FY2021 Project for Ministry of the Environment Japan

City to City Collaboration for Zero-carbon Society in FY2021 Project to Promote the Formation of an Autonomous Decarbonized Society through City-to-City Collaboration between Hiroshima Prefecture and Soc Trang Province, Vietnam Report

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Hiroshima Prefecture

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1. Introduction

1.1. Background and purpose of the survey

All countries participated in the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) held in December 2015 in the suburbs of Paris, France, where the Paris Agreement, a legal framework for fair and effective climate action beyond 2020, was adopted, followed by the adoption of a rulebook at COP24 in Katowice, Poland, in December 2018, which sets out specific obligations for each country starting in 2020.

At COP21, where the Paris Agreement was adopted, it was decided to recognize the actions of non-state actors, including cities, and to welcome the efforts of all non-governmental actors (cities and other local governments, etc.) and invite them to scale up their efforts. Cities are places of activity that support socio-economic development and are inhabited by large numbers of people. About half of the world's population lives in urban areas, which account for 2% of the world's total land area, and this proportion is expected to increase to 70% by 2050. As of 2006, more than 70% of the world's CO2 emissions were estimated to come from urban areas. Urban areas play a significant role in mitigating climate change, and the steady implementation of climate change countermeasures in urban areas and the reduction of greenhouse gas emissions are important for achieving the goals of the Paris Agreement. In this project, Japanese research institutes, private companies, universities, and other organizations, together with Japanese cities that have experience and know-how in the formation of a low-carbon society, will conduct research projects necessary to effectively and efficiently support efforts to form a low-carbon society in overseas cities.

This survey was conducted in Soc Trang Province, Socialist Republic of Vietnam, with the aim of reducing greenhouse gas emissions in the field of renewable energy, forming JCM projects that will contribute to such reduction, and strengthening cooperation among cities.

1.2. Survey overview

We conducted basic research on the geopolitics, economic situation, and agriculture, especially rice cultivation, of the target country, Vietnam, and Soc Trang Province. In addition, activities related to city-to-city collaboration between Hiroshima Prefecture and Soc Trang Province were conducted and workshops (online) were held. In addition, the possibility of reducing CO2 emissions through the use of rice husk solid fuel, solar power generation systems and BEMS, and the use of solid waste solidified fuel (RPF) was examined.

(1) Basic Survey of Soc Trang Province

Based on JETRO Vietnam's reports, local interviews, and other research, the content was prepared by gathering the latest local information.

(2) Collaboration between Hiroshima Prefecture and Soc Trang Province

Hiroshima Prefecture organized its know-how and knowledge and conveyed them to Soc Trang Province to discuss the possibility of collaboration.

(3) Survey on fuel replacement project of coal boiler using rice husk solid fuel

A feasibility study was conducted on the assumption that a rice husk solid fuel production system (curl chip production machine) from Tromso Co., Ltd. a company in Hiroshima Prefecture, would be introduced in Soc Trang Province.

(4) Survey on energy creation and energy saving projects by introducing solar power generation systems and BEMS

A feasibility study was conducted on the assumption that a solar power generation system and BEMS (Building Energy Management System) from Hirokawa Enath Co., Ltd., a company in Hiroshima Prefecture, would be installed in Soc Trang Province.

(5) Survey on an alternative energy to fossil fuels through the use of solidified waste fuel (RPF)

A feasibility study was conducted on the assumption that Ogawa Econos Inc, a company in Hiroshima Prefecture, would conduct a waste solidification fuel (RPF) manufacturing business in Vietnam.

1.3. Survey structure

The structure of this survey is shown below.

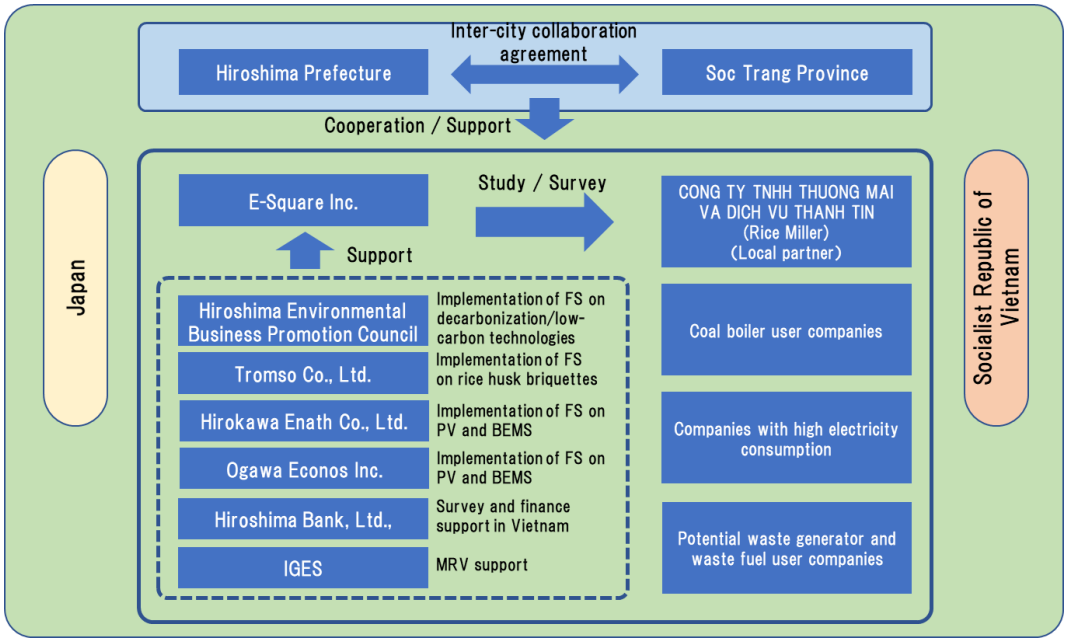


Figure 1 Survey structure

E-Square Inc. as the implementer, Hiroshima Prefecture as the Japanese local government, Hiroshima Environmental Business Promotion Council, Tromso Co., Ltd., Hirokawa Enath Co., Ltd., Ogawa

Econos Inc., Hiroshima Bank, Ltd. and Institute for Global Environmental Strategies (IGES) as the co-implementers.

1.4. Survey schedule

This study started in November 2021 and was completed in March 2022.

Item	Nov 2020	Dec	Jan 2021	Feb	Mar
Basic survey	→	→	→		
Collaboration between Hiroshima and Soc Trang	→	→	→	→	
FS on rice husk sold fuel	→	→	→	→	
FS on PV and BEMS	→	→	→	→	
FS on RDF	→	→	→	→	
Online work shop		★			
Briefing to MOEJ				★	★
Report			→	→	submission

Figure 2 Survey schedule

2. Basic Survey on Soc Trang Province

2.1. Overview of Vietnam

Vietnam is officially known as the "Socialist Democratic Republic of Vietnam" (hereinafter referred to as Vietnam). It is located on the east side of the Indochina Peninsula at latitudes 8.35-23.4 degrees north/longitudes 102.8-109.4 degrees east, bordered by Laos and Cambodia to the west, and the South China Sea to the east. The distance from Tokyo to Ho Chi Minh City is 4,336 km, and it takes about 6 hours by air.

Figure 3 Location of Vietnam and Japan

Figure 4 National flag of Vietnam

The political system is a socialist republic led by the Communist Party of Vietnam. The current system has been in place since the declaration of independence by Ho Chi Minh in 1945 (independence of the Democratic Republic of Vietnam), the Vietnam War, and the reunification of North and South Vietnam in 1976.

Vietnam has an area of 329,241 ㎢ (about 90% of the area of Japan), three quarters of which is

mountainous. The country can be roughly divided into the northern, central, and southern regions. In the north, the capital Hanoi is the political and cultural center. In the central region, tourism is becoming a major industry with Da Nang, the third largest industrial city after Hanoi and Ho Chi Minh. In the south, the former capital of South Vietnam, Saigon, has been replaced by Ho Chi Minh City as the commercial center of the country. The Mekong Delta region in the south is also the center of rice cultivation in Vietnam, where rice production is flourishing nationwide.

The population is approximately 94.67 million (2018 estimate). The Kinh people account for about 85% of the population, and the rest is made up of 53 ethnic minorities. 35.7% of the population live in urban areas such as Hanoi, Ho Chi Minh City and Can Tho City, while 64.3% live in rural areas. As can be seen from the population pyramid （Figure 5）, the population is predominantly young, with a large number of working-age and reserve population under 60 years old.

The number of Japanese residents in Vietnam was 22,125 as of October 1, 2018 (according to the Ministry of Foreign Affairs of Japan).

Table 1 Major indicators in Vietnam

Item	Content
Country name	Socialist Republic of Vietnam
Capital city	Hanoi
Area	329,241 ㎢（Equivalent to the area of Japan excluding Kyushu region）
Population	Approx.95.56 million （Estimation in 2018）
Religion	Urban area: Overall ratio 35.7% / Rural area: 64.3%
Language	Buddhism(80％), Christianity (9％)、others(Islam, Cao Dai etc.)
Administrative division	Official terminology：Vietnamese
unemployment rate	58 provinces、5 direct-controlled municipalities （Hanoi, Ho chi minh, Haiphong, Danang and Can Tho City）

Source：General Information of Vietnam April, 2019 by JETRO

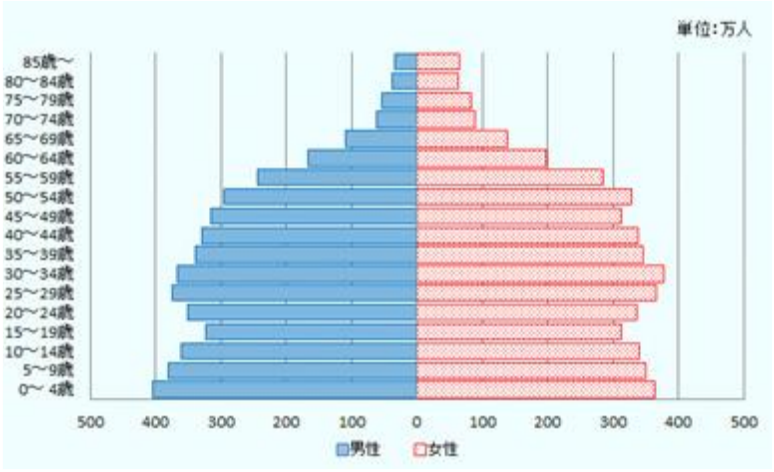


Figure 5 Population pyramid in Vietnam (2016)

Source：Region analysis report by JETRO

Figure 6 Economic development is remarkable in Ho Chi Minh City

2.2. Overview of Soc Trang Province

Soc Trang Province, with which Hiroshima Prefecture has concluded an inter-city partnership agreement, is a municipality in the Mekong Delta region of southern Vietnam, facing the South China Sea. It has a population of about 2 million people, and is an area where agricultural production, mainly rice cultivation, and shrimp farming are flourishing, and where many food processing factories are located.

Figure 7 Location of Soc Trang Province

(1) Land use

The total area of Soc Trang Province is 331,176 ha. The land in Soc Trang Province is fertile and suitable for the cultivation of paddy rice, sugarcane, soybeans, corn, onions, garlic and other vegetables, grapefruit, mangoes, durian and other fruit trees. Agricultural land accounts for 205,748 ha (62.13%), forest land 11,356 ha (3.43%), aquaculture land 54,373 ha (16.42%), and salt production and other agricultural land 0.97%. Land for rice cultivation occupied 144,156 ha, land for other annual crops 21,401 ha, and land for perennial crops and fruit trees 40,191 ha. In particular, non-agricultural land is 53,963 ha and unused land is 2,536 ha (Statistics of Soc Trang Province, 2008).

(2) Climate

Soc Trang Province has a mild climate throughout the year, with an average weather temperature of 26.7℃, a maximum temperature of 28.2℃ (April), and a minimum temperature of 25.2℃ (January). Located in the Mekong Delta and facing the South China Sea, the average humidity is as high as 86%. Floods and typhoons are rare.

Soc Trang Province has a tropical monsoon climate, with a dry season from November to April and a rainy season from May to October, with an average annual rainfall of 1,779.5 mm. The average annual sunny hours is 2,372 hours, and the average annual solar radiation is 140-150 kcal/cm2.[1]。

[1] Portal site of the Ministry of Planning and Investment, Vietnam

2.3. Economic situation in Vietnam

Vietnam's real GDP (gross domestic product) growth rate in 2020 was 2.91%, the lowest in the 2011-20 period due to the corona disaster. However, it is worth mentioning that Vietnam was able to secure positive growth in 2020, while some ASEAN countries will experience negative growth due to the corona disaster.[2]。

Also on December 29, 2021, the General Department of Statistics of Vietnam announced that the real GDP growth rate (estimated) for 2021 was 2.6% y/y. The growth rate was lower than the 2.91% of the previous year due to the economic stagnation caused by the spread of the new coronavirus, mainly in the third quarter (July-September), but the positive growth rate was maintained. By industry, the agriculture, forestry, and fisheries industry, mining and construction, and services industries grew by 2.9%, 4.0%, and 1.2%, respectively. The mining and construction industry maintained the same rate as the previous year (4.0%). Of these, the manufacturing sector continued to lead the economy with 6.4% for the year as a whole, although it was negative in the third quarter. The services sector was affected by the spread of the new coronavirus since the end of April, and its growth rate was lower than that of the previous year (2.3%). Of these, wholesale and retail trade was minus 0.2%, and accommodation and food services minus 20.8[3]。

2.4. Economic situation in Soc Trang Province

(1) Major industries

Soc Trang Province is a province with a thriving agricultural production and agro-fishery processing industry. The average annual production of rice is over 2 million tons, of which high-grade rice accounts for over 52% of the province's total rice production. The total annual volume of milled rice exceeds about 1 million tons/year, and the export value of rice reaches US$160 million (2020).

The total production of aquaculture in 2020 was 317,182 tons, with about 94,000 tons of processed frozen shrimp and 15,000 tons of frozen squid and fish; the export value of fishery products in 2020 was US$820 million.

