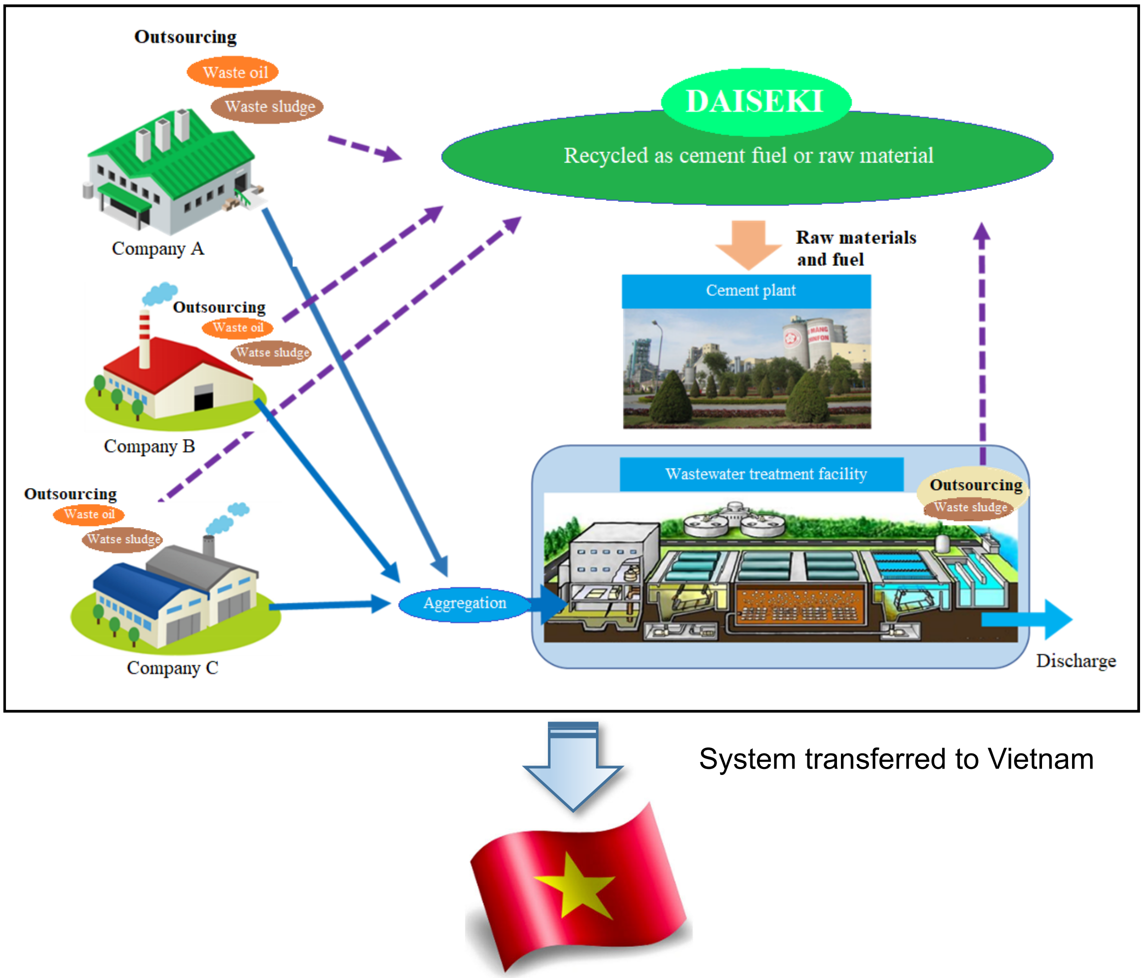


Figure 2.3.1. Scheme for converting waste liquid and sludge into cement raw materials and fuel.

2.3.2. Survey targets and methods

(1) Survey on legal systems

Information on the legal system in Vietnam regarding the conversion of waste liquids and sludge into raw materials and fuel was collected from interviews with the Japanese Embassy in Vietnam, JICA Vietnam, industrial parks, cement manufacturing companies, and from online sources.

(2) Survey on actual conditions of waste liquid treatment

Interviews were conducted with Nam Cau Kien Industrial Park and DEEP C Industrial Zones in Hai Phong City to obtain information on estimated emissions and types of wastewater and sludge, treatment methods and actual conditions for treatment and recycling.

Since Japanese petroleum product manufacturers are moving into the DEEP C Industrial Zones, waste oil treatment conditions for these companies was also investigated.

【Survey method】

- A questionnaire was distributed to the industrial park managers at Nam Cau Kien to determine the status of waste liquid treatment at water treatment facilities in the industrial park, and to confirm the status of water treatment facilities.
- A questionnaire was also distributed to the industrial zone managers at DEEP C Industrial Zones to obtain information on the status of waste liquid treatment at the water treatment facilities in the industrial zone, and to confirm the status of water treatment facilities. An additional questionnaire was also distributed to tenant companies and an online meeting was conducted to learn more about waste oil treatment.

(3) Survey on the actual conditions of the conversion of raw fuel at cement factories

A survey was conducted with Cement Company A in Hai Phong City on the actual conditions of existing fuels and raw materials, examples of introducing waste and waste liquid into cement raw materials, the unit prices of fuels and raw materials, local needs, and challenges faced over this process.

【Survey method】

- Cement Company A was interviewed via an online conferencing system about the status of converting raw fuel in relation to cement manufacturing. In addition, a questionnaire was distributed and an additional survey requested, but it was difficult for the company to disclose information on fuel consumption and costs, which resulted in little to no data. As of 14 February 2022, there has been no response to the questionnaire.

2.3.3. Survey on related legal systems

(1) Legal system for waste recycling

On 17 November 2020, the National Assembly of the Socialist Republic of Vietnam enacted the Law on Environmental Protection 2020 (No. 72/2020/QH14) and revised the conventional law (Law on Environmental Protection 2014), which comes into effect in January 2022. The revised Law on Environmental Protection incorporates the concept of a circular economy (Article 142) and extended producer responsibility (Article 54). Detailed rules will be stipulated by government ordinances and notifications in the future.

Japan is working on reducing the environmental load by regulating exhaust gas and wastewater from cement factories and harmful substances contained in products. Cement factories are also recognised as waste disposal facilities under the “Waste Management and Public Cleansing Law”.

However, in Vietnam, the distinctions between waste and raw materials, waste classifications, and permissible disposal methods are not clear. For this reason, even if waste liquid or sludge is used as recycled raw material, companies may be subject to penalties, which has stalled its use (from an interview with a cement company).

Under the EPR (Extended Producer Responsibility), recycling rates and other relevant rules and procedures are determined for each item (packaging, vehicles, tires, lubricating oil, home appliances and electronic devices, batteries, etc.), with the expectation that these will be introduced sequentially from 2024 or 2025. However, the recycling of waste liquid and sludge is not included in the target items (from an interview with JICA Vietnam).

(2) Legal system for wastewater treatment in industrial complexes

The treatment of wastewater in industrial zones complies with provisions set out in the following major documents. A number of governmental and central management organisations such as MONRE (Ministry of Natural Resources and Environment), People's Committees at the city / provincial level, and local organisations such as DONRE (Department of Natural Resources and Environment) and institutions are involved in the management of wastewater treatment in industrial areas.

- Consolidated document on the Law on Environmental Protection No. 13/VBHN-VPQH dated 4 July 2019.
- Circular No. 35/2015/TT-BTNMT dated 30 June 2015 providing for the environmental protection of economic zones, industrial parks, export processing zones and hi-tech parks.
- Decree No. 38/2015/ND-CP dated 24 April 2015 on the management of waste and discarded materials.
- Decree No. 40/2019/ND-CP dated 13 May 2019 amending and supplementing a number of articles of the decree detailing and guiding the implementation of the Environmental Protection Law.
- Decree No. 82/2018/ND-CP dated 22 May 2018 on the management of industrial parks and economic zones.

2.3.4. Survey on the actual condition of waste liquid treatment

(1) Actual condition of waste liquid treatment at Nam Cau Kien Industrial Park

Below is an overview of the water treatment facility at Nam Cau Kien Industrial Park.

✧ The water treatment facility in the industrial park receives 400-600 m^3 of wastewater a day (65% industrial wastewater, 35% domestic wastewater) from tenant companies, and performs physicochemical treatment and AO biological treatment.

✧ Companies in the industrial park discharge very little sludge or waste oil. The water treatment facility does not accept any sludge or waste oil.

✧ Criteria for accepting wastewater is based on QCVN 40:2011/BTNMT and standards (37 items) set by the industrial park.

✧ Wastewater from tenant companies that satisfies the above criteria is collected directly via a pipeline to the wastewater treatment facility.

✧ The average processing unit price is VND 18,000/m^3. Wastewater that exceeds standards are either not accepted, or are accepted at a higher unit price.

✧ Water treatment is performed in accordance with QCVN 40:2011/BTNMT, regulation category B. pH, COD, NH_3, temperature, flow rate (inlet/outlet) and TSS (outlet) are constantly monitored by an automatic monitoring system. Other items are subject to regular monthly inspections by DONRE.

- 100% of the treated wastewater is reused in the industrial park for watering plants, cleaning roads, cooling steel production systems, and for other purposes.
- As of 2021, 60 companies are located in the industrial park, with another 18 tenants moving into the park in 2022.
- Very little sludge is generated after wastewater treatment (about 30 to 40 kg/year). Sludge is post-analysed and treated in accordance with the national technical regulation, QCVN 50:2013/BTNMT, on hazardous thresholds for sludge generated from water treatment processes.
- Sludge generated from wastewater treatment is stored in a sludge tank at the centralised wastewater treatment plant in the industrial park.
- Polymer PAC (polyaluminum chloride) is added when treating the stored sludge. In addition, dehydrated cake is produced in a conveyor belt press, and finally outsourced for incineration as hazardous waste by a company in the industrial park.

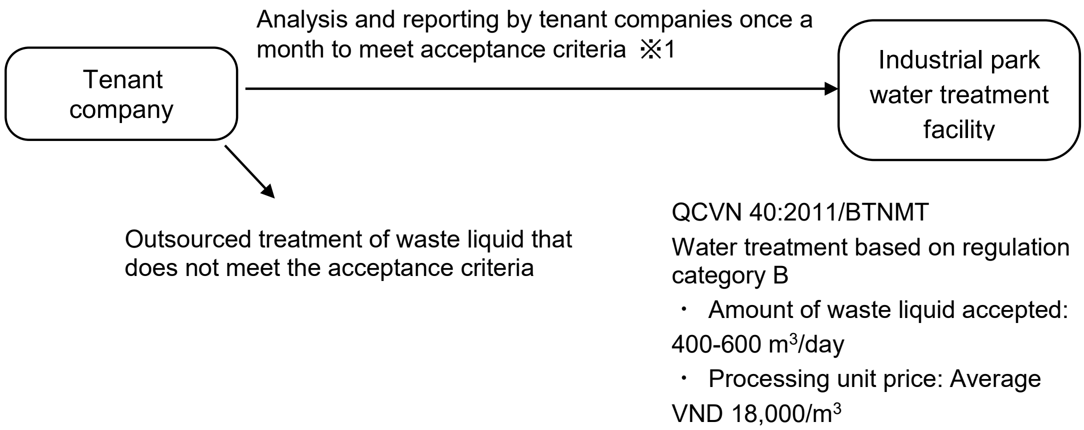


Figure 2.3.4.1. Conceptual diagram of wastewater treatment at Nam Cau Kien Industrial Park.

Table 2.3.4. Sludge analysis results at Nam Cau Kien Industrial Park.

Standard	Standard value
QCVN 50:2013/BTNMT National technical regulation on hazardous thresholds for sludge from water treatment process	As: 0.0005 mg/L; Pb: 0.006 mg/L; Total CN: 0.1 ppm; Total Oil: 255 mg/L; Phenol: 0.07 mg/L; Benzen: 0.07 mg/L; Toluen: 3.36 mg/L; Naphthalene: 0.07 mg/L (Analysis results in June 2021)

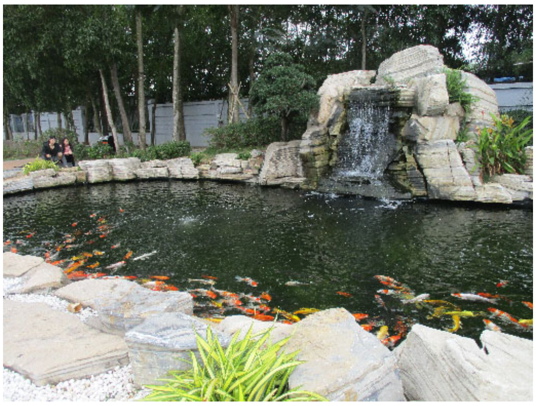
Entrance to wastewater treatment facility

Aeration tank

Settling basin

After treatment

Sludge dehydrator



Example of reuse of treated water

Figure 2.3.4.2. Status of wastewater treatment at Nam Cau Kien Industrial Park.

【Summary】

Industrial and domestic wastewater that meet the standards set by QCVN 40:2011/BTNMT and the industrial park is treated in Nam Cau Kien Industrial Park. Other wastewater is treated individually by each company, but the total amount is not known to the industrial park.

About 20 tonnes of sludge is treated individually by each company annually, and the amount of waste oil is about 5.6 tonnes/year. In addition, the amount of sludge generated from water treatment in the industrial park is as low as 30 to 40 kg/year.

According to the interview, the industrial park would benefit if the costs of treating these waste liquids and sludge could be reduced, but the water treatment facility at Nam Cau Kien Industrial Park alone does not produce enough sludge to supply to cement manufacturing companies. For this reason, it is necessary to consider expanding the scope of collection to include waste liquid that is primarily treated by each company in the industrial park, sludge generated during primary treatment, and waste liquid and sludge generated throughout Hai Phong City.

(2) Actual condition of waste liquid treatment at DEEP C Industrial Zones

Below is an overview of the water treatment facility at DEEP C Industrial Zones.

- ✧ The water treatment facility in the industrial zone receives 1,000 m^3 of wastewater a day from tenant companies, and performs physicochemical treatment and AO biological treatment.
- ✧ Companies in the industrial zone discharge very little sludge or waste oil, which is not accepted by the water treatment facility.
- ✧ Criteria for accepting wastewater is based on QCVN 40:2011/BTNMT and standards set by the industrial zone (※1).
- ✧ Wastewater from tenant companies that satisfies the above criteria is transferred from the pipeline to 10 water reservoirs in each area. When the water storage level is reached, it is pumped to the wastewater treatment facility.
- ✧ The processing unit price is VND 21,000/m^3. Wastewater that exceeds standards are either not accepted, or are accepted at a higher unit price.
- ✧ Water treatment is performed in accordance with QCVN 40:2011/BTNMT, regulation category B. pH, COD, NH_3, temperature, flow rate (inlet/outlet) and TSS (outlet) are constantly monitored by an automatic monitoring system. Other items are subject to regular monthly inspections by DONRE.
- ✧ The treated wastewater is supplied to the cooling towers, water supply plants, firefighting services and for other functions of factories operating in the industrial zone.
- ✧ As of 2021, there are 120 tenant companies in DEEP C. Hai Phong I is full and accepts wastewater from 80% of the companies. Hai Phong II is at 20% occupancy, and wastewater is accepted at the Hai Phong I treatment facility via the water reservoir.
- ✧ About 130 tonnes of sludge are discharged after wastewater treatment each year (calculated based on the latest results of 2.5 tonnes/week x 52 weeks/year). Sludge is post-analysed and treated in accordance with the national technical regulation, QCVN 50:2013/BTNMT, on hazardous thresholds for sludge generated from water treatment processes.
- ✧ Sludge generated during the wastewater treatment process is stored in three tanks (25 m^3/tank), and treated when capacity reaches 40% to 50%.
- ✧ A cationic polymer is added when treating the stored sludge. In addition, dehydrated cake with a moisture content of about 20% is produced in a belt press, and finally outsourced for incineration as hazardous waste.

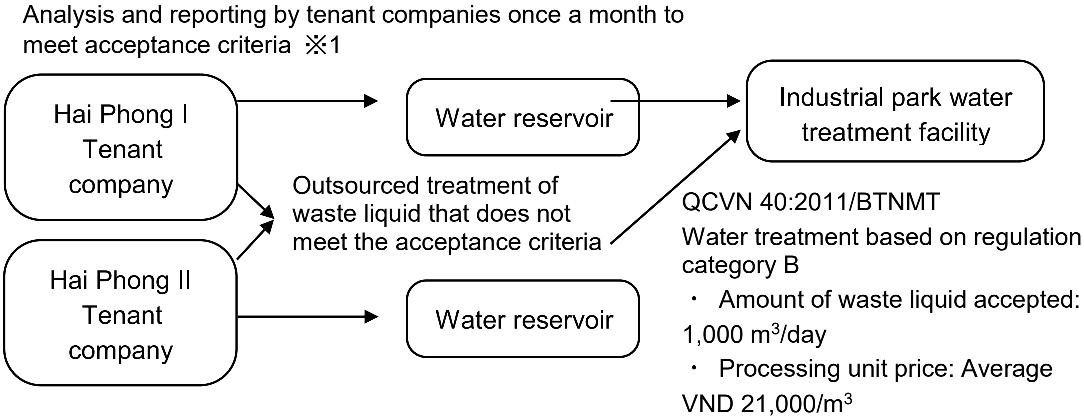


Figure 2.3.4.3. Conceptual diagram of wastewater treatment at DEEP C Industrial Zones.

Aerial view of wastewater treatment facility

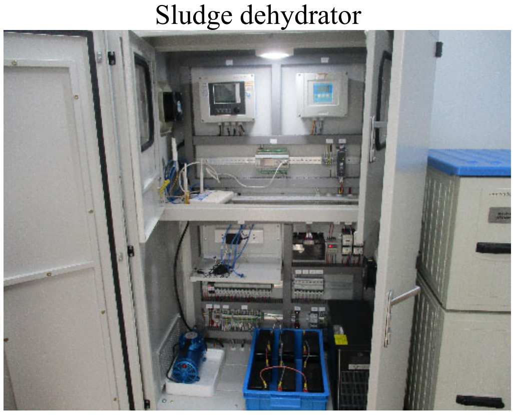
Water receiving tank

Aeration tank

Settlement tank

Sludge dehydrator

Dehydrated sludge



Wastewater monitoring system

Figure 2.3.4.4. Status of wastewater treatment at DEEP C Industrial Zones.

【Summary】

Industrial and domestic wastewater that meet the standards set by QCVN 40:2011/BTNMT and the industrial zone is treated at DEEP C Industrial Zones. Other wastewater is treated individually by each company, but the total amount is not known to the industrial zone, nor is the total amount of sludge and waste oil treated by each company. In addition, the amount of sludge generated from water treatment in the industrial zone is as low as 130 tonnes/year.

According to the interview, the industrial park would benefit if the costs of treating these waste liquids and sludge could be reduced, but the water treatment facility at DEEP C Industrial Zones alone does not produce enough sludge to supply to cement manufacturing companies. For this reason, it is necessary to consider expanding the scope of collection to include waste liquid that is primarily treated by each company in the industrial zone, sludge generated during primary treatment, and waste liquid and sludge generated throughout Hai Phong City.

(3) Disposal of waste oil by companies

Interviews were conducted with some tenant companies at DEEP C Industrial Zones that manufacture lubricating oil from raw materials to ascertain the actual conditions of treating waste oil discharged during the manufacturing process.

An overview of the waste oil treatment process is as follows.

✧ Some waste oil is discharged in the manufacturing process and some during daily analysis. The former is about 2 m^3/year, and the latter is about 0.05 to 0.1 m^3/year, which is negligible.
✧ All waste oil treatment is outsourced to a processing company, and no analysis of the components of the waste oil is conducted prior to outsourcing treatment. It is unclear how the oil is finally disposed because the contract does not cover final disposal, so regulations related to disposal are not known.
✧ The processing company determines the unit cost of treatment through a visual inspection. Depending on the waste oil conditions, it is treated as waste or recovered as valuable material, so the cost of treatment may be paid out or received.
✧ Since the standards for raw materials are strict, companies do not reuse waste oil. However, if the Recycling Law is enforced in the future, the standards for the reuse of raw materials may need to be reviewed, depending on the content.
✧ It is unclear whether the waste oil collected as valuable resources is reused by the waste disposal company.
✧ If an intermediate treatment company such as Daiseki Co., Ltd. collects waste oil for recycling, it is unclear how much of a cost benefit it would have, as the amount is small and it may contain valuable resources. However, there will likely be advantages if the collection of waste oil becomes mandatory with the enforcement of the Recycling Law.

【Issues of concern】

If the Recycling Law is enforced in the future, there are concerns about the level of responsibility manufacturing companies will face. For example, manufacturing companies may be required to build recycling facilities in factories to recycle waste oil after shipped products are used. The level of impact will vary significantly, depending on the level and scope of responsibility.

【Summary】

As shown in Table 2-1, manufacturers and importers of lubricating oil will be required to recycle oil from January 2023. Therefore, a number of target companies, as well as those surveyed in this study, will need to comply with these new regulations, meaning that the waste oil recycling business implemented by Daiseki Co., Ltd. in Japan may become an important point of reference for Vietnam as well. From the next fiscal year onward, it will be necessary to expand the scope of coverage and investigate how much waste oil is being discharged in Hai Phong City and the surrounding provinces.

2.3.5. Survey on the actual conditions of the conversion of raw fuel at cement factories

(1) State of cement manufacturing in Vietnam

Figure 2.3.5.1 shows the state of domestic cement production in Vietnam from 2016 to 2020. Figure 2.3.5.2 provides an overview of cement consumption, and Figure 2.3.5.3 includes a comparison between domestic consumption and overseas exports.

According to a report on the future outlook of the cement industry issued by Vietcombank Securities (VCBS), cement production in 2020 was 105 million tonnes (an 8.5% increase from the previous year), and consumption was 101 million tonnes (a 0.5% increase from the previous year).[16]

According to information released by the Vietnam National Cement Association (VNCA), total cement consumption increased 1.3 times from 2016 to 2020. In nine months in 2021, total cement consumption reached 79 million tonnes (about 46 million tonnes for domestic consumption and about 32.7 million tonnes for exports). Cement consumption was expected to reach 104 to 107 million tonnes in 2021 with increased investment in construction.

Based on the above, it is clear that cement production in Vietnam is on the rise, with increased exports, especially due to changes in China's cement industry policy, which mainly restricts factories to using cement for environmental purposes and to gradually reduce its use.

The domestic use of cement was about 55% of the production capacity in 2020, meaning that production capacity is higher than domestic demand.

[16] Report on the future outlook of the cement industry (https://www.vcbs.com.vn/vn/Communication/GetReport?reportId=8567)

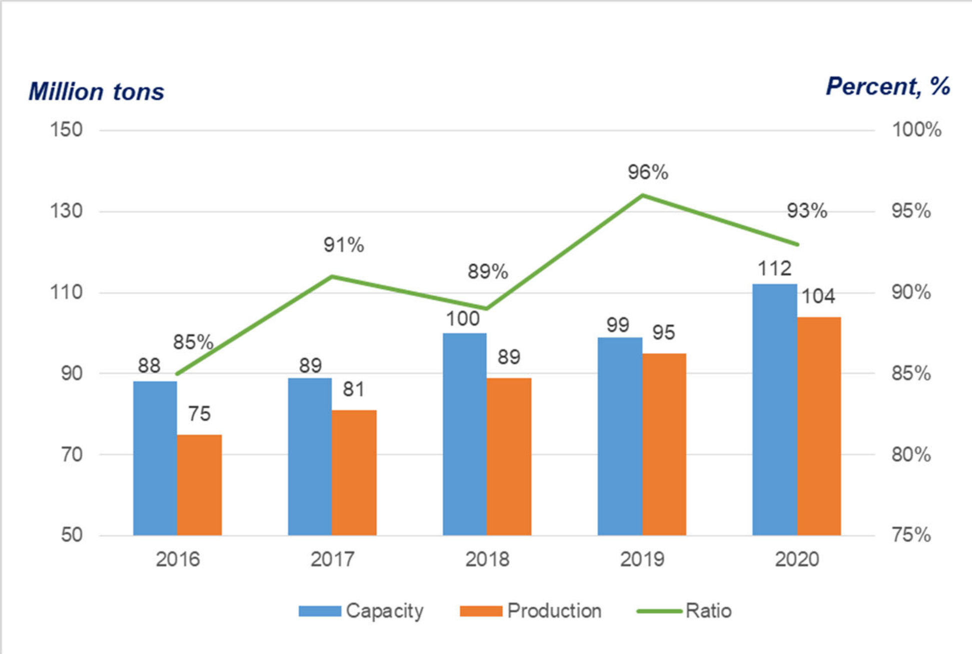


Figure 2.3.5.1. Cement production in Vietnam (2016 - 2020).

(Source: Based on the report on the future outlook of the cement industry (VCBS))

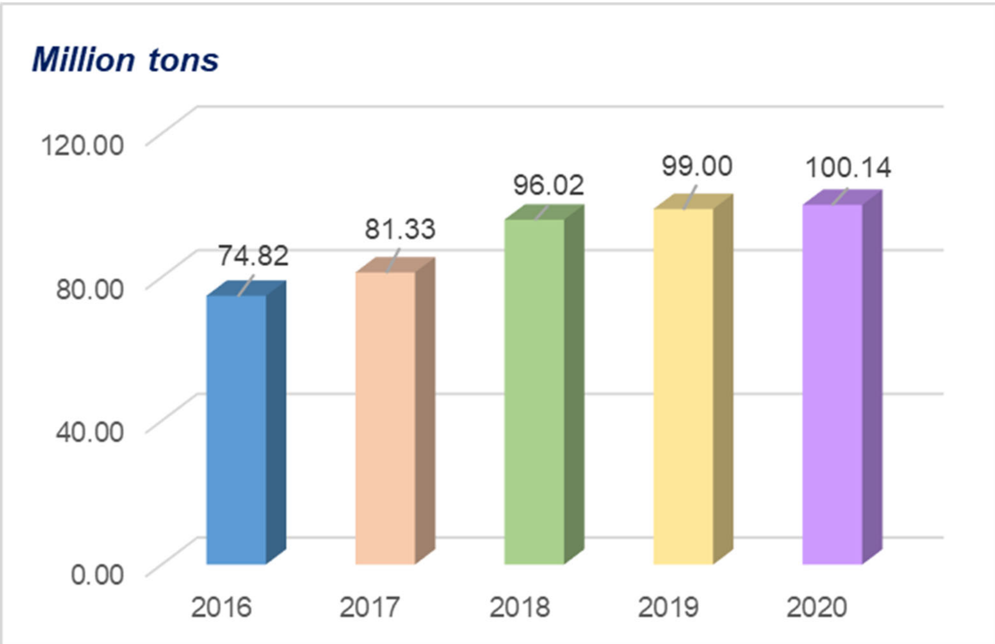


Figure 2.3.5.2. Total cement consumption in Vietnam (2016-2020).

(Source: Created based on information published by VNCA)

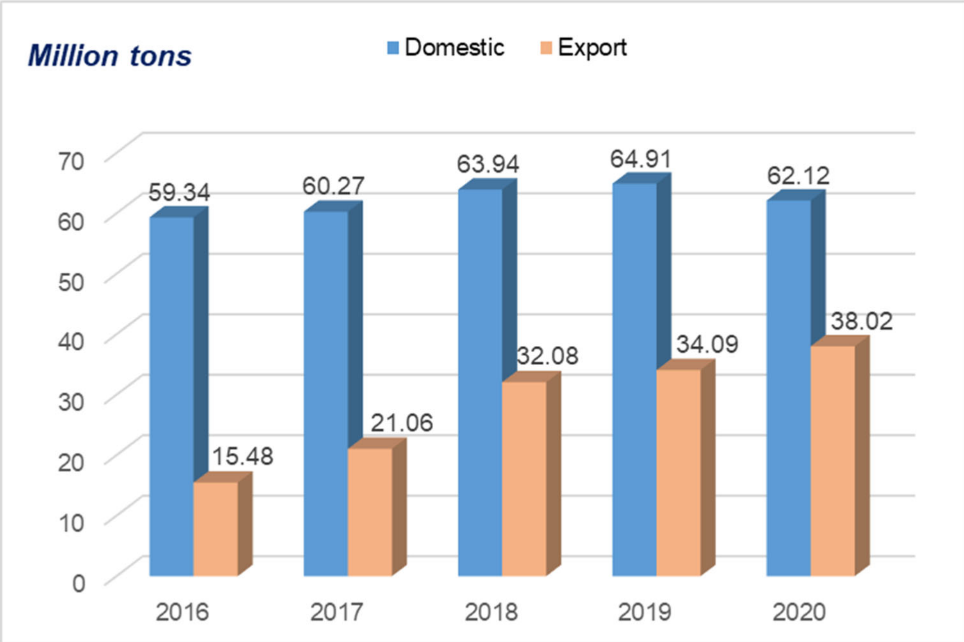


Figure 2.3.5.3. Comparison of domestic consumption and export of cement in Vietnam (2016-2020).
(Created based on information published by VNCA)

Figure 2.3.5.4 shows cement production by region for nine months in 2021. In Vietnam, the cement production ratio in the north is high compared to that in the southern part of the country.

According to a report by Vietnam Industry Research and Consultancy (VIRAC),[17] which conducts market research in Vietnam, while cement manufacturing costs in the three regions have not fluctuated significantly, manufacturing costs are mainly affected by coal prices, electricity costs and other factors. In addition, although manufacturing costs in the south are relatively high, demand for cement that is in short supply is high.

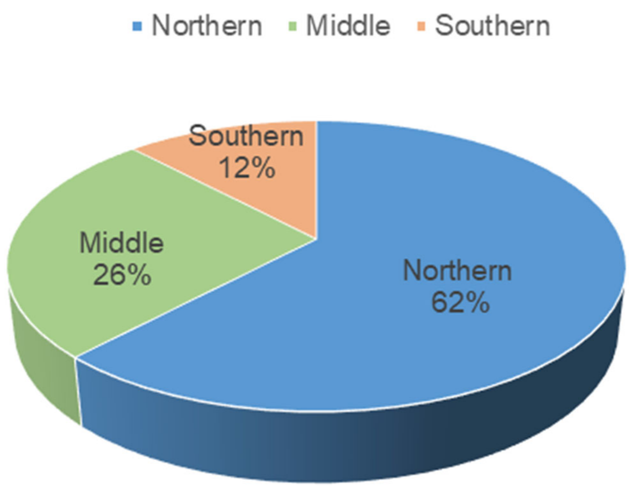


Figure 2.3.5.4. Cement production by region in Vietnam (9 months in 2021).
(Source: Created based on information published by VIRAC and VNCA)

[17] Vietnam Cement Industry Report Q2/2021: https://viracresearch.com/industry/vietnam-cement-industry-report-q2-2021/

Figure 2.3.5.5 shows the breakdown of cement manufacturing costs at Cement Company A. The cost of raw materials and coal used for firing accounts for 85% of all costs. The reduction of raw materials and carbon dioxide emissions by converting waste oil and waste into raw materials and fuels is considered to be a great advantage for cement manufacturers.

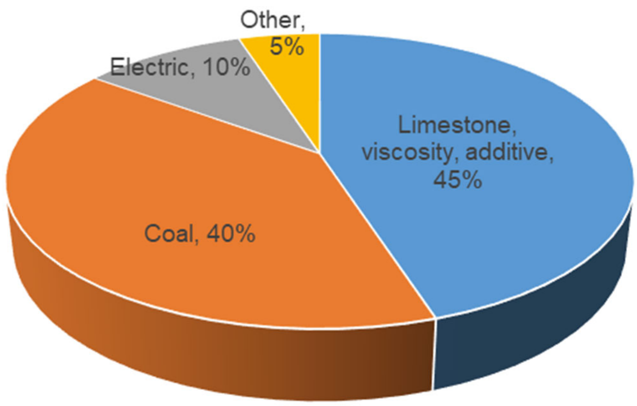


Figure 2.3.5.5. Structure of cement manufacturing costs at Cement Company A (2021).
(Source: Created based on information published by Cement Company A)

(2) Survey on the actual condition of converting raw fuel and materials for cement at Cement Company A

An overview of the results of a fact-finding survey at Cement Company A on converting raw material and fuel follows.

- ✧ There are two firing furnaces that are operated exclusively on coal after ignition, although oil is used at the time of ignition.
- ✧ 130 kg of coal is needed to produce one tonne of clinker, which has a caloric content of 6,700 kcal and a daily production capacity of 4,750 tonnes.
- ✧ The plant is in operation 24 hours a day, 322 to 330 days a year. The main equipment is made in Japan by manufacturers such as Onoda Cement and Taiheiyo Cement.
- ✧ The company does not currently accept waste. All waste discharged by the company (rubber, etc.) is treated in cooperation with other companies.
- ✧ MONRE's waste management laws and regulations are strict, and it is a violation to dispose of unauthorised materials.
- ✧ The company is looking for new raw materials to reduce production costs, but is not making progress. They have contacted and surveyed other cement factories in Vietnam, but there are few cases where waste is used as recycled materials.
- ✧ In order to balance production and the environment, KPIs have been set based on 2020, but there has been no progress in recycling.
- ✧ The goal is to reduce energy consumption by 9%, increase the recycling rate of waste by 15%, and introduce environmentally friendly fuel as a substitute for coal by 2030. The company will also focus on the use of new environmentally friendly raw materials and fuels for cement that can reduce energy consumption.

✧ The company is also considering how to contribute to the achievement of the country's greenhouse gas emission reduction targets. They predict that carbon dioxide emissions can be reduced by 20% by 2030 from 2020 levels.

【Challenges】

One of the challenges in converting waste into raw materials and fuel is that the distinction between what is hazardous waste and what is industrial waste is ambiguous under Vietnamese law. DONRE's waste disposal regulations have become stricter in recent years, and the method of distinguishing between sludge, a potential waste material, is often difficult to understand. It is unclear whether incineration ash and fly ash discharged from power plants can be recycled as raw materials because it is not possible to distinguish between raw materials and waste. It is not yet known what kind of waste can be used as raw materials and fuel. The use of raw materials and fuel containing harmful components without a detailed check of MONRE's regulations can result in fines.

【Summary】

This study found that although there is a need for waste raw materials from the perspective of reducing cement manufacturing costs and carbon dioxide emissions, there has been a lack of progress in the use of raw waste materials and fuels due to a lack of legislation regarding the classification and permission of waste for use as raw materials and fuel.

The survey also aimed to ascertain information on the amount and unit price of coal and raw materials used as fuel, as well as fuel conversion from coal to recycled oil, but no response has been received due to the confidential nature of this information.

From the next year and beyond, it will be necessary to increase the number of cement companies to survey, or expand the scope of interviews to include companies, such as Vietnam Cement Industry Corporation that has invested in various cement manufacturing companies and started to convert waste oil into raw materials and fuels.

2.3.6. GHG emission reduction effect

(1) GHG emission reduction effect in Japan

The intermediate treatment of industrial wastes such as waste oil and other highly concentrated liquid waste treated by Daiseki Co., Ltd. in Japan achieves a significant reduction in CO_2 emissions compared to simply incinerating industrial wastes. Based on the company's actual treatment results for fiscal 2020, this is equivalent to a reduction of more than 587,000 tonnes of CO_2. The breakdown can be found in Figure 2.3.6.

<u>When 1 tonne of waste oil is treated</u>

Comparing the CO_2 emissions from the simple incineration of 1 tonne of waste oil (2,920 $kgCO_2$) with the CO_2 emissions from oil-water separation and fuel treatment (recycling into recycled heavy oil) (31.3 $kgCO_2$), a 99% reduction is achieved. Since the company's shipment volume of recycled heavy oil in fiscal 2020 was 35,000 tons, this will result in a reduction of 102,000 tonnes of CO_2.

When 1 tonne of waste solvent is treated

Comparing the CO_2 emissions from the simple incineration of 1 tonne of waste solvent (1,491 kgCO_2) with those from fuel treatment (recycled into auxiliary fuel) (3.7 kgCO_2), a 99% reduction is achieved. Since the company's shipment volume of auxiliary fuel in fiscal 2020 was 294,000 tonnes, this will result in a reduction of 437,000 tonnes of CO_2.

When 1 tonne of waste acid and waste alkali is treated

Comparing the CO_2 emissions from the simple incineration of 1 tonne of waste acid and waste alkali (176 kgCO_2) and the CO_2 emissions from neutralization and biological treatment (13.9 kgCO_2), a 92% reduction is achieved. Since the company's processing volume of waste acid and alkali in fiscal 2020 was 299,000 tonnes, this will result in a reduction of 48,000 tonnes of CO_2.