(2) Economic growth rate

In Soc Trang Province, stable economic growth has continued (Table 2), with high positive growth in 2020 despite the impact of the novel coronavirus outbreak.

Table 2 Economic growth rate of Soc Trang Province

Year	Growth rate
2016	5.22%
2017	7.01%
2018	7.20%

[2] Vietnam Economic Statistics 2020 (compiled by Japan Embassy in Vietnam)
[3] JETRO business news letter (Jan 12, 2022)

2019	7.30%
2020	6.75%

Source: Soc Trang Province

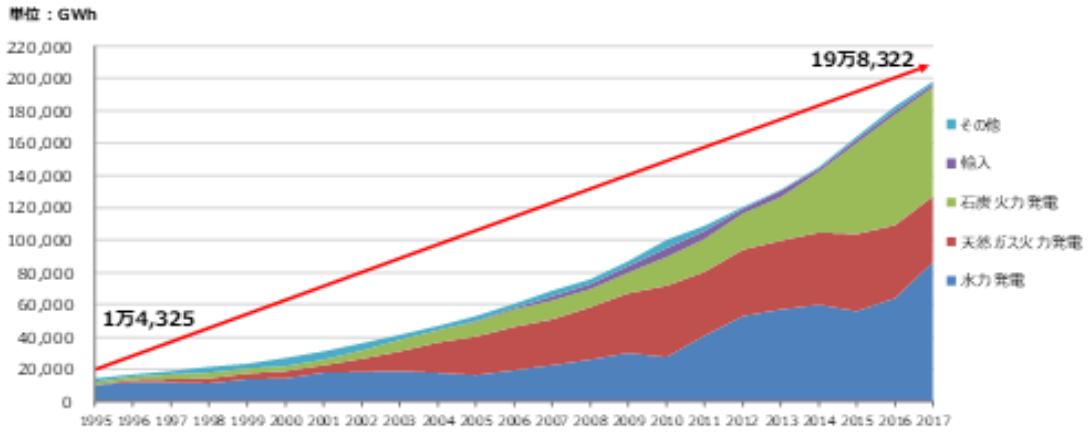
(3) Work force

Soc Trang Province has a population of about 2 million, with a population density of 362 persons/km2 , and a working population of about 658,000 persons aged 15 and over, of which 31.62% is urban and 68.38% is rural. The male to female ratio of the working population is 58.51% for males and 41.49% for females.

2.5. Electricity Situation in Vietnam

Vietnam's electricity demand has continued to grow in recent years, and total electricity generation has continued to increase substantially over the years: total electricity generation in 2017 increased by 8.4% year-on-year, nearly 14 times more than in 1995. The village electrification rate (penetration rate) reached 98.8% in 2015.

As of 2017, hydropower was the most common type of power generation in terms of both installed capacity and output, but since 2014 there has been a notable increase in coal-fired power generation. Since 2015, coal-fired power generation has surpassed hydropower generation as the largest amount of power generation, but in 2017, hydropower generation surpassed coal-fired power generation due to high precipitation and sufficient storage capacity in dams.



Source: JETRO Hanoi Office

Figure 8 Changes of total power generation

The electricity policy is being implemented in accordance with the revised Seventh National Electricity Master Plan (enacted on March 18, 2016) and the Revised Seventh National Electricity

Master Plan (2011-2020 Electricity Development Plan with an eye on 2030).In FY2017, the total power generation capacity was 198,322 GWh and In FY2017, the total power generation was 198,322 GWh, and the power generation capacity was 45,410 MW, but the goal is to increase the total power generation to 572,000 GWh and the installed power generation capacity to 129,500 MW by 2030.

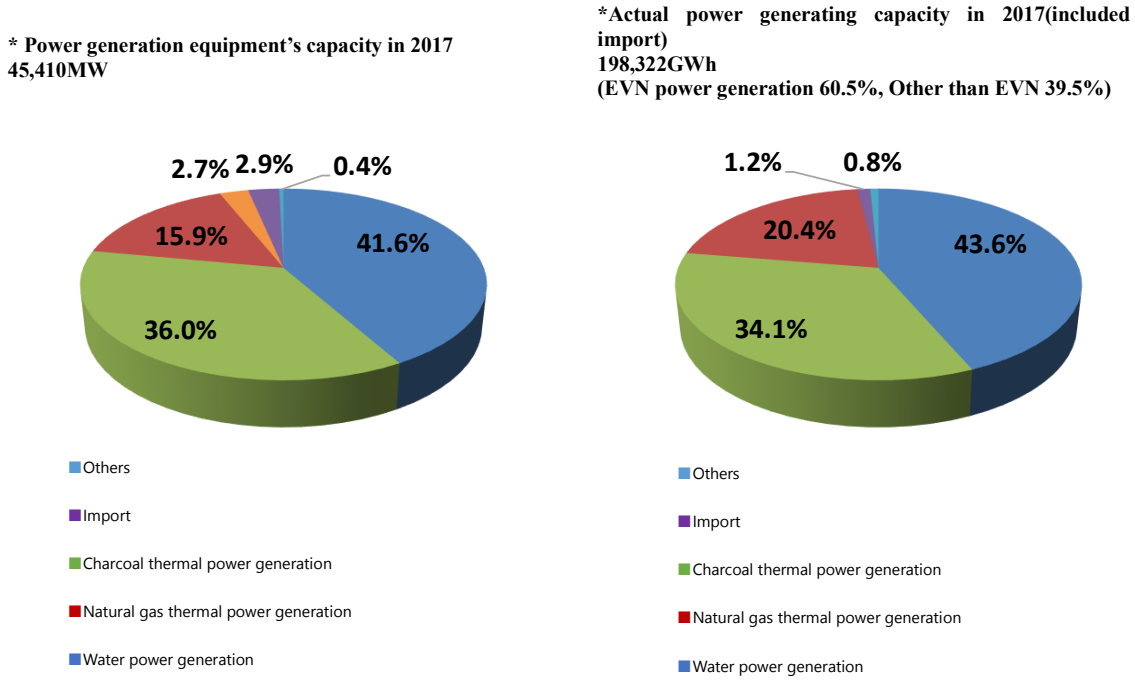


Figure 9 Total installed capacity and total power generation in Vietnam in 2017
Source: JETRO Hanoi Office

In the electricity system, the state-owned Electricity Generating Board of Vietnam (EVN), established in 1994, is responsible for the generation, transmission, supply, and trading of electricity. EVN has a monopoly on transmission and distribution of electricity.

The Vietnamese government is promoting the expansion of power generation from renewable energies, and has set a numerical target of 27,195 MW of installed capacity and 61,000 GWh of power generation by 2030. The target for biomass power generation by 2030 is 3,281 MW of installed capacity and 12,000 GWh of power generation.

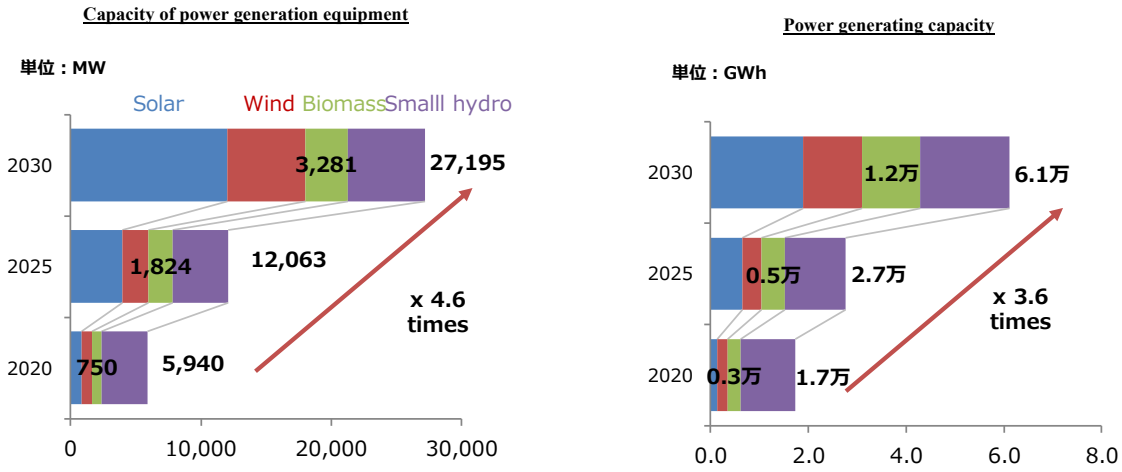


Figure 10 Renewable energy expansion targets in Vietnam

Source: JETRO Hanoi Office

In 2017, the ratio of thermal power generation using fossil fuels was nearly 60%, and the ratio of coal-fired thermal power generation was around 35%, so greenhouse gas emissions from power generation have remained high and need to be improved. The emission factor for electricity is 0.7 kg-CO2/kWh, which is higher than Japan's current factor of 0.55 kg-CO2/kWh, and an energy transition is required. The price of electricity has been increasing year by year (Figure 11). The reason for the increase in electricity prices is the improvement in the EVN deficit and the increase in coal prices. By industry, electricity prices are higher for commercial, consumer, and industrial sectors, in that order.

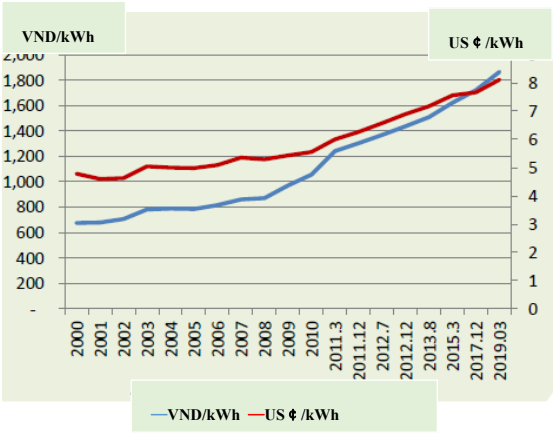


Figure 11 Changes in electricity charges （overall average）

Source：Survey on electricity in Vietnam by JETRO

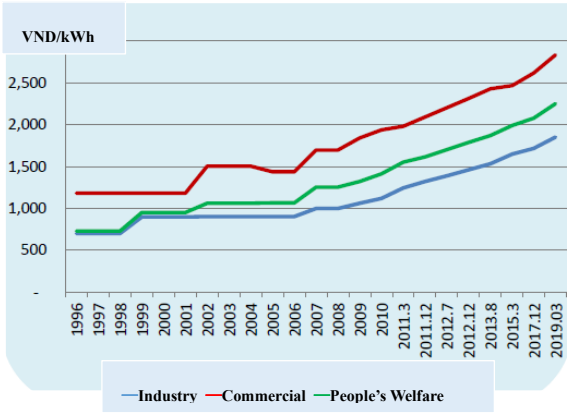


Figure 12 Changes in electricity charges （average of industries）

Source：Survey on electricity in Vietnam by JETRO

Vietnam does not have basic electricity tariffs like Japan, and industrial electricity tariffs consist of metered rates with three levels of unit prices by time of day.

On March 20, 2019, the Ministry of Industry and Trade of Vietnam promulgated Decision No. 648/QD-BCT of the Ministry of Industry and Trade on the increase of electricity tariffs, which will be increased by 8.36% on average. The average electricity tariff, excluding value-added tax, is now VND1,864.44 per kilowatt-hour (kWh), up from VND1,720.65 per kWh (about ¥8.1; 1 VND = about ¥0.0047). The price hike is the first since December 2017 and took effect on March 20, the day of the promulgation. Electricity tariffs were priced differently depending on usage and time of day, with prices in the industrial sector ranging from VND970 to VND3,076 per kWh.

Mr. Dinh Quang Chi, Vice President of the Electricity Generating Authority of Vietnam (EVN), pointed out that the main reason for the price hike was the rise in coal prices and the gap between the power trading prices. Vietnam has been increasingly relying on coal-fired power generation in recent years, but coal prices have been rising, increasing the cost of power generation. In addition, EVN purchases electricity from power producers, and the difference between the purchase price and the selling price is becoming substantial. In addition, payments for water resource development rights and rising natural gas prices have also contributed to the growing deficit in the power business. With this price hike, EVN will be able to pay its suppliers and deal with the increased cost of power generation, but further price hikes were necessary to improve power generation facilities and make new investments.

The electricity price hike will raise production costs in the manufacturing sector, and this has resulted in some companies having to consider whether to pass on the price hike to product prices or bear the cost themselves for the time being. The price hike was expected to raise the consumer price index (CPI) by 0.29 percent and push down GDP by 0.22 percent, according to estimates by the Ministry of Commerce and the General Administration of Statistics. The price hike was originally scheduled to

take place in 2018, but was postponed to 2019 after Prime Minister Nguyen Xuan Phuc indicated that he would not approve the price hike in order to achieve the CPI and GDP targets[4].

Table 3 The list of electricity charge in Vietnam(Revised on 20th March）

Unit:VND/kWh

Item by fields		Electricity charge	
		Pre-revision	Post-revision
1	Electricity charge in manufacturing industry		
1.1	Voltage: More than 110kV		
・General time a day		1,434	1,536
・Off-peak time a day		884	970
・Peak time a day		2,570	2,759
1.2	Voltage: 22kV to less than110kV		
・General time a day		1,452	1,555
・Off-peak time a day		918	1,007
・Peak time a day		2,673	2,871
1.3	Voltage: 6kV to less than 22kV		
・General time a day		1,503	1,611
・Off-peak time a day		953	1,044
・Peak time a day		2,759	2,964
1.4	Voltage: Less than 6kV		
・General time a day		1,572	1,685
・Off-peak time a day		1,004	1,100
・Peak time a day		2,862	3,076
2	Electricity charge in government and specialty		
2.1	Hospital, Nursery school, kindergarten and school		
2.1.1	Voltage: More than 6kV	1,531	1,659
2.1.2	Voltage: Less than 6kV	1,635	1,771
2.2	Public lighting, administrative business		
2.2.1	Voltage: More than 6kV	1,686	1,827
2.2.2	Voltage: Less than 6kV	1,755	1,902
3	Electricity charge in commerce		
3.1	Voltage: More than 22kV		
・General time a day		2,254	2,442

[4] JETRO Business Report

・Off-peak time a day		1,256	1,361
・Peak time a day		3,923	4,251
3.2	Voltage: 6kV to less than 22kV		
・General time a day		2,426	2,629
・Off-peak time a day		1,428	1,547
・Peak time a day		4,061	4,400
3.3	Voltage: Less than 6kV		
・General time a day		2,461	2,666
・Off-peak time a day		1,497	1,622
・Peak time a day		4,233	4,587
4	Electricity charge in People's welfare		
4.1	Electricity charge in household		
0 to 50kWh		1,549	1,678
51 to 100kWh		1,600	1,734
101 to 200kWh		1,858	2,014
201 to 300kWh		2,340	2,536
301 to 400kWh		2,615	2,834
More than 401kWh		2,701	2,927

・ Normal time (Monday to Saturday: 4:00am to 9:30am, 11:30am to 5pm and 8pm to 10pm Sunday: 4am to 10pm)

・ Off-peak time (10pm to 4am)

・ Peak time (Monday to Saturday: 9:30am to 11:30am, 5:00pm to 8pmSunday: None)

Source: JETRO

Vietnam's Ministry of Industry and Trade announced in April 2020 that it will reduce and exempt electricity tariffs from April to June 2020 as an economic measure in response to the impact of the spread of the new coronavirus. Electricity rates for industry and commerce will be reduced by 10 percent for all time periods, and tourism and accommodation facilities that have been hit hard will be subject to cheaper industrial electricity rates instead of the usual commercial rates.

Electricity tariffs for daily use for general households were reduced by 10% for households using less than 300 kilowatt-hours (kWh) per month, but households using more than 300 kWh were considered high-income households less affected by the new coronavirus and were excluded from the reduction[5].

In December 2020, the Ministry of Industry and Trade of Vietnam decided to reduce or exempt electricity tariffs for October to December following April to June as a measure against the new

[5] JETRO Business News Letter

coronavirus.

Electricity tariffs for daily use for general households were reduced by 10% for households using less than 300 kilowatt-hours (kWh) per month, while travel accommodations and warehouses with distribution stock were subject to cheaper industrial electricity tariffs instead of the usual commercial tariffs. In addition, facilities for the prevention and control of new coronaviruses were exempted from electricity charges, except for facilities that charge for centralized isolation. Specifically, facilities for the centralized isolation and examination of persons infected or suspected to be infected with the new coronavirus were exempted from all electricity charges. In addition, medical facilities where infected or suspected infected persons are diagnosed, examined, and treated have had their electricity rates reduced by 20%. (Note that the electricity rates for industry and commerce, except for the above, which were exempted in the first round, are not exempted in the second round.

2.6. Electricity situation in Soc Trang Province

In Soc Trang Province, the cumulative electricity output in 2020 reached 1,620.79 million kWh, an increase of 89.74 million kWh (5.86%) compared to 2019 (1,503.06 million kWh). Of this, commercial electricity consumption reached 1,512.26 million kWh, an increase of 94.12 million kWh (6.59%) compared to the same period in 2019 (1,427.14 million kWh).

As of December 2020, there were 386,437 electricity subscribers, with 352,717 residential customers (accounting for 91.27% of the total). The number of business customers is 33,720 (accounting for 8.73%).

Electricity projects (thermal, wind, etc.) in Soc Trang Province are under construction and have not yet been put into operation (generated electricity); the amount of solar power generated in 2020 is 9.4 million kWh.

In accordance with the decision of the Ministry of Industry and Trade (No. 2630/QĐ-BCT) on approving the power development plan for Soc Trang Province from 2016 to 2025, during the period 2021-2025, the power utility plans to invest in the power grid to ensure safe and continuous power supply for the development of the provincial economy.

2.7. Rice production in Vietnam

Vietnam is long and narrow from north to south, with three quarters of its land area consisting of mountains, hills, and plateaus, and its varied topography and climate produce a wide range of agricultural products.

Rice produced in the two fertile deltas of the Mekong (in the south) and the Red River (in the north) is the main agricultural crop, and is an important export. The country also produces sugarcane and cassava, and is the second largest coffee producer in the world after Brazil (2017).

Seafood, such as shrimp and tuna, is also a valuable export, and is often exported to Japan.

Table 4 Status of agriculture, forestry and fisheries in Vietnam and Japan in 2017

Unit: USD 100 million

	Vietnam		Japan	
	Nominal value	% of GDP	Nominal value	% of GDP
Gross Domestic Product (GDP)	2,238		48,724	
Agriculture, forestry and fisheries GDP	343	15	542	1.1
GDP per capita (USD)	2,342		38,220	

Source: Ministry of Agriculture, Forestry and Fisheries of Japan

Table 5 Production of major crops

Unit: 10,000 tons

	Vietnam					Japan
	2013	2014	2015	2016	2017	2017
Rice(Paddy)	4,404	4,497	4,509	4,311	4,276	978
Sugar cane	2,013	1,982	1,834	1,631	1,836	150
Other fresh vegetables	1,219	1,301	1,325	1,382	1,424	265
Cassava	976	1,021	1,074	1,091	1,027	-
Maize	519	520	529	524	511	0.02
Other fresh fruits	280	285	292	294	297	-
Banana	189	186	194	194	205	0.003
Caffee(raw beans)	133	141	145	146	154	-

Source: Ministry of Agriculture, Forestry and Fisheries of Japan

2.8. Rice production in Soc Trang Province

The area of paddy fields in Soc Trang Province is about 149,162 ha, and the area cultivated for rice in recent years has been between about 351,000 ha and 356,000 ha. The annual production of rice (unhulled) is about 2 million tons.

The annual amount of rice husk discharged accounts for about 400,000 tons (about 20% of unhulled rice). Currently, rice husks are used as fuel for rice dryers and industrial boilers, and as agricultural materials (subsoil, fertilizer, etc.) (interview with Soc Trang Province).

2.9. Environment and energy law of Vietnam

Laws related to renewable energy in Vietnam include the National Energy Development Strategy, the Electricity Law, and the Environmental Protection Law. The strategies and laws of Vietnam are set out in the following order: National Strategy, Laws, Decisions and Protocols, and Directives.

The basic plan is the Revised Seventh National Power Master Plan (Revised PDP7: REVISIONS TO

THE NATIONAL POWER DEVELOPMENT PLAN FROM 2011 TO 2020 WITH VISIONS EXTENDED TO 2030). The 7th National Power Master Plan was revised on March 18, 2016. The revised PDP7 announces the plan for the period 2016-2030 and aims to achieve a total power generation capacity of 572,000 GWh and installed capacity of 129,500 MW by 2030. The plan also includes ensuring energy security, introducing energy-saving technologies, and protecting the environment.

In March 2021, the 8th draft version of Vietnam's Power Development Plan, "Vision to 2045, National Power Development Master Plan from 2021 to 2030 (PDP8)," was released. The plan promotes the development of renewable energy sources (other than hydropower), with the goal of increasing the share of renewable energy in domestic power sources to 13% in 2020, 30% in 2030, and 44% in 2045, one year later at the end of February 2022 As of the end of this year, the project has not yet been approved.

(1) Environmental laws

Environmental laws and regulations in Vietnam are shown in the table below.

Table 6 List of environmental laws and regulations in Vietnam

Item	Law
General environmental management	Law on Environmental Protection enforced in 2015(No.55/2014/QH13)
	Decree detailing the Implementation of a Number of Articles of the Law on Environmental Protection (Decree No.19/2015/ND-CP)
	Decree on the Sanction of Administrative Violations in the Domain of Environmental Protection (Decree No.179/2013/ND-CP)
	Decree on February 14, 2015 on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (Decree No. 18/2015/ND-CP)
	Decree providing for Incentives and Supports for Environmental Protection Activities (Decree No.04/2009/ND-CP)
	Circular on December 31, 2015 on the Guidelines for the corporate income tax policies for environmental protection activities regulated at the government’s decree No. 19/2015/ND-CP（Circular 212/2015/TT-BTC）
	Decision approving the Strategy for Protecting the National Environment by 2020, and the Orientation towards 2030（Decision 1216/2012/QD-TTg）
	Decree on January 6, 2015 on Environmental Damage Assessment（Decree No. 03/2015/ND-CP）
	Decree on December 31, 2014 regulating the Requirements Applicable to Environmental Monitoring Service Activities（Decree No. 127/2014/ND-CP）
	Circular on December 8, 2015 on the Evaluation, Inspection, and Final

	Check and Acceptance of Projects on Application of Natural Resources and Environment Information Technology （ Circular No. 58/2015/TT-BTNMT）
Air quality	National Technical Regulation on Ambient Air Quality (QCVN 05/2013/BTNMT)
	National Technical Regulation on Hazardous Substances in Ambient Air (QCVN 06/2009/BTNMT)
	National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts (QCVN 19/2009/BTNMT)
	National Technical Regulation on Industrial Emission of Organic Substances (QCVN 20/2009/BTNMT）
	National Technical Regulation on Emission of Thermal Power Industry (QCVN 22/2009/BTNMT）
	National Technical Regulation on Road Vehicles - Maximum permitted limits of exhaust gases（TCVN 6438:2005）
	Circular on August 17, 2015 on the Technical Procedure on Monitoring Exhaust Gas（Circular No. 40/2015/TT-BTNMT）
Water quality	National Technical Regulation on Surface Water Quality (QCVN 08-MT:2015/BTNMT）
	National Technical Regulation on Domestic Water Quality (QCVN 02/2009/BTNMT)
	National Technical Regulation on Underground Water Quality (QCVN 09-MT:2015/BTNMT）
	National Technical Regulation on Coastal Water Quality (QCVN 10-MT:2015/BTNMT）
	National Technical Regulation on Domestic Wastewater (QCVN 14/2008/BTNMT）
	National Technical Regulation on Industrial Wastewater (QCVN 40/2011/BTNMT)
Waste	National Technical Regulation on Hazardous Waste Thresholds (QCVN 07/2009/BTNMT）
	Decree on April 24, 2015 on Management Of Waste And Discarded Materials（ Decree No.38/2015/ND-CP）
	Circular on June 30, 2015 on Management of Hazardous Wastes（Circular No.36/2015/TT-BTNMT）
	Decision on March 22, 2015 on the recovery and disposal of waste（Decision No.16/2015/QD-TTg）
Noise	National Technical Regulation on Noise (QCVN 26/2010/BTNMT)
Vibration	National technical Regulation on Vibration (QCVN 27/2010/BTNMT)
Soil	National Technical Regulation on the Allowable Limits of Heavy Metals in the Soils (QCVN 03/2008/TNMT)
Forest resources	Law on Forest Protection and Development（No.29/2004/QH11）
	Decree on the Implementation of the Law on Forest Protection and Development (Decree No.23/2006/ND-CP)
Biodiversity	Law on Biodiversity (No.20/2008/QH12)
Environmental assessment	Decree on February 14, 2015 on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans（Decree No. 18/2015/ND-CP）
	Circular on March 29, 2015 on Strategic Environmental Assessment,

	Environmental Impact Assessment and Environmental Protection Plans（Circular No. 27/2015/TT-BTNMT）
Land use and residents	Law on Land (No. 45/2013/QH13)
	Housing Law (No. 65/2014/QH13)
	Detail regulation on the Law on land (Decree No. 43/2014/ND-CP)
	Regulation on land price (Decree No. 44/2014/NĐ-CP)
	Law on Land lease, water lease (Decree No. 46/2014/NĐ-CP)
	Enforcement order on Housing Law (Decree No.90/2006/ND-CP)
	Law on Relocation, compensation, and support for land acquisition by the government (Decree No. 47/2014/NĐ-CP)
	Vocational training to Local residents until 2020 (Decision No.1956/2009/QD-TTg)
	Vocational training to farmer involved in farmland expropriation. (Decision No.52/2012/QD-TTg)
	The regulation of DONRE on Relocation, compensation, and support for land acquisition by the government (Circular No.37/2014/TT-BTNMT)
	The Ministry of Finance regulations on Establishment of fund and Accumulation on Relocation, compensation, and support for land acquisition by the government (Circular No.57/2010/TT-BTC)

Source： Ministry of Economy, Trade and Industry “Business FS for oversea expansion of high quality of energy infrastructure in 2017”

(2) Electricity law

Regarding renewable energy, the Law on Electricity (Luật Điện Lực, Electricity Law 28/2004/QH11) explicitly provides incentives for new energy and renewable energy source development project plans in relation to investment, taxes and electricity tariffs in accordance with the Ministry of Finance (MOF) policy (the basis for FIT) and encourages organizations and individuals to use renewable energy, especially for electrification of rural and remote areas.

(3) FIT

The Feed-in-Tariff (FIT) program was launched in 2011 and covers solar, wind, biomass, and waste energy, with a 20-year purchase period (Table 7).

Table 7 FIT (Feed-in Tariff) system in Vietnam

Category		FIT price (cent/kWh)	FIT introduction or FIT application period
Wind	Onshore	8.50	Introduced on August 20, 2011 Effective for projects that begin operation between November 1, 2018 and November 1, 2021 (no more effective)
	Offshore	9.80	

Waste	Incineration	10.05	Introduced on June 20, 2014 (still effective)
	landfill gas	7.28	
Biomass	Cogeneration	7.03	Introduced on May 10, 2014 (ended) Introduced on April 25, 2020 (still effective)
	Others	8.47	
Solar	Onshore	7.09	Effective for projects that begin operation between June 1, 2017 and the end of June 2019 (ended) Effective for projects that begin operation between July 1, 2019 and the end of December 2020 (ended)
	Offshore	7.69	
	Rooftop	8.38	

Source: JAPAN ELECTRIC POWER INFORMATION CENTER

The FIT is being applied to solar power projects approved by December 31, 2020, but not to projects approved after that date. The FIT system is expected to shift to a bidding system (reverse auction) in the future, but details have not yet been announced by the Vietnamese government.