(2) Potential for the development of a JCM Model Project in Vietnam

As mentioned above, in Japan, waste oil and other highly concentrated liquid waste are properly treated and actively reused as recycled heavy oil and auxiliary fuel, which contributes to a significant reduction in CO_2 emissions when compared to simple incineration. These treatments are carried out in a comprehensive treatment plant, and sludge and wastewater are also treated in addition to the waste oil, waste solvents, waste acids and alkalis above, creating an overall process that is quite complex.

In order to meet the cost-effectiveness standard for CO_2 emission reductions in the JCM Model Project (JPY 4,000/tCO_2), the application to individual treatment facilities, where the effect of CO_2 emission reductions is particularly visible, rather than to the entire plant, should be considered. However, since there have been no cases of the application of such treatment facilities to the JCM Model Projects, and JCM methodology has not been established yet, it is necessary to examine the applicability and development of the methodology. In addition, in the above calculations of the CO_2 emission reduction effect, simple incineration is used as a reference (baseline) for comparison, but in this fiscal year’s survey, it was not possible to ascertain how waste oil and liquid waste are generally treated in Vietnam. Therefore, surveys and studies should be conducted to obtain this information, including where the reference should be set.

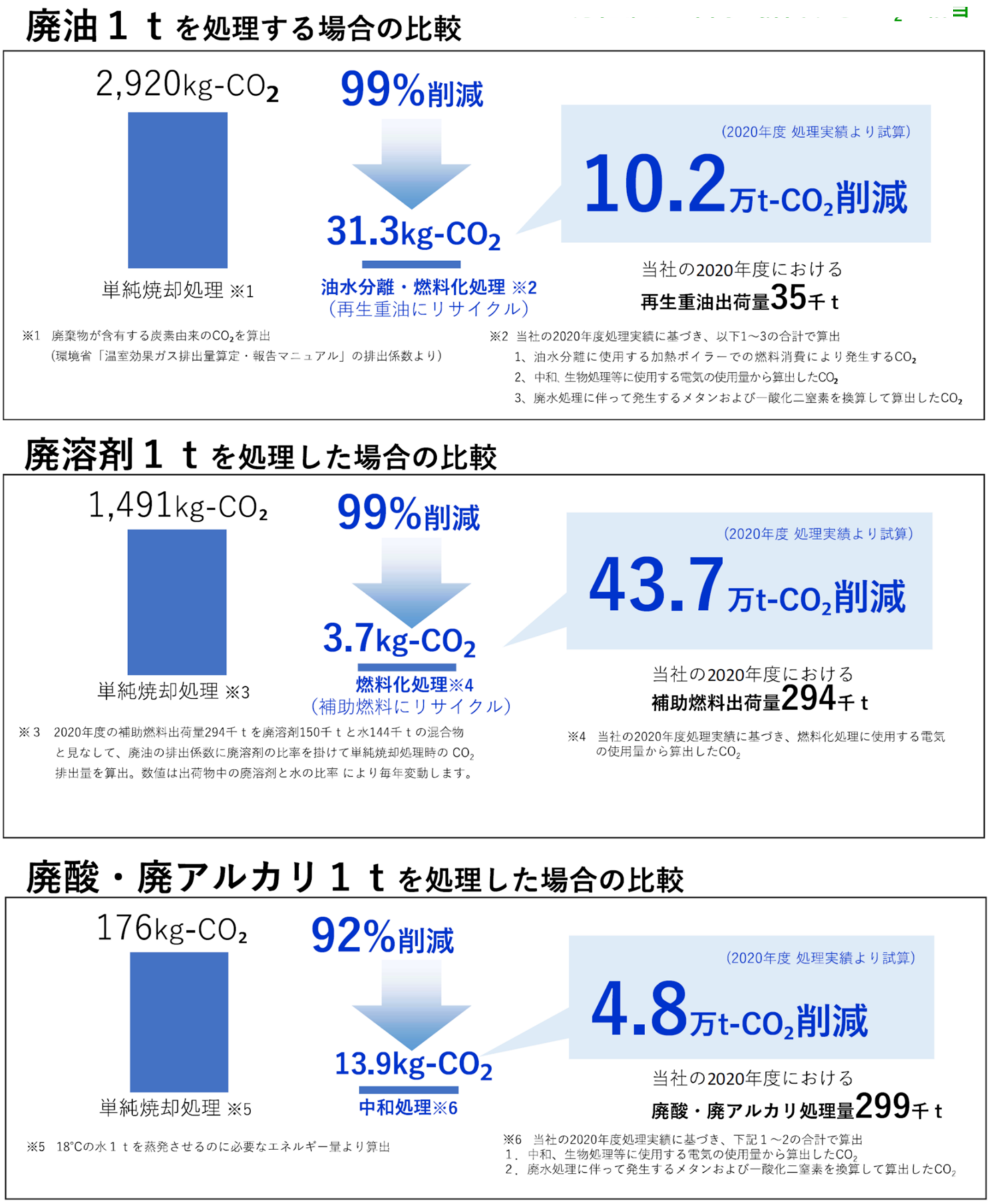


Figure 2.3.6. CO_2 emission reduction benefits calculated based on Daiseki Co., Ltd.'s actual industrial waste treatment in FY2020 (Source: Daiseki Co., Ltd.).

2.4. Survey on the installation of energy-saving and high-efficiency equipment

2.4.1. Background and purpose

With rising demand for energy (electricity and fuel) in industrial parks to power a wide range of large-scale industrial facilities, developing more energy and highly efficient equipment and facilities will both reduce operating costs (i.e., production costs) and help reduce GHG emissions.

Dhowa Technos Co., Ltd. is a trading company that offers comprehensive solutions and services, from the sale of industrial equipment to the installation, maintenance and renewal of facilities, providing customisation and maintenance services according to customer needs. The company participated in a survey of the Nam Cau Kien Industrial Park as part of a city-to-city collaboration project between Kitakyushu and Hai Phong in fiscal 2019, and conducted a survey on the introduction of high-efficiency equipment for a steel company with an electric furnace, which consumes a particularly large amount of energy in the industrial park, with the aim of applying for the JCM Model Project. Steel companies have a wide range of energy-intensive facilities, such as electric furnaces for melting steel scrap, large blowers and dust collectors, and large pumps for supplying water for cooling steel. Therefore, energy savings in equipment are directly related to production costs, creating a strong incentive to introduce energy savings and resulting in a high CO_2 emissions reduction effect.[18]

In fiscal 2021, a follow-up study was conducted on Vietnam-Italy Steel (VIS)'s high-efficiency dust collector + high-voltage inverter, one of the projects for which detailed discussions are underway based on a field survey in fiscal 2019.

2.4.2. Targets and methodology

VIS is a Vietnamese company (with headquarters in Hung Yen Province) in which Kyoei Steel Ltd. holds a 70% stake. VIS melts the scrap iron it receives in an electric arc furnace to produce and sell steel bars and wire rods for rebar. VIS has two plants in Hai Phong and Hung Yen (108 km from Hai Phong), with Hai Phong responsible for the upper end of the steelmaking process (steelmaking capacity: 400,000 tonnes/year) and Hung Yen for the lower end (rolling capacity: 250,000 tonnes/year). The Hai Phong plant is located in the Nam Cau Kien Industrial Park[18].

In the survey in fiscal 2019, actual measurements of dust collection equipment at the Hai Phong plant were taken during a field survey, and based on these measurements, energy consumption and other factors were calculated based on the assumption that a new blower would be designed by Murakami MFG. Co., Ltd. and controlled by a high-voltage inverter from Yaskawa Automation & Drives Corp. The survey found that the introduction of a high-efficiency blower and high-voltage inverter to the existing two-fan dust collection system would result in an energy saving effect of 3,604,800 kWh/year and a GHG emission reduction effect of 2,939 tCO_2/year[18].

To install this equipment, it was necessary to install a high-voltage transformer, and GHG emissions had to be recalculated in light of this work. Initially, the company was considering applying for the JCM Model Project in 2020, but the construction of the high-voltage transformer was delayed due to COVID-19.

[18] NTT Data Institute of Management Consulting, Inc. (2020) City-to-city collaboration programme for low-carbon society promotion of low carbon society in Iskandar Regional Area (City of Kitakyushu-Iskandar Regional Development Authority cooperation project) report (FY 2019). Ministry of the Environment.

In this fiscal year's survey, it was assumed that progress on the construction of the high-voltage transformer could be confirmed, GHG emissions would be recalculated, and preparations would be made for the application for the JCM Model Project.

2.4.3. Results of the field survey

In order to proceed with this year's survey, a follow-up consultation with VIS was held on 10 November 2020. In addition to VIS, the meeting was attended by Murakami MFG. Co., Ltd., Yaskawa Automation & Drives Corp., NTT Data Institute of Management Consulting, Inc., Dhowa Technos Co., Ltd., Kitakyushu Asian Center for Low Carbon Society, and the Institute for Global Environmental Strategies. The following points were confirmed at the meeting.

- The planned replacement of the high-voltage transformer has been delayed due to COVID-19, and is currently scheduled for June-July 2022.
- In addition, the construction of an additional rolling mill (the lower end of the steelmaking process) is under consideration (to be completed by the end of 2022), and there are plans to further increase the capacity of the steelmaking plant (the upper end of the steelmaking process). The larger the capacity, the more economies of scale there will be, so calculations need to be redone.
- As a result, an application for the JCM Model Project is expected to be submitted in 2023.
- A concrete blueprint for the facility expansion plan is expected to be available around January-February 2022. The parties agreed to discuss and consider the blueprint again when it is available, and to examine the possibility of conducting a site survey.

Based on the above discussions, a follow-up consultation was planned for early 2022, but due to COVID-19, a meeting could not be held before this report was prepared (as of February 2022), and therefore, no additional details are available.

2.4.4. Potential for future developments

In the coming year, we will continue to discuss the GHG emission reduction benefits and implementation arrangements for applying for the JCM Model Project based on the planned expansion of facilities in the VIS. A site survey must also be conducted, after which preparations will start for applying for the JCM Model Project in FY2023.

3. Workshops and International Conferences

3.1. Workshops with Hai Phong

As this survey targeted two industrial parks in Hai Phong City and the content of the survey was in line with the situation and needs of each, a kick-off and final (debriefing) workshop were held for each industrial park with local stakeholders, relevant organisations in Hai Phong City and other observers in attendance (Japanese Embassy in Vietnam, JICA Vietnam, etc.).

3.1.1. Kick-off meeting

(1) Kick-off meeting with Nam Cau Kien Industrial Park

Date: Friday, 10 December 2021, 11:00-13:00 (JST)

Location: Online (WEBEX)

Language: Vietnamese/Japanese (consecutive interpretation)

Attendees:

Hai Phong City	Department of Foreign Affairs (DOFA): Nguyen Thi Bich Dung (Deputy Director), Nguyen Minh Trang Department of Planning and Investment (DPI): Nguyen Thi Phuong Mai Economic Zone Authority (HEZA): Pham Hong Minh, Nguyen Van Vuong Department of Natural Resources and Environment (DONRE*)*: Doan Thi Nhat
Nam Cau Kien Industrial Park	Pham Hong Diep (Chairman - Director), Nguyen Anh Minh (Vice Director), Vu Duc Thanh, Vu Thi Lan Nhi
Survey group	Kitakyushu Asian Center for Low Carbon Society: Arita, Nagahara, Yamane IHI Corporation (IHI): Watase, Miyawaki, Nose, Matsuo Daiseki Co., Ltd.: Kusano, Minami Dhowa Technos Co., Ltd.: Watanabe Tokyo Century Corporation: Aoki, Yasufuku Chugai Technos Corporation: Morimoto (Vietnam branch), Furukawa (Kyushu branch) The Institute for Global Environmental Strategies (IGES): Hayashi, Akagi, Hibino, Horizono, Maehata
Observers	Embassy of Japan in Vietnam: Haga JICA Ogata Research Institute: Adachi
Interpreter	Vu Hoang Anh

A workshop was held with Nam Cau Kien Industrial Park (NCK) to mark the start of the Kitakyushu-Hai Phong City-to-City Collaboration Project in FY2021. The purpose of this meeting was to: (1) share the contents of the survey with the parties concerned; (2) understand the needs and issues of NCK; and (3) obtain feedback on the data and information needed for the survey.

I. Overview of the City-to City Collaboration Project (Hibino, IGES) (Annex 1)

Japan and Vietnam have declared their intention to achieve a carbon-neutral society by 2050. Kitakyushu and Hai Phong have also declared that they are both aiming to become zero-carbon cities. Under the City-to-City Collaboration Project between Kitakyushu and Hai Phong, a survey will be conducted to realize a zero-emission industrial park. This fiscal year, several Japanese companies will conduct basic research and transfer expertise in collaboration with local companies in NCK. NCK's cooperation is requested in responding to the survey form, conducting individual interviews, and introducing tenants.

II. Survey on smart power plants (Watase, IHI) (Annex1)

One of the proposals under the project is the establishment of a Smart Power Plant to reduce CO_2 emissions through alternative energy and efficient operation. Since Smart Power Plants can be more effective in balancing supply and demand with a limited number of plants, the study should target a smaller number of plants or areas for investigation. Electricity demand is so high in an entire industrial park that it is more efficient to directly use the few megawatts of electricity generated by solar and other power generation equipment, instead of storing it.

IHI proposes three options: (1) a combination of PV power and batteries, (2) a combination of EMS + solar power + batteries + gas generator (gas engine), and (3) a combination of (2) plus the effective use of steam supply using waste heat.

The following data is requested: designation of areas to be covered, actual demand data for 24 hours, electricity rates for industrial parks, rules for operating/non-operating days, prices of LNG and other energy sources when using gas engines, and the annual capacity factor for PV power.

Q&A:

- There is a website that lists the prices of LNG and gas that we can share later. (NCK)
- How big does the site area need to be for the three options? (NCK)
    - Rather than the area itself, IHI would like to target factories that use several megawatts to several tens of megawatts of electricity. Furthermore, if the plant uses steam, a high CO_2 reduction effect can be expected. (IHI)
- The requested data and information will be compiled and sent within 10 days. (NCK)
- Some of NCK's tenant companies have installed PV power systems on the roofs of their factories. This data will be compiled and shared. (NCK)

III. Survey on the conversion of liquid waste into raw fuel for cement (Kusano, Daiseki) (Annex 1)

Daiseki operates intermediate treatment and recycling businesses for industrial waste (waste oil, waste water, sludge) at six sites in Japan, and has achieved a 90% recycling rate and an 80% reduction in CO_2 emissions compared to simple incineration in cooperation with cement plants. A high recycling rate has been achieved by having the cement industry use the oil and sludge collected during intermediate treatment.

In Vietnam, coal is widely used for primary energy, and the cement industry also uses a lot of coal. Vietnam is a major exporter of cement, which is an energy intensive industry along with steel. A comparison between Japan and Southeast Asia shows that there is a large difference in CO_2 emissions per tonne of cement, so Daiseki believes that its technology can be deployed to Vietnam.

Daiseki would like to request the following data: (1) to cement companies: acceptance capacity, etc.; (2) to industrial parks: status of industrial waste disposal, etc. Chugai Technos Vietnam is in charge of the survey. NCK's cooperation is appreciated in filling out the survey form.

Q&A:

- The requested information will be compiled and sent in two weeks. However, the amount of liquid waste discharged at NCK is small. (NCK)
  - ➢ NCK's cooperation is appreciated. (Daiseki)

IV. Survey on the creation of a framework for promoting renewable energy (Hibino, IGES) (Annex 1)

Kitakyushu plans to power all public facilities in the city (over 2,000 buildings) with renewable energy by 2025. Cost is a major issue, but Kitakyushu plans to accelerate the introduction of the system through a third-party ownership model (zero initial investment). It is envisioned that Kitakyushu's expertise will be transferred to industrial parks in Haiphong through a model that is suitable for local conditions.

A table comparing the financing used in Japan for the introduction of solar power was introduced. Those with zero initial investment include roof rental models, PPA models, leasing, and solar loans. Each has its own advantages and disadvantages, so the most suitable model for Vietnam can be discussed by exchanging ideas with NCK.

This fiscal year, IGES will confirm NCK's model for installing PV power generation equipment and conduct research on issues related to accelerating the introduction of solar panels and the possibility of applying a third-party ownership model.

Q&A:

- In order to install PV panels on the roofs of tenant companies, NCK has developed a plan for a PV power generation project in 2020, which will be shared later. However, NCK has not been able to proceed due to the ambiguity of relevant laws and regulations in Vietnam. NCK appreciates the information on various multiple business models that were shared, and will respond to questions after compiling data and information. (NCK)
  - ➢ NCK's cooperation is appreciated. (IGES)

V. General discussion

- In this project, a feasibility study will be conducted from 2021 to 2023 on converting NCK into an Eco-Industrial Park. Is an MOU required for the implementation of this project? (NCK)
  - Since this project is under the City-to-City Collaboration Programme, and Kitakyushu and Hai Phong have already signed a sister city agreement, there is no need for a separate MOU with individual companies. However, it will be smoother if there is a letter of interest from next year. (IGES)
- What has happened with the plan to develop a PV power generation project in NCK by 2020? (DOFA)
  - Although surveys have been conducted and plans developed, the plan has not moved forward due to the ambiguity of relevant laws and regulations in Vietnam. Once these issues are resolved, NCK would like to work together with Japanese companies to promote the project. (NCK)
- NCK will do our best to work together to ensure that the survey proceeds smoothly. (NCK)
  - IGES would like to have a designated contact person so that we can communicate with NCK in English to move forward with research. (IGES)
  - Noted. (NCK)
- In addition to DOFA and NCK, representatives from HEZA, DPI, and DONRE also attended this meeting. If there is any information or data you would like to share, please let me know. We will work with the relevant bureaus to compile and send it out. (DOFA)
  - Thank you for your cooperation. IGES would like to ask the survey group to let us know if there is any citywide data that is needed. We will compile a list and send it to DOFA. (IGES)
- I would like to thank DOFA, DPI, HEZA, and DONRE for their participation today. We have been deepening our relationship with NCK since we signed the MOU on designating NCK as an Eco-Industrial Park in 2021. Through this project, we hope to contribute to Haiphong's efforts to decarbonise the city by 2050. (Kitakyushu City)

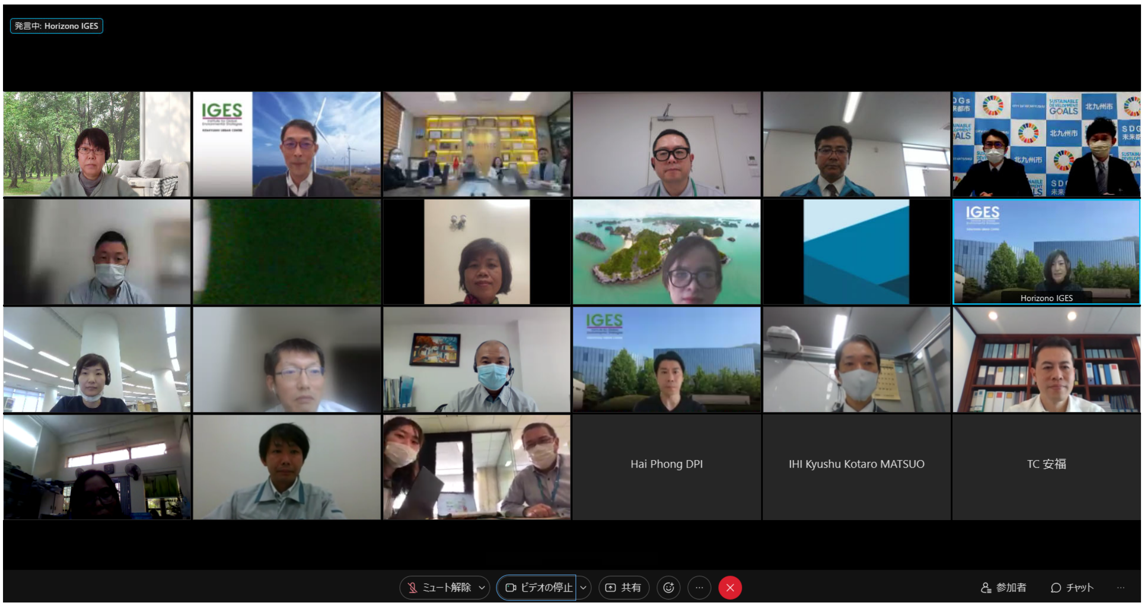


Figure 3.1.1.1. Group photo of the kick-off meeting with Nam Cau Kien Industrial Park.

(2) Kick-off meeting with DEEP C Industrial Zones

Date: Wednesday, 15 December 2021, 11:00-12:30 (JST)

Location: Online (WEBEX)

Language: Vietnamese/Japanese (consecutive interpretation)

Attendees:

Hai Phong City	Department of Foreign Affairs (DOFA): Nguyen Thi Bich Dung (Deputy Director), Nguyen Minh Trang Department of Planning and Investment (DPI): Nguyen Thi Phuong Mai Economic Zone Authority (HEZA): Nguyen Van Vuong, Mr. Dao Hoang Hai Department of Natural Resources and Environment (DONRE): Tran Thu Ha
DEEP C	Takei (Project Development Manager)
Other relevant organisations	Executive Partners Inc.: Yumoto (Advisor for DEEP C) Vietnam National Productivity Institute (VNPI) : Nguyen Tung Lam (Acting Director)
Survey group	Kitakyushu Asian Center for Low Carbon Society: Nagahara, Yamane IHI Corporation (IHI): Watase, Miyawaki, Matsuo, Sono Daiseki Co., Ltd.: Kusano Dhowa Technos Co., Ltd.: Watanabe Tokyo Century Corporation: Aoki, Yasufuku, Harada The Institute for Global Environmental Strategies (IGES): Akagi, Hibino, Horizono, Maehata
Interpreter	Vu Hoang Anh

A workshop was held with DEEP C Industrial Zones (DEEP C) as a kick-off meeting for the Kitakyushu-

Hai Phong City-to-City Collaboration Project in FY2021. The purpose of this meeting was to: (1) share the contents of the survey with the parties concerned; (2) understand the needs and issues of DEEP C; and (3) obtain feedback on the data and information needed for the survey.

I. Overview of the City-to City Collaboration Project (Hibino, IGES) (Annex 2)

The content of this presentation is the same as that in "(1) Kick-off meeting with Nam Cau Kien Industrial Park".

II. Survey for smart power plant (Watase, IHI) (Annex 2)

The content of this presentation is the same as that in "(1) Kick-off meeting with Nam Cau Kien Industrial Park".

Q&A:

- Has a decision already been made on a candidate site for the planned 5ha of land? (DEEP C)
  - IHI has heard that solar panels will be installed after filling and curing the landfill, but there are no details on the specific method of installation. (IHI)
  - Noted. DEEP C will check on this. (DEEP C)
- DEEP C is currently discussing a project for the 5 ha of land with Hai Phong City, so details can be explained to all parties depending on progress. Tenant companies in DEEP C must be asked about disclosing specific information. (EP)
- What are the criteria for option 2, such as the percentage of solar power and gas? (HEZA)
  - There are no clear standards; the more PV power projects, the better. The capacity of gas engines will then considered. (IHI)
- Is the target of this survey a single factory, an area, or the entire industrial park? (HEZA)
  - Industrial parks are too large to be considered as a target. (IHI)
- There are companies in the industrial park that have already installed PV power generation systems, so if DEEP C only wants to install EMS, would subsidies from JCM be available? (HEZA)
  - Subsidies would be available, but only for EMS equipment, so it will not be very beneficial. PV power that has already been installed is not eligible for equipment subsidies. (IHI)

III. Survey on the conversion of liquid waste into raw fuel for cement (Kusano, Daiseki) (Annex 2)

The content of this presentation is the same as that in "(1) Kick-off meeting with Nam Cau Kien Industrial Park".

Q&A:

- DEEP C has a centralised wastewater treatment facility, but what is being done about sludge treatment? (IGES)
  - DEEP C already has facilities for sludge treatment that are likely different from Daiseki's treatment methods, but technical aspects need to be confirmed, so a survey should be conducted. (DEEP C)

- Is it possible to interview a company that uses a lot of oil? (IGES)
- Interviews can be arranged. (DEEP C)

IV. Survey on the creation of a framework for promoting renewable energy (Hibino, IGES) (Annex 2)

The content of this presentation is the same as that in "(1) Kick-off meeting with Nam Cau Kien Industrial Park".

Q&A:

- Since there are only a limited number of banks that have relationships with Japanese companies operating in Vietnam, it would be better to conduct interviews directly. However, it may be necessary to introduce local banks. (EP)
  - Noted. IGES would be happy to discuss the interview with EP again. (IGES)

V. General discussion

- HEZA manages industrial parks in Haiphong, including both DEEP C and NCK. Daiseki's proposal included a cement factory as a subject of investigation. Haiphong City has two large cement factories that are managed by DPI. Please contact DPI with any questions about the cement factories. (DPI)
  - Noted. Thank you for your cooperation (Daiseki)
- Is the target of the current survey limited to Japanese companies? To apply for the JCM, does the company need to be Japanese? (EP)
  - Targets include local companies as well as companies that are expanding from overseas. For the JCM, the representative business operator needs to be a Japanese company, but the target company can be a local company. (IGES)
- IGES was able to interview one of the two cement factories through DOFA. An introduction to the second company would be helpful. (IGES)
  - We will check the situation and arrange a meeting. (DOFA)
- All of the proposals are good. DEEP C would like to investigate the feasibility of each of the proposals. DEEP C's immediate goal is to cover 50% of the electricity consumed by the entire industrial park with renewable energy by 2030, a point that we want to pay attention to as we move forward. (DEEP C)
- Today's meeting was meaningful as a lot of information was exchanged. DEEP C's target of increasing the ratio of renewable energy to 50% by 2030 is a wonderful goal. We would like to support you in any way we can. (DOFA)
  - Thank you. (DEEP C)
  - We have always benefitted from the support of DOFA, and thank you for your continued support. (IGES)
- Thank you for taking time out of your busy schedule to participate in this event. We were able to share information that will prove important down the line. We would like to exchange information even more closely in the future. We hope that Hai Phong and Kitakyushu will continue to work

together to achieve the creation of a zero-carbon city. (City of Kitakyushu)

Figure 3.1.1.2. Group photo of the kick-off meeting with DEEP C Industrial Zones.

3.1.2. Final meeting

(1) Final meeting with Nam Cau Kien Industrial Park

Date : Wednesday, 16 February 2022, 12:00-14:00 (JST)

Location: Online (Zoom)

Language: Vietnamese/Japanese (consecutive interpretation)

Attendees:

Hai Phong City	Department of Foreign Affairs (DOFA): Nguyen Thi Bich Dung (Deputy Director), Nguyen Minh Trang Department of Planning and Investment (DPI): Nguyen Phuong Mai Economic Zone Authority (HEZA): Bui Ngoc Hai, Deputy Director Department of Natural Resources and Environment (DONRE): Vu Thi Thu Huong, Tran Thi Thu Ha
Nam Cau Kien Industrial Park	Pham Hong Diep - Chairman of Shinec JSC Vu Thi Lan Nhi - Environmental specialist
Other relevant organizations	Vietnam National Productivity Institute (VNPI): Nguyen Tung Lam (Acting Director) Chugai Technos Corporation: Morimoto, Kim Van Dung (Vietnam); Furukawa (Kyushu Branch)
Survey group	Kitakyushu Asian Center for Low Carbon Society: Arita, Nagahara, Yamane IHI Corporation (IHI): Watase, Terakawa Daiseki Co., Ltd.: Kusano, Minami Dhowa Technos Co., Ltd.: Watanabe

	Tokyo Century Corporation: Aoki, Yasufuku The Institute for Global Environmental Strategies (IGES): Akagi, Hibino, Maehata
Observer	Embassy of Japan in Vietnam: Haga, Kurino
Interpreter	Vu Hoang Anh

The final meeting (debriefing session) was held to share the results of this fiscal year's survey of the Nam Cau Kien Industrial Park with the parties concerned and to discuss future developments.

I. PV power generation and smart power plants (Watase, IHI) (Annex 3)

The results of the study on the combination of "PV power generation + storage battery" was reported at the individual meeting with NCK. However, since the economic viability of this option was not promising, the results of a study on the output and economic efficiency of PV power generation per unit area (1 ha), without the storage battery, will be reported. When the subsidy rate is 30%, cost-effectiveness is JPY 6,000/tCO_2, which is higher than the standard (JPY 4,000/tCO_2). When the amount of the subsidy was recalculated so that it is equivalent to the standard, it was found that the payback period is about 10 years (or 11 years if taking the aging and degradation of PV power into account), and the subsidy rate is equivalent to about 20%.

Q&As:

- NCK would like to know the output per 100 ha and the required investment for rooftop PV. (NCK)
  - ➢ Since the results presented here are based on a unit area, any of them can be multiplied by 100 to obtain a value for 100 hectares. However, only the payback year remains the same. (IHI)

II. Recovery and utilisation of liquid waste energy (Morimoto, Chugai Technos) (Annex 3)

Chugai Technos conducted a survey on GHG emission reductions that can be achieved by expanding Daiseki's liquid waste and sludge recycling business in Japan to Vietnam. A field survey on wastewater treatment and sludge discharge for NCK and the tenant companies found that the industrial park is not aware of the amount of wastewater because it is treated individually, and that the amount of sludge discharged is small. A survey conducted on cement manufacturing companies revealed that coal for raw materials and calcination accounts for 80% of the manufacturing cost, that there is a strong need for raw material and fuel alternatives to coal, and that it is not clear whether waste can be converted into raw materials and fuels, so laws and regulations need to be established.

Q&A:

- The model proposed is wonderful. NCK hopes that a facility will be established to centrally treat waste liquid not only in NCK but also from each industrial zone in Haiphong. I think HEZA in Haiphong also has data on sludge emissions, so please continue to investigate. (NCK)
  - ➢ CT would like to expand the scope of the survey and promote it through various channels. (CT)

- If NCK wants to visit Japanese companies, when can that be arranged? (NCK)
  - ➢ CT will consider how to arrange an opportunity to show the actual situation in Japan. (CT)

III. <u>Introduction of energy-saving and high-efficiency equipment (Watanabe, Dhowa Technos)</u>

Since FY2019, Dhowa Technos has visited about 20 tenant companies in NCK and presented proposals on the introduction of high-efficiency blowers and other equipment. As a result, Vietnam-Italy Steel (VIS), a steel manufacturer with electric furnaces, has shown interest in the project, and preparations have started to apply for the JCM Model Project based on the results of the field survey. The progress of the survey has stalled because the construction of the transformer necessary for the installation of the equipment has been delayed due to COVID-19 and due to the expansion project. At the moment, Dhowa Technos is studying the possibility of updating equipment in 2023, and will continue to examine the possibility of applying for the JCM Model Project.

IV. <u>Framework for promoting the introduction of renewable energy (Hibino, IGES) (Annex 3)</u>

IGES conducted a survey on how to apply the expertise of the "Kitakyushu Model for 100% Renewable Energy" to industrial parks in Haiphong. This fiscal year, interviews were conducted with both industrial parks as well as local banks in Vietnam as part of basic research on the mechanisms and challenges of promoting the introduction of renewable energy. The survey found that deregulated rooftop PV power schemes with a capacity of 1 MW or less and a voltage 35 kV or less has been helpful in expanding the application of PV power. However, that is about the only mechanism found for expanding PV power. Of all Kitakyushu's expertise, subscription, optimal use of products using IoT and AI, and long service life were considered to be helpful for Hai Phong. When applying for the JCM Model Project for PV power, it is effective to collaborate with Japanese tenant companies.

Q&A:

- NCK is expanding the industrial park in the second phase, and considering a PV power generation project within the park. A subsidiary has been established that has obtained a license to supply electricity. NCK is also discussing the possibility of renting out the roofs of companies that are considering moving into the industrial park. NCK is interested in this project and would like to discuss it in the future. (NCK)
  - ➢ IGES is willing to explain the JCM to NCK tenant companies anytime. (IGES)

V. <u>Wastewater purification technology (Nagahara, Kitakyushu City) (Annex 3)</u>

NCK expressed an interest in water purification technology at an individual meeting. Kitakyushu City would like to introduce its U-BCF technology, which is a biological treatment method that is expected to reduce the amount of chlorine and other inputs, as well as lower construction and maintenance costs. Hai Phong is also in the process of introducing this technology, and a large-scale treatment facility is currently being constructed using Japanese ODA. During a discussion with the Water and Sewer Bureau of Kitakyushu City, we were told that although it is technically possible to use industrial wastewater as drinking water, it is not used as drinking water due to image and cost considerations. In Japan, this water is used for factories or flushing toilets. The water quality must be analysed in detail to determine if it can be used as drinking water. Kitakyushu also has a track record of using the JCM to install equipment such as replacing high-efficiency pumps.

Q&A:

- When NCK conducts wastewater treatment/recycling projects, we want to use it for industrial and flushing water, not drinking water. (NCK)
  - ➢ Kitakyushu City thinks there are places where this technology can be used, so please let us know if there is anything we can do. (Kitakyushu City)

VI. General discussion

- ➢ Solar power generation would be highly effective in reducing CO_2 emissions, but the amount of investment is too high. (DONRE)
  - ➢ The underlined PV power purchase price is information from IHI, so please review it with the price of the installation source. (IHI)
- ➢ How is the subsidy amount calculated? (DOFA)
  - ➢ The subsidy rate is currently up to 30% for PV power in Vietnam, and cost-effectiveness is about JPY 6,000/tCO_2; in order to receive a subsidy equivalent to JPY 4,000/tCO_2, the maximum subsidy can be calculated backwards by reducing the subsidy rate. (IHI)
- ➢ HEZA has data on waste liquid and waste oil and can share it. Since companies pay high costs to dispose of hazardous waste, it would be wonderful if Daiseki's business could be developed. However, there are two challenges that can be expected in Vietnam: one is the lack of laws regarding the conversion of waste to raw fuel, and the other is the possibility of high production costs if a recycling business is implemented. In Vietnam, there are rules on receiving subsidies from the government by implementing environmental protection and recycling initiatives, but the method of receiving these subsidies is not clear. If there is any support available from international organisations for environmental protection, HEZA would like to be informed. Vietnamese companies are aiming at the development of a recycling and circular economy, so this will be feasible. (HEZA)
  - ➢ Chugai Technos would be grateful if HEZA could cooperate with us in the interview survey and provide information on liquid waste and sludge throughout Hai Phong. As for recycling systems, we understand that a law for lubricating oil will be established around 2023 to 2024. We would like to investigate if other highly concentrated special liquid waste and sludge can be added to the scope of the recycling system. (Chugai Technos)
  - ➢ It was mentioned that costs will be higher, but the cost of treatment will also be higher as landfill sites run out of land. Processing costs can be reduced if cement companies can use raw materials and fuel, so I think a compromise can be found between the two sides. (Daiseki)

Figure 3.1.2.1. Group photo of the final meeting with Nam Cau Kien Industrial Park.

(2) Final meeting with DEEP C Industrial Zones

Date：Wednesday, 16 February 2022, 15:00-16:30 (JST)

Location: Online (Zoom)

Language: English

Attendees:

Hai Phong City	Department of Foreign Affairs (DOFA): Nguyen Thi Bich Dung (Deputy Director), Nguyen Minh Trang Department of Natural Resources and Environment (DONRE): Vu Thi Thu Huong
DEEP C	Hai Phong HQ: Melissa, Takei Tokyo Office: Tsuchiya
Other relevant organizations	Executive Partners Inc.: Yumoto (Advisor for DEEP C) Vietnam National Productivity Institute (VNPI): Nguyen Tung Lam (Acting Director) Chugai Technos Corporation: Morimoto, Kim Van Dung (Vietnam); Furukawa (Kyushu Branch)
Survey group	Kitakyushu Asian Center for Low Carbon Society: Arita, Nagahara, Yamane IHI Corporation (IHI): Watase, Terakawa Daiseki Co., Ltd.: Kusano, Minami Dhowa Technos Co., Ltd.: Watanabe Tokyo Century Corporation: Aoki, Yasufuku The Institute for Global Environmental Strategies (IGES): Akagi, Hibino, Maehata

Observer	Embassy of Japan in Vietnam: Haga JICA Vietnam: Ono

The final meeting (debriefing session) was held to share the results of this fiscal year's survey of the DEEP C Industrial Zones with the parties concerned and to discuss future developments.