Major directives and decisions related to FIT include Decision 24/2014/QD-TTg (Decision on support mechanisms for the development of biomass The main directives and decisions related to biomass power projects in Vietnam are Decision 24/2014/QD-TTg (Decision on support mechanisms for the development of biomass power projects in Vietnam) and Decision 31/2014/QD-TTg (Decision on support mechanisms for the development of power generation projects using solid waste(s) in Vietnam). generation projects using solid waste(s) in Vietnam), Decision 31/2014/QD-TTg on support mechanisms for the development of power generation projects using solid waste in Vietnam (Decision on support mechanisms for the development of power generation projects using solid waste(s) in Vietnam) and Decision 37/2011/QD-TTg on support mechanisms for the development of (Decision on support mechanism for the development of wind power project).

In addition, the term "biomass for power generation" is defined in the current regulations of Vietnam. However, the definition does not mention any specific goods, such as which types are included in the definition. As for "biomass energy for power generation", Decision (24/2014/QĐ-TTg) on the support mechanism for the development of biomass power generation projects in Vietnam states that "by-products and wastes generated in agricultural production and processing and other cultivation in agriculture and forestry that can be used for power production". Waste".

In addition, Vietnam has a draft National Master Plan for Biomass Power Development by 2025 for the year 2035. This was drafted by the Energy Research Institute at the request of the Ministry of Industry and Trade, and although it was published in 2017, it has not yet been approved by law. However, this draft may be operationalized as a document for policy consideration for biomass power generation. The draft focuses on two types of biomass (wood residues and agricultural crop residues) and mentions specific objects for each.

＜Wood residues>

Wood residues include woody fuels from forest trees, perennial industrial crops, and fruit trees (obtained from felling and pruning), as well as their wastes (from felling and pruning):

- Logs: from natural forests, populated forests, and scattered trees
- Shrubs: from forested areas
- Bamboo (Neohouzeaua, Bambusa nutans): from forested areas
- Periodically harvested logs and branches: from perennial industrial crops
- Prunings: of fruit tree origin
- Branches, stumps and bark: from harvested logs
- Wood residues (e.g. sawdust, wood chips, etc.): originating from wood processing
- Other (wood from construction work, house/furniture repair/renovation, where database is available or estimable)

＜Crop residues

Biomass derived from agricultural crops (by-products after harvest) and waste (generated during processing).

- Rice straw, rice husks
- Sugarcane bagasse, leaves and tips
- Stems, pods, and cobs
- Groundnut stalks and husks
- Soybean stalks and husks
- Cassava
- Coconut leaves, husks
- Shells: cashew nuts, coffee
- Other trees (if database is available or estimable)

It can be seen that rice husk, which is one of the targets of this project, is also recognized as biomass.

3. Collaboration between Hiroshima Prefecture and Soc Trang Province

3.1. Past collaboration between Hiroshima Prefecture and Soc Trang Province

The past collaboration between Hiroshima Prefecture and Soc Trang Province is as follows (for details, refer to the appendix at the end of the FY2020 report).

(1) Period of building a foundation for B-to-B business exchange between the two municipalities (2013-2016)

In Hiroshima Prefecture, there are many leading companies that are active in the global market and have distinctive products by using the technology and know-how cultivated in environment-related equipment and pollution prevention measures. As part of its industrial policy for the 2020 Challenge Vision, Hiroshima Prefecture is supporting the overseas expansion of environment-related industries in the prefecture, with the aim of promoting the concentration of environment-related industries in the prefecture, economic growth, and the resolution of environmental pollution and contamination overseas.

In order to smoothly promote industrial exchange with Vietnam and link it to concrete business results, Hiroshima Prefecture is aiming to organize and realize an environment-related project in southern Vietnam by concentrating the technologies of Hiroshima Prefecture's companies. In 2013, we used the overseas basic research project of JETRO's Regional Industry Tie-Up Project (RIT Project) to conduct research on organizations and companies that could cooperate with the project, as well as business fields and regions with potential needs.

During the survey, we received a very positive indication from Soc Trang Province that they would like to promote business exchange. We also interviewed the People's Committee and the Department of Natural Resources and Environment about the environmental issues in the province, and found that the needs for the following three items are extremely high, and that there are technologies in the province that can help solve these issues.

-Access to Clean Water in Rural Areas
-Effective use of rice husks in Soc Trang Province, one of Vietnam's leading rice-producing regions
-Improving water pollution around shrimp farms, one of the most productive shrimp farms in the world

Therefore, for three years from 2014 to 2016, JETRO's Regional Industry Tie-Up Project (RIT Project) was utilized to start a business exchange with Soc Trang Province in order to solve the environmental issues faced by Soc Trang Province, mainly the three needs mentioned above, in a business sustainable manner. The counterpart was the Department of Natural Resources and Environment (DONRE), a department that understands the environmental issues faced by each company in Soc Trang Province

and the environmental needs of Soc Trang Province itself.

In the RIT project, DONRE compiled a list of local companies from Soc Trang Province that were facing environmental issues each year, and the prefecture's staff met with these companies to delve into their needs, and for projects with a high probability of business development, business matching was conducted by meeting with companies in Hiroshima Prefecture that had the corresponding technology. When discussing business with Soc Trang Province companies in Hiroshima, the prefecture's own budget was used to invite the vice chairman of Soc Trang Province's Personnel Committee and the director of DONRE, along with Soc Trang Province companies, to gain better understanding of Hiroshima Prefecture's environmental technologies and to hold a seminar in Hiroshima Prefecture to provide an opportunity to discuss environmental issues and needs in Vietnam. In addition, a seminar was held in Hiroshima Prefecture to create an opportunity for matching about environmental issues and needs in Vietnam. In addition, in order to demonstrate the projects created by these matching opportunities and to lead to orders, we have been conducting demonstration experiments in the field while providing companies with the "Subsidy for Promotion of Environmental Business Cluster" of Hiroshima Prefecture. The results shown in Table 8 have been produced so far.

Table 8 Results of exchange between Hiroshima Prefecture and Soc Trang Province

Product/Service	Entities in Soc Trang Province that gave order	Year
Water Purifier	Soc Trang Province Water Purification Center	2015～
Water purification agent for shrimp cultivation	Shrimp cultivators	2019～
Water purification membrane for shrimp aquaculture	Shrimp aquaculture operators	2019～
Waste-derived organic fertilizer	Fertilizer wholesaler	2018～
Rice husk fermented liquid	Vegetable farmers	2016
Agricultural materials	fertilizer manufacturer	2016
Recycled plastic materials	Plastic molding companies	2016～

(2) B to B business + project projects (2017-2020)

After the completion exchange program by JETRO RIT project in 2016,we continued to discuss the scope of future collaboration by using Invitation Program for Promising Asian Leaders of CFIEC (Center for International Economic Collaboration, formerly known as Institute for International Studies and Training: IIST) and a Memorandum of Understanding(MOU) in the field of environmental remediation industry was signed with Soc Trang Province at the Mekong Delta Business Matching Seminar jointly held by Hiroshima Prefecture and Soc Trang Province in September 2017. In the MOU, in addition to the B to B business matching that has been actively promoted, the two regions have agreed to cooperate in organizing cooperative projects and holding regular meetings.

With the signing of this MOU, in addition to the introduction of individual companies from Soc Trang

Province, a cooperative system has been established to address and solve the environmental issues faced by Soc Trang Province as a project. At present, the two sides are cooperating on the following projects in order to solve the problems and create new values. In addition, in order to build on this cooperative relationship and turn the project into a business, a Vietnam Support Desk was established in 2018 in cooperation with Hiroshima Bank to provide support for companies entering the Vietnamese market. Some of the projects currently underway with Soc Trang Province are listed in Table 9.

Table 9 Project by Hiroshima Prefecture and Soc Trang Province

Project Name	Period	Summary
Project for purification of shrimp farm environment and branding of shrimp with low environmental impact	2018～	Project to use water purification products owned by companies in Hiroshima Prefecture to cultivate shrimp with reduced environmental impact that will not pollute the surrounding environment, and to brand and sell the shrimp in Japan and Vietnam. Tromso Co., Ltd. has developed a water purification agent using rice husks, and it is hoped that this product can be applied to shrimp farms in the future.
Efficient collection and transportation of general waste and waste treatment projects	2019～	Project to utilize know-how on efficient collection and transportation of general waste, waste collection services, and data collected during collection and transportation to construct optimal waste treatment facilities.
Water purification service business to reduce plastic waste	2020～	By installing water purifiers in each household's water supply, the project aims to reduce the large amount of plastic waste generated by the plastic bottled water service that is widely used in the region.

3.2. Creating a mechanism for continuous identification and formation of new projects through collaboration between Hiroshima Prefecture and Soc Trang Province

In order to continuously identify projects, a "Hiroshima- Soc Trang City to City Cooperation Council" (tentative name) will be established as a mechanism to match the needs of Soc Trang Province with the seeds of Hiroshima Prefecture, and promising projects will be identified and narrowed down, leading to the implementation of FS in the intercity cooperation project and subsequent subsidy schemes. This will lead to the implementation of FS and subsequent subsidy schemes in inter-city collaborative projects（Figure 13）.

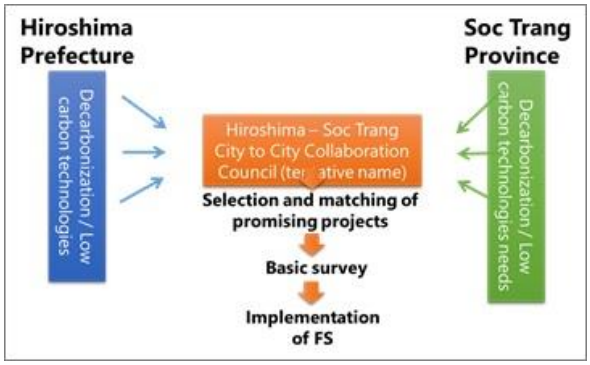


Figure 13 Mechanism for continuous identification and formation of new projects through collaboration

3.3. Hiroshima Prefecture's support for know-how on community-based renewable energy

installation projects

Hiroshima Prefecture operates a mega solar power plant jointly with a local electric power company, and has the know-how to create and operate a system that returns part of the profits to the local community in the form of subsidies for the installation of renewable energy and energy-saving equipment (Figure 14）.In addition to transferring this know-how to Soc Trang Province, the project also aims to introduce equipment and services from companies in the prefecture to the local market. The goal is to establish a self-sustaining and developmental mechanism to support small-scale renewable energy and energy-saving projects in the region by utilizing large-scale renewable energy projects such as the JCM equipment subsidy project as seeds

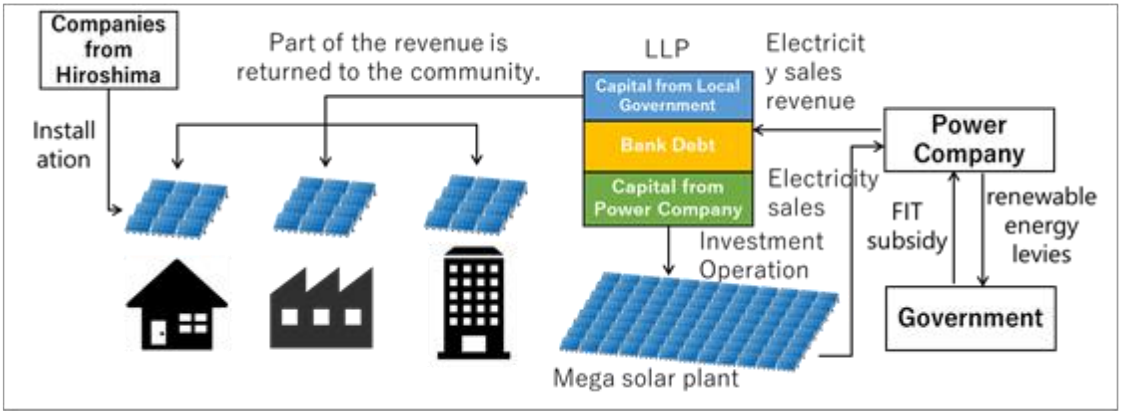


Figure 14 Hiroshima Prefecture's community-based renewable energy project

3.4. Online workshop between Hiroshima Prefecture and Soc Trang Province

Due to the extremely difficult travel conditions between Japan and Vietnam this fiscal year, as in the previous year due to the outbreak of the new coronavirus, the workshop (information exchange meeting), which is usually held locally, was agreed to be conducted online in Soc Trang Province.

See the material at the end of this report for an introduction to Hiroshima Prefecture's renewable energy initiatives used in this online workshop.

The outline of the online workshop is as follows.

Date/Time	January 21, 2021 (Thu) 10:00 ~ 11:00
Style	Online
Participants	＜Japan＞ Hiroshima Prefecture: Ms. Tomomi Matsuda (Supervisor , Environment and Citizens Affairs Bureau Environmental Policy Division) Ms. Honami Tarutani（Manager, Foreign Business Division, Commerce, Industry and Labor Bureau）

	E-Square Inc.: Mr. Hiroyuki Yanagida, (Senior Manager)
	＜Vietnam＞ Soc Trang Province Mr. Tran Thanh Tuan (Manager, Energy Management Division, Bureau of Commerce and Industry) Thanh Mai（Coordinator）
Program	✓ Introduction and Opening Remarks (Ms. Tarutani, Hiroshima Prefecture) ✓ Introduction of Hiroshima Prefecture's community-based renewable energy introduction project (Ms. Matsuda, Hiroshima Prefecture) ✓ Introduction of Soc Trang Province's renewable energy initiatives (Mr. Tran Thanh Tuan, Soc Trang Province) ✓ Exchange of Opinions（Participants）

First, Mr. Tarutani of Hiroshima Prefecture introduced a project for introducing renewable energy to the local community and proposed to support the development of decarbonization measures in Soc Trang Province through the transfer of know-how from Hiroshima Prefecture's project.

Ms. Matsuda, Hiroshima Prefecture made following remarks.

- ✓ In Japan, 40 of the 47 prefectures, including Hiroshima Prefecture, have declared themselves Zero Carbon Cities in response to a call from the Ministry of the Environment. These declarations are not legally binding or punitive, but are intended to build momentum for global warming countermeasures.
- ✓ Until 2030, energy conservation and renewable energy will continue as in the past, but after 2030, CO2 emissions will be reduced through new technologies such as CO2 capture and utilization.
- ✓ We would also like to work on a "Hiroshima-style carbon cycle" to achieve net-zero carbon by circulating carbon.
- ✓ The "Hiroshima-style carbon cycle" is a mechanism to recycle carbon on the earth, including the oceans, by reusing CO2 as a carbon resource and promoting the spread of marine biodegradable plastics, which break down into CO2 in the ocean, while taking advantage of Hiroshima Prefecture's strengths.
- ✓ In order to realize a net-zero carbon society by 2050, in addition to energy conservation measures and the promotion of renewable energy introduction, efforts to build a Hiroshima-style carbon cycle will be promoted by separating and recovering CO2 generated in production activities and reusing it as raw materials for construction materials and fuels, utilizing it in the agriculture, forestry and fishery industries, and promoting alternatives to petroleum-based plastics.
- ✓ Since Japan raised CO2 reduction target at COP26, Hiroshima Prefecture is also considering raising its target.

- ✓ Hiroshima Prefecture has formed a LLP (Limited Liability Partnership) with a local electric power company to conduct a power generation business and earn profits from the sale of electricity. Hiroshima Prefecture is responsible for project planning, operation, public relations, and land provision, while the power company is in charge of materials procurement, construction, and maintenance. Currently, the company owns six power plants in Hiroshima Prefecture with a total generating capacity of 10 MW.
- ✓ Utilizing the FIT system, the company will be able to sell electricity for 20 years at a unit price of 40 yen/kW starting in FY2021. After deducting expenses, an annual profit of approximately 300 million yen will remain. The profits are used to increase renewable energy in Hiroshima Prefecture by installing solar panels and energy-saving air conditioners in facilities in the prefecture, and for public relations activities to promote energy conservation and renewable energy.
- ✓ Hiroshima Prefecture is not only working on the hardware side of solar power generation, but also on the software side. If there are any issues in Soc Trang Province in terms of environmental education, etc., we would like to support you.

Mr. Tran Thanh Tuan, Soc Trang Province made the following remarks.

- ✓ In FY2020, Soc Trang Province used a budget of VND1 billion to install solar power systems on the roofs of four buildings in the province, with an output capacity of 16-17 kW per location. In FY2021, Soc Trang Province had budgeted 3 billion VND for 10 locations, but the funds were not made available and the capital investment could not be made in 2021. The unspent budget was postponed to FY2022 and will be installed on 10 rooftops.
- ✓ Under Vietnamese law, private companies may engage in renewable energy projects. Government agencies can install renewable energy facilities but cannot generate revenue, so the purpose of installing solar power systems is to reduce energy and electricity bills.
- ✓ There are 20 wind power projects in Soc Trang Province with a total output of 435 MW. 1,024 solar power plants as of the end of 2020.
- ✓ Government agencies are not allowed to invest in solar power projects, but they do lease land to obtain rental fees and taxes. 100% of the income from land leases is paid into the national treasury.
- ✓ Vietnamese Prime Minister Pham Minh Chinh also participated in the COP26 meeting and announced his country's goal of becoming carbon neutral by 2050. The 8th Draft National Electricity Master Plan (PDP8) prepared by Vietnam's Ministry of Industry and Trade in October 2021 indicates a reduction in the share of coal-fired power generation and an increase in the share of renewable energy sources such as wind and solar power.
- ✓ The contents of today's meeting will be reported to the Deputy Director of the Commerce and Industry Bureau. We would be grateful for any future cooperation from Hiroshima Prefecture in education-related projects.

3.5. Prospects for further collaboration

Through the efforts of the " City-to-City Collaboration Council of Hiroshima-Soc Trang" the potential for new large-scale investment in projects related to renewable energy was identified.
Onshore and offshore wind power (total capacity: 12,849 MW)
Solar power generation (total capacity: 7,956 MW)
Biomass power (total capacity 125 MW)
We will continue to exchange information with the Soc Trang Province on these plans and explore the possibility of participation.

In addition, through the "Continuous Mechanism for Identifying and Forming New Projects in Collaboration with Hiroshima Prefecture and Soc Trang Province," we have identified local issues such as medical waste treatment, water quality monitoring technology, exhaust gas purification for charcoal manufacturers, and effective use of straw, and we are trying to match member companies of the Hiroshima Environmental Business Promotion Council with these projects on a case-by-case basis. On the other hand, solving these issues does not end with the sale of products, but requires ongoing maintenance and on-site operations.

Although the system for identifying projects has taken shape to some extent, the issue is how to materialize projects in the future, during COVID-19 pandemic, in the absence of a local base of operations.

In addition, the survey on the possibility of transferring the know-how of Hiroshima Prefecture's solar power generation business to Soc Trang Province revealed that it is not possible to develop the business in Soc Trang Province. Regarding the implementation of renewable energy power generation projects in Vietnam, local governments are not legally allowed to be directly involved in for-profit projects, including investment. In Soc Trang Province, installation of solar panels on publicly-owned facilities has been in place since 2020, and although public institutions are promoting renewable energy, the publicly installed solar panels are currently operated solely for self-consumption. In addition, the revenues from public land rentals from private solar power companies are consolidated and centrally managed by the central government, making it difficult to implement a mechanism to directly return the revenues to decarbonization measures even if the province were able to implement its own power generation projects.

Therefore, from the perspective of fostering momentum for decarbonization in Soc Trang Province, we will provide and exchange information on the support for environmental activities and activation of environmental education for residents, which Hiroshima Prefecture is developing with the proceeds

from power generation projects.

4. Survey on fuel conversion of coal boilers using rice husk solid fuel

A field survey was conducted to study the feasibility of introducing a rice husk solid fuel production system (curl chip production machine) from Tromso Co., Ltd., a company in Hiroshima Prefecture, to Soc Trang Province. For the survey and analysis of coal and coal utilization equipment, we obtained the cooperation of the JAPAN COAL FRONTIER ORGANIZATION (JCOAL), which has expert knowledge.

4.1. Technologies / products proposed

(1) Grind Mill (rice husk briquette machine: TRM-200CR)

Tromso's Grind Mill (rice husk briquette machine) is the machine to be proposed. In the Grind Mill - specifically designed to produce briquette (TRM-120F/120JPF) - of Tromso, the rice husk extruded by the rotor screw passes through a nozzle heated to 310°C by an electric heater, where it is compressed and molded, and the surface is baked to form a bar-shaped briquette (solid fuel) Figure 15.

Figure 15 Grind Mill

The Grind Mill is a device that grinds rice husks and solidifies them through compression molding and heating processes and can convert 120 kg of rice husks into solid fuel per hour (120 kg of rice

husks ≒ 120 kg of rice husk solid fuel). The solid fuel produced is 100% derived from rice husks, and no adhesives need to be added when solidifying the fuel.

The rice husk has a water-repellent cuticular layer (waxy) on its surface, and silica is accumulated in this layer, making it very solid. Therefore, the processing of rice husks causes metal parts to wear quickly, but the main parts of the Grind Mill have a special surface treatment that greatly improves wear resistance.

In addition, the volume of the solid fuel is reduced to about 1/10 (when compared with the volume of raw rice husk) because it is manufactured through a compression molding process. The calorie content of rice husk solid fuel is about 4,000 kcal/kg, and when ignited, it burns with a flame for about 30 minutes and then continues to burn for about one hour.

The main parts of the Grind Mill for the rice husk grinding compression molding and heating processes are shown in the Figure below.

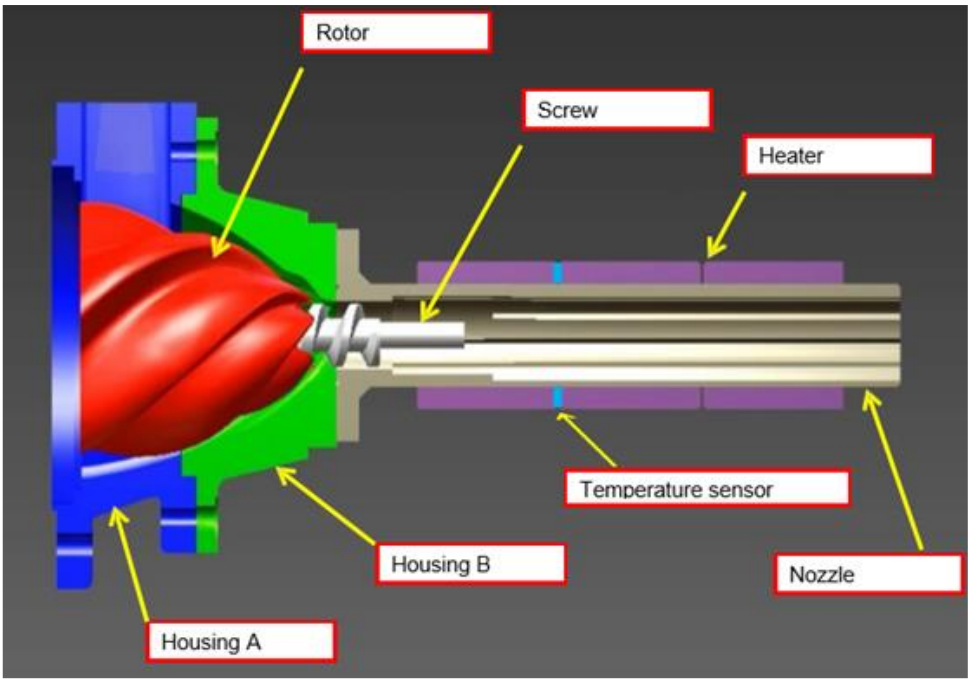


Figure 16 The core parts of Grind Mill

When rice husks are fed into the material hopper, they are ground by the rotation of the rotor and the engagement of housings A and B. The ground rice husks are pushed out toward the nozzle by the rotation of the rotor and screw. The ground rice husks are heated by the heater attached to the outer circumference of the nozzle and are pushed out toward the nozzle exit. The heating causes the husks to adhere to each other and solidify due to the action of lignin contained in the husks. When the rice husks are pushed out of the nozzle, they are discharged as solid fuel in the form of sticks. About 37 cm of solid fuel is equivalent to about 1 kg.

For the results of component analysis of rice husk solid fuel and rice husk, refer to the appendix "Compositional analysis data on rice husk solid fuel and rice husk" at the end of this report.
On the other hand, the proposed Grind Mill (a special machine for curl chips) can produce curl chips made of coiled rice husks without an electric heater. The lignin in the rice husk is softened by frictional heat and pushed into the nozzle, which is specially designed for making curl chip, by a screw. The pressed husk is formed into a coiled solid fuel that follows the shape of the screw. The curl chip has a slightly lower heat value of about 3,700 kcal compared to the briquette (approx. 4,000 kcal). When ignited, it burns with a flame for about 15 minutes and then continues to burn for about an hour. In addition, because of the compression molding process, the volume of the curl chip is reduced to about 1/8 to 1/9 (relative to rice husk).

Figure 17 Grind Mill for curl chip Production (TRM-200CR)

The curl chip machine, when operated with the nozzle removed, can produce ground rice husks with a size of 1 to 3 mm. Since the ground rice husks are produced by applying pressure to the husks and rubbing them together, frictional heat of about 90°C is applied inside the machine. As a result, the ground rice husk is sterilized to some extent and has excellent water absorption and retention properties. The ground rice husk can be used as gardening soil or livestock bedding.

The characteristics of briquettes, curl chips, and ground rice husks that can be made by the Grind Mill are shown in the following table.

Table 10 Comparison of briquette, curl chip, and ground rice husk

Item	Briquette	Curl chip	Ground rice husk
Machine Type	Briquette Machine	Curl Chip Machine	Briquette/ Curl Chip
Size	Diameter 55mm, hole diameter 15mm, length 350mm	Width 20 mm, thickness 17 mm	1～3 ㎜
Shape	Hollow Bar	Coil Shaped	Powder
Heater	Yes	No	No
Main Application	Fuel	Fuel	Soil medium, bedding material, fertilizer material
Heat Generation	3,970kcal/kg	3,700kcal/kg	－
Image			

The table below shows a comparison of Grind Mills (machines dedicated to briquetting and curl chips).

Table 11 Comparison of Grind Mills (machines dedicated to briquetting and curl chips)

Item	Briquette	Curl chip
Capacity	Approx.120kg/h	Approx.240kg/h
Dimensions	Approx. width 2,500 x depth 990 x height 1,500 (mm)	Approx. width 2,250 x depth 1,100 x height 1,550 (mm)
Weight	Approx.850kg	Approx.985kg
Drive power	AC200-400V 3 ϕ 50/60Hz 4P Reduction ratio 1/15	AC200-400V 3 ϕ 50/60Hz 4P Reduction ratio 1/7.12
Power Consumption	20kW	30kW
Price (JPN)	5 million Yen(+tax)	4 million Yen(+tax)

(2) Sales and introduction record of the machine and similar models

Domestic and overseas sales and introduction results for ① above (year of sales launch, sales volume, sales amount, market share, etc.)

Sales started June 2008/ Grind Mill is launched in Japan – domestic market.