I. PV power generation and Smart Power Plant (Watase, IHI) (Annex 4)

The content of this presentation is the same as that in "(1) Final Meeting with Nam Cau Kien Industrial Park".

Q&A:

- Is it correct to assume that the combination of storage batteries and PV power is not expected to be economically viable due to the inclusion of storage batteries? (DEEP C)
- That is correct. The initial investment cost for storage batteries impacted this significantly. (IHI)
- We now understand that the reason it takes more than 10 years to recover the investment is because storage batteries are included. (DEEP C)

II. Recovery and utilisation of liquid waste energy (Kim Van Dung, Chugai Technos) (Annex 4)

The content of this presentation is the same as that in "(1) Final Meeting with Nam Cau Kien Industrial Park".

Q&A:

- Since DEEP C is currently surveying tenant companies about the amount of waste generated, types of industrial waste, and disposal methods, this information will be made available. It may be possible to collaborate in the future in the field of waste management. (DEEP C)
- We would like to conduct a survey from next fiscal year. (Chugai Technos)

III. Introduction of energy-saving and high-efficiency equipment (Watanabe, Dhowa Technos)

A questionnaire form on the needs for high-efficiency blowers and dust collectors has been sent to DEEP C. We are currently awaiting responses.

Q&A:

- The questionnaire arrived before the Tet holidays, so we have not been able to handle it yet, but we will do so. (DEEP C)

IV. Framework for promoting the introduction of renewable energy (Hibino, IGES) (Annex 4)

The content of this presentation is the same as that in "(1) Final Meeting with Nam Cau Kien Industrial Park".

Q&A:

- DEEP C would like to know more about the mechanism of conversion from owner to user. (DEEP C)
    - When a municipality procures equipment, it usually owns the equipment, but it cannot install a large amount of equipment because of the initial investment required. By using financial institutions as intermediaries for this initial investment, municipalities will be able to install more equipment in a short period of time by paying a monthly fee. (IGES)
- DEEP C is also promoting the installation of solar panels and aims to install 50% renewable energy by 2030. We are following the international trend of decarbonisation and believe that electricity prices will soar in Vietnam in the future. Therefore, we believe that there is potential for PV power even in the northern regions where sunshine conditions are not favourable. In fact, there is an issue of excessive power generation in the southern region. Although capacity is limited to 1 MW, we understand that it is possible to operate it collectively. (DEEP C)
    - If Japanese tenants are interested in the JCM Model Project subsidy program, we are always happy to explain it to them. (IGES)
- Some of the existing tenants have problems with the shape and resistance of their roofs when installing PV. We hope to use JCM efficiently for installing PV power. (DEEP C)

V. <u>Discussion on the overall survey</u>

- Several presentations mentioned that the regulations and legal system are unclear. DEEP C would like to ask DOFA and other Hai Phong authorities to improve this. (DEEP C)
    - Bridging the gap between the development of the legal system and its implementation is an issue that will take time. DOFA would like to work with the central government and make an effort to change the system so it reflects actual situations. (DOFA)
- The Hai Phong authorities are listening to our requests and responding to them. This was a good opportunity for us to share the challenges we are facing. (DEEP C)
    - We would like to continue working together to find solutions. (DOFA)
    - We can cooperate by providing evidence and technical information to promote the development of laws. (IGES)

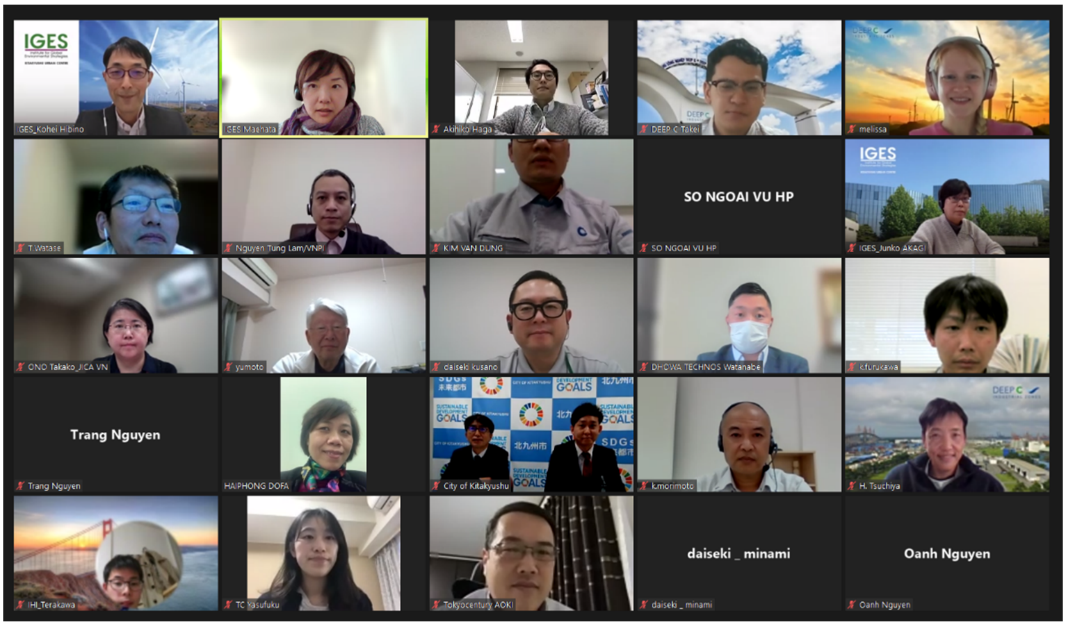


Figure 3.1.2.2. Group photo of the final meeting with DEEP C Industrial Zones.

3.2. Presentations at conferences (international conferences) designated by the Ministry of the Environment Japan

The Ministry of Environment Japan and the Ministry of Natural Resources and Environment (MONRE) of Vietnam co-organised "Viet Nam-Japan Environmental Week " from 14 to 27 December 2021, which included a virtual exhibition, online business matching, and web seminars. Kitakyushu City, Hai Phong City and IGES (representative entity) presented at "Session 3: JCM Implementation in Viet Nam" during the "Webinar on the Implementation of the Joint Crediting Mechanism (JCM) in Viet Nam 2021 – Innovation for Carbon Neutrality through the JCM –" (17 December, 10:30-13:10). The presentation title and speakers are listed below. The organiser and cities worked together on the content of the presentation when preparing the materials (Annex 5).

Theme: Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City
(FY2021 City-to-City Collaboration for Zero-Carbon Society)
Co-presenters:

- Director of the Kitakyushu Asian Center for Low Carbon Society Takanori Arima
- Deputy Director of Department of Foreign Affairs (DOFA) Nguyen Thi Bich Dung
- Kitakyushu Urban Centre, The Institute for Global Environmental Strategies (IGES) Kohei Hibino

3.3. Presentations at conferences (related to the City-to-City Collaboration Programme) designated by the Ministry of the Environment Japan

A report on achievements of city-to-city collaboration projects adopted this year will be exhibited online at the "2nd Zero Carbon City International Forum" organised by the Ministry of the Environment Japan (scheduled to be held in March 2022). Two versions were prepared in English and Japanese according to the format specified by the secretariat of the meeting. (Annex 6)

Annex

Thúc đẩy các khu công nghiệp sinh thái hướng tới trung hòa cacbon ở thành phố Hải Phòng

Viện Chiến lược Môi trường Toàn cầu
Cục Môi trường, Thành phố Kitakyushu
Sở ngoại vụ thành phố Hải Phòng
IHI Corporation
Daiseki Co., Ltd.
Công ty TNHH Dhowa Technos
Tokyo Century Corporation

IGES
Institute for Global Environmental Strategies

CAM KẾT TẠI HỘI NGHỊ COP26

- Cả Nhật Bản và Việt Nam đều cam kết phấn đấu đạt được mức độ trung hòa các-bon vào năm 2050
- Cả Kitakyushu và Hải Phòng cũng cam kết phấn đấu xây dựng các thành phố không carbon

Thủ tướng Nhật Bản
Fumio Kishida

https://www.mofa.go.jp/ic/ch/page6e_000257.html

Hội nghị thượng đỉnh các nhà lãnh đạo thế giới
(Ngày 2/11/2021)

Thủ tướng Việt Nam
Phạm Minh Chính

https://vietnamnews.vn/environment/1071075/viet-nam-strives-to-achieve-net-zero-by-2050-with-international-support-pm.html

Hội nghị thượng đỉnh về khí hậu
(Ngày 1/11/2021)

"Kitakyushu sẽ tiếp tục hỗ trợ tìm kiếm giải pháp cho các vấn đề bằng cách triển khai các công nghệ môi trường của chúng tôi ở nước ngoài."

Thị trưởng TP Kitakyushu
Kenji Kitahashi

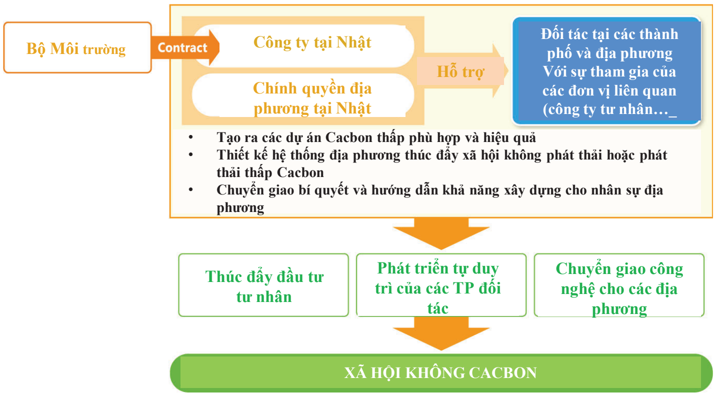
"... chúng tôi chắc chắn sẽ tiếp tục hợp tác với thành phố Kitakyushu để hiện thực hóa một thành phố không carbon ".

Phó Giám đốc Sở Ngoại vụ
Nguyễn Thị Bích Dung

Sự kiện bên lề "Những nỗ lực hàng đầu hướng tới việc đạt được các thành phố không carbon" (ngày 2 tháng 11 năm 2021, do MOEJ, IGES, ICLEI, OECD tổ chức)

Bối cảnh dự án

Dự án hợp tác giữa thành phố với thành phố



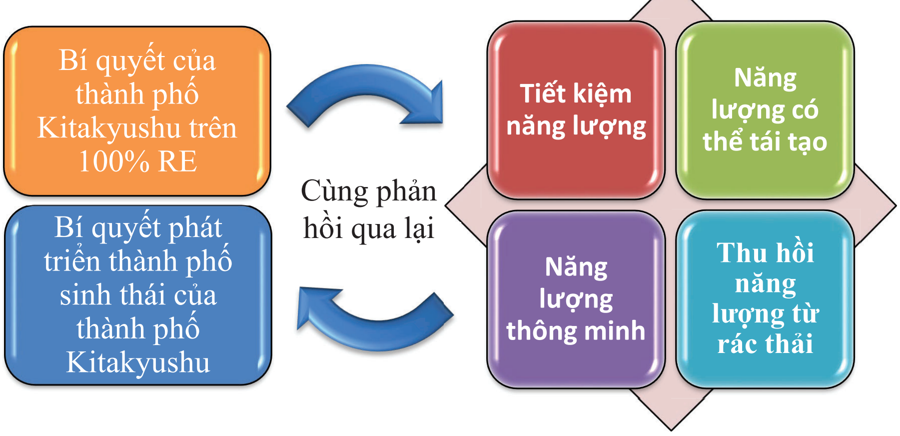
Cơ chế tín chỉ chung (JCM)

Phác thảo dự án

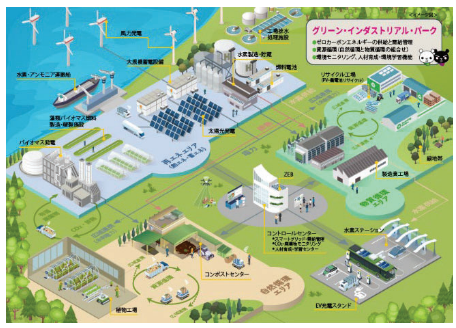
Chuyển giao bí quyết

Phát triển dự án

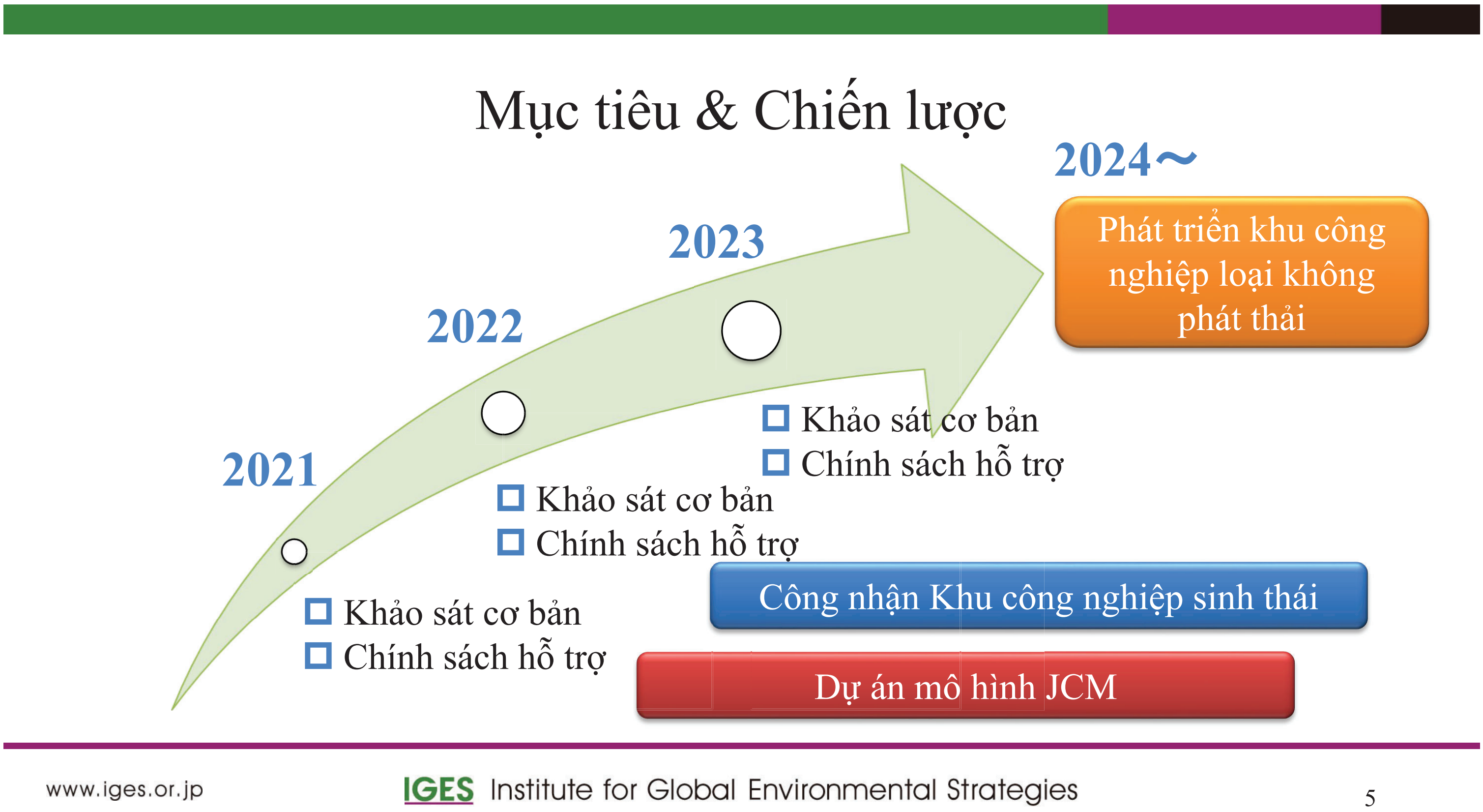
Đầu ra được kỳ vọng



Khu công nghiệp không phát thải



- ✓ Công nhận Khu công nghiệp sinh thái
- ✓ Khu công nghiệp không phát thải
- ✓ Chuỗi khử Cacbon
- ✓ Bản địa hóa một cách bền vững các Khu công nghiệp


Mục tiêu & Chiến lược
2021
2022
2023
2024～
Phát triển khu công nghiệp loại không phát thải
Khảo sát cơ bản
Chính sách hỗ trợ
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Chính sách hỗ trợ
Công nhận Khu công nghiệp sinh thái
Dự án mô hình JCM
www.iges.or.jp
IGES Institute for Global Environmental Strategies
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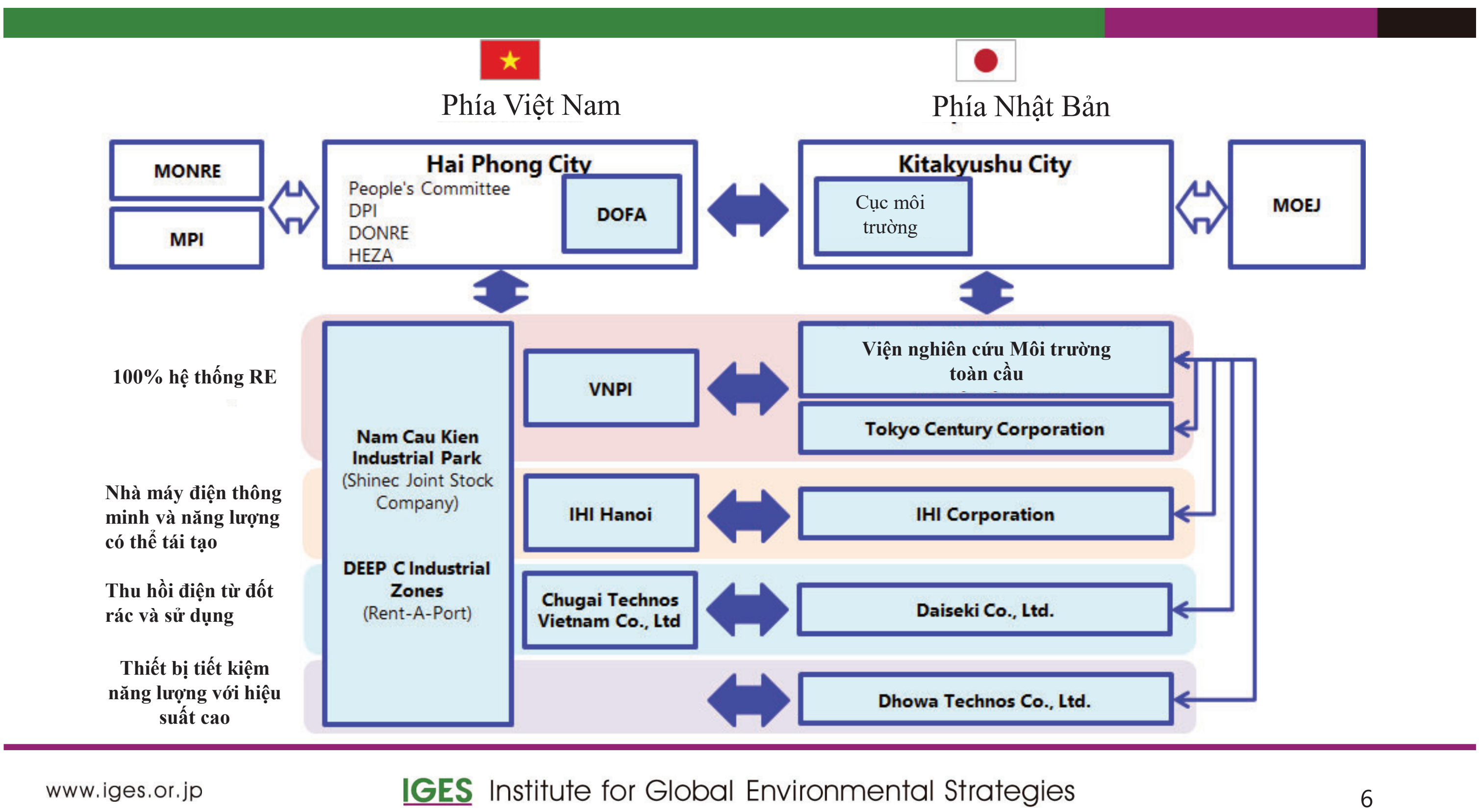
Phía Việt Nam
Phía Nhật Bản
MONRE
MPI
Hai Phong City
People's Committee
DPI
DONRE
HEZA
DOFA
Kitakyushu City
Cục môi trường
MOEJ
100% hệ thống RE
Nhà máy điện thông minh và năng lượng có thể tái tạo
Thu hồi điện từ đốt rác và sử dụng
Thiết bị tiết kiệm năng lượng với hiệu suất cao
Nam Cau Kien Industrial Park
(Shinec Joint Stock Company)
DEEP C Industrial Zones
(Rent-A-Port)
VNPI
IHI Hanoi
Chugai Technos Vietnam Co., Ltd
Viện nghiên cứu Môi trường toàn cầu
Tokyo Century Corporation
IHI Corporation
Daiseki Co., Ltd.
Dhowa Technos Co., Ltd.
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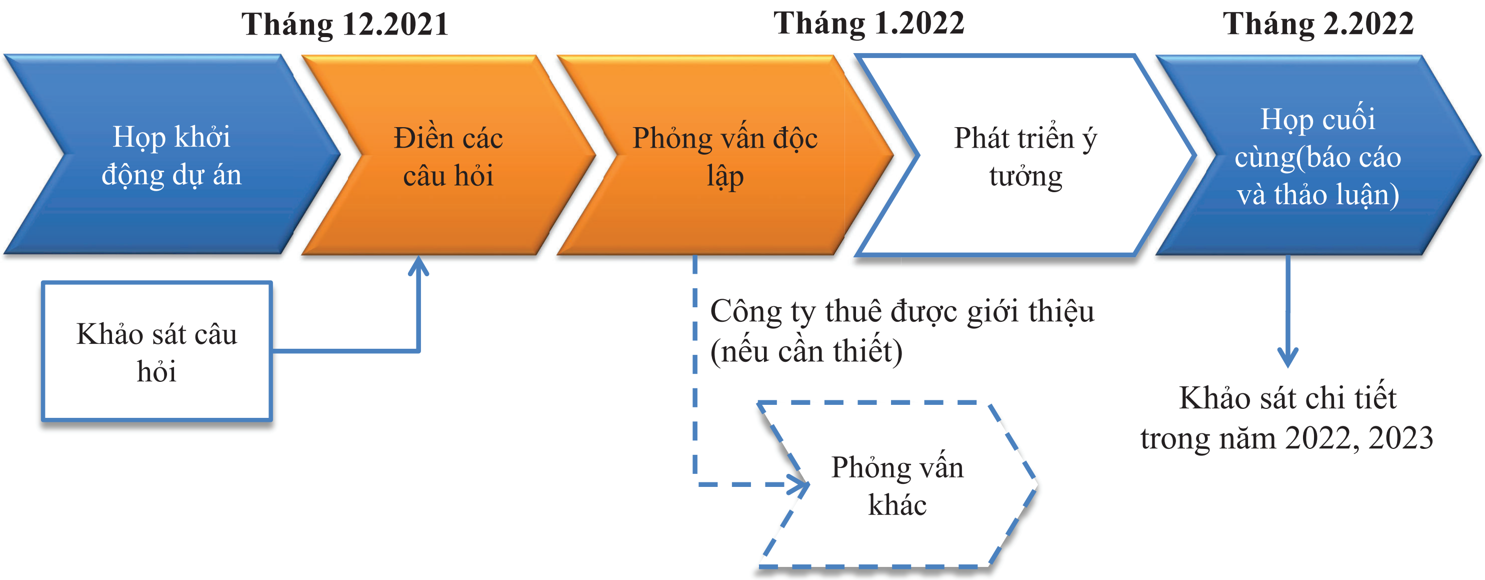
6

Quy trình khảo sát đề xuất trong năm tài khóa 2021



https://www.jprsi.go.jp/ew2021vn

IHI

Đề xuất của IHI về nhà máy điện THÔNG MINH (SMART Power Plant) cho Khu công nghiệp

Và các yêu cầu của IHI

IHI

Ngày 15 tháng 12 năm 2021

I H I Corporation
Phòng thiết kế cơ bản
Bộ phận kinh doanh giải pháp Cacbon

Mục lục

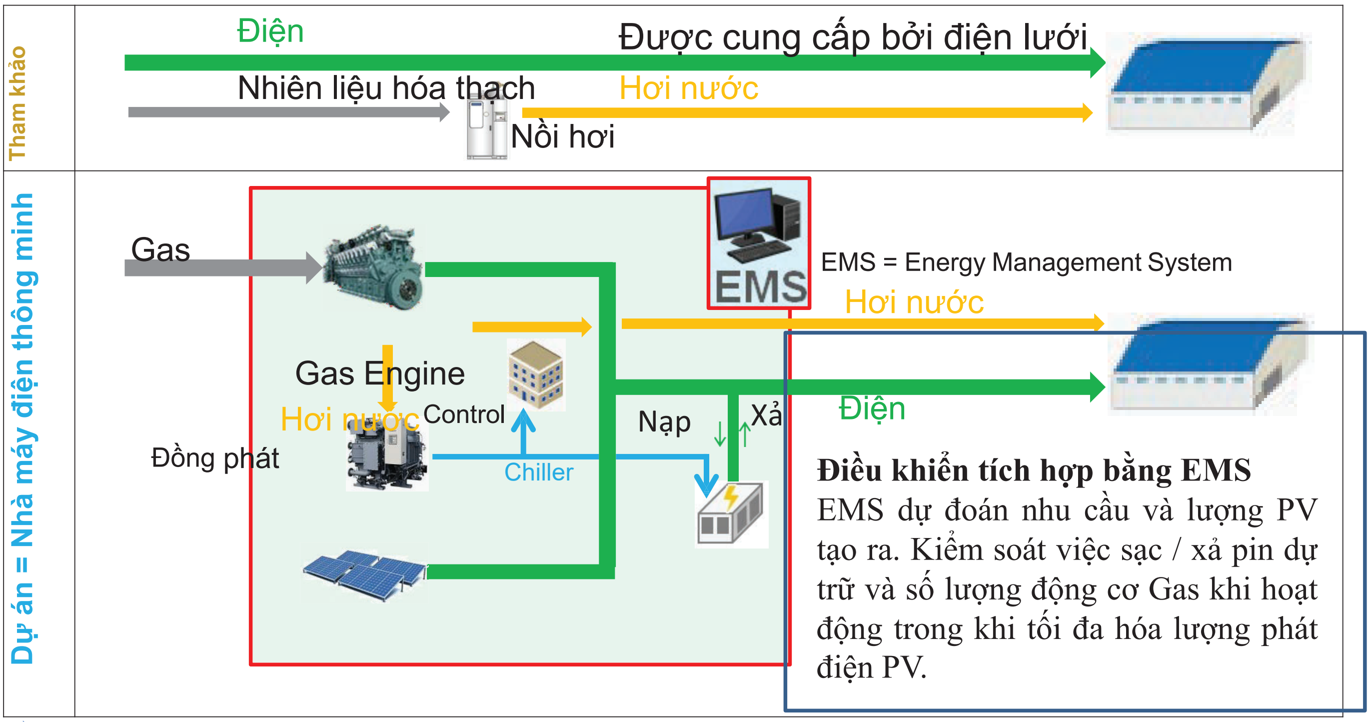
IHI

- Nhà máy điện thông minh của IHI và ưu điểm
- Khu vực (nhà máy) mục tiêu đề xuất của IHI cho Nhà máy điện thông minh
- Điều gì sẽ xảy ra nếu khu vực mục tiêu được giả định dành cho toàn bộ khu công nghiệp.
- Nhà máy điện thông minh do IHI đề xuất cho khu vực mục tiêu hạn chế (nhà máy)
- Yêu cầu của IHI về việc công bố dữ liệu để tiếp tục nghiên cứu sâu hơn.

Nhà máy điện thông minh của IHI và các ưu điểm

IHI

Giảm CO2 bằng nhà máy điện SMART bằng PV và kiểm soát tối ưu bằng EMS



IHI cung cấp các giải pháp giảm thiểu CO2 với vận hành hiệu quả

3

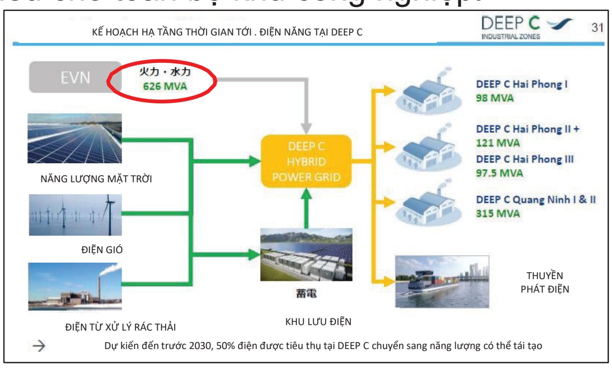
Khu vực (nhà máy) mục tiêu đề xuất của IHI cho Nhà máy điện thông minh

IHI

- IHI muốn lựa chọn khu vực giới hạn hoặc nhà máy và thực hiện nghiên cứu khả thi cho nhà máy điện thông minh.
  - ✓ Nhà máy điện thông minh thể hiện thế mạnh của mình khi lượng điện phát ra của PV + một số máy phát và nhu cầu sử dụng gần như nhau. Điểm mạnh của hệ thống này là hoạt động hiệu quả, loại bỏ sự thất thoát năng lượng.
  - ✓ Thông thường, nhu cầu dao động nên máy phát điện được vận hành với phụ tải một phần theo nhu cầu. Có sự thất thoát năng lượng.
  - ✓ Trong nhà máy điện thông minh, EMS vận hành từng bộ phận với hiệu suất tối đa bằng cách lưu trữ năng lượng thặng dư trong pin.
- Điều gì sẽ xảy ra nếu xác định diện tích mục tiêu cho toàn bộ khu công nghiệp.

✓ Tổng nhu cầu dự kiến là 626 MVA

✓ Mặt khác, nếu lượng PV + các máy phát điện khác là vài MW, thì việc tiêu thụ trực tiếp năng lượng được tạo ra mà không cần EMS và nhà máy điện thông minh sẽ hiệu quả hơn.



4

Nhà máy điện thông minh theo đề xuất của IHI cho khu vực mục tiêu giới hạn

IHI

- **Đề xuất nhà máy điện thông minh**

Phương án	Chi tiết
Phương án 1: PV + BESS (Hệ thống lưu trữ năng lượng pin)	Phương án 1-A: Tiết giảm phụ tải đỉnh (Peak shaving) bằng cách lưu trữ đầu ra PV vào trong pin và xả ra vào lúc cao điểm Phương án 1-B: Tiết giảm phụ tải đỉnh (Peak shaving) bằng cách lưu trữ đầu ra PV & điện lưới ở ngoài giờ cao điểm vào pin và xả ra vào lúc cao điểm
Phương án 2: EMS + PV + BESS + Động cơ khí với thế hệ đơn	Công suất tải cơ bản được tạo ra bởi động cơ gas, được vận hành tối ưu bởi EMS cùng với đầu ra PV.
Phương án 3: EEMS + PV + BESS + Động cơ khí+ Cung cấp hơi với phương thức đồng vận hành.	Công suất tải cơ bản được tạo ra bởi động cơ khí, được vận hành tối ưu bởi EMS cùng với sản lượng PV. Ngoài ra, việc sử dụng năng lượng hiệu quả hơn có thể được tiến hành bằng cách đồng phát với cung cấp hơi

Nhà máy điện thông minh theo đề xuất của IHI cho khu vực mục tiêu giới hạn

IHI

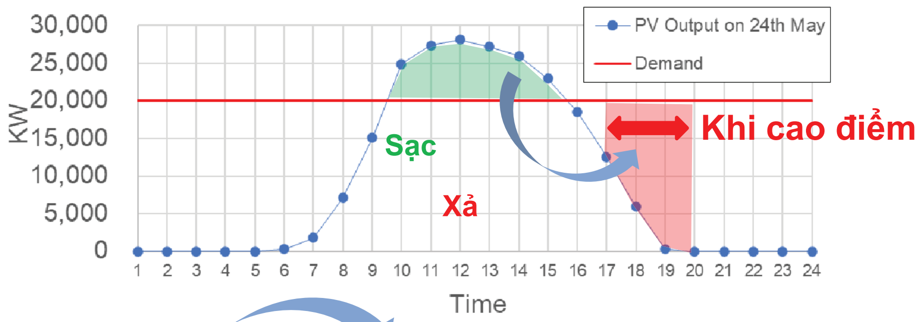
- Phương án 1: PV + BESS

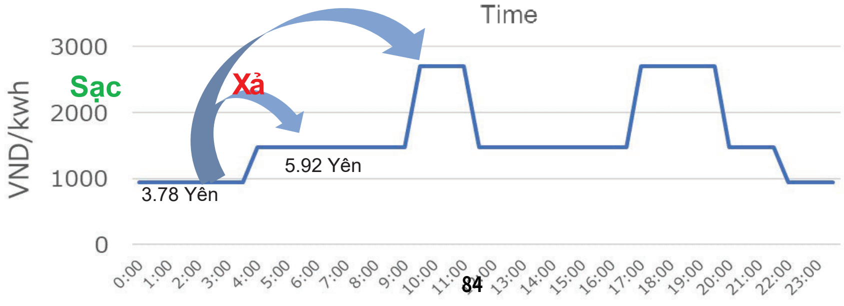
✓ Tiết giảm phụ tải đỉnh (Peak shaving) bằng cách lưu trữ đầu ra PV vào trong pin và xả ra vào lúc cao điểm

✓ Tiết giảm phụ tải đỉnh bằng cách lưu trữ đầu ra PV vào pin và xả ra ở chế độ Thường xuyên hoặc Cao điểm. Nhưng không thể áp dụng JCM trong trường hợp này.

Ngày 24 tháng 5 với PV 40MWp trên bức xạ mặt trời MAX trong năm

Tiết giảm phụ tải đỉnh (Chuyển dịch cao điểm)





Nhà máy điện thông minh theo đề xuất của IHI cho khu vực mục tiêu giới hạn IHI

- Phương án 1 : PV + BESS
  - ✓ Yêu cầu JCM: Một pin chỉ sạc điện được phát ra bởi modules quang điện được đưa vào

(Tham khảo trang -29) : https://gec.jp/jcm/jp/kobo/r03/mp/(tentative)2021_Guidelines_for_Submitting_Proposals.pdf

Phụ lục 3 Các điều kiện để được áp dụng bằng công nghệ
1. Nhà máy điện mặt trời
Tỷ lệ chuyển hóa từ quang năng thành điện năng của môđun quang điện phải là 20% hoặc cao hơn.
2. Nhà máy điện mặt trời bằng pin;
Tất cả các điều kiện sau đây phải được đáp ứng.
➢ Mô-đun quang điện
Hiệu suất của môđun quang điện phải từ 20% trở lên.
➢ Pin
(1) Một pin chỉ sạc năng lượng được tạo ra bởi các mô-đun quang điện được đưa vào, và
Có thể đo lượng điện cung cấp từ pin.
(2) Về sự cần thiết lắp đặt của pin, một trong các yêu cầu sau phải đáp ứng:
1) Lắp đặt tại các khu vực ngoài lưới
2) Trong trường hợp cung cấp nguồn điện được tạo ra vào lưới điện, việc lắp đặt pin được yêu cầu bởi luật pháp hoặc các quy định của quốc gia đối tác, chẳng hạn như nhằm mục đích ổn định hệ thống lưới điện.
3) Tất cả những điều sau đây phải được đáp ứng để tự tiêu thụ trong nhà máy hoặc nguồn điện địa phương kinh doanh cung cấp.
(a) Về nguyên tắc, pin phải được sạc và xả mỗi ngày.
(b) Dung lượng pin lớn hơn 20% hoặc lớn hơn công suất của mô-đun quang điện được lắp đặt và nằm trong lượng điện năng tối đa có thể tính phí hàng ngày.