Domestic sales approx. 130 units (as of January 2022)

Overseas sales 30 units (see Table 12)

Most recent sales 55million Yen (annual domestic/overseas sales of Grind Mills)

Table 12 Overseas deliveries of Grind Mills (dedicated to briquetting and curl chips)

year	country	Number of units	Model name	Remarks
2014	China	1	TRM-120F	
2014	Tanzania	4	TRM-120F	Introduced through JICA dissemination and demonstration project
2015	Tanzania	4	TRM-120JPF	Introduced through JICA dissemination and demonstration project
2015	Tanzania	1	TRM-120TA	
2015	Nigeria	1	TRM-120TA	
2015	Vietnam	1	TRM-120TA	
2016	Vietnam	3	TRM-120JP	
2018	Madagascar	3	TRM-120JPF	
2019	Nigeria	7	TRM-120JPF	Grant Aid, Ministry of Foreign Affairs
2019	Tanzania	3	TRM-120JPF	Assembled by local partner
2020	Senegal	2	TRM-200CR	

Tromso has already sold Grind Mills (specialized for curl chip machines) to the Republic of Senegal in 2020 and plans to introduce them as part of a project by JICA to improve the organizational capacity of vocational training centers in Senegal. One Grind Mill will be installed in the training building of the Center for Japanese Vocational Training (CFPT) in Dakar, Senegal, and one in the premises of a private company in Saint-Louis, which is linked to the CFPT. One Grind Mill will be installed in the premises of a private company in the state of Saint-Louis, with the aim of procuring equipment and conducting training that will strengthen CFPT's human resource development function to demonstrate and prove the feasibility of promoting Grind Mills in the region through the sale of solid fuel operation and maintenance of the equipment. At the same time, a Grind Mill will be installed at the CFPT and maintenance skills will be taught to the CFPT instructors. The trained instructors will then teach the same skills to trainees and graduates, enabling CFPT graduates to take up jobs in Grind Mll maintenance and manufacturing. Therefore, it is contributing to various fields such as human resource development, job creation, and effective utilization of waste, not only for commercial use but also to promote environmental protection by replacing the fuel for daily cooking in households, and to create employment opportunities for local workers engaged in machine manufacturing.

(3) Dimensions

The Figure 18 shows dimensions of the Grind Mill (for curl chips).

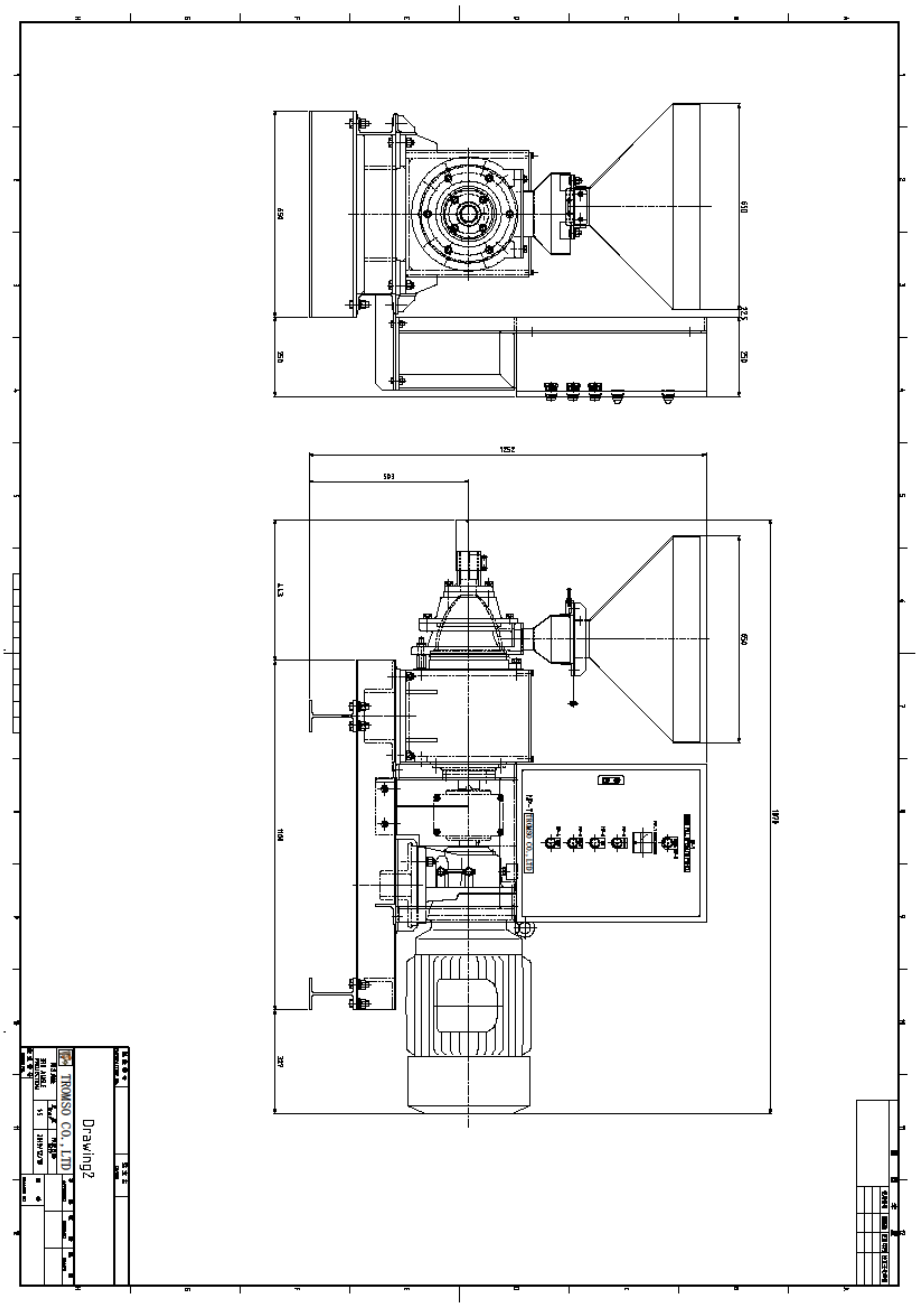


Figure 18 Grind Mill (TRM-200CR) dimension

4.2. Survey on rice mills

With the cooperation of two rice milling companies in Soc Trang Province, we continued our survey this year. Both rice mills are located along the riverside and the unhulled rice is delivered to the mills by boat, Chau Hung is a small-scale rice mill, while Than Tin is a large-scale rice mill that also exports milled rice and plans to increase its production in the future. Although both rice mills produce rice

husk solid fuel , they are not equipped with coal boilers and do not consume rice husk solid fuel on their own; instead, their customers (e.g., feed companies) purchase it as fuel for their boilers.

Table 13 Results of hearings with Rice Millers

Company name	Chau Hung	Thanh Tin
Location (Province)	Soc Trang	Soc Trang
Factory type	rice mill	rice mill
Number of Employees	20	250
Site area	5,000 m2	70,000 m2
Production output	3,000 t/year	180,000t/year Mainly exports, targeting 500,000 tons in 5 years
	Rice husk production: 600t/year	Rice husk production: 36,000t/year
Selling price	Rice husk: 1.4 yen/kg	Rice husk: 5.4 yen/kg
	After solidification: 5.9 yen/kg	After solidification: 8.2~9.1 yen/kg
Boiler	No	No
Grind Mill introduction	Possible	Possible
	Currently owns 4 briquetting machines	Currently owns 15 briquetting machines
	Production of rice husk briquettes 2t/day	Production of rice husk briquettes 200t/day
Transportability (curl chip)	The river is narrow and requires transportation by small boat.	river transport
	Large ship is 20km away	The factory is on riverside
Curl chip storage space	No site or building available, acquisition required	
Interest in Grind Mill introduction	No plan to increase production volume	Would be interested the selling price goes up.
(interest in utilizing rice husks)	Yes, if the price of the product is increased.	Yes, as long as selling curl chip is profitable.

(Exchange rate: 199.5VND=1yen, January 14, 2022)

(1) Chau Hung rice milling Plant

The Chau Hung Rice Milling Plant has a briquette production unit that solidifies rice husks that can be used as fuel for the boiler. Rice husks that are not used for briquette production are sold to other companies or used as fuel for the company's own rice drying equipment.

The briquette manufacturing equipment is shown in the Figure 19 and the equipment for processing rice husks into briquettes is shaped as shown in the Figure 20

The supplied rice husks are fed into a funnel-shaped receptacle from the top of the machine, and then transported to the rotor in the lower processing section, where they are processed into a cylindrical shape by the rotation of the rotor, and briquettes are manufactured as solid fuel (cylindrical). The briquettes are piled up and stored in the factory. Currently, there are four of these machines installed in the plant. The equipment is purchased at a cost of 46,000,000VND/unit in 2012 and has a production capacity of 2 t/day.

Specifications of the Briquette Machine.

Production capacity	2 t/day
Price	46,000,000VND (approx.230,000 yen)/unit
Manufacturing temperature	300° C
Motor	30HP
Consumables	① Nozzle, ② Screw, ③ Heater

The following are the current response to each consumable item.

・ Nozzle

The company orders nearby machining companies to manufacture the products with available materials. The price is 2,000,000VND (approx. 10,000 yen)/unit and the materials are not specified and built with the materials that are in stock at the time of order.

・ Screw

It is replaced about every five years, and since they are worn out after about 12 hours of normal operation, they are soldered and repaired as they are used. Since the repair work is very complicated, there is only one 1person in the factory who can handle it. 2000,000VND (about 10,000 yen)/unit, made of iron.

Although they approach a university professor they knew and tried to develop a screw with high wear resistance material, the development has been stalled due to lack of cost-effectiveness.

・ Heater

They use Vietnamese commercial heaters, which are replaced once a month. The price is 200,000VND (approx. 1,000 yen)/unit.

Figure 19 Local briquette machine

Figure 20 Local briquette machine with a hopper

Figure 21 Nozzle of a briquette machine

Figure 20 Manufactured tubular briquettes

Figure 23 Screw of current briquette processing equipment

Figure 22 Site of briquette sales

At the time of last year's survey, an average of about 200t/month of unhulled rice was delivered to rice mills for milling and generated about 40t/month of rice husks; half of these husks were processed into briquettes and were sold as fuel for boilers. This year, about 250t/month of unhulled rice was delivered on average, and about 50 t/month of unhulled rice was generated, so the scale of handling is increasing, however, by developing new sales channels – such as brick manufacturer and brewery, the plant is selling the unprocessed

husk at 200-250VND/kg (300VND/kg at the time of the 2020 survey). With the development of sales channels, the proportion of unprocessed rice husks has risen to 80% of the total, and currently only about 10t/month is processed into briquettes; only one of the four briquette-making machines installed is in operation. The briquettes were mainly sold to the general public, but the increase in the gas penetration rate of ordinary households in the neighborhood has led to an increase in the sales volume of unprocessed rice husks and a decrease in the briquette production volume.

Chau Hung Rice Milling Plant is built beside on the riverside, and the unhulled rice is transported by waterway. Since it is a small river, it is difficult for large ships to pass through, so the ships dock at places where large ships can dock, and when transporting the unhulled rice, small ships of about 10 tons are used to transport the rice over a distance of about 20 km to and from the places where large ships are docked.

Figure 24 Rice husk transport boat

Figure 25 Rice husk storage

The company wishes to expand its facilities in the future, giving priority to business expansion of existing businesses. In addition, at present, unprocessed rice husks are transported to the facility for sale, but a business plan is being formulated so that sales can be started around the rice field where the rice husks are generated. With regard to the introduction of the Grind Mill, the price is a concern.

The following is an installation plan for installing a Grind Mill in an existing building (inside a factory).

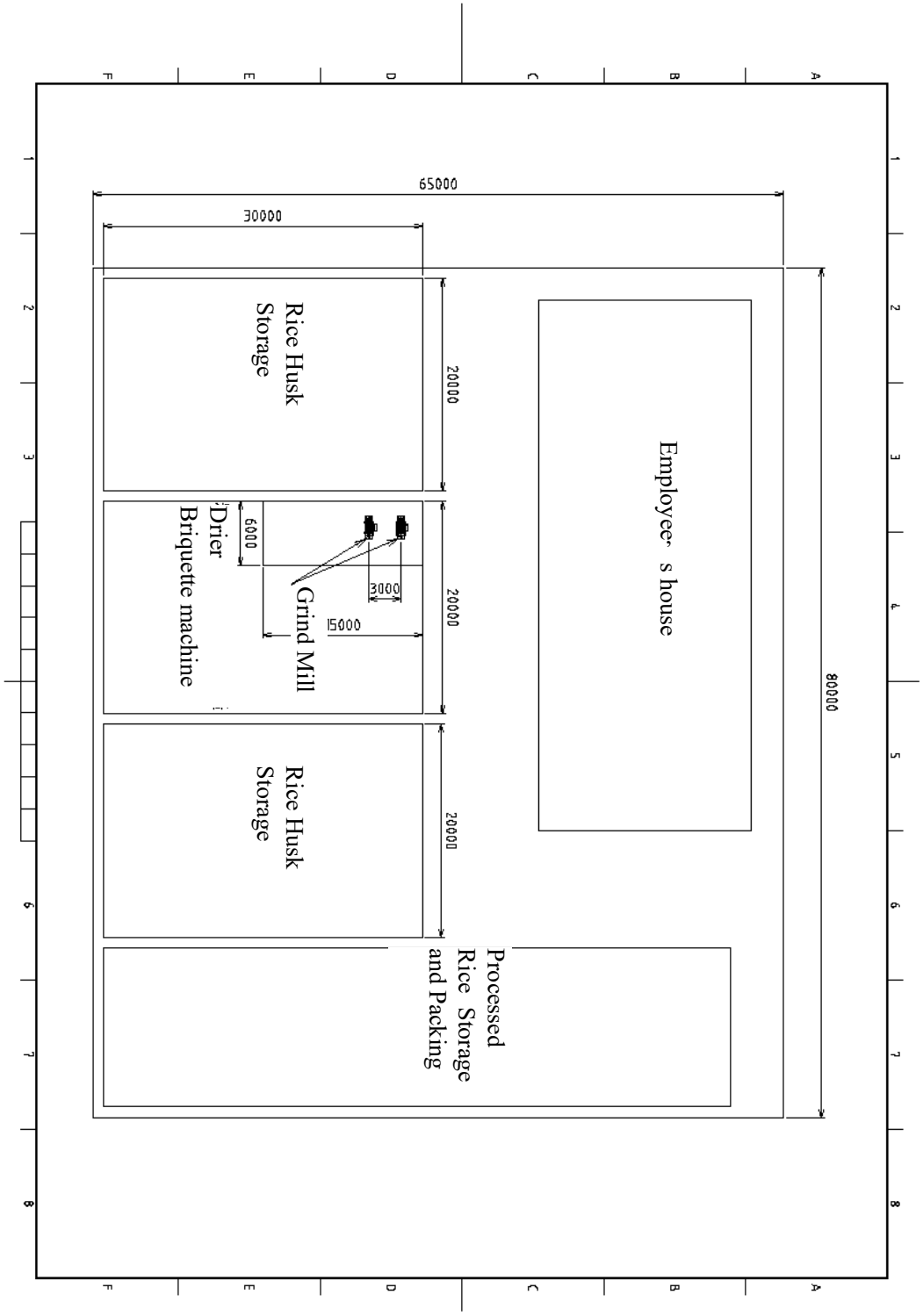


Figure 26 Proposed installation of Grind Mill (Chau Hung Rice Milling Plant)

(2) Thanh Tin rice milling plant

The Thanh Tin rice mill is equipped with a number of state-of-the-art, large-scale, Vietnamese-made briquetting machine.