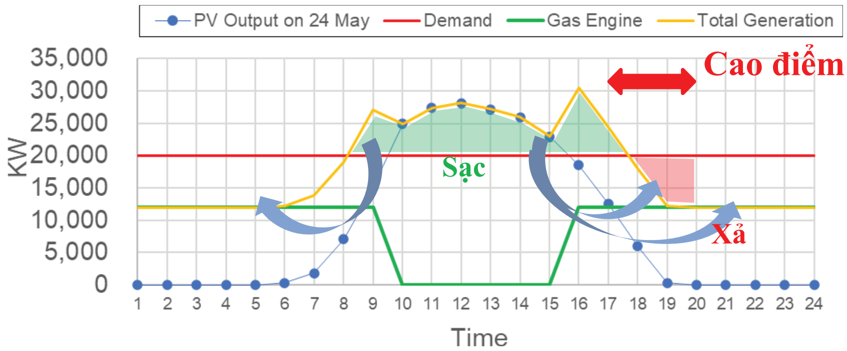
Nhà máy điện thông minh theo đề xuất của IHI cho khu vực mục tiêu giới hạn IHI

- Phương án: PV + BESS
  - ✓ Công suất của PV tại khu vực 5Ha đang được kỳ vọng với khoảng 6MWp.
  - ✓ Sản lượng trung bình có thể được kỳ vọng ở mức 0,6MW - 0,9MW nếu tỷ lệ sử dụng là 10% -15%.
  - ✓ Có khu vực tiềm năng nào để lắp đặt PV không? Có khu vực lắp PV dạng nổi có sẵn không?

Nhà máy điện thông minh theo đề xuất của IHI cho khu vực mục tiêu giới hạn IHI

- Phương án 2: EMS +PV + BESS + Động cơ khí phát điện đơn
  - ✓ Công suất tải cơ bản được tạo ra bởi động cơ khí, được vận hành tối ưu bởi EMS cùng với đầu ra PV.
  - ✓ Có khu vực nào có nhu cầu điện từ vài MW đến vài chục MW không?

Ngày 24 tháng 5 với PV 40MWp trên bức xạ mặt trời MAX trong năm và với động cơ khí 6MW x 2 tổ máy



- Phương án 3: EMS +PV + BESS + Động cơ Gas + hơi nước với hệ thống đồng phát (điện nhiệt kết hợp) Ngoài ra, có thể mong đợi việc sử dụng năng lượng hiệu quả hơn bằng cách đồng phát điện với cung cấp hơi nước. Hiện có nhà máy nào đang có sẵn việc sử dụng hơi nước không?

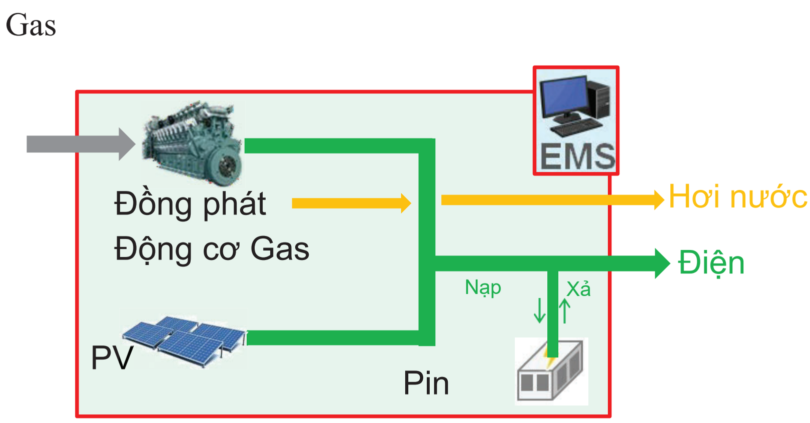
 9

Yêu cầu của IHI về việc cung cấp dữ liệu để tiếp tục nghiên cứu sâu hơn IHI

- Khu vực mục tiêu để nghiên cứu khả thi

(1) Khu vực mục tiêu và nhu cầu của nó
  - ✓ Có khu vực nào có nhu cầu điện từ vài MW đến vài chục MW không?
  - ✓ Và IHI muốn biết nhu cầu điện năng thực tế của mức tiêu thụ điện 24Hr từ lưới điện.

(2) Cung cấp hơi nước
  - ✓ Có bất kỳ dự án nào sẵn sàng sử dungh hơi nước không?



Yêu cầu của IHI về việc cung cấp dữ liệu để tiếp tục nghiên cứu sâu hơn IHI

- Biểu giá điện
- (3) Vui lòng xác nhận xem giá điện sau có áp dụng trong khu công nghiệp của bạn hay không.

Sạc điện: https://en.evn.com.vn/d6/news/WHOLESALE-ELECTRICITY-TARIFF-9-28-260.aspx

Định nghĩa về giờ: https://en.evn.com.vn/d6/news/TIME-OF-USE-ELECTRICITY-CHARGE-9-28-264.aspx

VIETNAM ELECTRICITY
Enlightening Trust
EVN

Khu công nghiệp

Nhóm khách hàng		Giá VND/kWh
1	**Tại thanh cái 110 kV của trạm biến áp 110 kV/35-22-10-6 kV**	
1.1	**Tổng công suất đặt các MBA của trạm biến áp lớn hơn 100 MVA**	
1.1.1	Giờ bình thường	1.480
1.1.2	Giờ thấp điểm	945
1.1.3	Giờ cao điểm	2.702

a) Quy định về giờ:

+ Giờ bình thường

Gồm các ngày từ thứ Hai đến thứ Bảy
- Từ 04 giờ 00 đến 9 giờ 30 (05 giờ và 30 phút);
- Từ 11 giờ 30 đến 17 giờ 00 (05 giờ và 30 phút);
- Từ 8 giờ 00 tối đến 10 giờ 00 tối (02 giờ).

Ngày Chủ nhật
Từ 04 giờ 00 đến 10 giờ 00 tối (18 giờ).

+ Giờ cao điểm

Gồm các ngày từ thứ Hai đến thứ Bảy
- Từ 09 giờ 30 đến 11 giờ 30 (02 giờ);
- Từ 17 giờ 00 đến 8 giờ 00 tối (03 giờ).

Ngày Chủ nhật: không có giờ cao điểm.

+ Giờ thấp điểm:

Tất cả các ngày trong tuần: từ 10 giờ 00 tối đến 04 giờ 00 sáng ngày hôm sau (06 giờ).

(4) Nếu một số ngày trong tuần là ngày nghỉ lễ, những ngày bình thường như từ thứ Hai đến thứ Bảy có được áp dụng không? (Nói cách khác, định nghĩa về giờ vào ngày Chủ Nhật hoặc giờ vào ngày thứ Hai có thể áp dụng nếu Thứ Hai là ngày lễ quốc gia.)

 11

Yêu cầu của IHI về việc cung cấp dữ liệu để tiếp tục nghiên cứu sâu hơn IHI

- Biểu giá LNG hoặc Gas tại thành phố.

(5) Vui lòng cho IHI biết website về biểu giá LNG hoặc Gas vì IHI muốn đưa biểu giá Gas vào Nghiên cứu khả thi với động cơ Gas.

✓Một số website đăng tải giá Gas khoảng 6,5 USD / MMBTU.

IHI muốn xác nhận giá Gas trên website của các cơ quan hiện đang đăng tải công khai.

12

Yêu cầu của IHI về việc cung cấp dữ liệu để tiếp tục nghiên cứu sâu hơn IHI

- Tỷ lệ sử dụng trung bình hàng năm của PV (Hệ số công suất)

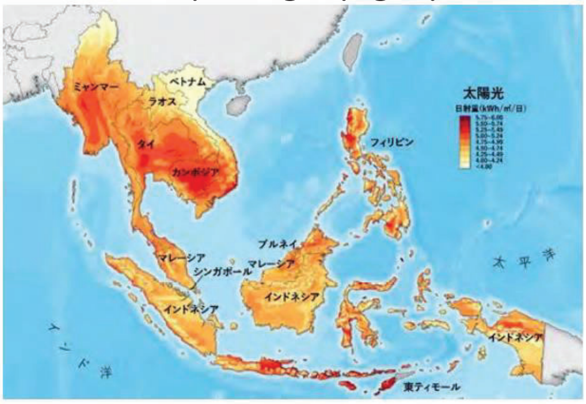
Vui lòng cho IHI biết giá trị của tỷ lệ sử dụng trung bình hàng năm của PV tại miền Bắc Việt Nam.

✓ Một số website đăng tin là 15% tại miền Bắc Việt Nam

✓ Nhưng khoảng 10% có thể được tính bằng 24 giờ của dữ liệu bức xạ mặt trời của 365 ngày.

✓ Vui lòng cho IHI biết giá trị chung của tỷ lệ sử dụng PV ở miền Bắc Việt Nam nếu có sẵn số liệu

Bản đồ điện năng lượng mặt trời



Nguồn: Cục phát triển Quốc tế Mỹ (USAID) và Viện nghiên cứu năng lượng tái tạo (NREL) Số liệu 6.2019

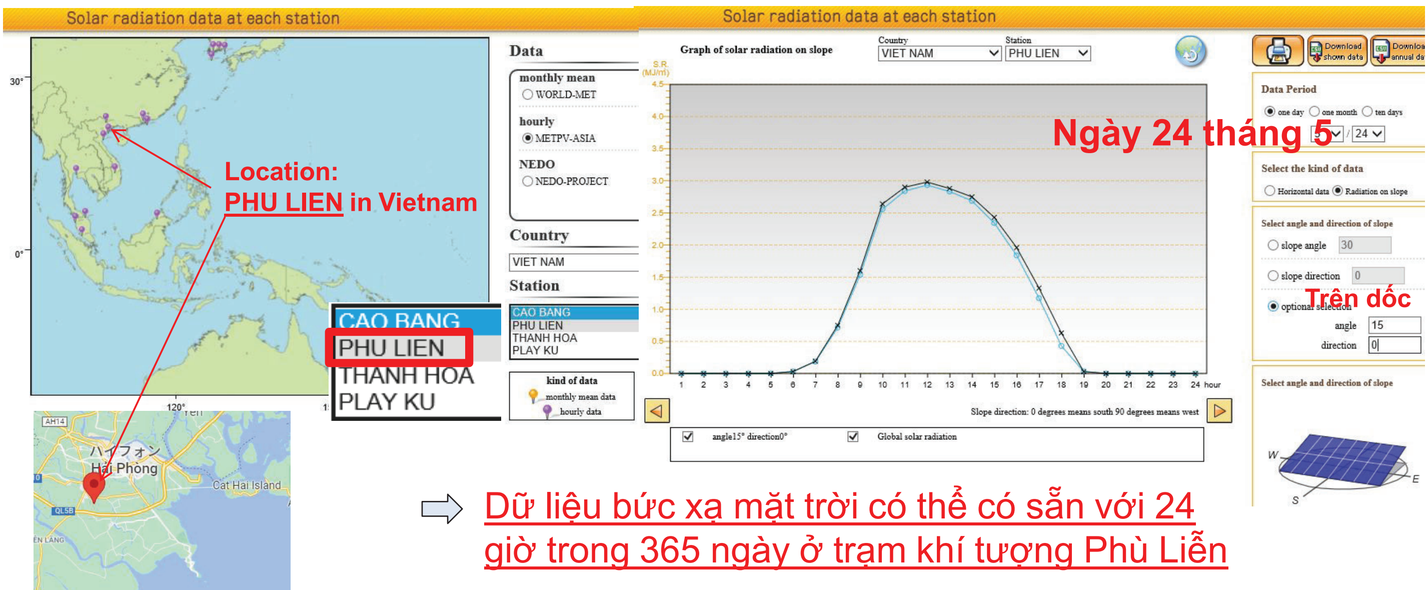
Dữ liệu hỗ trợ để thiết kế phát điện PV IHI

Dữ liệu bức xạ năng lượng mặt trời tại Việt Nam

- Mời xem website của NEDO Tham khảo) NEDO: Tổ chức Phát triển Kỹ thuật Công nghiệp và Năng lượng Mới

✓ Cơ sở dữ liệu (Bản tiếng Anh) :https://appww1.infoc.nedo.go.jp/appww/index.html?lang=2

✓ Sách hướng dẫn sử dụng (Bản tiếng Anh) :https://www.nedo.go.jp/content/100926825.pdf



⇨ Dữ liệu bức xạ mặt trời có thể có sẵn với 24 giờ trong 365 ngày ở trạm khí tượng Phù Liễn

IHI

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PHỤC HỒI VÀ SỬ DỤNG NĂNG LƯỢNG TỪ CHẤT THẢI DẠNG LỎNG

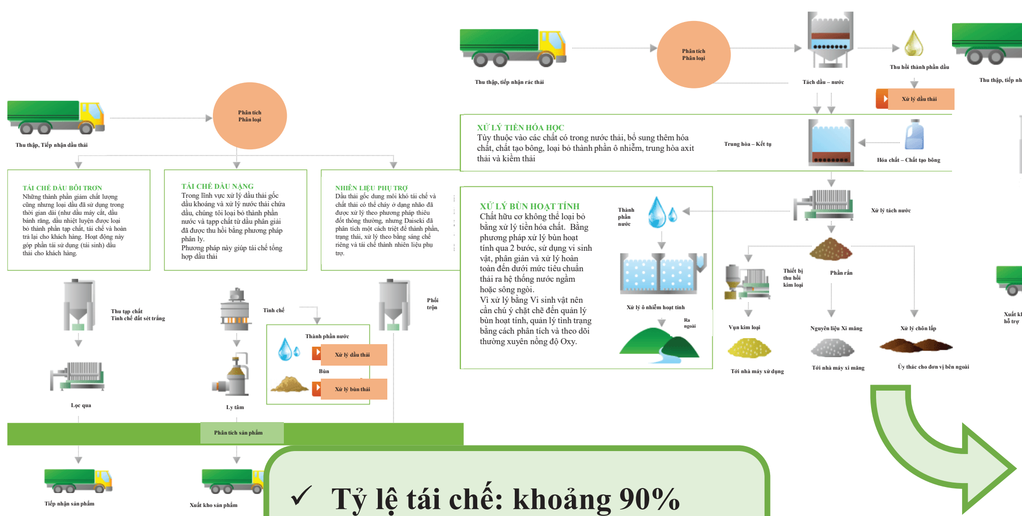
株式会社ダイセキ

PHỤC HỒI VÀ SỬ DỤNG NĂNG LƯỢNG TỪ CHẤT THẢI DẠNG LỎNG (DAISEKI CO., LTD)

Tái chế dầu thải

Tái chế nước thải

Tái chế bùn



- ✓ Tỷ lệ tái chế: khoảng 90%
- ✓ Giảm CO2: hơn 90% so với phương pháp xử lý đốt

JOGMEC

Các quốc gia được khảo sát – Tổng quan khu vực (Năm 2014)

Cơ cấu tiêu thụ năng lượng thứ cấp và lượng tiêu thụ than đá

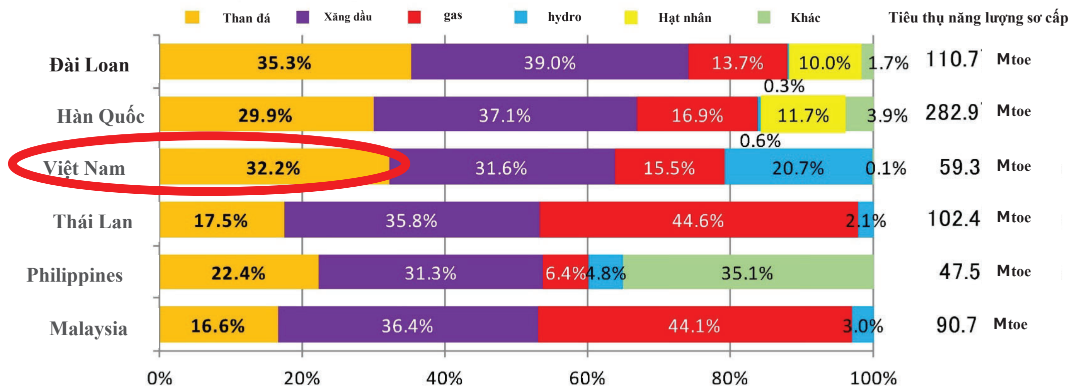
Cơ cấu năng lượng thứ cấp:

■ Tại Đài Loan, Hàn Quốc và **Việt Nam Lượng tiêu thụ than đá trên 30%**

■ Tỷ lệ than đá ở Thái Lan, Malaysia và Philippines khoảng 20%

■ Than đá (than đá nói chung) được sử dụng nhiều nhất cho nhà máy phát điện. **Tiếp theo đó là trong các nhà máy sản xuất Xi măng.**

	Tiêu thụ than trên toàn khu vực khảo sát (Mton)				
	Tổng	Phát điện	Thép	Xi măng	Khác
Malaysia	2,525	2,267	0	258	0
Philippines	2,016	1,559	0	320	137
Thái Lan	3,926	2,550	0	780	596
Việt Nam	3,424	1,455	88	1,095	786
Hàn Quốc	13,336	8,033	3,761	496	1,047
Đài Loan	6,382	4,520	963	171	728
Tổng	31,609	20,384	4,812	3,120	3,293



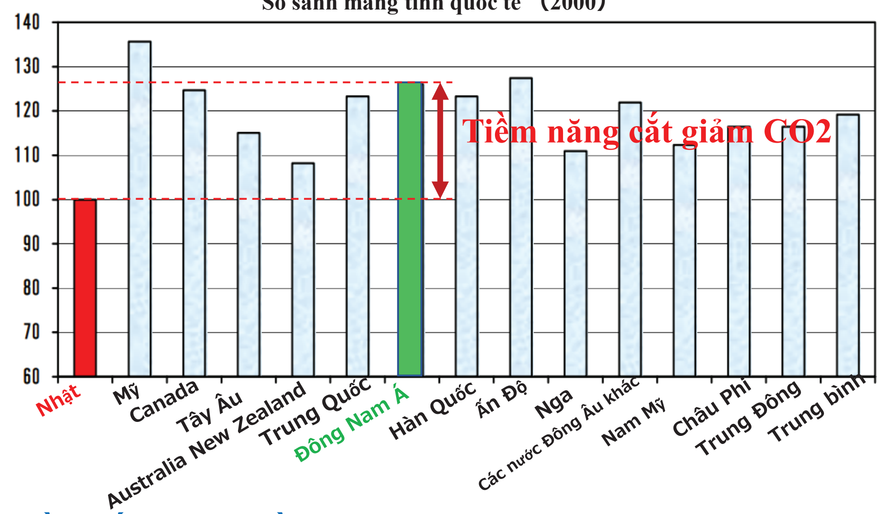
Nguồn: Tài liệu thống kê các quốc gia và khu vực là đối tượng điều tra

Chú ý: Cơ cấu năng lượng thứ cấp của Malaysia là số liệu thực tế năm 2013

Xuất khẩu xi măng của Việt Nam năm 2018 lên tới 32 triệu tấn đưa Việt Nam trở thành nước xuất khẩu xi măng lớn nhất thế giới.

Ngành xi măng là ngành tiêu thụ năng lượng công nghiệp lớn thứ ba và là ngành phát thải CO2 công nghiệp lớn thứ hai trên toàn cầu.

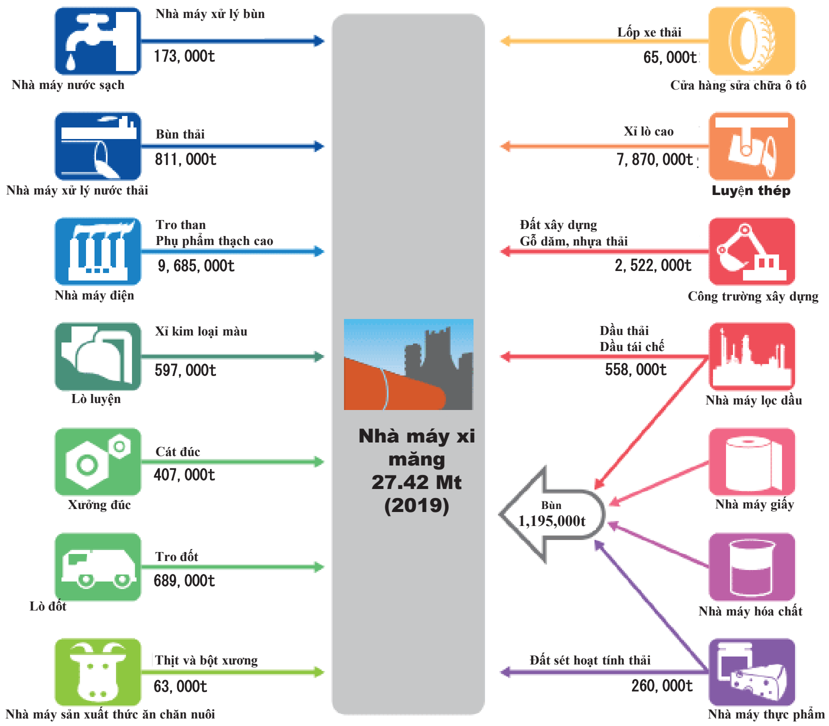
Lượng khí thải CO2 trên một tấn xi măng
So sánh mang tính quốc tế (2000)



Đây là nhu cầu cấp bách nhằm giảm lượng phát thải khí CO2 từ nhà máy xi măng

Sử dụng chất thải và phụ phẩm tại nhà máy xi măng

Ngành công nghiệp xi măng Nhật Bản đã phát triển các công nghệ cho phép sử dụng chất thải làm nguyên liệu thô thay thế hoặc năng lượng nhiệt thay thế cùng với Công ty Daiseki.
Công nghệ này mang đến hiệu quả tiết kiệm tài nguyên thiên nhiên và kéo dài tuổi thọ của các bãi chôn lấp hiện có.
Daiseki phát triển và đề xuất các sản phẩm tái chế cho các nhà máy xi măng và cung cấp cho các nhà máy xi măng sử dụng ổn định.

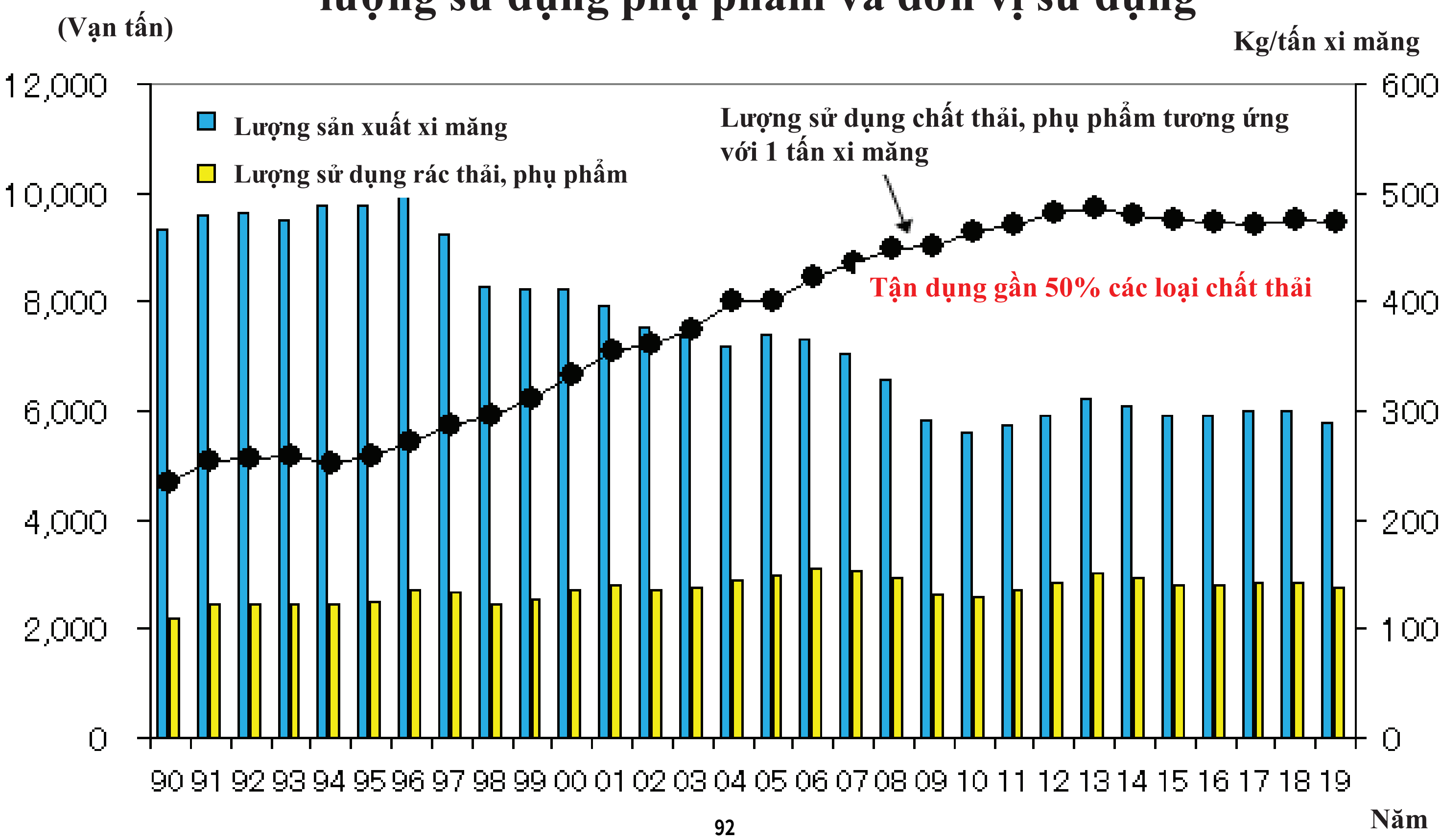


○ Lợi ích cho nhà máy xi măng

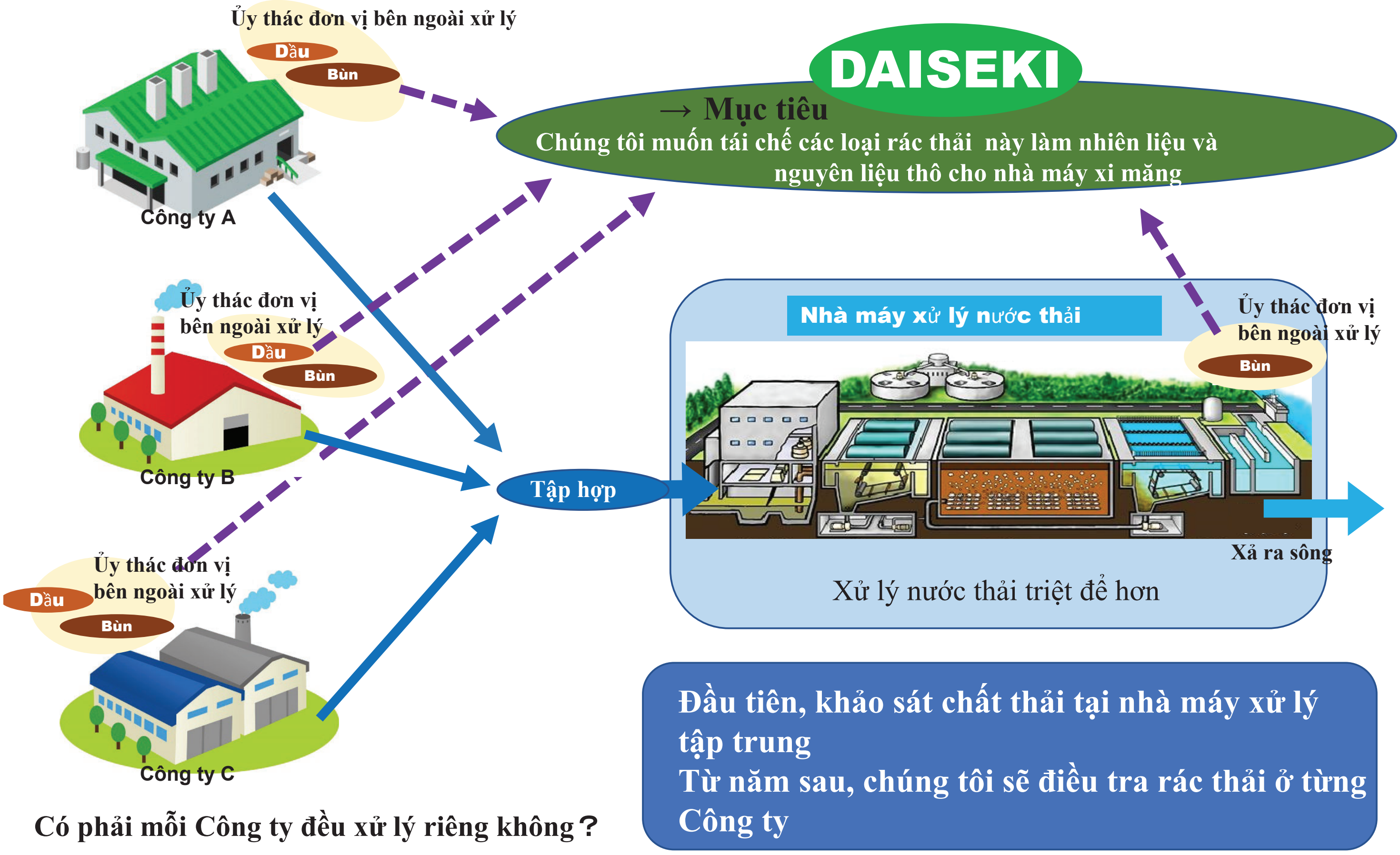
1. Giảm tiêu thụ nhiên liệu hóa thạch
2. Giảm phát thải CO2
3. Giảm chi phí nguyên liệu thô
4. Đảm bảo ổn định nguyên liệu thô
5. Giảm chi phí nhiên liệu
6. đảm bảo nhiên liệu ổn định
7. Giảm chi phí điện

Năm nay, chúng tôi sẽ khảo sát tình hình sử dụng chất thải tại nhà máy xi măng.

Chuyển đổi lượng sản xuất xi măng với lượng chất thải, lượng sử dụng phụ phẩm và đơn vị sử dụng



Hình ảnh tổ hợp xử lý nước thải trong Khu công nghiệp giả định



Bảng điều tra (dùng cho nhà máy Xi măng)

1. Tổng quan về nhà máy
Sản lượng hàng năm (t/năm)
Kế hoạch sản xuất trong tương lai (t/năm)
Các loại và đầu vào của nguyên liệu thô hiện có
Đơn giá nguyên vật liệu hiện có
Loại và lượng nhiên liệu đầu vào (t/năm)
Đơn giá nhiên liệu hiện có
Tình trạng rác thải / rác thải xi măng lỏng chuyển đổi nguyên liệu
Chuyển đổi nhiên liệu thô xi măng Loại chất thải / chất lỏng thải, lượng sử dụng, đơn giá

2. Tái chế rác thải/dầu thải thành nguyên nhiên liệu xi măng, khả năng chấp nhận, các vấn đề
Khả năng mức độ quan tâm việc tiếp nhận/ ý định
Các vấn đề về tiếp nhận
Giá trị tham chiếu được tiếp nhận cho các nguyên liệu và nhiên liệu thay thế

Bảng điều tra (dùng cho Khu công nghiệp)

1. Tình trạng tiếp nhận của nước thải, bùn và dầu thải
Công suất xử lý hàng năm (t/năm)
Số lượng doanh nghiệp tiếp nhận (công ty)
Thành phần / số lượng cho từng hạng mục tiếp nhận
Phân tích tình trạng nước thải, v.v.

2. Tổng quan về xử lý chất lỏng / bùn thải (xả thải)
○ Đang được xử lý trong Khu công nghiệp, ○Đang ủy thác cho đơn vị xử lý bên ngoài?
Phát thải theo loại (t/năm)
Phương pháp xử lý
Giá thành (VND/m3 hoặc tấn)
Tình trạng phân tích
Khả năng sử dụng tài nguyên

Địa chỉ liên hệ để được giải đáp thắc mắc về Bảng điều tra

Nhà máy Xi măng
Thông tin liên lạc：Chugai Technos Vietnam Co., Ltd
Phụ trách ：VIM VAN DUNG（Mr.）

Khu công nghiệp：
Thông tin liên lạc ：Chugai Technos Vietnam Co., Ltd
Người phụ trách 1 ：MORIMOTO KAZUYOSHI（Mr.）
Người phụ trách 2 ：VIM VAN DUNG（Mr.）

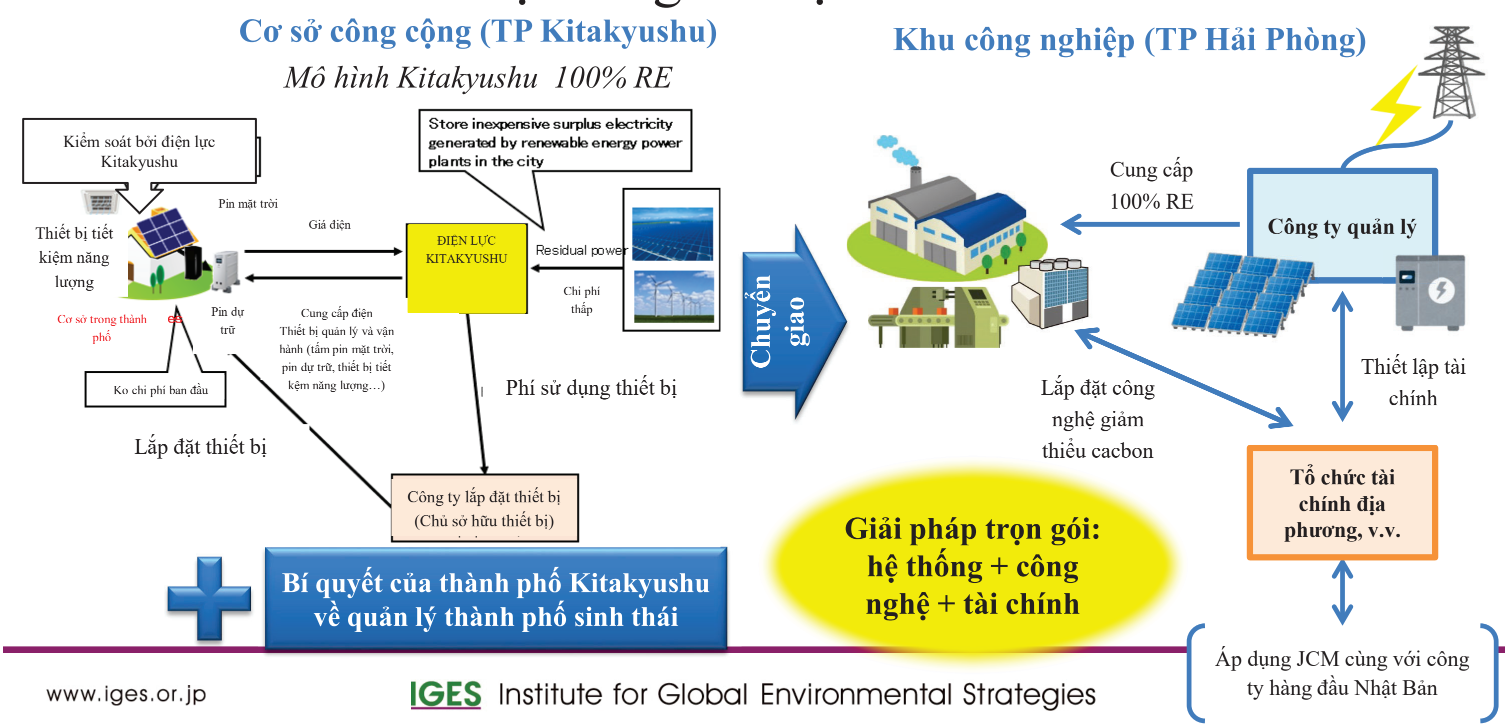
Hệ thống tăng cường lắp đặt năng lượng tái tạo

Viện Chiến lược Môi trường Toàn cầu
Cục Môi trường, Thành phố Kitakyushu

Họp khởi động, ngày 10 tháng 12 2021

IGES
Institute for Global Environmental Strategies

Hệ thống cài đặt RE



Các kế hoạch hỗ trợ để giới thiệu PV ở Nhật Bản

	Thuê mái	PPA	Cho thuê	Vay	Tự sở hữu
Chủ sở hữu tài sản	Công ty sản xuất điện	Nhà cung cấp dịch vụ cho thuê (tự sở hữu sau hợp đồng PPA)	Nhà cung cấp dịch vụ cho thuê (tự sở hữu sau hợp đồng PPA)	Khách hàng	CÓ
Chi phí ban đầu	—	—	—	— (có thể được đặt thành không)	CÓChi phi
Chi phí O&M	—	—	—	CÓ	CÓ
Chủ sở hữu sản xuất điện	Công ty sản xuất điện	Nhà cung cấp PPA	Khách hàng (Có thể chọn tự tiêu thụ hoặc bán điện)	CÓ	CÓ r
Chi phí khác	—	Thanh toán tiền điện tự tiêu thụ	Thanh toán tiền thuê (xảy ra ngay cả khi điện không được tạo ra)	Trả nợ	—
Thu nhập từ bán điện	—	—	CÓ (Không tính phí tự tiêu thụ)	CÓ (Không tính phí tự tiêu thụ)	CÓ ((Không tính phí tự tiêu thụ)
Thu nhập khác	Phí sử dụng mái	—	—	—	—

Khảo sát vào năm tài khóa 2021

Mục tiêu khảo sát

- ☐ Để hiểu sâu hơn về các hệ thống lắp đặt PV hiện có
- ☐ Để làm rõ những thách thức trong việc đẩy nhanh sự ra đời của các hệ thống PV
- ☐ Để làm rõ thực trạng và khả năng giới thiệu hệ thống sở hữu của bên thứ ba cho các PV tại Việt Nam
- ☐ Để làm rõ định hướng cho cuộc khảo sát năm sau

Phương pháp khảo sát

- ☐ Phỏng vấn các công ty quản lý các khu công nghiệp
- ☐ Phỏng vấn các ngân hàng chính của các khu công nghiệp
- ☐ Khảo sát trực tiếp qua trao đổi

Câu hỏi khảo sát

Khu công nghiệp

- Các hệ thống PV hiện có được lắp đặt như thế nào?
- Ai là nhà đầu tư?
- Nguồn tài chính như thế nào?
- Các công ty cho thuê có liên quan như thế nào (có lợi gì cho họ)?
- Điện sản xuất được tự tiêu thụ hay bán cho EVN?
- Những thách thức trong việc lắp đặt hệ thống PV ở quy mô lớn là gì?

Ngân hàng chính

- Các dịch vụ tài chính hiện có để hỗ trợ việc lắp đặt PV là gì?
- Có thể cung cấp bất kỳ dịch vụ tài chính nào như hệ thống quyền sở hữu của bên thứ ba cho PV không?
- Suy nghĩ cơ hội hay thách thức của hệ thống sở hữu bên thứ ba đối với PV tại Việt Nam là gì?

Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City

Institute for Global Environmental Strategies
Environment Bureau, Kitakyushu City
Department of Foreign Affairs, Hai Phong City
IHI Corporation
Daiseki Co., Ltd.
Dhowa Technos Co., Ltd.
Tokyo Century Corporation

Kick-off workshop, 15th December 2021

IGES Institute for Global Environmental Strategies

Commitments at the COP26

- ☐ Both Japan and Viet Nam pledged to strive for carbon neutrality by 2050
- ☐ Both Kitakyushu and Hai Phong also committed to strive for zero carbon cities

Japanese Prime Minister
Fumio Kishida

https://www.mofa.go.jp/ic/ch/page6e_000257.html

World Leaders Summit
(Nov. 2nd, 2021)

Vietnamese Prime Minister
Phạm Minh Chính

https://vietnamnews.vn/environment/1071075/viet-nam-strives-to-achieve-net-zero-by-2050-with-international-support-pm.html

Climate Summit
(Nov. 1st, 2021)

"Kitakyushu will continue to provide support in finding solutions to issues by deploying our environmental technologies overseas."

Kitakyushu City Mayor
Kenji Kitahashi

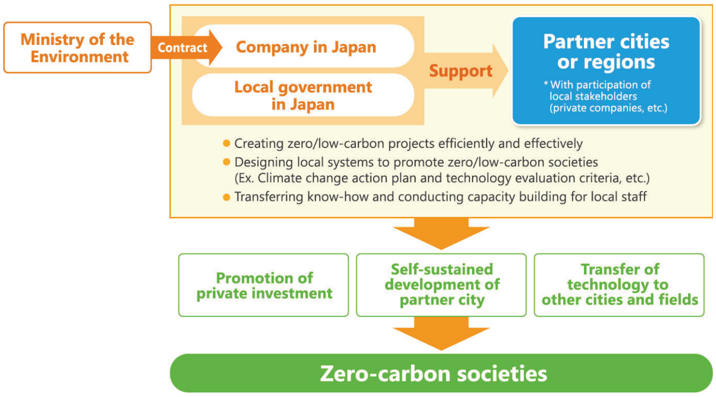
"..., we will certainly continue to work hand in hand with Kitakyushu city to realize a zero carbon city."

Deputy Director of DOFA
Dung Nguyen Thi Bich

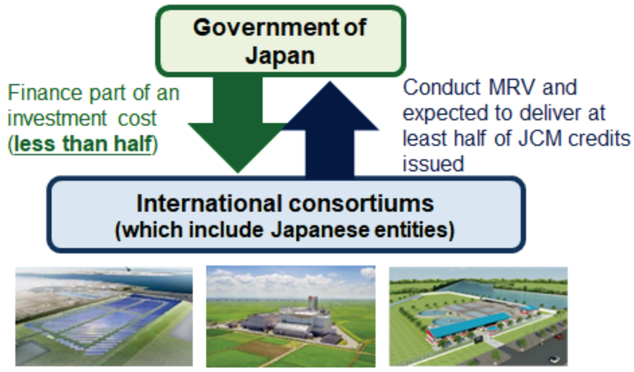
Side Event "Leading efforts towards achievement of zero carbon cities"
(Nov. 2nd 2021, Organized by MOEJ, IGES, ICLEI, OECD)

Project background

City-to-city collaboration project



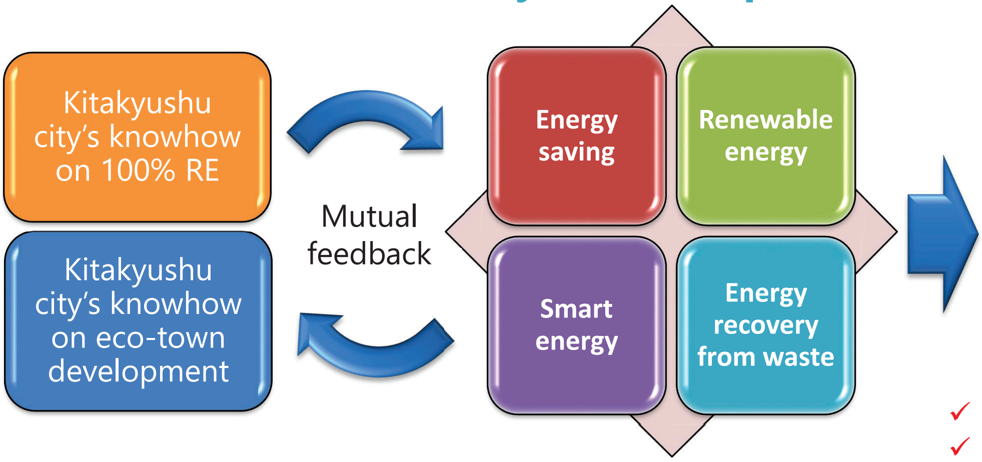
Joint Crediting Mechanism (JCM)



Project outline

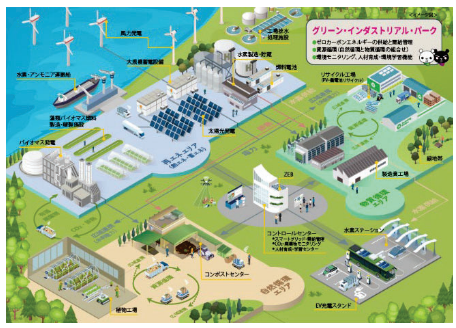
Know-how transfer

Project development



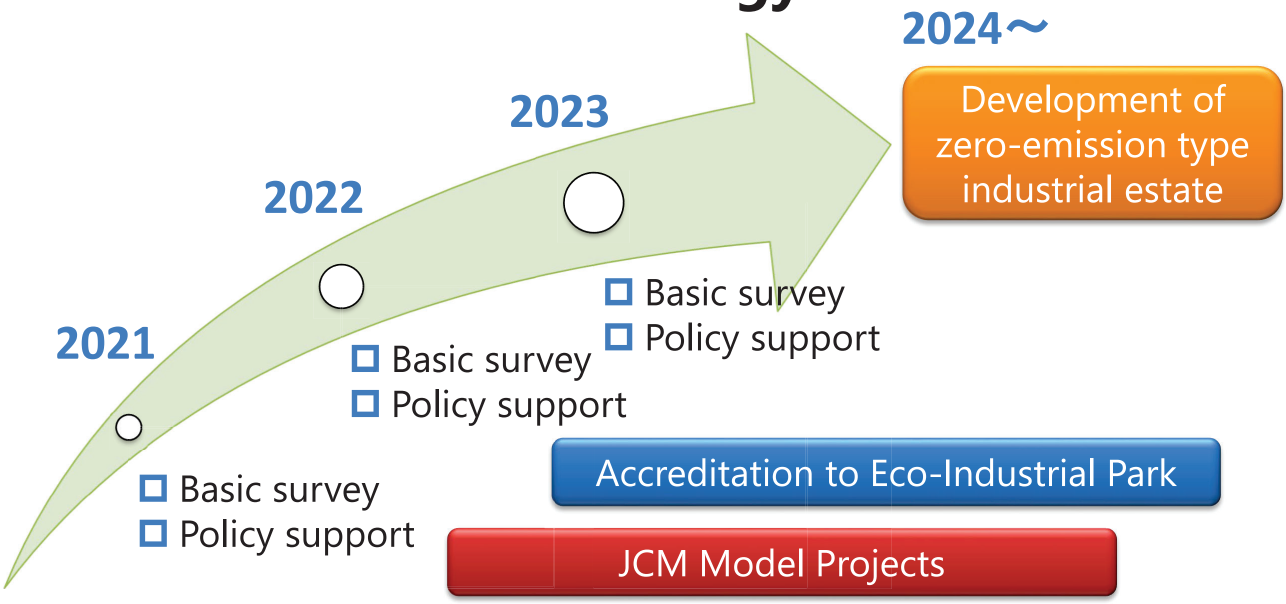
Expected outcome

Zero Emission Industrial Estates

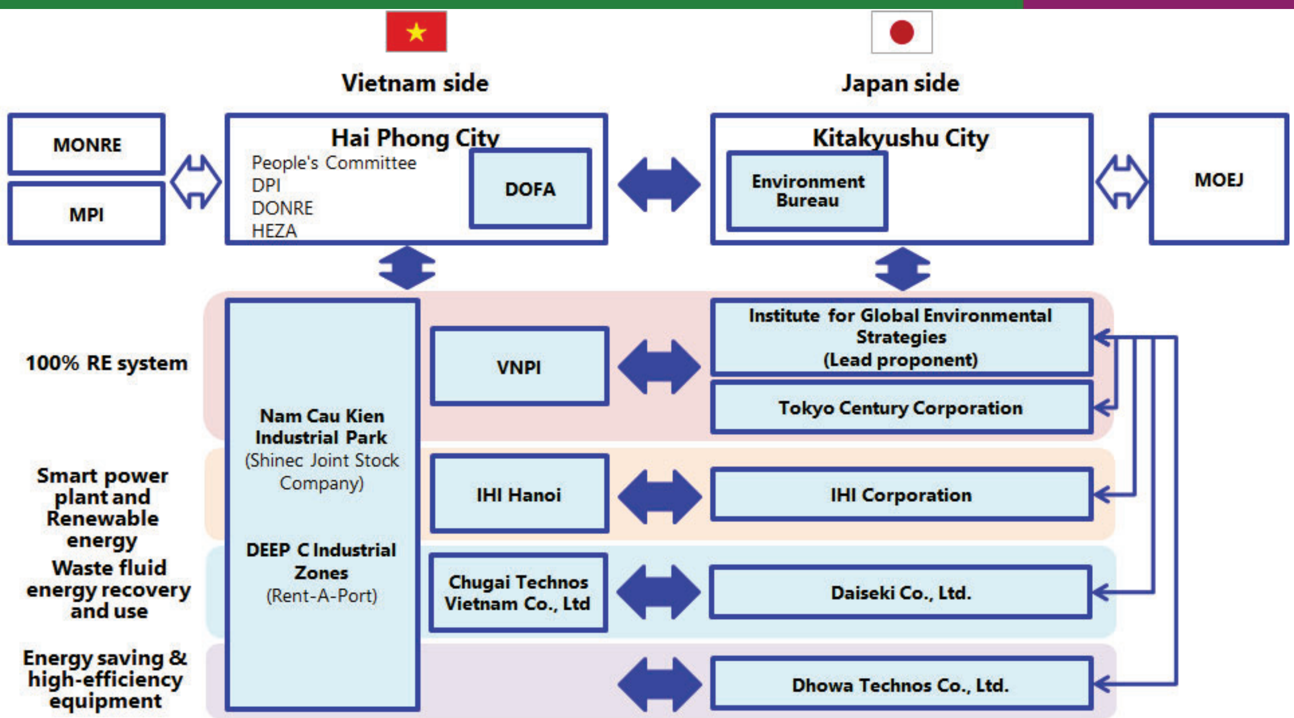


- ✓ Accreditation to Eco-Industrial Park
- ✓ Zero-emission industrial estates
- ✓ Decarbonization domino
- ✓ Localizing SDGs in industrial estate

Goal & Strategy



www.iges.or.jp IGES Institute for Global Environmental Strategies 5



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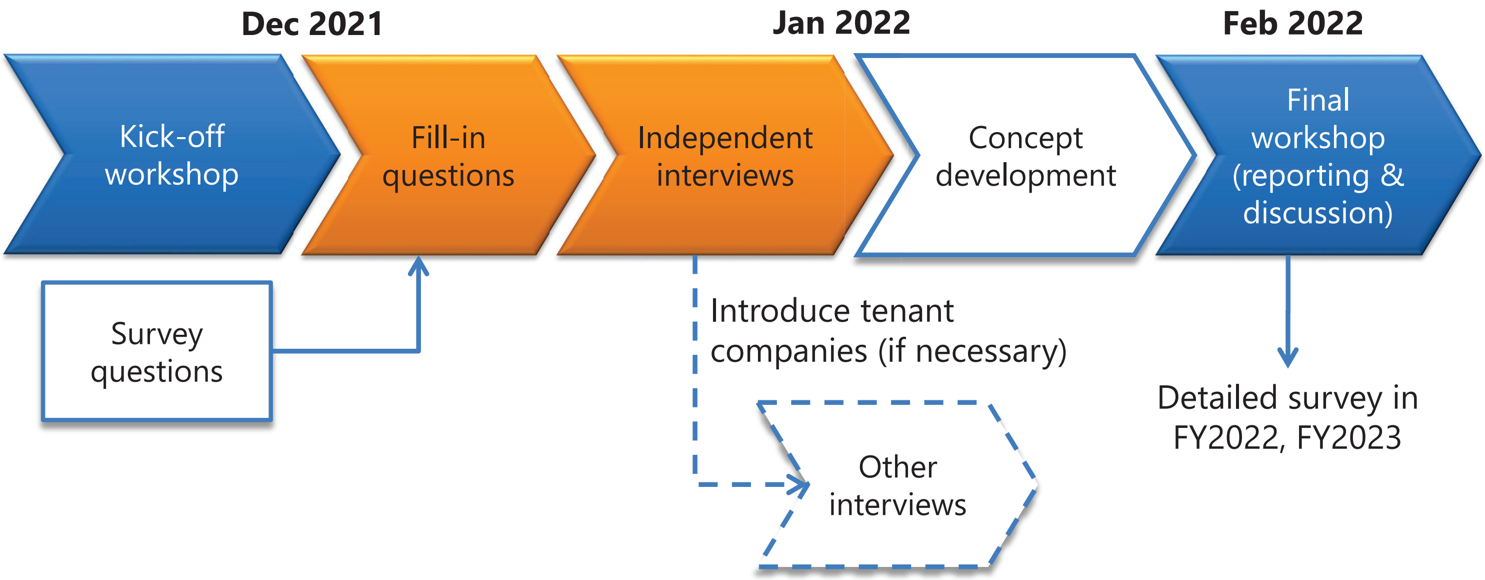
Proposed survey procedure in FY2021



https://www.jprsi.go.jp/ew2021vn

Business matching: 14-27 Dec 2021; Online Seminar: 15-17 Dec 2021

IHI's Proposal SMART Power Plant for Industrial Park and IHI's Request

IHI

Dec 15th 2021

I H I Corporation
Carbon Solution Business Unit
Basic Design Dept.

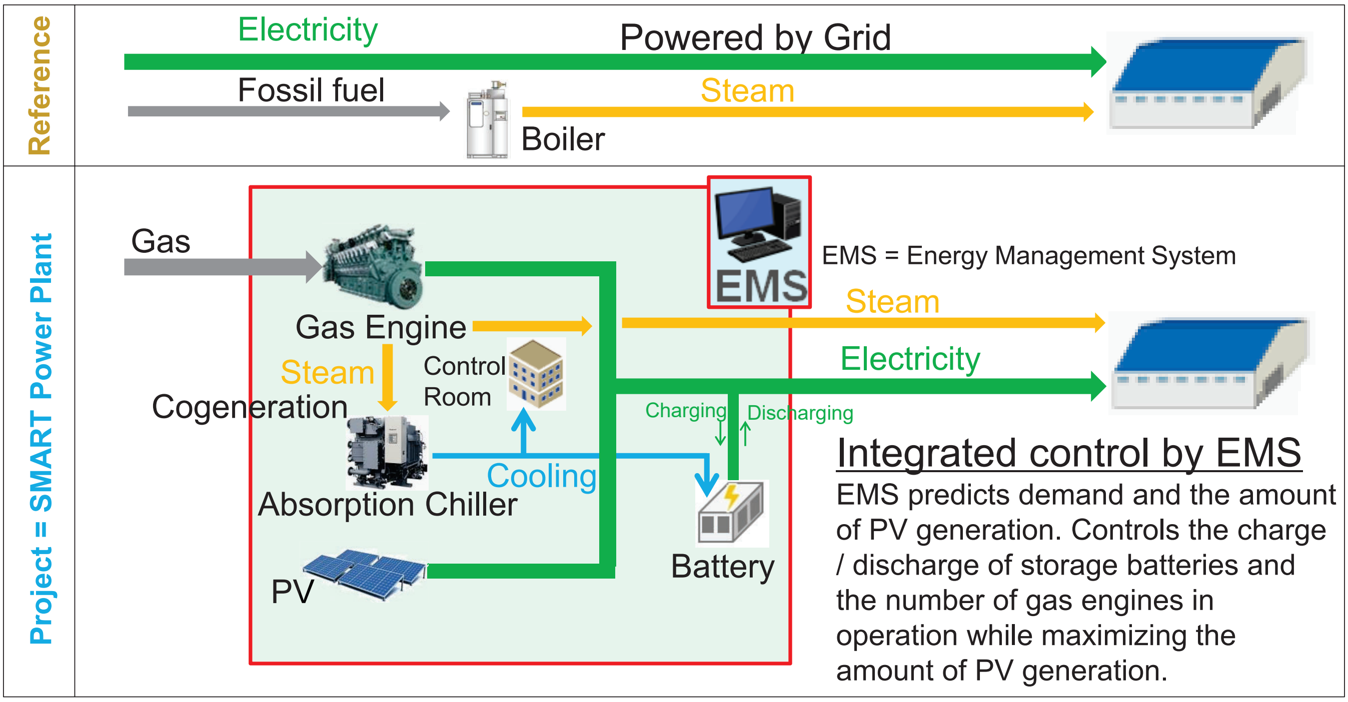
Contents

IHI

IHI's Smart Power Plant and its strength

IHI

CO2 reduction by SMART power plant with PV and optimal control by EMS

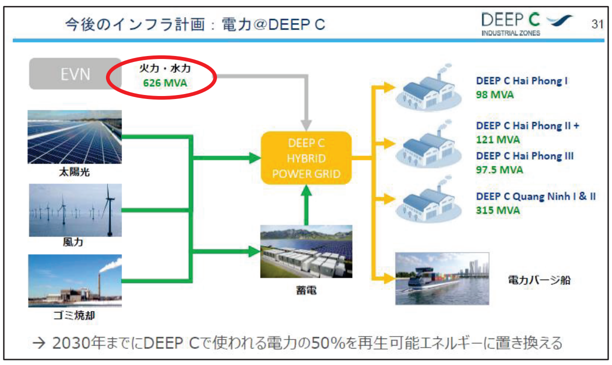


IHI provide CO2 reduction solutions with efficient operation

IHI's proposed target area (plants) for Smart Power Plant

IHI

- IHI would like to select the limited area or plants and carry out the feasibility study for smart power plant.
  - ✓ Smart power plant show its strength when the amount of power generation of PV + some generator and the demand are almost the same. Its strength is efficient operation eliminating the energy loss.
  - ✓ Normally, the demand fluctuates, so the generator is operated with the partial load according to the demand. There is the energy loss.
  - ✓ In the smart power plant, the EMS operates each components with the maximum efficiency by storing the surplus energy in the battery.
- What will happen if target area is assumed for the entire industrial zone.
  - ✓ The total demand is expected as 626 MVA.
  - ✓ On the other hand, if the amount PV + other generators is several MW, it's more effective to consume the generated energy directly without EMS and smart power plant.



IHI's proposed Smart Power Plant for the limited target area IHI

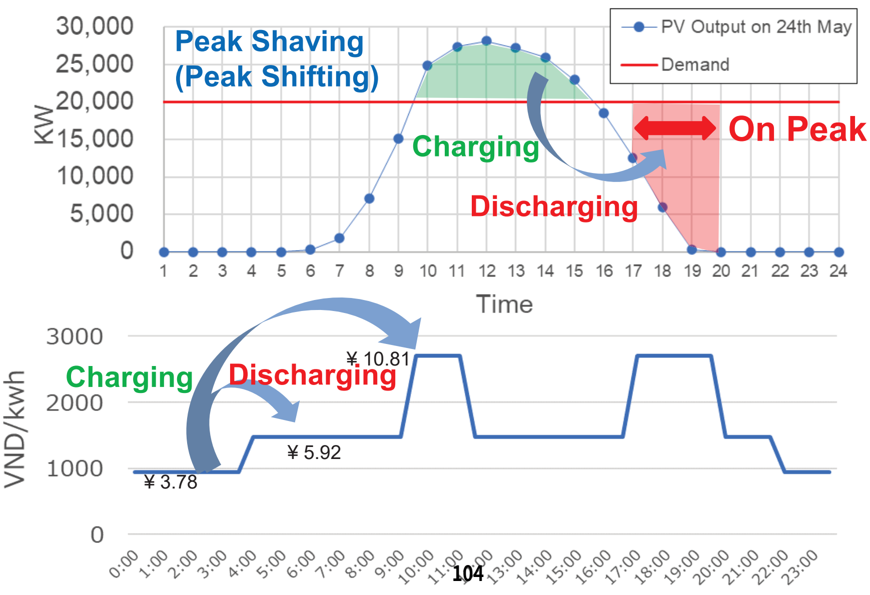
- Proposed smart power plant

option	Details
op-1: PV + BESS (Battery Energy Storage System)	op-1-A: Peak shaving by storing PV output into battery and discharging it in On-Peak op-1-B: Peak shaving by storing PV output & grid electricity in Off-Peak into battery and discharging it in On-Peak
op-2: EMS +PV + BESS + Gas Engine with mono-generation	Base load power is generated by the gas engine, which is optimally operated by EMS along with PV output.
op-3: EMS +PV + BESS + Gas Engine + Steam supply with co-generation	Base load power is generated by the gas engine, which is optimally operated by EMS along with PV output. Additionally, more effective energy utilization can be expected by co-generation with steam supply.

IHI's proposed Smart Power Plant for the limited target area IHI

- op-1: PV + BESS
  - ✓ Peak shaving by storing PV output into battery and discharging it in On-Peak.
  - ✓ Cost saving by storing grid energy into battery and discharging it in Regular or On-Peak. But JCM can not be applicable in this case.

May 24th with 40MWp PV on the MAX solar radiation in year



IHI's proposed Smart Power Plant for the limited target area IHI

- op-1: PV + BESS
  - ✓ JCM requirement: A battery charges only the power generated by photovoltaic modules to be introduced

(Refer to page-29) : https://gec.jp/jcm/jp/kobo/r03/mp/(tentative)2021_Guidelines_for_Submitting_Proposals.pdf

Annex 3 Conditions for Adoption by Technology

1. Solar Power Plant

The conversion rate from optical to electric energy of photovoltaic modules must be 20% or higher.

2. Solar Power Plant with Battery

All the following conditions must be met.

➤ Photovoltaic module

The efficiency of photovoltaic modules must be 20% or higher.

➤ Battery

(1) A battery charges only the power generated by photovoltaic modules to be introduced, and the amount of power supplied from the battery can be measured.

(2) Regarding the installation necessity of a battery, one of the following requirements must be met.

1) Installation at off-the-grid areas

2) In case of supplying the generated power to grid, the installation of batteries is required by the laws or the regulations of the partner country, such as for the purpose of stabilizing the grid system.

3) All of the followings must be met for the self-consumption in the factory or the local power supply business.

(a) In principle, the battery should be charged and discharged every day.

(b) The battery capacity is 20% or larger than the wattage of photovoltaic modules installed and within the maximum daily chargeable amount of generated power.

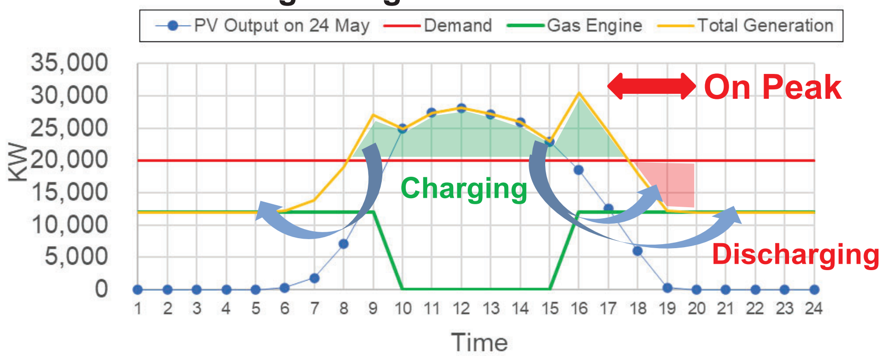
IHI's proposed Smart Power Plant for the limited target area IHI

- op-1: PV + BESS
  - ✓ PV's capacity in 5Ha area is expecting with approx. 6MWp.
  - ✓ Ave output can be expected with 0.6MW – 0.9MW if the utilization rate is 10%-15%.
  - ✓ Is there any potential area to be installed with PV? Floating PV is available?

IHI's proposed Smart Power Plant for the limited target area IHI

- op-2: EMS +PV + BESS + Gas Engine with mono-generation
  - ✓ Base load power is generated by the gas engine, which is optimally operated by EMS along with PV output.
  - ✓ Is there any area with the power demand of several MW to several tens of MW?

May 24th with 40MWp PV on the MAX solar radiation in year and with 6MW gas engine x 2 units



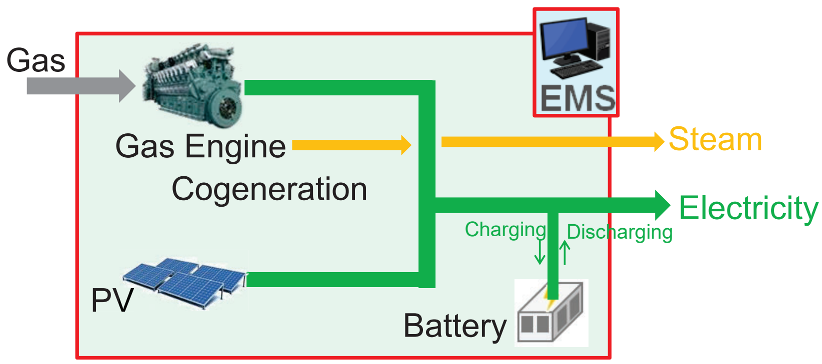
- op-3: EMS +PV + BESS + Gas Engine + Steam with co-generation
  - ✓ Additionally, more effective energy utilization can be expected by co-generation with steam supply. Any plants are available with using the steam ?

IHI' request for data disclosure to proceed to the further study IHI

- Target Area for feasibility study

(1) Target area and its demand
  - ✓ Is there any area with the power demand of several MW to several tens of MW?
  - ✓ And IHI would like to know the actual power demand of 24Hr's electricity consumption from grid.

(2) Steam supply
  - ✓ Any plants are available with using the steam ?



IHI' request for data disclosure to proceed to the further study

IHI

- Electric Tariff

(3) Please confirm if the following rate is applicable in your industrial park.

Charge: https://en.evn.com.vn/d6/news/WHOLESALE-ELECTRICITY-TARIFF-9-28-260.aspx

Definition of hours: https://en.evn.com.vn/d6/news/TIME-OF-USE-ELECTRICITY-CHARGE-9-28-264.aspx

VIETNAM ELECTRICITY
Enlightening Trust
EVN

d) Industrial zone

	Customer group	Rate (VND/kWh)
1	*Wholesale charge at the 110kV busbars of 110/35-22-10-6kV substations*	
1.1	*Total capacity of transformers exceeding 100MVA*	
	a) Standard hour	1,480
	b) Off-peak hour	945
	c) Peak hour	2,702

a) Definition of hours:

+ Standard hour

From Monday to Saturday

- From 4.00 a.m. to 9.30 a.m. (5 hours and 30 minutes);
- From 11.30 a.m. to 5.00 p.m. (5 hours and 30 minutes);
- From 8.00 p.m. to 10.00 p.m. (2 hours).

Sunday

From 4.00 a.m. to 10.00 p.m. (18 hours).

+ Peak hour

From Monday to Saturday

- From 9.30 a.m. to 11.30 a.m. (2 hours);
- From 5.00 p.m. to 8 p.m. (3 hours).

Sunday: No peak hours.

+ Off-peak hours:

All days: from 10 p.m. to 4 a.m. of the following day (6 hours).

(4) If some weekday is the national holiday, the regular day such as Monday - Saturday is applied ? (In other word, which the definition of Sunday hours or Monday hours are applicable if Monday is the national holiday.)

IHI' request for data disclosure to proceed to the further study

IHI

- LNG or City Gas Tariff

(5) Please let IHI know the web site of LNG or Gas tariff because IHI would like to incorporate the gas tariff rate into the Feasibility Study with the gas engine.

✓ Some web site show that the gas price is around 6.5 USD/MMBTU. IHI would like to confirm the gas price by the public institution's web site.

IHI' request for data disclosure to proceed to the further study

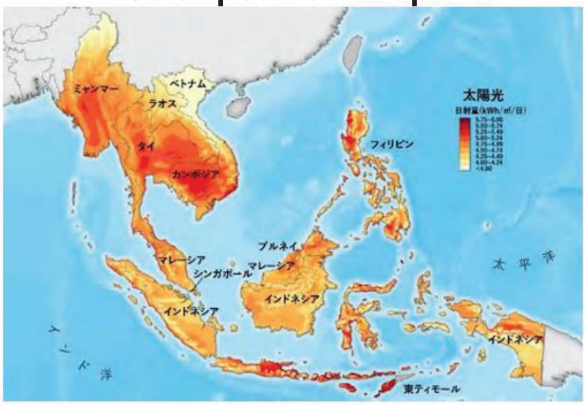
IHI

- PV annual average utilization rate (Capacity Factor)

(6) Please let IHI know the value of PV's annual average utilization rate in north Vietnam.

- ✓ Some web site information is 15% in north Vietnam.
- ✓ But around 10% can be calculated by 24Hr of 365 day's solar radiation data.
- ✓ Please let IHI know the general value of PV's utilization rate in north Vietnam if available.

Solar potential map



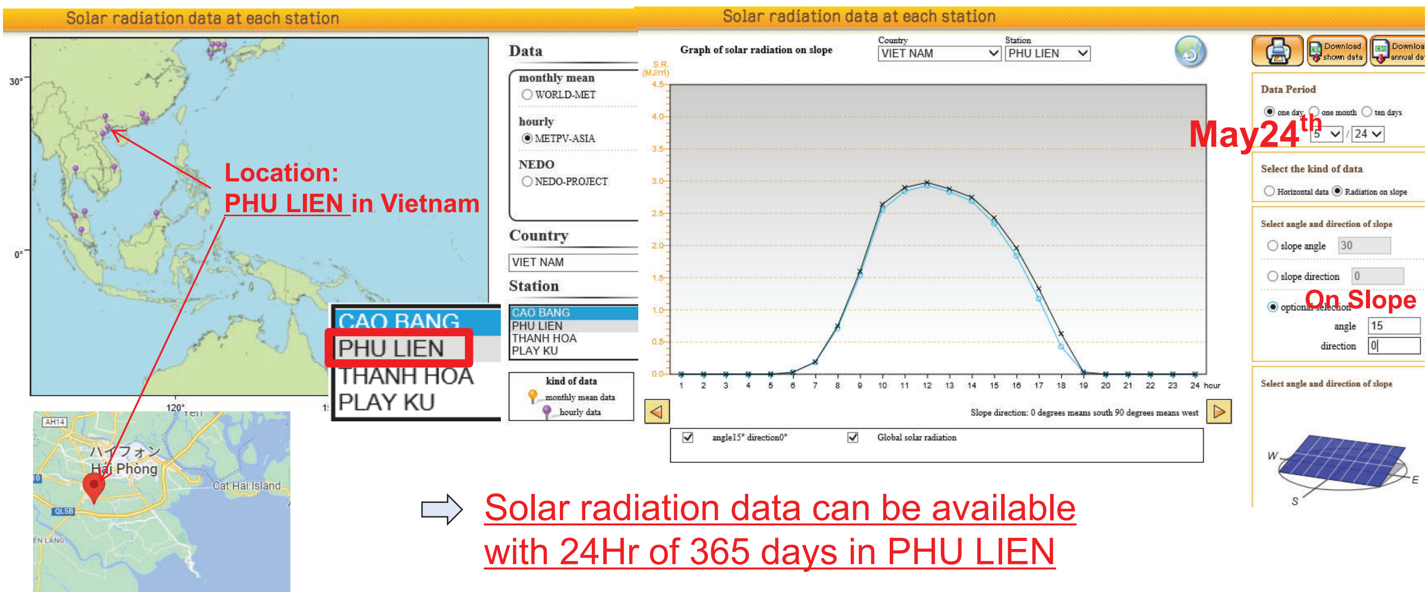
出典：米国国際開発庁（USAID）および国立再生可能エネルギー研究所（NREL）「Exploring Renewable Energy Opportunities in Select Southeast Asian Countries」（2019 年 6 月）

Supportive data for Designing PV Power Generation

IHI

Solar radiation data in Vietnam

- Please visit NEDO's web site ref) NEDO: New Energy and Industrial Technology Development Organization
  - ✓ Data base (English version) :https://appww1.infoc.nedo.go.jp/appww/index.html?lang=2
  - ✓ Manual (English version) :https://www.nedo.go.jp/content/100926825.pdf



IHI
Realize your dreams

Daiseki

Waste fluid energy recovery and use

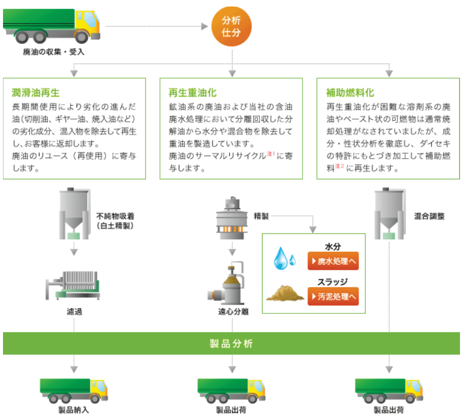
株式会社 ダイセキ

Daiseki Co., Ltd.

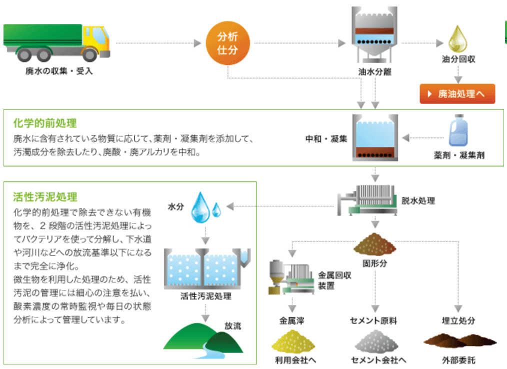
Waste fluid energy recovery and use

(Daiseki Co., Ltd.)