The unhulled rice delivered to the rice mills is milled by the large automatic production equipment shown in the Figure 27 and the resulting chaff is discharged by the automatic production equipment as solid fuel in the form of cylindrical briquettes. The amount of milled rice produced by the rice mills is 220,000 t/year and the estimated amount of rice husks generated is 44,000 t/year in 2019; out these rice husks, about 70% are processed into briquettes and sold to companies that produce livestock feed.

Currently, due to an increase in the percentage of unhulled rice, the amount of unhulled rice generated by the mill has decreased to 36,000 tons/year, but the percentage of unhulled rice used for briquette production has increased to about 80%. Of the briquettes produced, about 80% is supplied to a foreign (Thai) feed manufacturer at a price of 1,500-2,200 VND/kg. The supplier conducts semi-annual audits and evaluations, and the briquettes are manufactured and sold according at the specified specifications.

Figure 27 Rice milling machine

Figure 28 Manufactured tubular briquettes

Figure 29 Rice paddy

Figure 30 Rice paddy transport vessel (usually larger vessels areused)

This rice mill is located beside a river, and rice and unhulled rice are transported by waterway. The largest

vessel that can operate on the river can transport 3,000 tons of unhulled rice. The maximum length of the vessel is 50 meters.

They are planning to expand their business by expanding the facilities and scale of their existing business and developing products using by-products such as rice husk oil. In the project to introduce a Grind Mill (a specialized machine for curl chips), they will consider introducing it if it can further increase the sales volume along with the processed rice husk products that they are currently selling. At present, 15 briquetting machines made in Vietnam are installed, and they can produce about 1.6t/unit of briquettes per day. In addition, they are less expensive than Grind Mills, but the consumption of consumable parts is high, so the company's maintenance team (about 30people) repairs the equipment while it is in operation.

Figure 31 Existing briquette machine

Figure 32 Conveyer belt that feeds briquette

In order to process all the rice husks discharged from the company, 79 Grind Mills need to be installed. At the time of the survey, the space available (Figure 33 and Figure 34) was studied for installing the Grind Mills in the existing building (inside the factory), however, it is necessary to rearrange the existing equipment (existing briquetting machines, etc.) or secure a new installation space. Figure 35 is the installation plan when the existing equipment in the space available for installation is removed and the Grind Mill is installed.

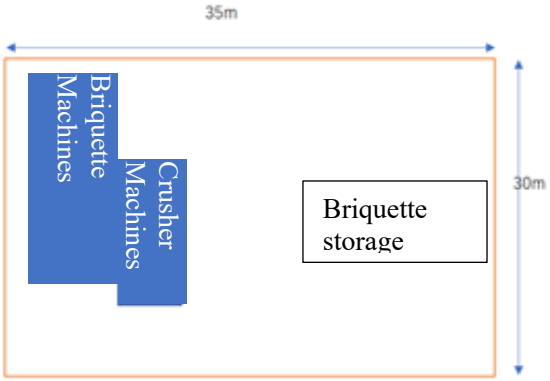


Figure 33 The layout of the current factory

Figure 34 Space available for installation of Grind Mill

The proposed installation of the Grind Mill to the company is as follows.

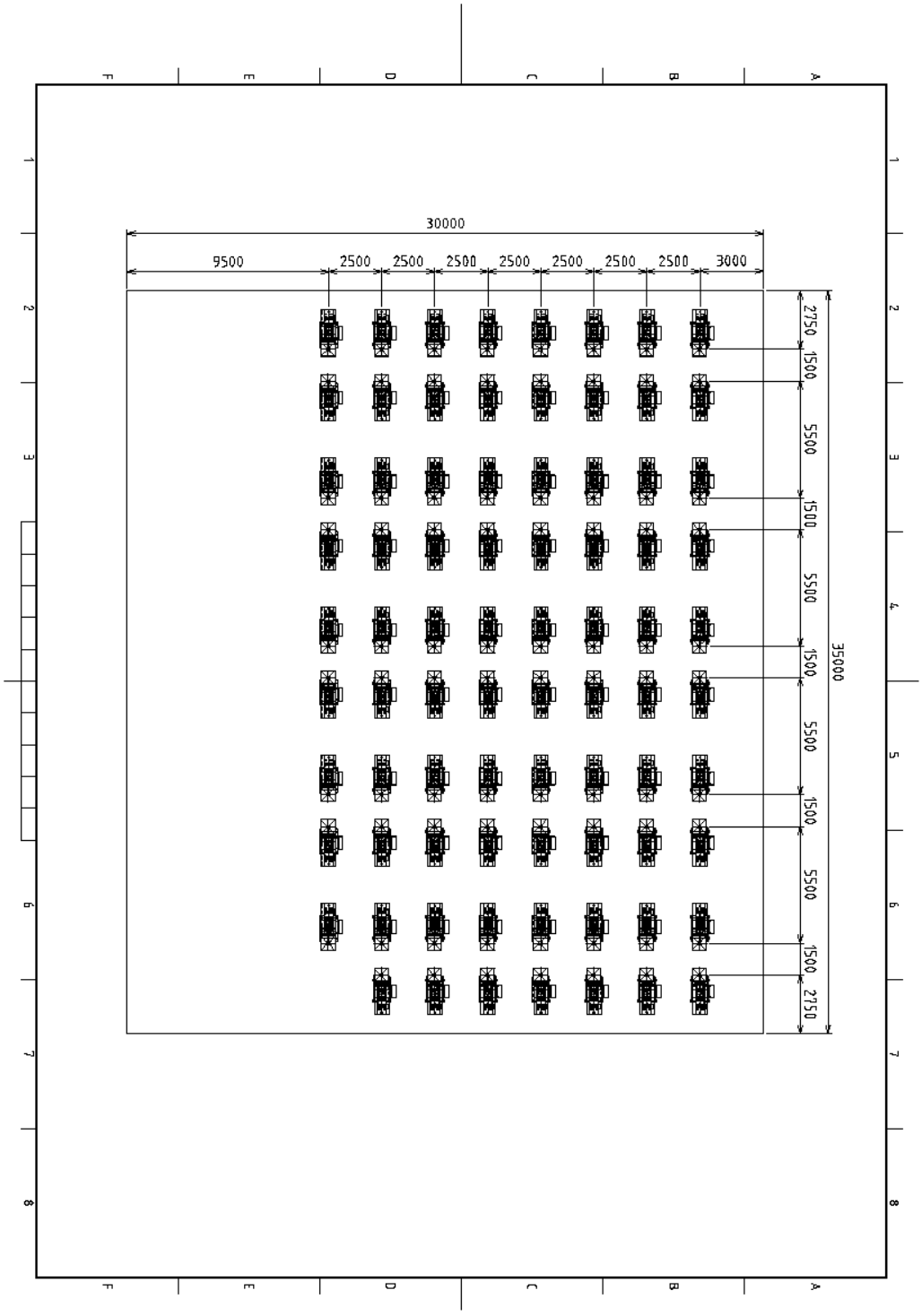


Figure 35 Proposed installation of a Grind Mill (Thanh Tin rice milling plant)

See the frame for the location of the Grind Mill.

4.3. Survey on use of coal in Vietnam

(1) Characteristics of coal in Vietnam

The quality of coal in Vietnam was surveyed in order to provide basic data for the feasibility study on fuel conversion of coal boilers in this study. Vietnam is one of the leading coal-producing countries in the ASEAN region, producing more than 40 million tons per year domestically. However, the supply of domestic coal cannot keep up with the demand for electricity that supports the country's economic growth, and imports have been increasing rapidly in recent years.

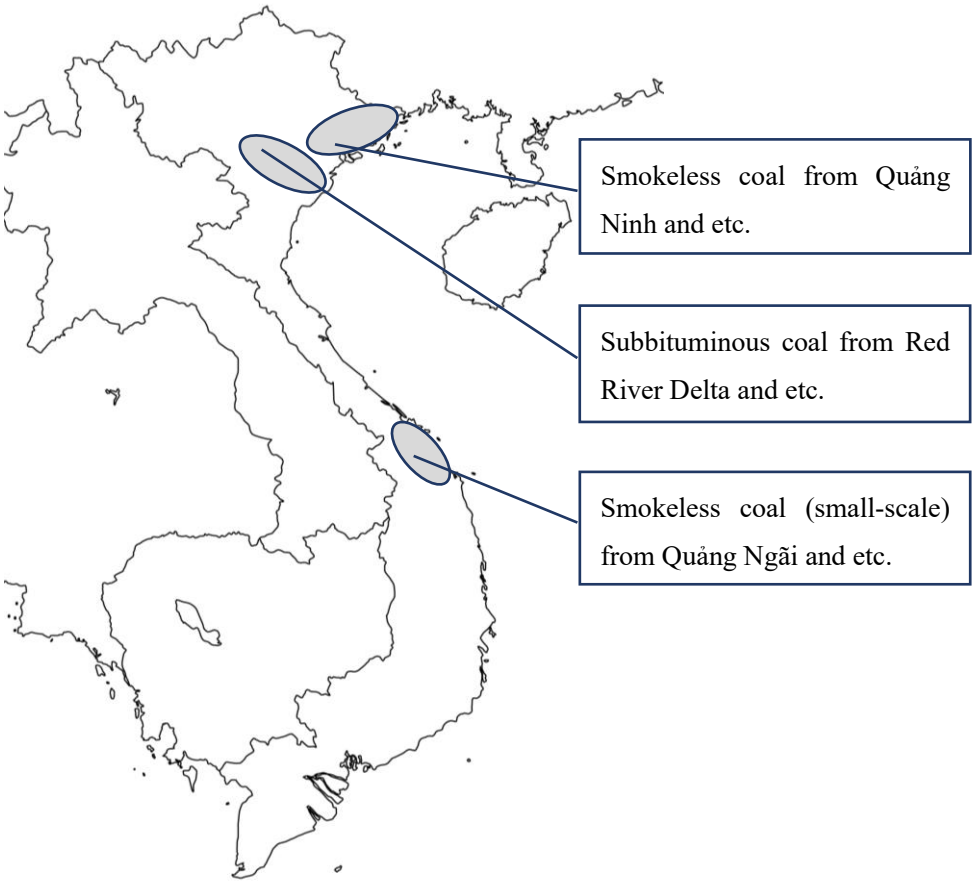


Figure 36 Major coal mines in Vietnam

Source: Compiled by JCOAL

The major coal fields are shown in the Figure 36. The age of coal formation in Vietnam is Paleozoic to Cenozoic, and it is mainly found in the northeast of the country. It is also distributed in the central and southern parts of the country, but except for a small amount of anthracite coal around Quang Ngai in the central part, it is peat, lignite, or sub-bituminous coal. In the north, anthracite coal from the Quang Ninh coalfield and sub-bituminous coal from the Red River Delta coalfield in southern Hanoi are representative.

Since the coal-producing areas are mainly located in the northern part of the country, the central and southern parts of the country are transported by rail and coastal vessels. As a result, southern coal users must pay a

premium for transportation. Some major power companies also import coal from Indonesia for their own power plants.

The following table shows the specifications and quality of domestic charcoal in Vietnam. Vietnamese charcoal produces a lot of anthracite coal, which is enriched with carbonaceous matter (Figure 37 and Table 16), and high-quality anthracite coal is exported to such countries as Japan and China for steal processing as a source of foreign currency. In recent years, the government has adopted a policy of prioritizing the domestic market, and exports have frequently been unilaterally suspended. On the other hand, grades with high ash content and relatively low calorific value are distributed to coal-fired power plants and small domestic users.