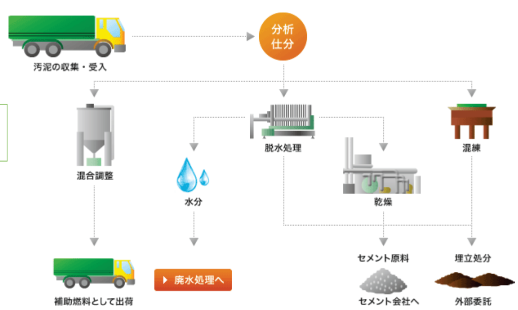
Waste oil recycling



Waste water recycling



Sludge recycling



- ✓ Recycling rate: approx.90%
- ✓ CO_2 reduction: more than 90% compared to incineration

Countries surveyed · regional Overview（2014）

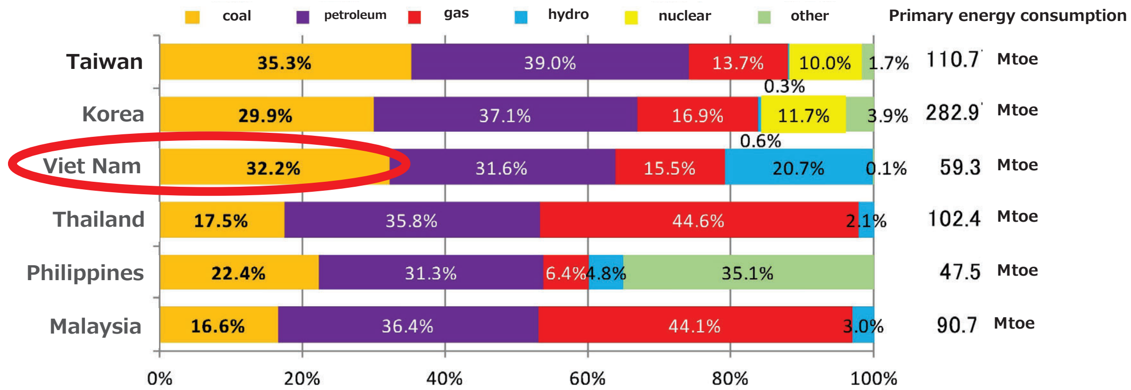
JOGMEC

Primary energy consumption composition and Coal consumption

Primary energy composition :

- In Taiwan, Korea, and **Vietnam, Coal accounts for more than 30%**.
- Coal ratio in Thailand, Malaysia and the Philippines is about 20%
- Coal (general coal) is often used for power generation. **Then cement**.

	Coal consumption across the surveyed area (Mton)				
	total	generating	steel	cement	other
Malaysia	2,525	2,267	0	258	0
Philippines	2,016	1,559	0	320	137
Thailand	3,926	2,550	0	780	596
Viet Nam	3,424	1,455	88	1,095	786
Korea	13,336	8,033	3,761	496	1,047
Taiwan	6,382	4,520	963	171	728
合計	31,609	20,384	4,812	3,120	3,293

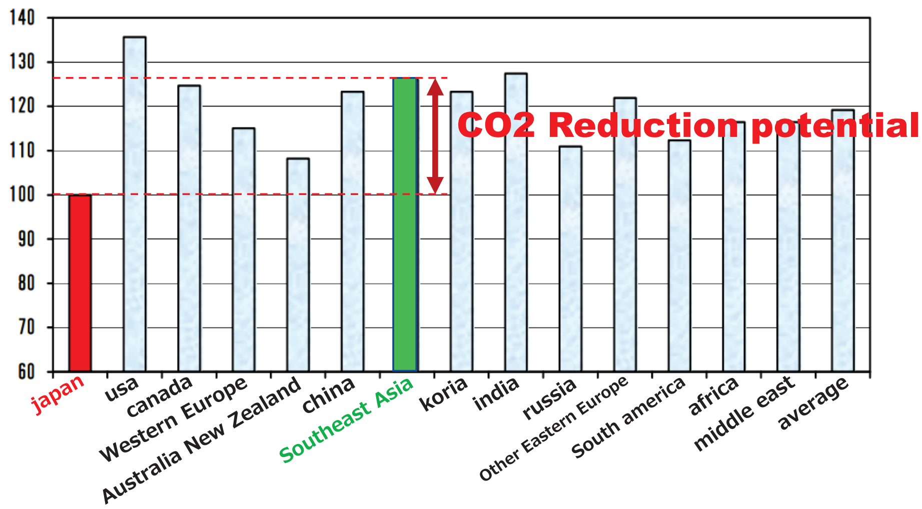


出所:調査対象国･地域統計資料　　注:マレーシアの一次エネルギー構成は2013年実績

Vietnam's cement exports in 2018 amounted to 32 million tons making it the world's largest exporter of cement.

The cement sector is the third-largest industrial energy consumer and the second-largest industrial CO2 emitter globally.

CO2 emissions per ton of cement
international comparison（2000）

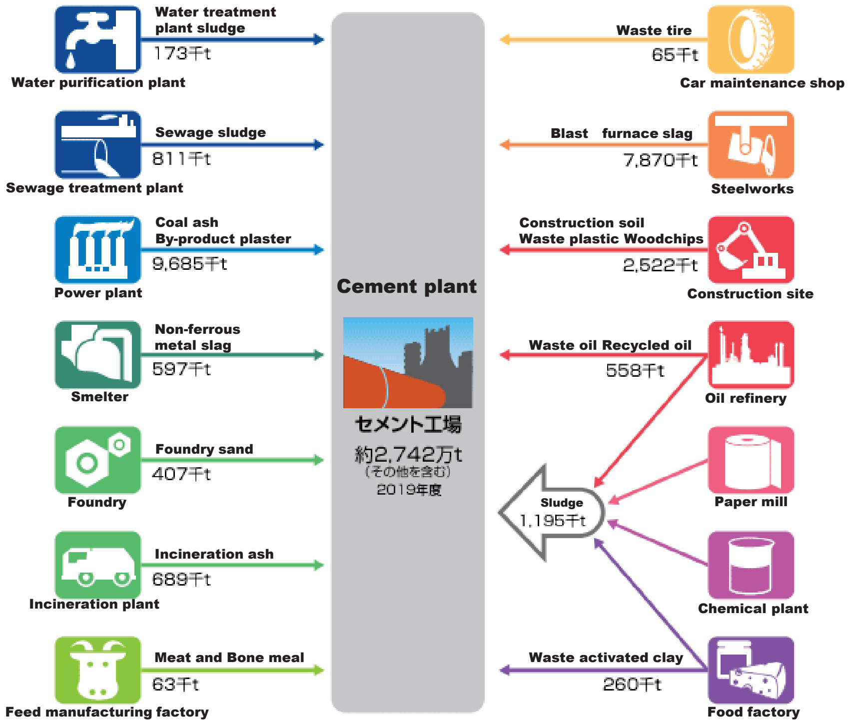


There is an urgent need to reduction CO2 emissions from cement plant

Use of wastes and by-products

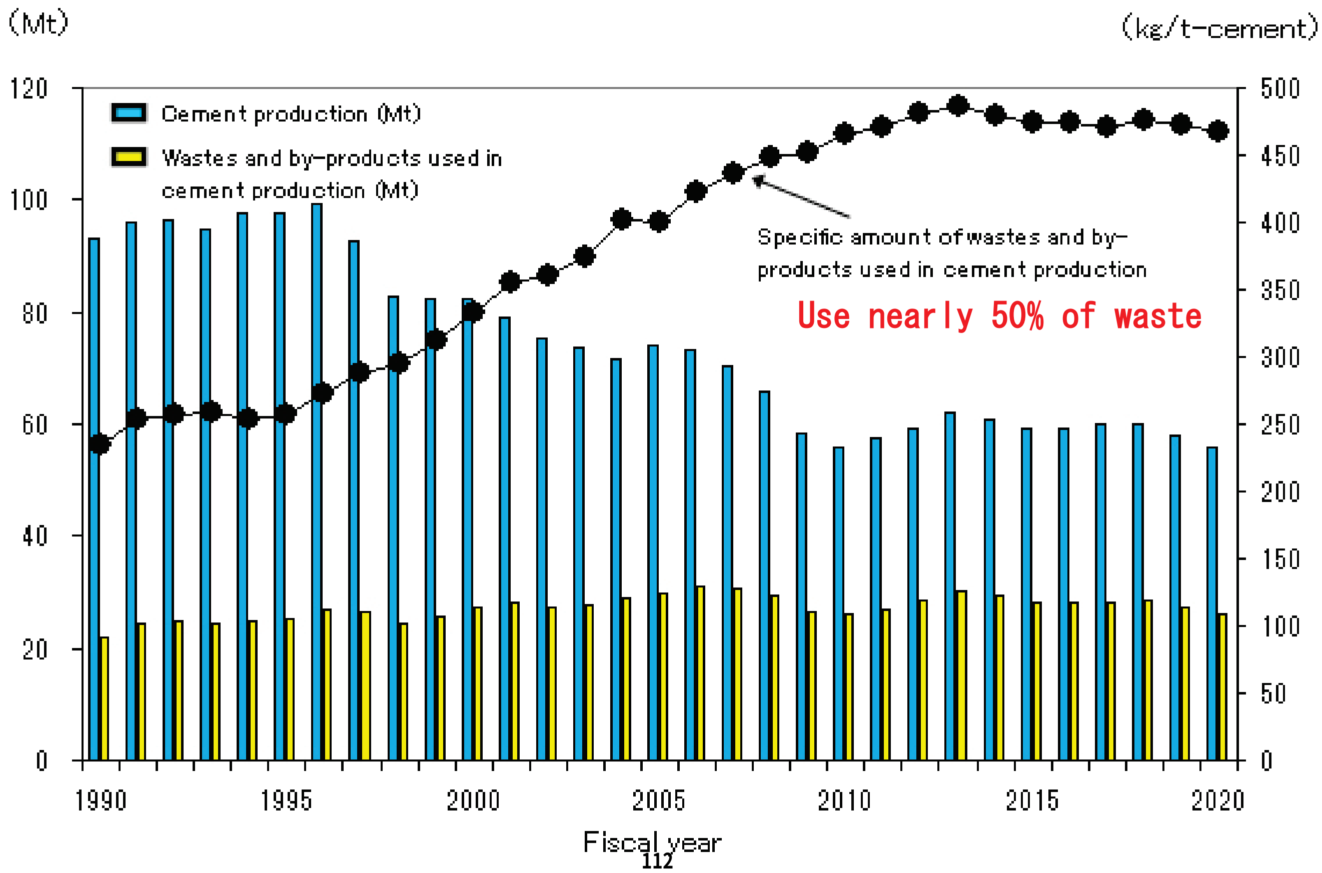
The Japanese cement industry has developed technologies that enable the use of wastes as alternative raw materials or alternative thermal energy. It leads to save natural resources and extend the life of existing landfill sites.

Our job is to make the waste available in cement plant.

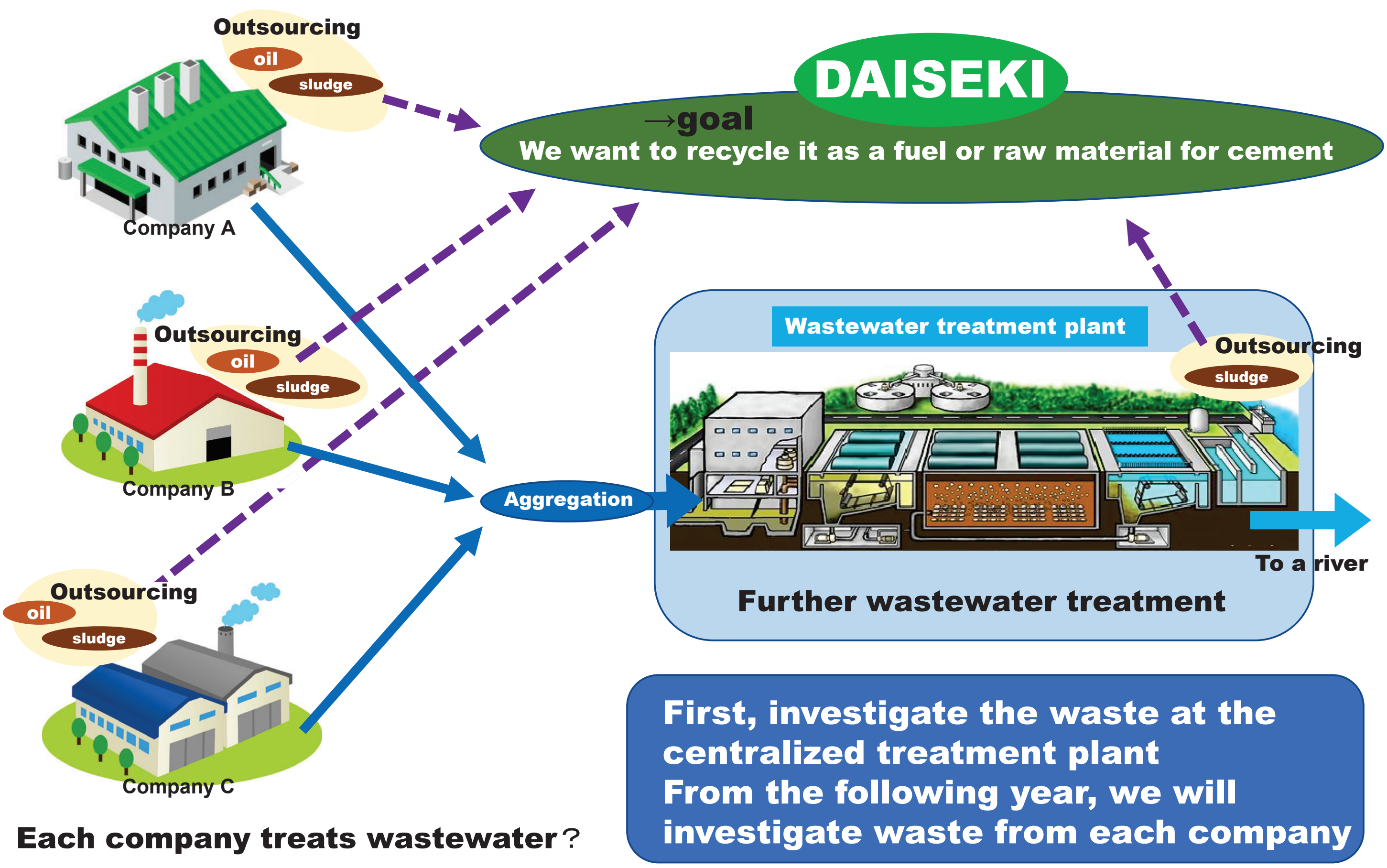


This year, we will investigate the waste usage status at cement plant.

The transition of cement production, wastes and by-products, and the specific amount of wastes and by-products used in cement productionct usage/basic unit



Wastewater treatment facility in the assumed corporate complex



Survey form (For the cement factories)

1. Factory overview
   - Production per year (t/year)
   - Future production plan (t/year)
   - Types of raw materials and Input amount
   - Raw material unit price
   - Fuel type and usage(t/year)
   - Fuel unit price
   - Uses of wastes and by-products in cement factory
   - Type, amount, and unit price of waste used
2. Acceptability of waste and problem for cement factory
   - Interest in waste utilization
   - Issues that must be solved
   - Alternative fuel and waste acceptance standards

Survey form (For the industrial complex)

1. Acceptance status of wastewater, sludge, and waste oil

- Disposal capacity per year (t/year)
- How many companies do you accept from?
- Composition and quantity for each category
- Analysis items of treated water, etc.

2. Outline of waste liquid/sludge treatment

～Internal treatment and outsourcing～

- Emissions by type (t/year)
- Disposal method
- unit price (VND/m3ort)
- Analysis status
- Possibility of resource utilization

Please find contact information here for the survey form

For cement the factory	
Contact	Chugai Technos Vietnam Co., Ltd
Contact person	VIM VAN DUNG (Mr.)

For the industrial complex	
Contact	Chugai Technos Vietnam Co., Ltd
Contact person.1	MORIMOTO KAZUYOSHI (Mr.)
Contact person.2	VIM VAN DUNG (Mr.)

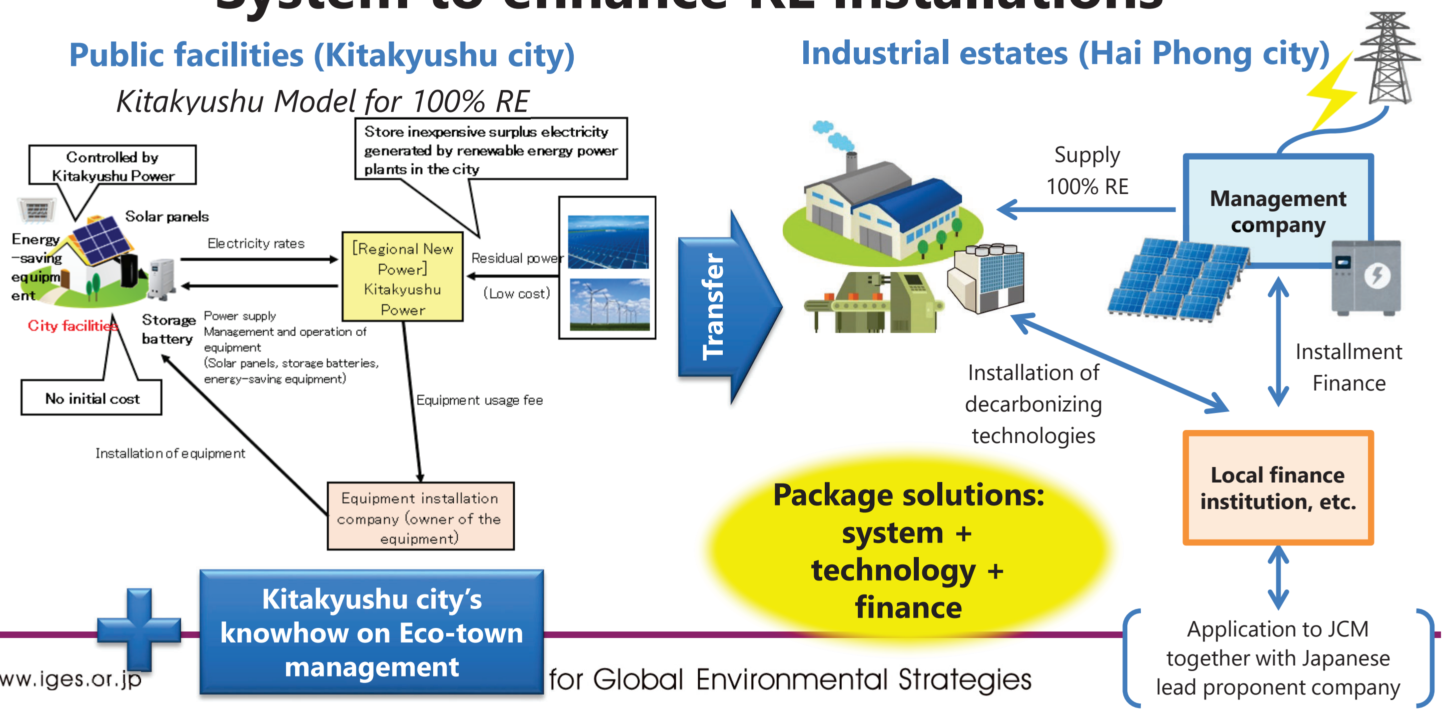
System to enhance renewable energy installations

Environment Bureau, Kitakyushu City
Institute for Global Environmental Strategies

Kick-off workshop, 15th December 2021

IGES
Institute for Global Environmental Strategies

System to enhance RE installations



Financing schemes to introduce PVs in Japan

	Rent-a-roof	PPA	Lease	Solar loan	Self-owned
Property owner	Power generation company	PPA provider (self-owned after PPA term)	Lease provider (self-owned after PPA term)	Customer	Customer
Initial costs	—	—	—	— (can be set to non)	YES
O&M costs	—	—	—	YES	YES
Owner of generated electricity	Power generation company	PPA provider	Customer (Can choose either self consumption or selling of electricity)	Customer	Customer
Other expenses	—	Payment for self-consumed electricity	Lease payments (Occurs even when electricity is not generated)	Loan repayment	—
Income from electricity sales	—	—	YES (No charge for self-consumption)	YES (No charge for self-consumption)	YES (No charge for self-consumption)
Other income	Roof usage fees	—	—	—	—

Survey in FY2021

Survey Objectives

- ☐ To deepen the understanding of existing PV installation systems
- ☐ To clarify the challenges in accelerating the introduction of PV systems
- ☐ To clarify the status and possibility of introducing the third party ownership system for PVs in Vietnam
- ☐ To clarify the direction for the next year's survey

Survey methods

- ☐ Interview with the management companies of the industrial estates
- ☐ Interview with the main banks of the industrial estates
- ☐ Desktop survey

Survey questions

Industrial Estates

- How was the existing PV systems installed?
  - Who was the investor?
  - How was it financed?
  - How are the tenant companies involved (any benefits to them)?
  - Is generated electricity self-consumed or sold to EVN?
- What are the challenges in installing PV systems at large scale?

Main Bank

- What are the existing financial services to support installation of PVs?
- Do you provide any financial services like third party ownership system for PVs?
- What do you think are the opportunities or challenges of the third party ownership system for PVs in Vietnam?

IHI Co. Confidential

Kết quả nghiên cứu của IHI với PV trên mái nhà

Ngày 16 tháng 2 năm 2022

I H I Corporation
Lĩnh vực Kinh doanh Tài nguyên, Năng lượng & Môi trường
Phòng Kinh doanh Giải pháp Carbon
Thiết kế cơ bản G.

Điều kiện nghiên cứu khả thi

- Các điều kiện giả định cho nghiên cứu FS

Được cập nhật theo hiện tại của Việt Nam

✓ 1Ha mái: Công suất PV 1,67 MWp (mỗi 1MWp = 6.000m2 trên mái)

✓ Bức xạ mặt trời: METPV-Asia của NEDO

✓ Sản lượng PV đầu ra: Tất cả đầu ra của PV được tiêu thụ theo nhu cầu lớn của khu công nghiệp

✓ Chi phí ban đầu của PV: Một trăm triệu yên / MWp

✓ Hỗ trợ tài chính: theo quy định của JCM (JCM: Cơ chế tín dụng chung)

d) Khu công nghiệp

2	*Wholesale tariff for medium-voltages electricity at the 110/35-22-10-6kV substations*	
2.1	*Voltage levels from 22kV to below 110kV*	
	a) Standard hour	1,526
	b) Off-peak hour	989
	c) Peak hour	2,817

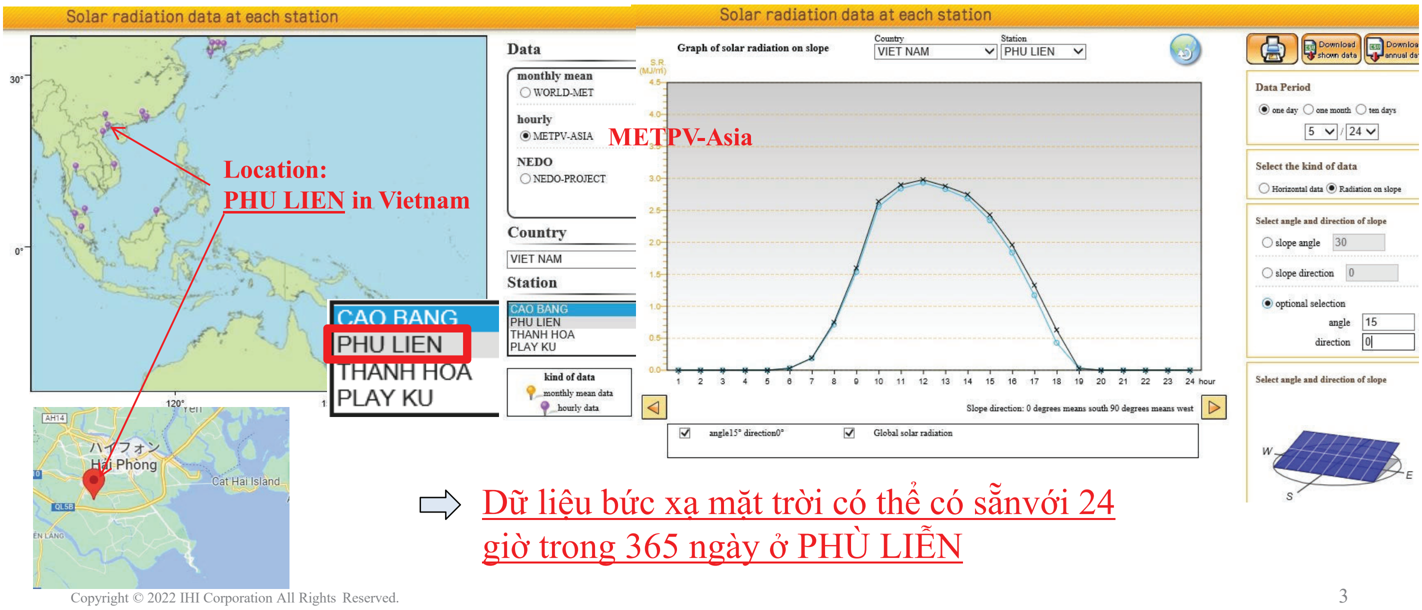
Dữ liệu hỗ trợ để thiết kế sản xuất điện PV

IHI

Dữ liệu bức xạ mặt trời ở Việt Nam: Vui lòng truy cập trang web của NEDO

Tham khảo: NEDO: Tổ chức Phát triển Công nghệ Công nghiệp và Năng lượng Mới

- ✓ Cơ sở dữ liệu (Bản tiếng Anh) :https://appww1.infoc.nedo.go.jp/appww/index.html?lang=2
- ✓ Cẩm nang (Bản tiếng Anh) :https://www.nedo.go.jp/content/100926825.pdf



⇨ Dữ liệu bức xạ mặt trời có thể có sẵnvới 24 giờ trong 365 ngày ở PHÙ LIỄN

3

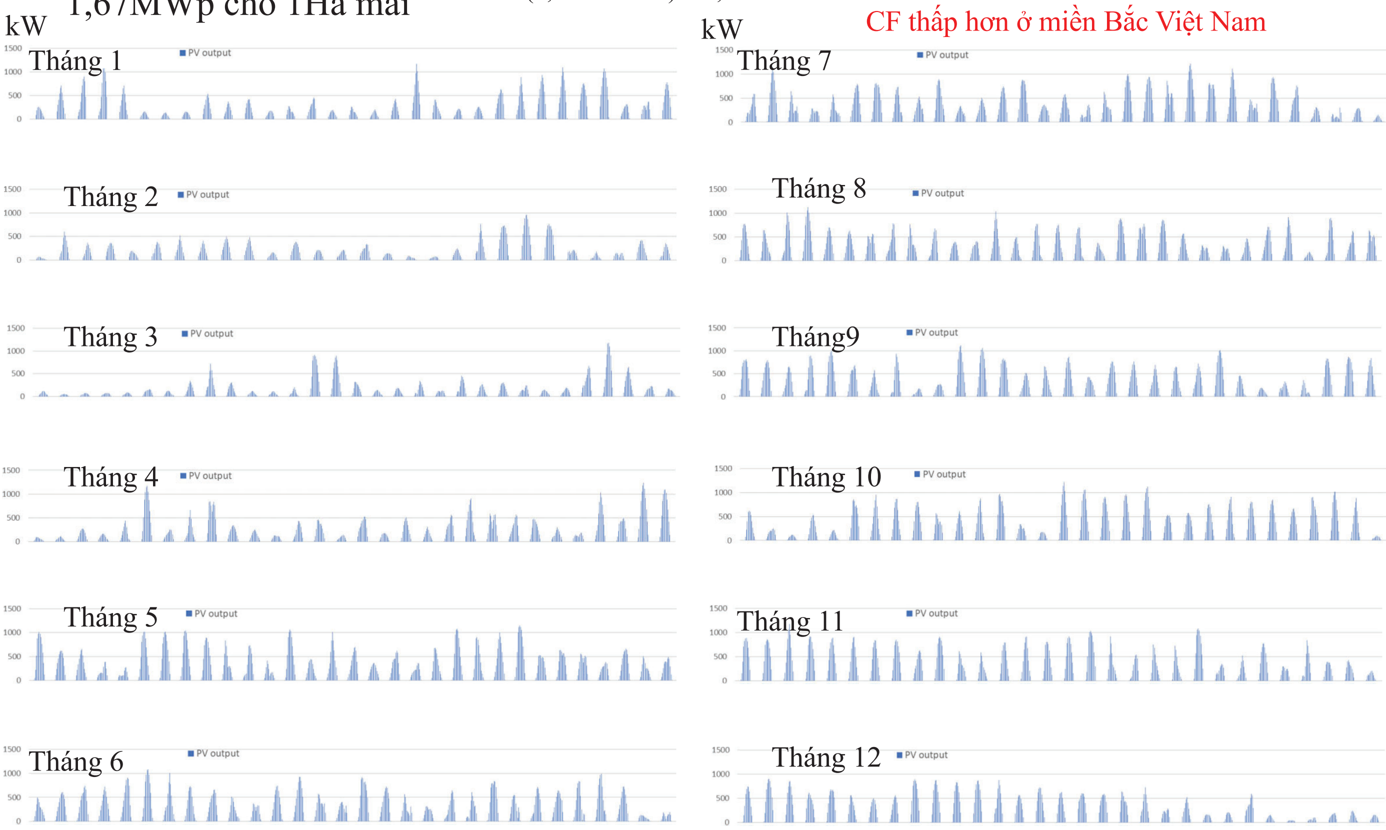
PV đầu ra của 24Hr x 365 ngày

IHI

Công suất PV: 1,67MWp cho 1Ha mái

Năng lượng sản xuất 1436 MWh / năm→ CF (hệ số công suất) = 1436 / (1,67x24x365) = 9,8%

CF thấp hơn ở miền Bắc Việt Nam



Sự biến đổi lớn của bức xạ mặt trời ở miền Bắc Việt Nam

4

Nghiên cứu khả thi cho PV trên mái với 1,67MWp

IHI

- Kết quả FS với hoạt động trong 17 năm được coi là năm lâu bền hợp pháp của Nhật Bản bằng cách sử dụng cơ chế hỗ trợ tài chính của JCM

Hạng mục	PV 1.67MWp	
Sản lượng PV có thể sử dụng hàng năm (MWh)	1,436	(1)
Chi phí tiết kiệm hàng năm (MVND)	2,618	(2)
Hệ số phát thải trên Năng lượng tái tạo của JCM (tCO_2/MWh)	0.333	(3) (4)=(1)x(3)
Lượng giảm CO_2 theo JCM (tCO_2/year)	478	(5)
Độ bền số năm sử dụng tại Nhật	17	(6)=(4)x(5) (7)
Lượng giảm CO_2 trong giai đoạn dự án của JCM (tCO_2)	8,130	(8) (9)=(7)x(8)/(6)
PV chi phí ban đầu (JPY)	166,600,000	
Phần trăm hỗ trợ tài chính của JCM	30%	
Hiệu quả chi phí (JPY/tCO_2)	6,148	
Số tiền trợ cấp tương đương 4000 yên tính hiệu quả về chi phí (JPY)	32,518,390	(10)=4000JPYx(6)
Năm hoàn vốn	10.2	(11)=((7)-(10))/((C2)x10^6x0.005)

(10) / (7) = 20%

Bằng cách sử dụng hỗ trợ tài chính của JCM, khoản đầu tư ban đầu có thể giảm khoảng 20%. Tuy nhiên, nghĩa vụ giám sát & báo cáo & xác minh (MRV) trong 17 năm là bắt buộc.

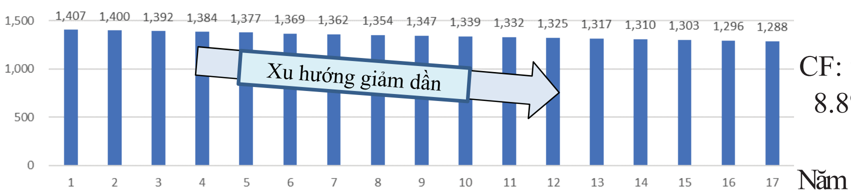
5

FS cho PV với 1,67MWp và xem xét sự thoái hóa

IHI

- Điều kiện giả định cho FS với sự thoái hóa của PV — Được cập nhật theo đặc điểm kỹ thuật của PV
  - ✓ Độ xuống cấp thoái hóa của 1 năm đầu tiên : 2%
  - ✓ Thoái hóa tối đa từ năm thứ 2 đến năm thứ 25 : 0.55% mỗi năm

Năng lượng sản xuất hàng nămMWh



CF: 9.2% vào năm thứ 10
8.8% vào năm thứ 17

- Kết quả FS có sự thoái hóa pin

Hạng mục	PV 1.67MWp	Có sự thoái hóa
Tiết kiệm chi phí hàng năm (MVND)	2,618	2,456
Độ bền theo tiêu chuẩn Nhật	17	17
Lượng giảm CO_2 trong giai đoạn dự án của JCM (tCO_2)	8,130	7,626
Chi phí ban đầu (JPY)	166,600,000	166,600,000
hần trăm hỗ trợ tài chính của JCM	30%	30%
Hiệu quả chi phí(JPY/tCO_2)	6,148	6,554
Số tiền trợ cấp tương đương 4000 yên tính hiệu quả về chi phí (JPY)	32,518,390	30,503,539
Số năm hoàn vốn	10.2	11.1

Ước tính mỗi= 2618x (7626/8130)

6

IHI

Realize your dreams

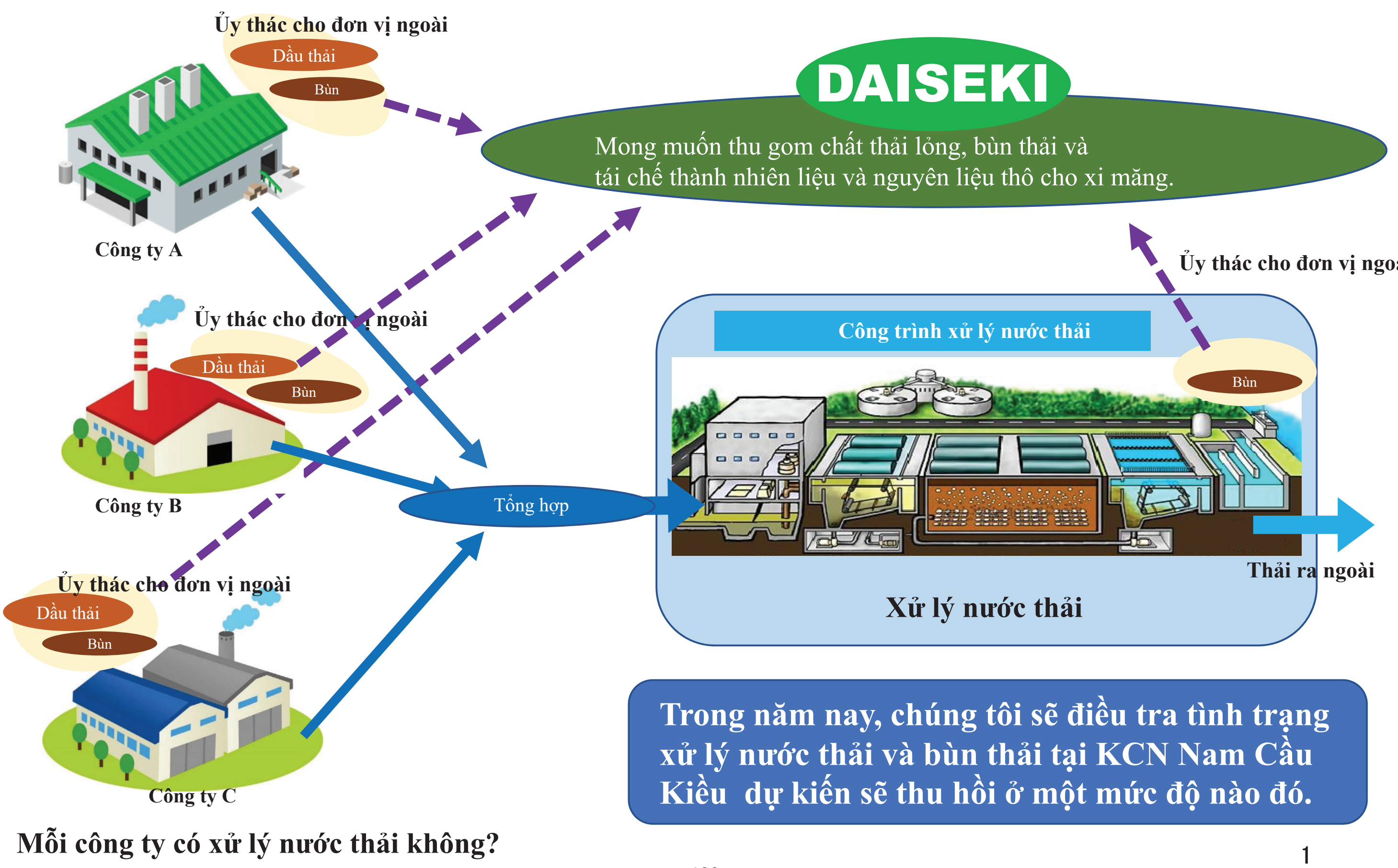
Nghiệp vụ ủy thác dự án liên kết giữa hai thành phố nhằm thực hiện mục tiêu xã hội không phát thải Cacbon
(Dự án thúc đẩy KCN sinh thái hướng tới không phát thải Cacbon tại Hải Phòng, Việt Nam)
Kết quả khảo sát việc thu hồi và sử dụng năng lượng từ các chất thải dạng lỏng

VỀ VIỆC THU HỒI VÀ SỬ DỤNG NĂNG LƯỢNG TỪ CÁC CHẤT THẢI DẠNG LỎNG

Tháng 2 năm 2022

Công ty TNHH Daseki
Chugai Technos Việt Nam
Viện nghiên cứu chiến lược môi trường toàn cầuThành phố Kitakyushu
Thành phố Hải Phòng

Tình trạng xử lý nước thải giả định tại KCN Nam Cầu Kiền



1

KẾT QUẢ KHẢO SÁT TẠI NHÀ MÁY XI MĂNG

DAISEKI

Tái chế làm nhiên liệu hoặc nguyên liệu thô cho xi măng

Thực hiện khảo sát

Nguyên nhiên liệu thô

(1) Tìm kiếm nguồn nguyên liệu mới để giảm chi phí sản xuất

(2) Nhà máy xi măng hiện không tiếp nhận rác thải.

(3) Luật quản lý chất thải của Bộ TNMT rất chặt chẽ, và chưa quy định rõ liệu chất thải có thể được sử dụng làm nguyên liệu và nhiên liệu hay không. Luật pháp vẫn chưa

Nếu vấn đề (3) có thể làm rõ, công ty sản xuất xi măng sẽ sẵn sàng chấp nhận.

Chiếm hơn 80% chi phí sản xuất

Nhiên liệu cần thiết để nung

Than đá

Nguyên liệu Xi măng

Đá vôi

Đất sét

Đá Silic

Không có tình trạng sử dụng chất thải

Nguyên nhiên liệu thay thế

Dầu tái chế

Bùn

Nhựa thải

TẠO RA LỢI ÍCH TRONG KCN NAM CẦU KIỀN

[Giả định 1] Khi có triển vọng có thể tái chế thành nguyên nhiên liệu trong nhà máy xi măng.
[Giả định 2] Việc tiếp nhận rác thải của công ty có công nghệ vượt trội về tái chế chất lỏng dạng thải và bùn thải như Daiseki.
[Giả định 3] Chi phí tiếp nhận chất thải dạng lỏng và bùn thải thấp hơn chi phí xử lý và chi phí vận chuyển hiện tại.

Lợi ích của việc xử lý chất thải dạng lỏng và bùn thải là gì?

[Khu công nghiệp]
- Giảm bớt gánh nặng cho nhà máy xử lý nước thải tập trung
- Giảm chi phí xử lý bùn
- Làm tăng thêm giá trị gia tăng của mô hình KCN Sinh thái

[Nhà đầu tư]
- Giảm gánh nặng liên quan đến xử lý nước thải, bùn thải, dầu thải
- Giảm chi phí xử lý nước thải, bùn thải, dầu thải
- Giảm gánh nặng cho hệ thống tái chế (EPR) để xử lý dầu thải

[Thành phố Hải Phòng]
- Phòng chống ô nhiễm do xử lý dầu thải và chất lỏng phù hợp
- Giảm lượng khí thải CO2
- Tăng tỷ lệ tái chế

Nghiên cứu bổ sung để tạo ra lợi ích, giải quyết vấn đề

(1) Khảo sát bổ sung nước thải xử lý trong KCN

- Kết quả đầu ra vượt trên cả tiêu chuẩn QCVN40 / 2011 / BTNMT do Daiseki xử lý.

⇒ Tạo ra lợi ích về chi phí.

- Daiseki xử lý một phần trong khối lượng tiếp nhận từ 400-600m3 / ngày.

⇒ Giảm gánh nặng xử lý cho nhà máy xử lý nước thải tập trung và tạo ra lợi ích về chi phí

(2) Khảo sát việc xử lý chất lỏng, bùn thải và dầu thải tại các nhà máy trong KCN và thành phố Hải Phòng

- Nắm được lượng chất thải dạng lỏng và bùn thải được ủy thác xử lý bên ngoài
- Lợi ích về chi phí khi chuyển sang xử lý bởi Daiseki
- Giảm gánh nặng cho các nhà máy trong KCN nhà bằng quản lý tổng hợp chất thải dạng lỏng và bùn thải
- Lợi ích các công ty xử lý chất thải như chất lỏng và bùn thải

Khảo sát vấn đề, đề xuất giải pháp

- Thu thập, bảo quản, quản lý, vận chuyển, v.v. ⇒ Các vấn đề về vận hành ⇒ Nghiên cứu giải pháp
- Thiết lập các quy định tái chế chất lỏng thải và bùn thải ⇒ Các vấn đề về quy định pháp luật ⇒ Nghiên cứu các giải pháp

Dựa trên tình hình thực tế tại Nhật Bản, đề nghị hỗ trợ xây dựng cơ chế thông qua kênh đối thoại chính sách Môi trường Nhật Bản - Việt Nam..v.v.

4

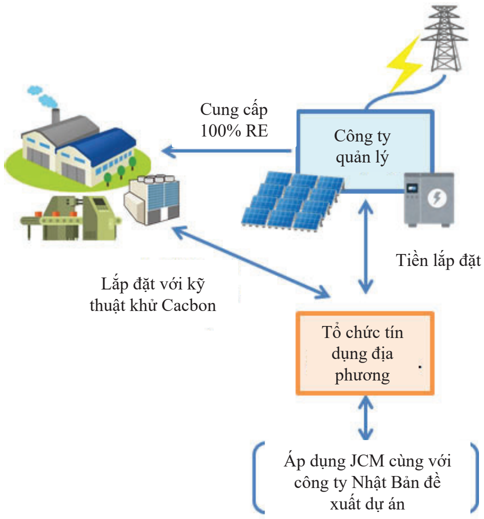
Hệ thống tăng cường lắp đặt năng lượng tái tạo

Cục Môi trường, Thành phố Kitakyushu
Viện Chiến lược Môi trường Toàn cầu

Hội thảo cuối, ngày 16 tháng 2 năm 2022

IGES
Institute for Global Environmental Strategies

KHẢO SÁT HỎI ĐÁP

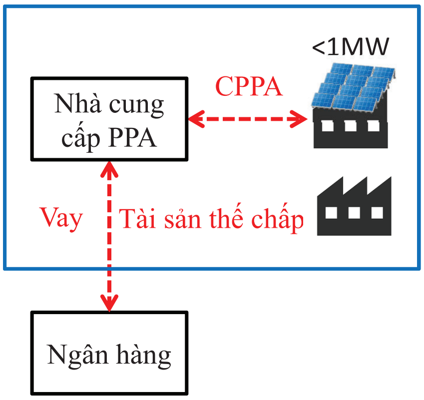


Thành phố Kitakyushu
Phòng Quy hoạch và Xúc tiến Năng lượng Tái tạo

Khu Công nghiệp
- Nam Cầu Kiền
- DEEP C

Ngân hàng địa phương
- Vietcombank (+ Mizuho Bank)
- VietinBank

Tóm tắt kết quả



https://globalsolaratlas.info/

Các cơ hội

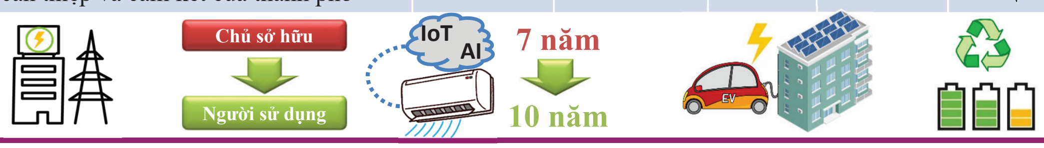
- PPA doanh nghiệp
- (<1 MW, <35 kV mái nhà)

Thách thức

- Giá điện thấp bởi EVN
- Thiếu cơ chế khuyến khích (FIT)
- Tiềm năng năng lượng mặt trời thấp (ở phía bắc)
- Thời gian hoàn vốn dài (15-20 năm)
- Chỉ giới hạn tài chính doanh nghiệp (tối đa tín dụng và tài sản thế chấp)
- Giới hạn trong sự can thiệp của chính phủ

Kitakyushu đang làm gì

	Lắp đặt nâng cao	Tiết kiệm năng lượng	Kéo dài tuổi thọ	Tiết kiệm chi phí	Tín dụng cải tiến
Thành lập công ty điện lực địa phương (Kitakyushu Power)	√				
Chuyển từ quyền sở hữu sang quyền sử dụng (đăng ký)	√				
Tối ưu hóa việc sử dụng sản phẩm bằng AI & IoT		√	√	√	
Chia sẻ sử dụng (đa dụng)	√			√	
Hệ thống thu gom và tái chế	√				
Tái sinh và cung cấp	√				
Sự can thiệp và cam kết của thành phố					√



https://gec.jp/jcm/jp/projects/

Xu hướng các dự án năng lượng mặt trời áp dụng JCM

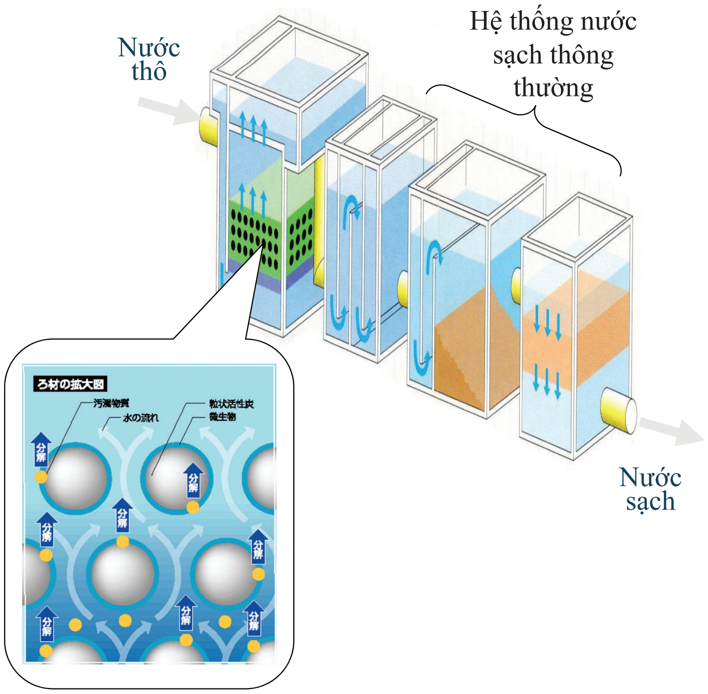
Năm	Địa điểm	Công suất	Loại	Đơn vị đề xuất thực hiện	Đối tác địa phương
2021	Binh Duong	5.8MW	Mái nhà	Asian Gateway Corporation	VES Joint Stock Company
2021	Dong Nai	9.8MW	Mái nhà	Osaka Gas Co., Ltd.	SOL Energy Co., Ltd.
2021	North, South	2.5MW	Mái nhà	Kansai Electric Power Company Inc.	Kansai Energy Solutions (Vietnam) Co., Ltd.
2021	North, Central, South	12MW	Mái nhà	Marubeni Corporation	Marubeni Green Power Vietnam
2021	Hanoi, Bacninh, Ha Nam, Ba Ria Vung Tau, Ho Chi Minh	9MW	Mái nhà	Sharp Energy Solutions Corporation	I RENEWABLE ENERGY VIETNAM CO., LTD.
2020	Binh Dinh	2MW	Mái nhà	Idemitsu Kosan Co., Ltd.	TTCL Public Company Limited
2020	An Giang	57MW	Land	Kanematsu KGK Corp.	SAO MAI GROUP CORPORATION
2019	An Giang	49MW	Land	Kanematsu KGK Corp.	SAO MAI GROUP CORPORATION

- Yêu cầu các công ty cho thuê của Nhật Bản trở thành đơn vị đề xuất dự án chính theo cơ chế JCM
- Ứng dụng gói năng lượng mặt trời trên mái nhà (<1MW x một vài đơn vị) trong các khu công nghiệp
- Tỷ lệ hỗ trợ JCM dự kiến: 30%

Tái sử dụng nước thải công nghiệp làm nước nước uống (nước sinh hoạt)

Khu công nghiệp Nam Cầu Kiền
15/02/2022

Kỹ thuật lọc tiếp xúc sinh học (U-BCF)



Đặc điểm của U-BCF

- Loại bỏ chất ô nhiễm bằng cách sử dụng các vi sinh vật sống trong sông mà không sử dụng hóa chất
- Tỉ lệ loại bỏ:

Nitơ amoniac: 70-80%
Mangan hòa tan: 60-70%
Chất hữu cơ: 30-40%

- So sánh với với hệ thống xử lý ozone tiên tiến

✓ CAPEX: ½
✓ OPEX: 1/20

U-BCF tại thành phố Hải Phòng

Bước 1: 2010-2012
Dự án thí điểm U-BCF (JICA)

Bước 2: 2013
Quy mô nhỏ (5,000 m^3/day)
U-plant (Ngân sách phía Hải Phòng)

Bước 3: Tổ hợp công trình đang xây dựng
Nhà máy quy mô lớn100,000 m^3/day
(ODA Nhật Bản)

Phản hồi từ Cục Cấp thoát nước Thành phố Kitakyushu

- ✓ Lọc nước thải công nghiệp thành nước uống khả thi về mặt kỹ thuật
- ✓ Tuy nhiên, do chi phí cao và hình ảnh không đẹp nên thành phố Kitakyushu không chuyển đổi nước thải công nghiệp thành nước uống
- ✓ Thay vào đó, thành phố Kitakyushu đang tái sử dụng nước thải công nghiệp thành nước phục vụ sản xuất công nghiệp và nước xả nhà vệ sinh
- ✓ Phân tích chất lượng nước thải chi tiết là cần thiết để xem xét và đánh giá thêm

Dự án mô hình JCM

1) Áp dụng máy Bơm Nước Hiệu Quả Cao Tại Thành Phố Đà Nẵng

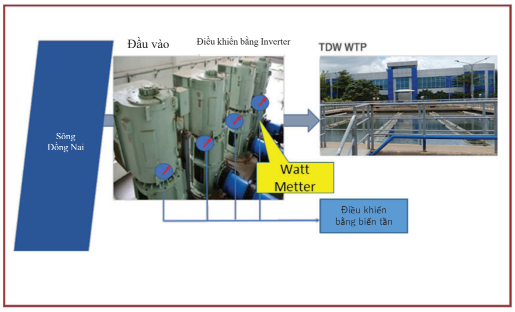
Yokohama Water Co., Ltd.
Danang Water Supply One-member Limited Company (DAWACO)

Danang City (2016)

2) Tiết kiệm năng lượng bằng cách áp dụng biến tần cho máy bơm lấy nước thô

Yokohama Water Co., Ltd.
Thu Duc Water B.O.O Corporation

Ho Chi Minh City (2018)



IHI Co. Confidential

IHI's study results only with roof-top PV

IHI

Feb 16th 2022

I H I Corporation
Resources, Energy & Environment Business Area
Carbon Solution Business Unit
Basic Design G.

Overview of IHI

IHI

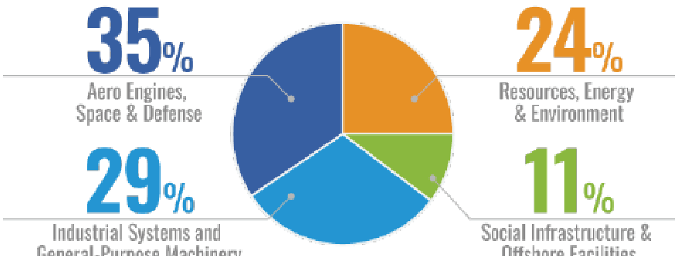
About IHI IHI's Web site: https://www.ihi.co.jp/en/products/industrial_general_machine/energy_storage_system/

Company Profile

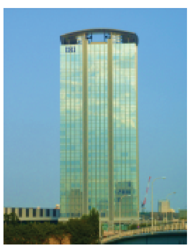
I H I Corporation	
Founded	December 5, 1853
Capital	JPY 107 Billion *(USD 1,007Million)
Net Sales (consolidated)	JPY 1,386 Billion *(USD 12,715Million)
Operating Profit	JPY 60.7 Billion *(USD 557Million)
Employees (consolidated)	28,964 (as of March 31, 2020)
Domestic Branches & Offices	8
Overseas Offices	14
Subsidiaries & Affiliates	216 (including 148 overseas companies, as of March 31, 2020)

Based on fiscal year 2019 ended March 31, 2020
*Average exchange rates for FY2019 : US$ 1.00= \109.16

Consolidated sales by business segment



Fiscal 2019



IHI
Realize your dreams

Overview of IHI

IHI

Feasibility Study Conditions

IHI

- Assumed conditions for FS study — To be updated per As-Is of Vietnam
  - ✓ 1Ha roof-top : 1.67 MWp PV capacity (per 1MWp=6,000m^2 on roof-top)
  - ✓ Solar radiation: METPV-Asia by NEDO
  - ✓ PV output : All PV's outputs are consumed in large demand of industrial park
  - ✓ PV's initial cost: One hundred million yen / MWp
  - ✓ Financial support: per JCM's rule (JCM: Joint Crediting Mechanism)

d) Industrial zone

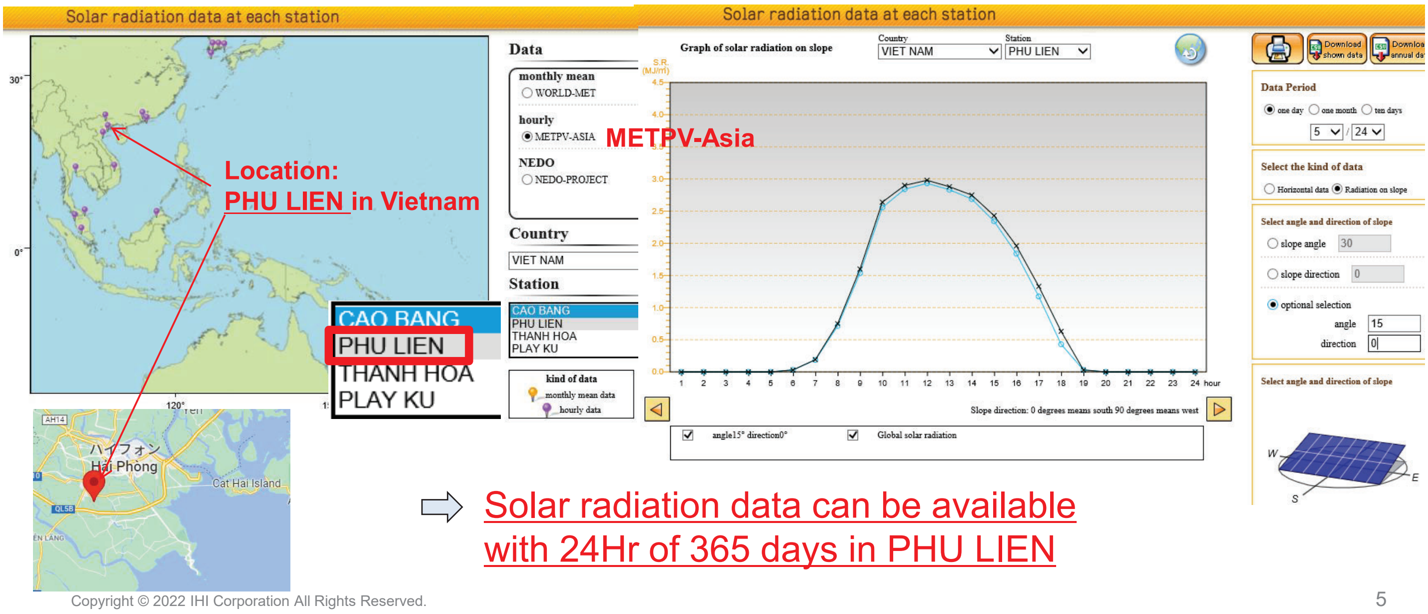
2	*Wholesale tariff for medium-voltages electricity at the 110/35-22-10-6kV substations*	
2.1	*Voltage levels from 22kV to below 110kV*	
	a) Standard hour	1,526
	b) Off-peak hour	989
	c) Peak hour	2,817

Supportive data for Designing PV Power Generation

IHI

Solar radiation data in Vietnam

- Please visit NEDO's web site ref) NEDO: New Energy and Industrial Technology Development Organization
  - ✓ Data base (English version) :https://appww1.infoc.nedo.go.jp/appww/index.html?lang=2
  - ✓ Manual (English version) :https://www.nedo.go.jp/content/100926825.pdf



⇨ Solar radiation data can be available with 24Hr of 365 days in PHU LIEN

5

PV output of 24Hr x 365days

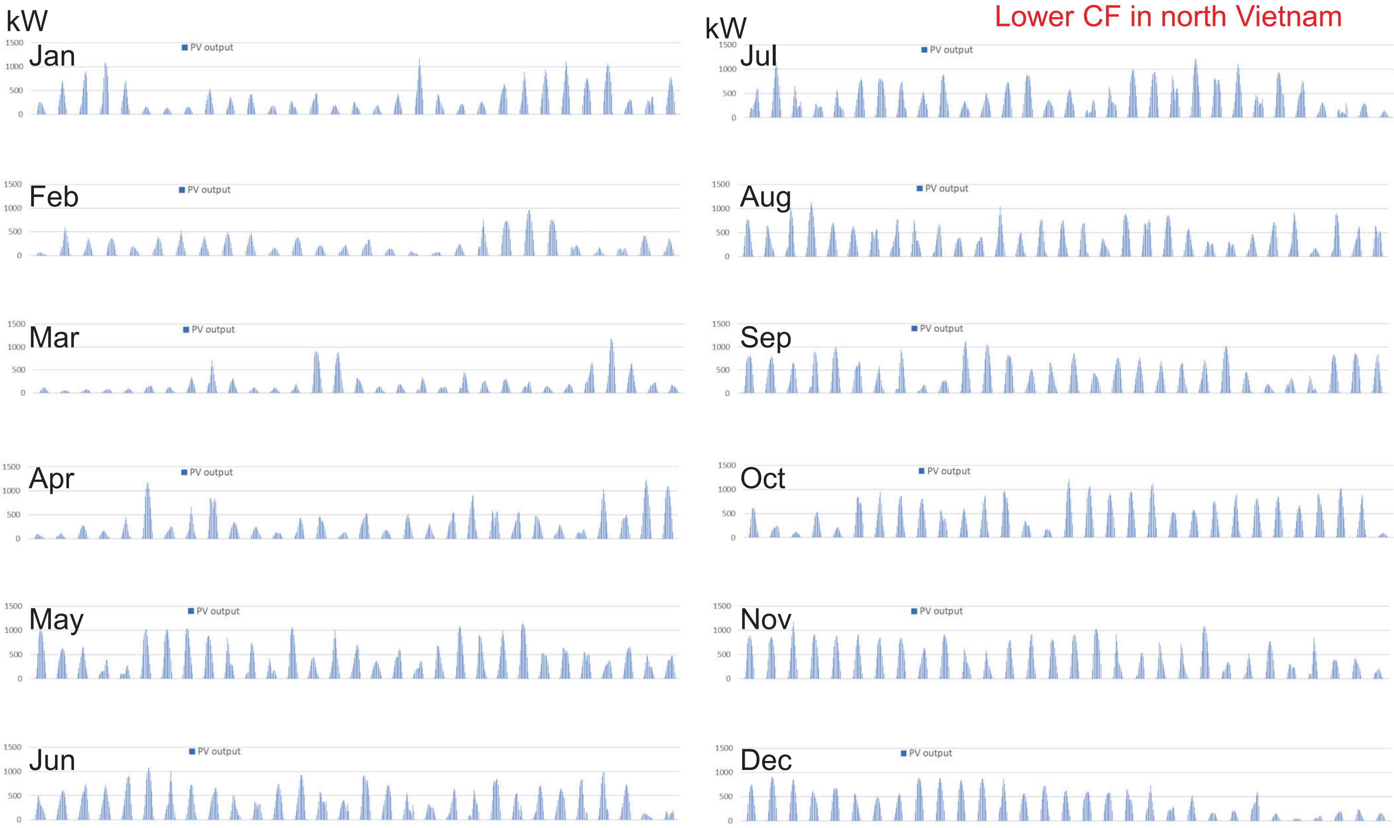
IHI

PV capacity: 1.67MWp for 1Ha Roof-Top

Produced Energy 1436 MWh/year

→ CF(capacity factor) = 1436 / (1.67x24x365) = 9.8%

Lower CF in north Vietnam



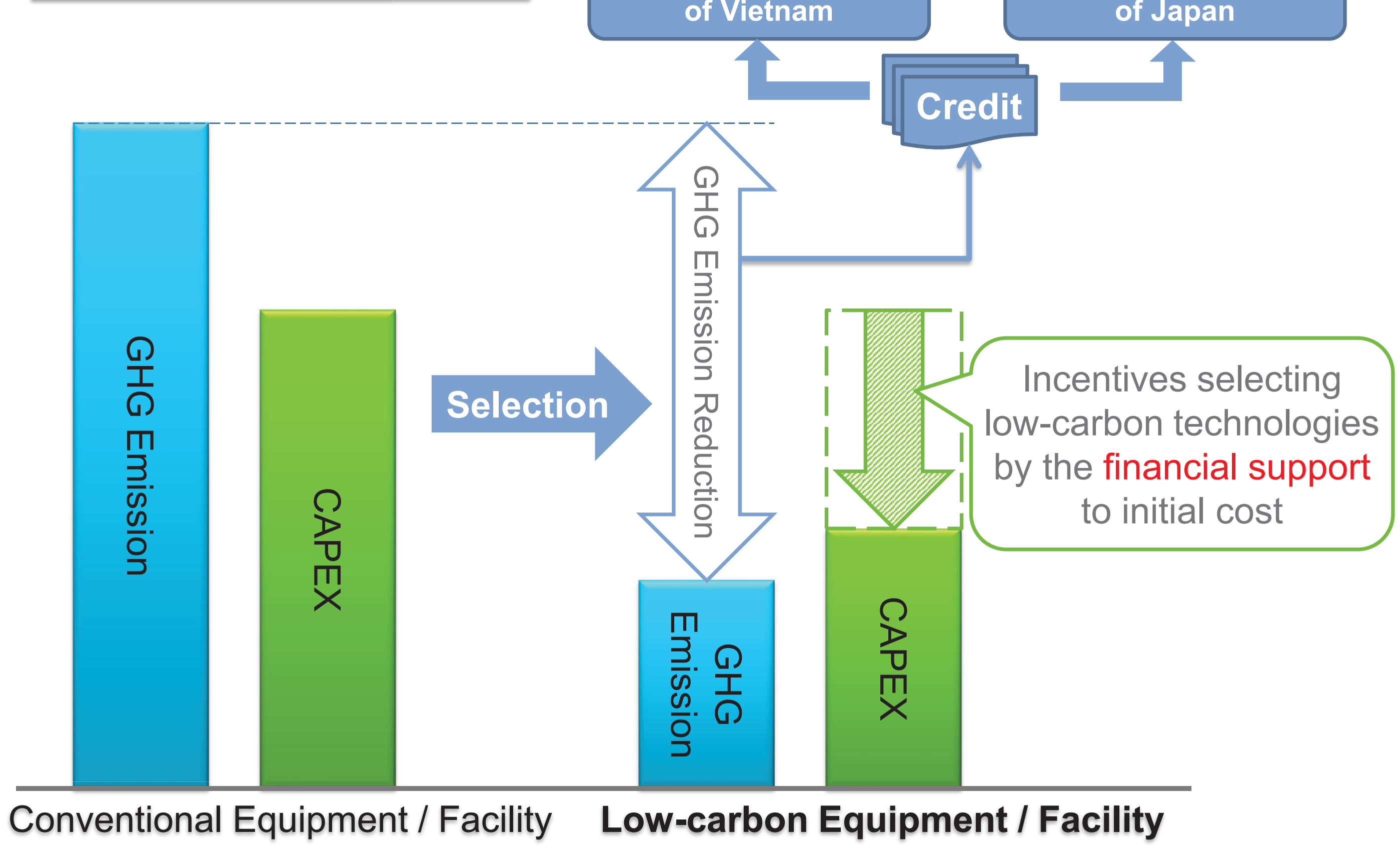
Large variation of solar radiation in north Vietnam

6

Joint Crediting Mechanism (JCM)

IHI

Advantages of JCM



Joint Crediting Mechanism (JCM)

IHI

Amount of FINANCIAL SUPPORT by JCM

Amount of financial support shall be smallest of the followings:

- Maximum grant ratio

Number of past projects with "similar technologies" in Vietnam	0 project (1st adoption)	1 project to 3 projects	4 projects and more
Maximum grant ratio	50 %	40 %	30 %

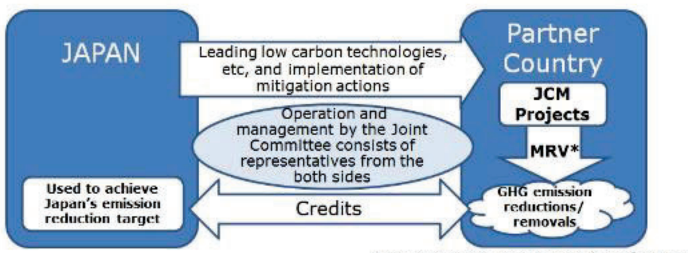
- Cost-effectiveness of emission reductions of GHG
  4,000 JPY/tCO_2eq or lower

- Maximum amount per one project = 2 BJPY (18 MUSD)

Basic concept of the JCM https://gec.jp/jcm/about/

Details for:
https://gec.jp/jcm/jp/kobo/r03/mp/(tentative)2021_Guidelines_for_Submitting_Proposals.pdf

- Facilitating diffusion of leading low carbon technologies, products, systems, services and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries;
- Appropriately evaluating contributions from Japan to GHG)emission reductions or removals in a quantitative manner, and use them to achieve Japan's emission reduction target;
- Contributing to the ultimate objective of the UNFCCC by facilitating global actions for GHG emission reductions or removals.



*measurement, reporting and verification

Feasibility Study for Roof-Top PV with 1.67MWp

IHI

- FS results with operating for 17 years as Japanese legal durable years by utilizing JCM financial support

Item	PV 1.67MWp	
Annual usable PV output (MWh)	1,436	(1)
Annual saving cost (MVND)	2,618	(2)
Emission factor per JCM's Renewable Energy (tCO2/MWh)	0.333	(3)
CO2 reduction amount of JCM (tCO2/year)	478	(4)=(1)x(3)
Japanese legal durable years	17	(5)
CO2 reduction amount for project period of JCM (tCO2)	8,130	(6)=(4)x(5)
PV initial cost (JPY)	166,600,000	(7)
Percentage of JCM financial support	30%	(8)
cost effectiveness (JPY/tCO2)	6,148	(9)=(7)x(8)/(6)
Subsidy amount equivalent to 4000 yen as cost effectiveness (JPY)	32,518,390	(10)=4000JPYx(6)
Payback Year	10.2	(11)=((7)-(10))/((C2)x10^6x0.005)

(10) / (7) = 20%

By utilizing JCM financial support, the initial investment can be reduced by approx. 20%. However, 17-years' monitoring & reporting & verification (MRV) obligation is required.

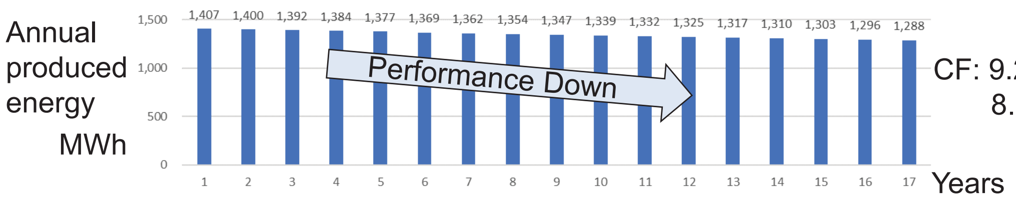
FS for PV with 1.67MWp considering degradation

IHI

- Assumed condition for FS with PV's degradation

To be updated per PV's specification

  - ✓ Max degradation of 1st 1 year : 2%
  - ✓ Max degradation from 2nd to 25th years : 0.55% every year



CF: 9.2% in 10th year
8.8% in 17th year

- FS results with degradation

Item	PV 1.67MWp	With Degradation
Annual saving cost (MVND)	2,618	2,456
Japanese legal durable years	17	17
CO2 reduction amount for project period of JCM (tCO2)	8,130	7,626
PV initial cost (JPY)	166,600,000	166,600,000
Percentage of JCM financial support	30%	30%
cost effectiveness (JPY/tCO2)	6,148	6,554
Subsidy amount equivalent to 4000 yen as cost effectiveness (JPY)	32,518,390	30,503,539
Payback Year	10.2	11.1

Estimated per =2618x(7626/8130)

IHI
Realize your dreams

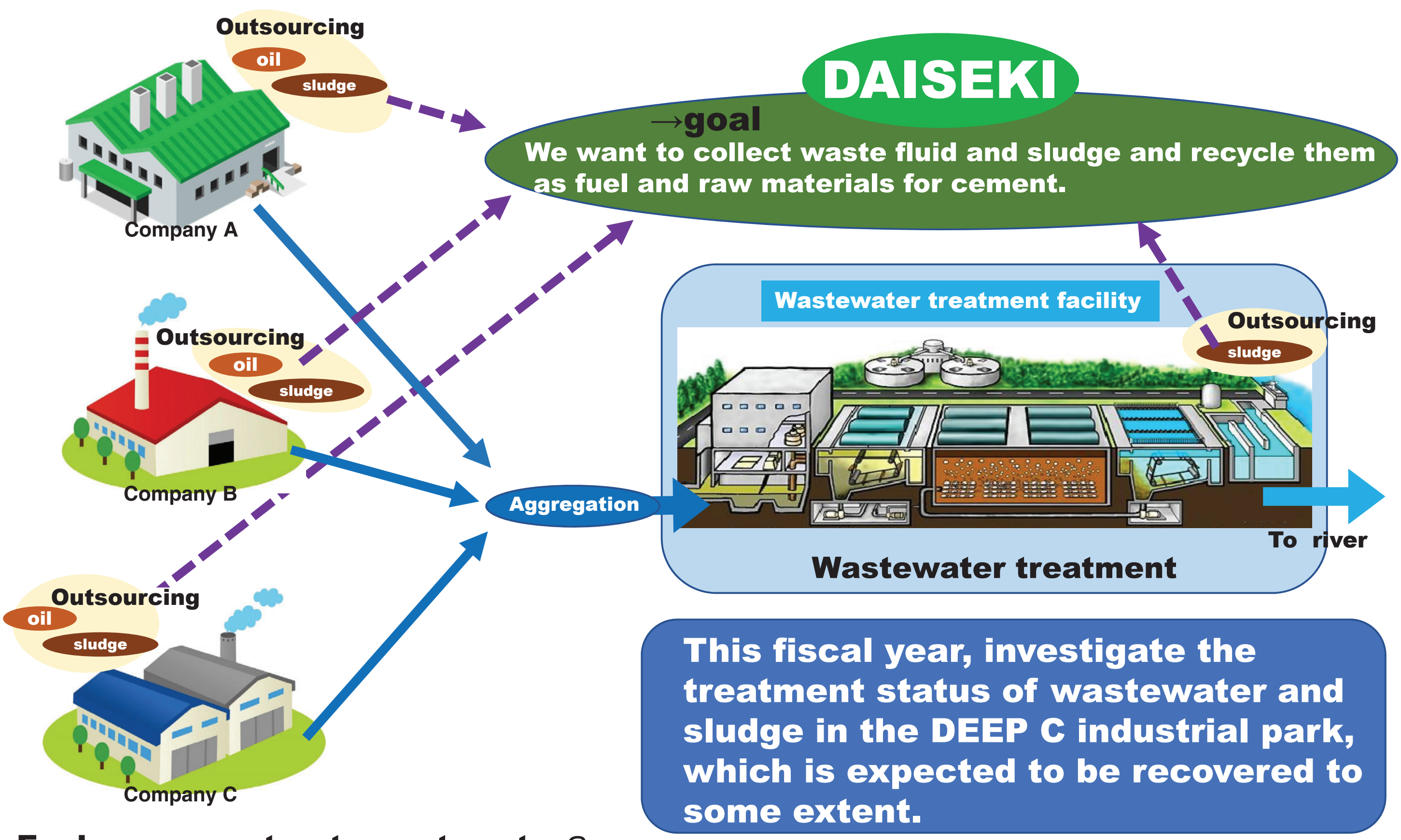
Reiwa 3rd year City-to-City Collaboration for Zero Carbon Society
(Eco-industrial park promotion project for decarbonization of Haiphong, Vietnam)
Survey results of waste liquid energy recovery and use

Waste liquid energy recovery and use

February 2022

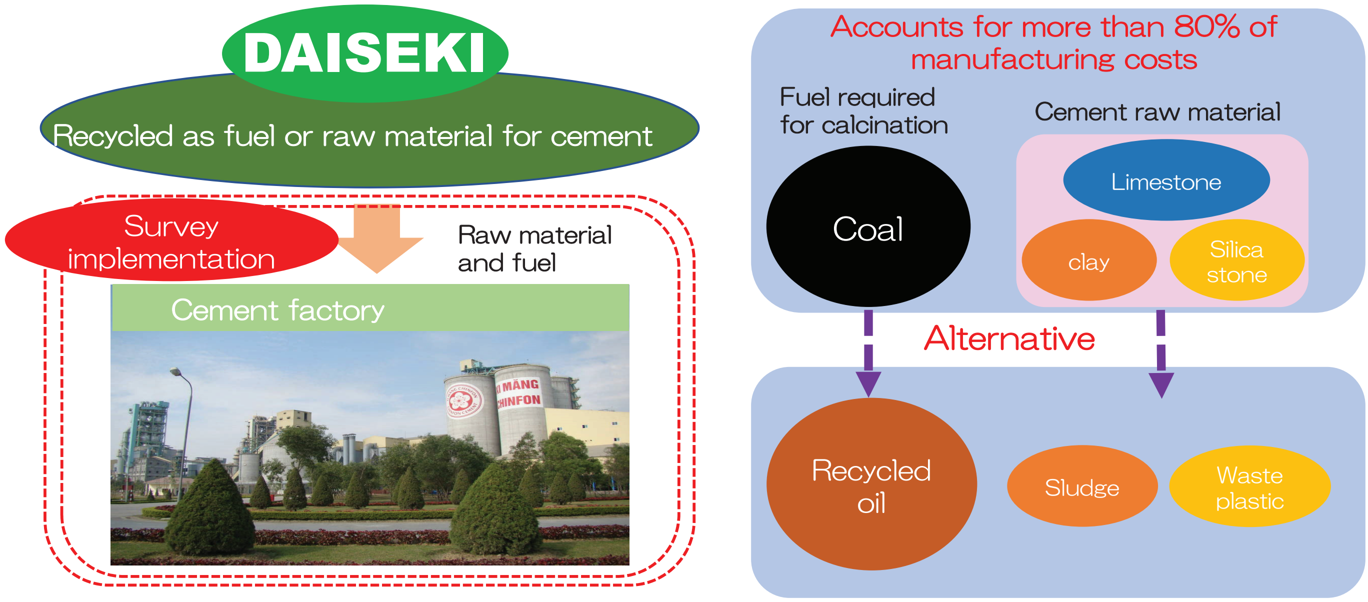
DAISEKI
CHUGAI TECHNOS VIETNAM
IGES
KITAKYUSHU CITY
HAI PHONG CITY

Assumed wastewater treatment status in DEEP C industrial park



1

Survey results at cement manufacturing company



① Looking for new raw materials to reduce production costs
②The cement factory does not currently accept waste.
③MONRE's waste management law is strict, and it is unclear whether waste can be used as raw material and fuel. The law has not been established.

If the problem ③ can be cleared, the cement manufacturing company will actively accept it.

2

Creation of benefits in the DEEP C industrial park

【Assumption 1】When the cement manufacturing company has a prospect of using waste as raw material and fuel.
【Assumption 2】Acceptance of waste by companies that excel in recycling technology for waste liquids and sludge such as DAISEKI
【Assumption 3】When waste liquid and sludge can be accepted at a lower cost than existing processing costs and transportation costs

Regarding waste liquid and sludge treatment, what kind of benefits can be created?

【Industrial park】
- Reducing the treatment burden of centralized wastewater treatment facilities
- Reduction of sludge treatment costs
- Improving added value as an eco-industrial park

【Tenant company】
- Reducing the treatment burden of wastewater, sludge, waste oil treatment
- Reduction of wastewater, sludge and waste oil treatment costs
- Reducing the burden of responding to the recycling system (EPR) for waste oil treatment

【Hai Phong City】
- Prevention of pollution by proper treatment of waste oil and liquid
- CO_2 emission reduction
- Improved recycling rate

3

Additional research and problem solving to create benefits

①Additional survey of wastewater treatment in industrial park

- Wastewater that exceed the QCVN40 / 2011 / BTNMT standard will be processed by DAISEKI.

⇒Creating cost benefits

- Part of the received amount 1,000 m3 / day will be processed by DAISEKI

⇒Reducing the treatment burden of centralized wastewater treatment facilities and creating cost benefits

②Survey of waste liquid, sludge, and waste oil treatment in tenant company, and Haiphong City as well

- Understanding the amount of waste liquid and sludge outsourced.
- Cost benefit when shifting to processing by DAISEKI.
- Reducing the treatment burden by centralized management of waste liquid and sludge.
- Advantages of waste treatment companies such as sludge

Problem survey, solution proposal

- Aggregation, storage, management, transportation, etc. ⇒ Operational issues ⇒ Considering a solution
- Establishment of recycling regulations for waste liquid and sludge ⇒ Institutional issues ⇒ Considering a solution

Request support for system construction through the Japan-Vietnam Environmental Policy Dialogue Channel, etc., based on the implementation status in Japan.

4

System to enhance renewable energy installations

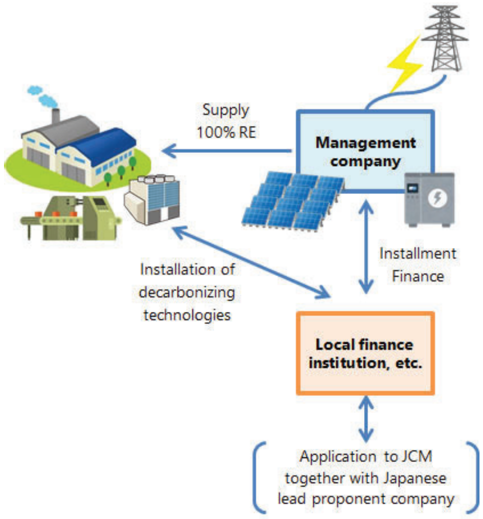
Environment Bureau, Kitakyushu City

Institute for Global Environmental Strategies

Final workshop, 16th February 2022

IGES Institute for Global Environmental Strategies

Interview surveys



Kitakyushu City
- Renewable Energy Planning and Promotion Division

Industrial estates
- Nam Cau Kien
- DEEP C

Local banks
- Vietcombank (+ Mizuho Bank)
- VietinBank

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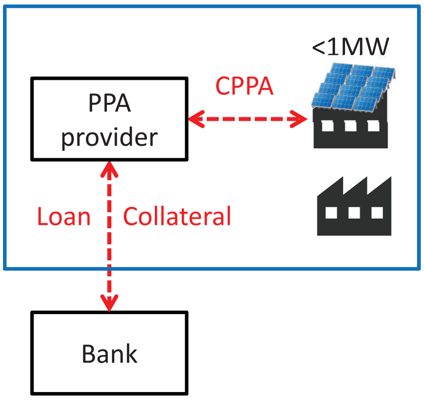
Summary of findings



https://globalsolaratlas.info/

Opportunities

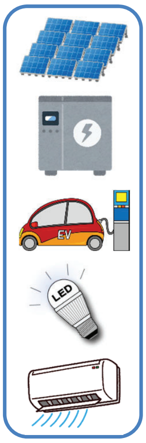
- Corporate PPA (<1 MW, <35kV rooftop)

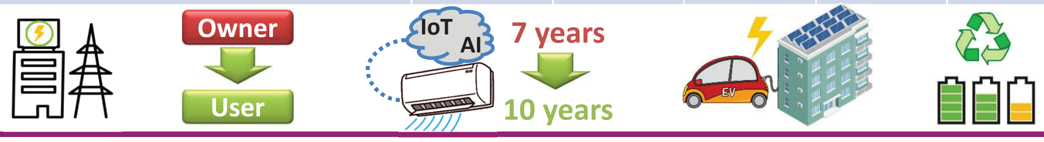
Challenges

- Low electric price by EVN
- Lack of incentives (FIT)
- Low solar potential (in the north)
- Long payback period (15-20 years)
- Only corporate finance (up to credit and collateral)
- Limitation in government intervention

What Kitakyushu is doing

	Enhance installation	Energy saving	Extension of lifetime	Cost saving	Improve credit
Established local electric power utility (Kitakyushu Power)	√				
Shift from ownership to use (subscription)	√				
Optimization of product use by AI & IoT		√	√	√	
Sharing use (multiuse)	√			√	
Collection and recycling system	√				
Regeneration and supply	√				
Intervention and commitment by the city					√





Trends of solar projects by JCM

https://gec.jp/jcm/jp/projects/

Year	Location	Capacity	Type	Lead proponent	Local counterpart
2021	Binh Duong	5.8MW	Rooftop	Asian Gateway Corporation	VES Joint Stock Company
2021	Dong Nai	9.8MW	Rooftop	Osaka Gas Co., Ltd.	SOL Energy Co., Ltd.
2021	North, South	2.5MW	Rooftop	Kansai Electric Power Company Inc.	Kansai Energy Solutions (Vietnam) Co., Ltd.
2021	North, Central, South	12MW	Rooftop	Marubeni Corporation	Marubeni Green Power Vietnam
2021	Hanoi, Bacninh, Ha Nam, Ba Ria Vung Tau, Ho Chi Minh	9MW	Rooftop	Sharp Energy Solutions Corporation	I RENEWABLE ENERGY VIETNAM CO., LTD.
2020	Binh Dinh	2MW	Rooftop	Idemitsu Kosan Co., Ltd.	TTCL Public Company Limited
2020	An Giang	57MW	Land	Kanematsu KGK Corp.	SAO MAI GROUP CORPORATION
2019	An Giang	49MW	Land	Kanematsu KGK Corp.	SAO MAI GROUP CORPORATION

- Ask the Japanese tenant companies to be the lead proponent of JCM
- Bundle application for rooftop solar (<1MW x several units) within the industrial estates
- Expected JCM subsidy rates: 30%

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Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City

City-to-City Collaboration between Kitakyushu City and Hai Phong City, 2021

Kitakyushu City
Hai Phong City
Institute for Global Environmental Strategies

Webinar on the Joint Crediting Mechanism (JCM) Implementation in Viet Nam, December 17, 2021

IGES Institute for Global Environmental Strategies

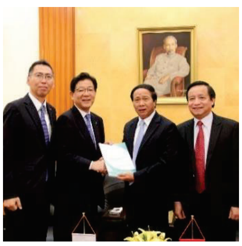
Collaboration background

2009 | 2010 | ··· | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020

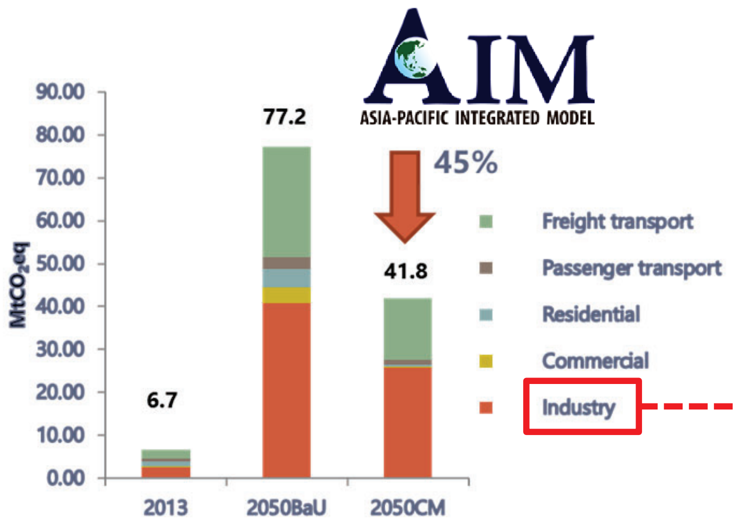
- Cultural exchange, Business exchange (JICA)
- Water and sewage (JICA, CLAIR)
- Low carbon technology (MOEJ C2C)
- Composting (city budget)

- MOU on friendship cooperation
- MOU on technical cooperation of water and sewage sector
- MOU on sister city agreement
- Green Growth Promotion Plan
- Installation of EV bus in Cat Ba Island
- MOU with NCK & Deep C

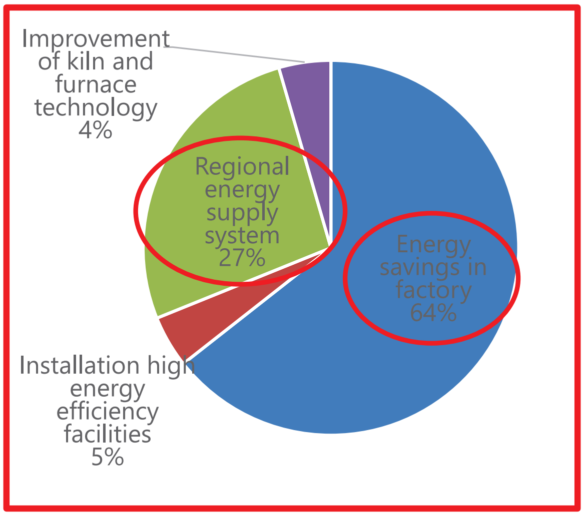



GHG reduction needs in Hai Phong



Low carbon scenario in Hai Phong city



GHG reduction potential in Green Industry sector

Commitments at the COP26

- Both Japan and Viet Nam pledged to strive for carbon neutrality by 2050
- Both Kitakyushu and Hai Phong also committed to strive for zero carbon cities

“Kitakyushu will continue to provide support in finding solutions to issues by deploying our environmental technologies overseas.”

“…, we will certainly continue to work hand in hand with Kitakyushu city to realize a zero carbon city.”

Japanese Prime Minister
Fumio Kishida
https://www.mofa.go.jp/ic/ch/page6e_000257.html

Vietnamese Prime Minister
Phạm Minh Chính
https://vietnamnews.vn/environment/1071075/viet-nam-strives-to-achieve-net-zero-by-2050-with-international-support-pm.html

Kitakyushu City Mayor
Kenji Kitahashi

Deputy Director of DOFA
Dung Nguyen Thi Bich

World Leaders Summit
(Nov. 2nd, 2021)

Climate Summit
(Nov. 1st, 2021)

Side Event “Leading efforts towards achievement of zero carbon cities”
(Nov. 2nd 2021, Organized by MOEJ, IGES, ICLEI, OECD)

Project outline

Know-how transfer

- Kitakyushu city's knowhow on 100% RE
- Kitakyushu city's knowhow on eco-town development

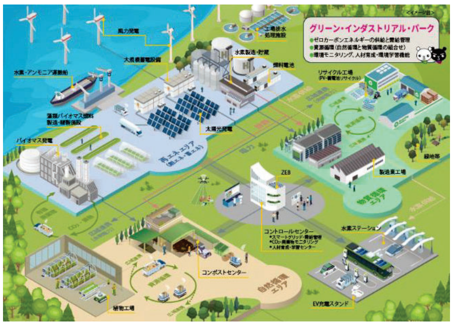
Mutual feedback

Project development

- Energy saving
- Renewable energy
- Smart energy
- Energy recovery from waste

Expected outcome

Zero Emission Industrial Estates



- ✓ Accreditation to Eco-Industrial Park
- ✓ Zero-emission industrial estates
- ✓ Decarbonization domino
- ✓ Localizing SDGs in industrial estate

Goal & Strategy

2021
- ☐ Basic survey
- ☐ Policy support

2022
- ☐ Basic survey
- ☐ Policy support

2023
- ☐ Basic survey
- ☐ Policy support

2024～

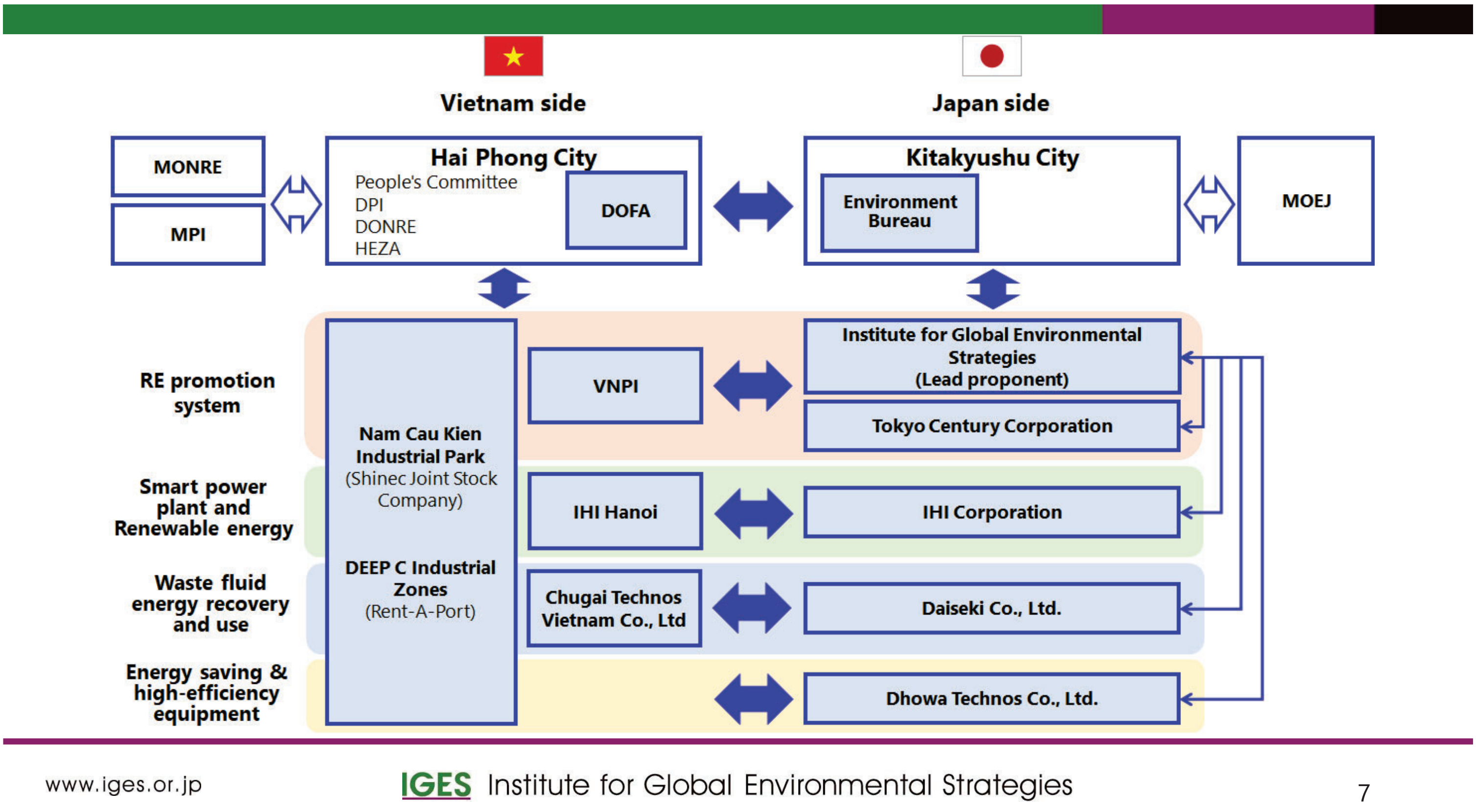
Development of zero-emission type industrial estate

Accreditation to Eco-Industrial Park

JCM Model Projects

Policy dialogue on zero carbon cities

AIM ASIA-PACIFIC INTEGRATED MODEL



Vietnam side
Japan side
MONRE
MPI
Hai Phong City
People's Committee
DPI
DONRE
HEZA
DOFA
Kitakyushu City
Environment Bureau
MOEJ
RE promotion system
Smart power plant and Renewable energy
Waste fluid energy recovery and use
Energy saving & high-efficiency equipment
Nam Cau Kien Industrial Park
(Shinec Joint Stock Company)
DEEP C Industrial Zones
(Rent-A-Port)
VNPI
IHI Hanoi
Chugai Technos Vietnam Co., Ltd
Institute for Global Environmental Strategies
(Lead proponent)
Tokyo Century Corporation
IHI Corporation
Daiseki Co., Ltd.
Dhowa Technos Co., Ltd.
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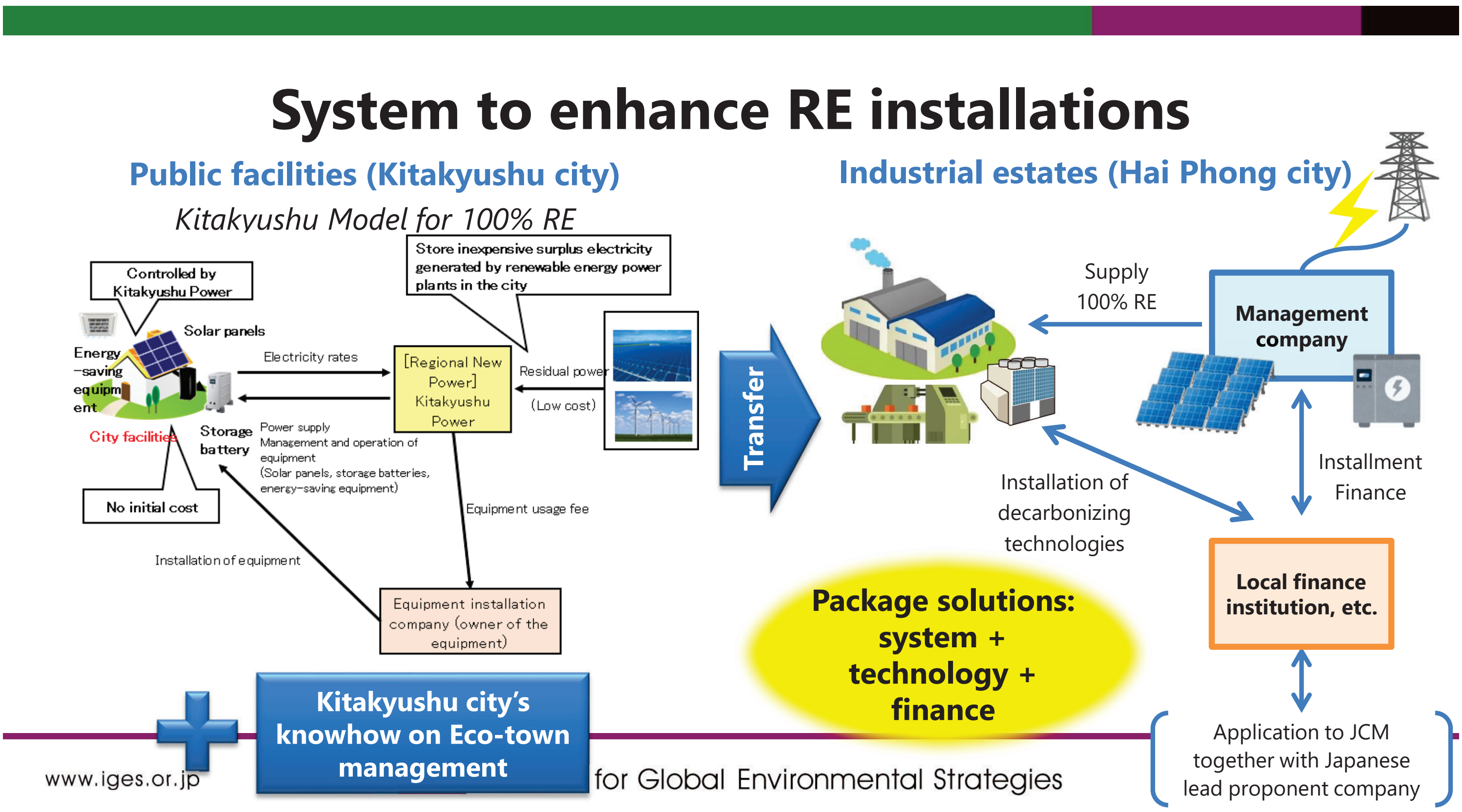
7



System to enhance RE installations
Public facilities (Kitakyushu city)
Kitakyushu Model for 100% RE
Controlled by Kitakyushu Power
Store inexpensive surplus electricity generated by renewable energy power plants in the city
Solar panels
Energy–saving equipment
Electricity rates
[Regional New Power] Kitakyushu Power
Residual power
(Low cost)
City facilities
Storage battery
Power supply
Management and operation of equipment
(Solar panels, storage batteries, energy–saving equipment)
No initial cost
Equipment usage fee
Installation of equipment
Equipment installation company (owner of the equipment)
Kitakyushu city's knowhow on Eco-town management
Transfer
Industrial estates (Hai Phong city)
Supply
100% RE
Management company
Installation of decarbonizing technologies
Installment Finance
Package solutions: system + technology + finance
Local finance institution, etc.
Application to JCM together with Japanese lead proponent company
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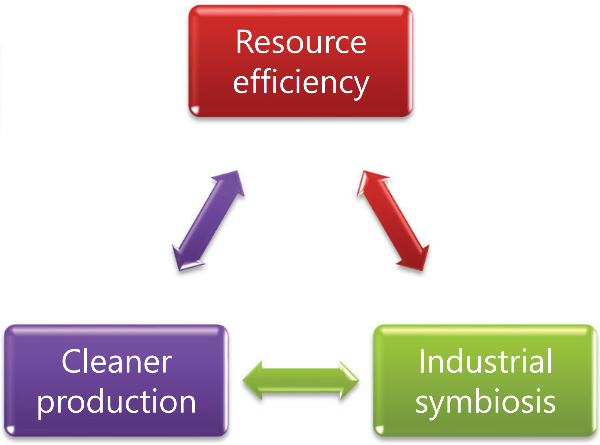
JCM feasibility studies

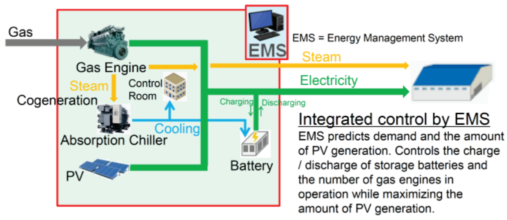
Eco-Industrial Park

Energy saving & high-efficiency equipment

Renewable energy



Smart Power Plant



Waste fluid energy recovery & use

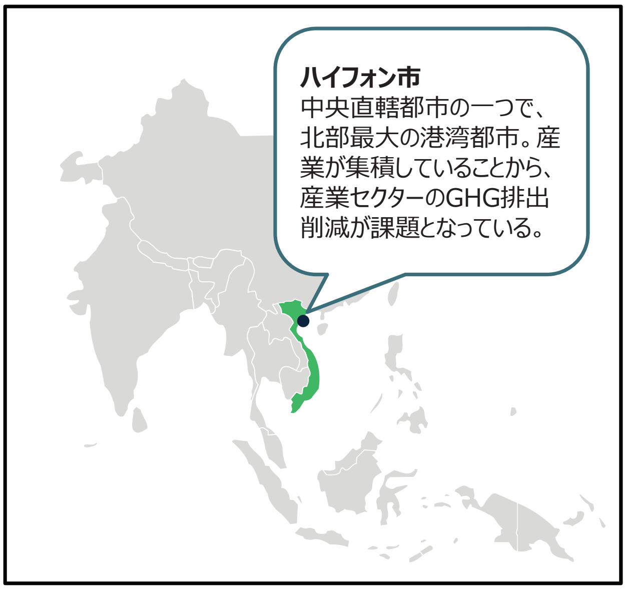
Thank you!

For further inquiries:

Overall project	**Kohei HIBINO** Institute for Global Environment Strategies (IGES)
Kitakyushu City	**Junichi YAMANE** Kitakyushu Asian Center for Low Carbon Society Environment Bureau, Kitakyushu City
Hai Phong City	**Dung NGUYEN THI BICH** Department of Foreign Affairs, Hai Phong City E-

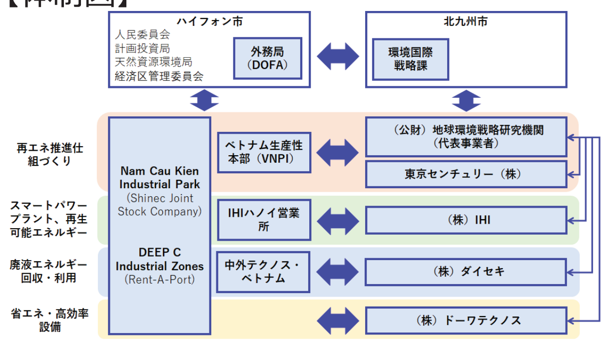
ベトナム・ハイフォン市–北九州市に関する都市間連携

ハイフォン市と北九州市は、2009年に「友好協力協定」を締結後、主に上下水道分野の技術交流や文化・経済交流を行ってきた。さらに、2014年には「姉妹都市協定」を締結し、廃棄物部分野、低炭素技術分野等も含め包括的な連携に発展してきた。特に、2014年には「ハイフォン市グリーン成長推進計画」を共同で作成し、そこで特定された15のパイロットプロジェクトの具体化に取り組んできている。

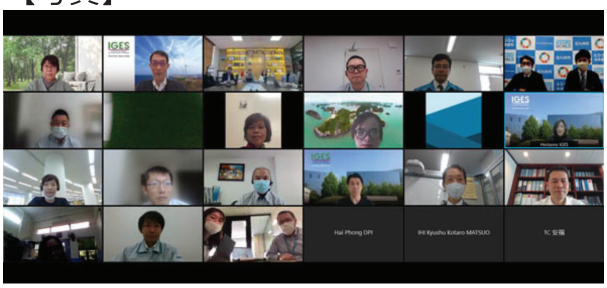


ベトナム・ハイフォン市–北九州市に関する都市間連携

【体制図】



【写真】



Nam Cau Kien工業団地とのキックオフ会合の様子

【事業活動・成果】

活動

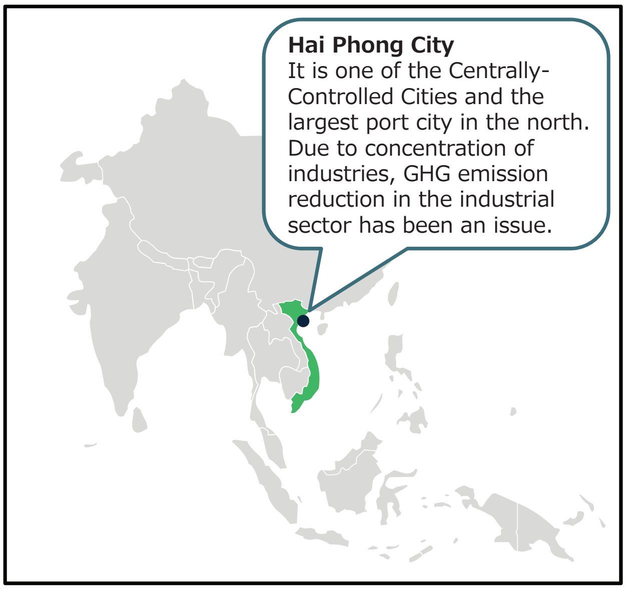
- キックオフ会合（2回）の開催
- ファイナル会合（2回）の開催
- 現地企業との個別コンサルテーション会合（複数回）の開催
- 調査団による個別調査・分析

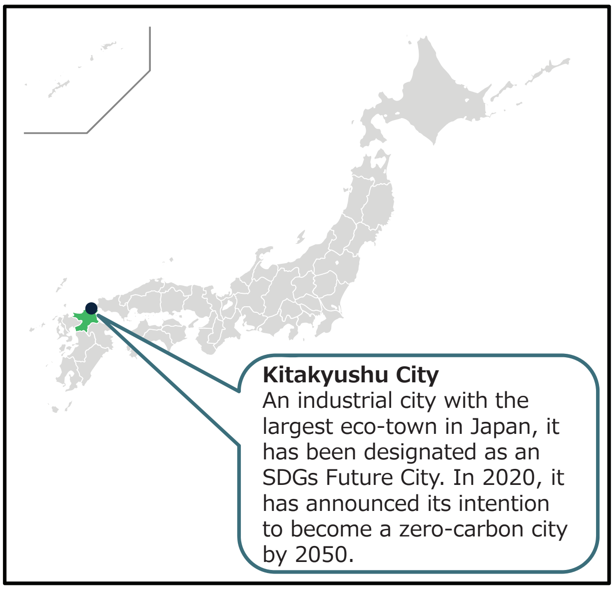
成果

- 電力小売り料金の安さと日照条件の悪さから、太陽光発電・蓄電池の組合せでは投資回収期間が長くなる。
- セメント原燃料化への関心・需要が高いが、国の制度・基準が曖昧であるため、導入ができていない状況である。国の基準づくりが必要。
- 水処理及び廃棄物処理に関する新たなニーズがハイフォン市及び工業団地から挙がってきたため、これらの分野について更なる検討が必要。

City-to-city collaboration between Hai Phong City and Kitakyushu City

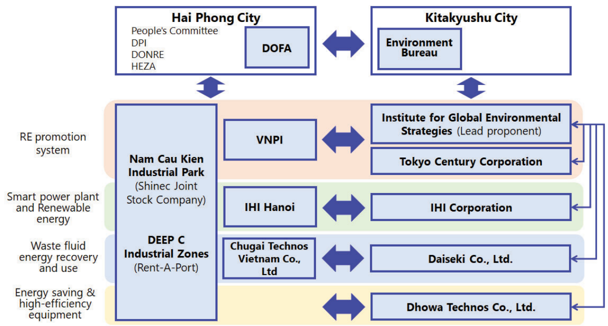
Hai Phong City and Kitakyushu City have signed the Friendship, Cooperation Agreement in 2009, and since then, two cities have engaged in technological exchange mainly in the field of water supply and sewerage as well as cultural and economic exchanges. Furthermore, in 2014, the two cities concluded an agreement regarding Sister-Cities Friendship and Cooperation Relations, which has developed into a comprehensive collaboration that includes the fields of waste management and low-carbon technology. In particular, in 2014, the two cities jointly developed the Green Growth Promotion Plan of Hai Phong and have been working on the materialization of the 15 pilot projects identified in the plan.



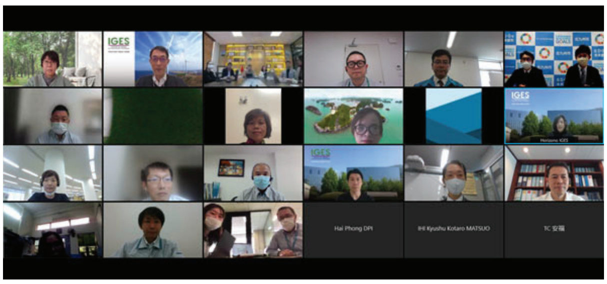


ベトナム・ハイフォン市−北九州市に関する都市間連携

Structure



Photos



Kick-off meeting with Nam Cau Kien Industrial Park

Activities and tentative results

Activities

- Kick-off meeting (2 times)
- Final workshop (2 times)
- Consultation meetings with local companies (several times)
- Independent survey and analysis by the survey team

Tentative results

- Due to low retail electricity prices and poor sunlight conditions, the payback period for the combination of solar power and storage batteries will be long.
- There is a high level of interest and demand for the use of cement as a raw material and fuel, but the introduction of this technology has not been possible due to the ambiguity of the national system and standards. National standards need to be established.
- New needs for water treatment and waste treatment have been raised by Haiphong City and the industrial parks, so further study is needed in these areas.

FY2021 City-to-City Collaboration for Zero-Carbon Society
（Promotion of Eco-Industrial Parks Toward Carbon Neutrality in Hai Phong City, Vietnam）
Commission Report
March 2022

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