Table 14: Grades of domestic coal in Vietnam

	Grade		Size	Ash content (%)	
	Domestic	World	(mm)	Average	Scope
Lump	2a	02A	35-100	8.00	6.00-10.00
(Lump coal)	2a	02B	25-100	12.50	10.01-15.00
	3	03A	25-50	4.50	3.00-6.00
	4a	04A	15-35	5.50	4.00-7.00
	4a	04B	15-35	9.50	7.01-12.00
	4a	04C	15-35	14.00	12.01-16.00
	5a	05A	6-18	6.50	5.00-8.00
	5b	05B	6-18	10.00	8.01-12.00
Fine	1	06	<15	6.50	5.00-8.00
(Powdered coal)	2a	07	<15	9.00	8.01-10.00
	3a	08A	<15	11.50	10.01-13.00
	3a	08B	<15	14.50	13.01-16.00
	3a	08C	<15	17.50	16.01-19.00
	4a	09A	<15	21.00	19.01-23.00
	4a	09B	<15	25.00	23.01-27.00
	5a	10A	<15	29.00	27.01-31.00
	5b	10B	<15	33.00	31.01-35.00
	6a	11A	<15	37.50	35.01-40.00
	6b	11B	<15	42.50	40.01-45.00
Sludge	1a	12A	<0.5	29.00	27.01-31.00
(Sludge)	1b	12B	<0.5	33.00	31.01-35.00

Source: Compiled by JCOAL from VINAVCON data

Table 15 Quality of Domestic Coal in Vietnam

	Grade	mineral content (%)	moisture (%)	Volatile Component (%)	Sulfur Content (%)	Calorific value (kcal/kg)
		average	average	average		
Lump	2a	8.00	4.00	6.00	0.65	7,600
(Lump coal)	2a	12.50	4.00	6.00	0.65	7,100
	3	4.50	4.00	6.00	0.65	7,950
	4a	5.50	4.50	6.00	0.65	7,900
	4a	9.50	4.50	6.00	0.65	7,400
	4a	14.00	4.50	6.00	0.65	7,050
	5a	6.50	4.50	6.00	0.65	7,850
	5b	10.00	4.50	6.00	0.65	7,400
Fine	1	6.50	8.00	6.50	0.65	7,800
(Powdered coal)	2a	9.00	8.00	6.50	0.65	7,600
	3a	11.50	8.00	6.50	0.65	7,300
	3a	14.50	8.00	6.50	0.65	7,000
	3a	17.50	8.00	6.50	0.65	6,750
	4a	21.00	8.00	6.50	0.65	6,400
	4a	25.00	8.00	6.50	0.65	5,950
	5a	29.00	8.00	6.50	0.65	5,600
	5b	33.00	8.00	6.50	0.65	5,250
	6a	37.50	8.00	6.50	0.65	4,800
	6b	42.50	8.00	6.50	0.65	4,350
Sludge	1a	29.00	20.00	7.00	0.65	5500
(Sludge)	1b	33.00	20.00	7.00	0.65	5200

Source: Compiled by JCOAL from VINAVCON data

As can be seen from the Table 15, the moisture, volatile matter, and sulfur content of Vietnamese coals are the same regardless of the grade, indicating typical anthracite properties. The difference in calorific value is inversely proportional to the amount of ash contained, and since the price is set based on calorific value, the higher the grade, the higher the price. However, depending on the volume of trade and transportation costs, selected coal[6] may be used.

The Table 17 shows the projected demand for coal in Vietnam. Most of the demand is for coal-fired power generation to meet the increasing demand for electricity, while the demand from other industries is increasing slightly.

[6] It is also called washed coal. A method of continuous sedimentation and separation of rocks and coal under a stream of water, using the difference in specific gravity between the two.

Figure 24

①Wood
②Cellulose
③Lignin
④Peat
⑤Lignite
⑥Low Level Bituminous Charcoal
⑦Bituminous Charcoal
⑧Highly Bituminous Charcoal
⑨Semi-anhydrous Coal
⑩Anthracite Coal

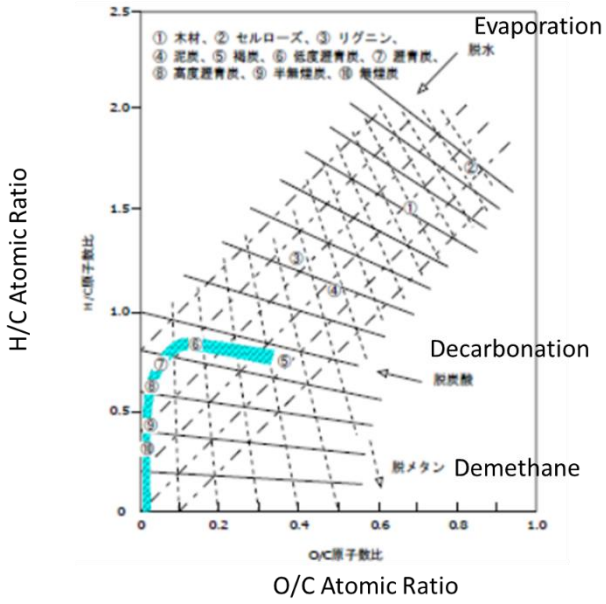


Figure 37 Coal type, coal band

Source: JCOAL Call Note 2011 (original source: Van Krevelen, "Coal")

Table 16 Types and characteristics of coal

Types of coal	Features
lignite	It is the youngest coal in terms of coalification reaction and contains a large amount of volatile matter and moisture. Therefore, it is not suitable for long-distance transportation because of its tendency to spontaneously combust during long-term storage and is often used in coal-producing areas .Figure 37⑤.
bituminous coal	It has properties intermediate between those of lignite and bituminous coal. It is less expensive than bituminous coal on the international market, and its use as a fuel for power generation in blends with bituminous coal has been increasing in Japan in recent years. Figure 37⑥
bituminous coal	The coal commonly used in Japan for power generation. High in calorie content and low moisture, ash, and sulfur content is expensive, but Japan procures it under long-term contracts. Some of it is also used for steel production.Figure 37 ⑦, ⑧
smokeless coal	It is a bituminous coal that has undergone further coalification reactions. It is high in calories, but takes a long time to burn. Good quality anthracite is used as a raw material for steel coke. Figure 37⑨, ⑩

Table 17 Projected Coal Demand in Vietnam

(Unit: million tons)

No.	Coal demand	2016	2020	2025	2030
1	Thermal Power Generation	33.2	64.1	96.5	131.1
2	Fertilizers and Chemicals	2.4	5.0	5.0	5.0
3	Cement	4.7	6.2	6.7	6.9
4	Metallurgy	2.0	5.3	7.2	7.2
5	Others	5.2	5.8	6.1	6.4
Total		47.5	86.4	121.5	156.6

Source: Compiled by JCOAL from CDP, Ministry of Industry and Trade, Vietnam

(2) The position of coal power in Vietnam

Vietnam's power operations were governed by Power Development Plan 7 (PDP7), the country's most recent power generation capacity plan, which was amended in March 2016 and revised to significantly increase the share of renewable energy for 2030, as shown in Figure 38.

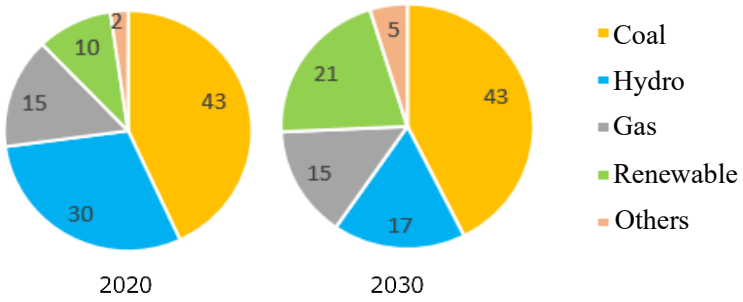


Figure 38 Share of installed capacity and share of electricity generation by power generation plan in Vietnam

Source: Compiled by JCOAL from the revised PDP7 of the Vietnamese Ministry of Industry and Trade

As a result, the share of renewable energy is expected to increase substantially, not only in electricity, but also in projected demand for primary energy from agriculture, forestry, and fisheries, industry and construction, and consumer-related industries. Among the renewable energies, the use of biomass for power generation and heat supply is expected to increase substantially. As coal-fired power generation is expected to continue, the increased use of biomass in renewable energies is expected; therefore, the use of biomass in coal boiler is desirable.

(3) The energy policy in PDP8 draft version

In the draft version of Vietnam Power Development Plan (PDP8), "Vision to 2045 and National Power Development Master Plan for 2021-2030 (PDP8)," was released in March 2021. Due to the impact of COP26 in 2021, the government has yet to approve the draft version of PDP8, and is expected to review the introduction of renewable energy in the near future. This section outlines the coal policy in the draft version

of PDP8.

The Ministry of Industry and Trade of Vietnam has released the first draft of the "Vision to 2045 and National Power Development Master Plan for 2021-2030 (PDP8)" to hear the opinions of relevant ministries and agencies. Vietnam's GDP growth rate is 6.6%/year on average in the phase of 2021-2030 and 5.7%/year on average in the phase of 2021-2045. Electricity forecast to maintain high growth rate is expected to be 491 TWh in 2030 and 877 TWh in 2045.

By 2030, Vietnam's total installed capacity will reach 137.2 GW (coal-fired: 27%; gas-fired: 21%; hydro: 18%; wind, solar and other renewable energy: 29%; imports: less than 4%; pumped storage and other energy storage: less than 1%). By 2045, the total installed capacity, including nuclear power, will reach 276.7 GW (of which coal-fired power: 18%; gas-fired power: 24%; hydro: 9%; wind, solar and other renewable energy: more than 44%; imports: less than about 2%; pumped storage and other energy storage: about 3%).

The Vietnamese government is encouraging the development of renewable energy, excluding hydropower, and the capacity ratio in 2020 is about 13%, while it is expected to increase to just under 30% in 2030 and 44% in 2045. On the other hand, the coal-fired power development plan has made it a policy not to develop new coal-fired power plant projects except for those under construction or under construction investment promotion that can be put into operation between 2021 and 2025 in the 2021-2030 phase. Therefore, the power supply mix of coal-fired power generation will decrease from 34% in 2020 to 27% in 2030, which is a 16% decrease compared to the revised PDP7 plan. Furthermore, if this plan is implemented, the share of coal-fired power generation will decrease 17-18% in 2045. Only advanced technologies above the ultra-supercritical (USC) power generation system are to be introduced in coal-fired plants after 2025 to reduce CO2 emissions from coal-fired power generation by thus achieving higher efficiency of generating electricity. Looking at this trend in terms of power generation, the composition of coal-fired power generation is expected to decrease from about 40% in 2030 to 28-30% in 2045.

As for coal-fired power generation, the production and supply of domestic coal has already reached a ceiling of 45-50 million tons, and the country – mainly for coal-fired power plants in the south – is dependent on imported coal from Indonesia and other countries. Coal imports for power generation are expected to be 47-52 million tons as of 2030 and 75-96 million tons as of 2045, depending on the scenario.

4.4. Survey on coal boiler users

Since out of four companies that cooperated with us during the last year's survey, three companies except MTV were unable to continue the survey due to the impact of COVID-19, we requested cooperation from two new coal boiler users to conduct this year's survey.

(1) List of coal boiler user survey results

Table 18 and Table 19 show the survey results of coal boiler users and others in the Mekong Delta region.

Table 18 Results of interview survey of coal boiler users

Company name	MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)
Location (Province)	Dong Nai	Ho Chi Minh	Long An
Factory type	Drying of agricultural products (paddy, sorghum)	Fabric and clothing manufacturing	Feed manufacturing (livestock and fisheries)
Number of employees	5	1,800	400
site	1,000 ㎡	90,000 ㎡ (of which boiler operation site is1 ,500 ㎡)	53,000 ㎡
production output			27,000t/month
boiler	Yes (2 units owned)	Yes (unit owned)	Yes
fuel	Coal: 200～250t/year	Coal: 12,000t/year	Coal: 29,5000t/year
coal properties	6,200 kcal/kg	5,500 kcal/kg	4,500 kcal/kg
Coal purchase price	25.8 yen/kg	Varies between 4.7 and 8.7 yen/kg (the price at the time of the survey was 6.1 yen/kg)	10.2 yen/kg
Coal transportation method	truck	truck	truck
Boiler equipment (coal use)	Drying furnaces (2 furnaces: 4x8m)	3 steam boilers (made in Taiwan×1, made in Vietnam×2)	Steam boiler×1 (made in Vietnam×1)
	Manufactured by local drying oven manufacturer	Purchased from the Southern Branch of Vietnam Boiler Co.	Purchased from Vietnam Boiler Co.
Crusher	No	No	No
coal mining equipment	No	Transported by a bulldozer	Transported by a forklift
Coal storage.	No (15 ㎡ of storage space next to the furnace)	Covered warehouse of about 300 ㎡	Warehouse with room of about200 ㎡ (almost no inventory as coal is delivered by order.).
ash disposal	Backfilling the pond Dumped on factory grounds	Entrusted to a contractor for processing at about 3 yen/kg	Disposed of as general waste
Dust removal equipment	No	Waste gas is passed through water and then discharged.	Waste gas is passed through water and then discharged.

Table 19 Results of interview survey of coal boiler users (continued)

Company name	MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)
Possibility of using curl chips	Medium possibility	Medium possibility	High possibility
	No place to store, requires more labor	Possible, however, curl chip may clog.	Can be used as is
	Questionable in terms of cost	If clogging occurs, additional grinding steps are required	
Transport ability of curl chip	Purchased from a rice mill in Soc Trang Province	Purchased from a rice mill in Soc Trang Province	Purchased from a rice mill in Soc Trang Province
	About 250 km by sea, then 90 km by truck.	About 250 km by sea, then 25 km by truck.	About 200 km by sea, then 7 km by truck.
How to procure coal	Carried in by truck by neighboring coal dealers (within 5km)	Late at night, contractors bring in and unload containers.	Carried in by truck by neighboring coal dealers (within 2km)
Curl chip storage space	Coal storage area of 15 ㎡ next to furnace only	Can be stored in existing coal storage facilities There is enough room on the site for additional construction.	Can be stored in a coal storage room of about 2 00 ㎡. There is enough room on the site for additional construction.
Business development (interest or not)	Can be used if drying capacity is maintained. Possible if there is a profit after subtracting all costs.	Consider introducing it if it solves the smoke generation and economic problems.	Consider introducing the system if it is cheaper than coal operating costs and can be stably supplied.

1JPY=199.5VND (as of January 14, 2022)

(2) MTV produce drying plant

At the time of last year's survey, the coal was pulverized to the extent that it could be fed into the system, and since there was no particular pulverizing equipment and the amount of coal handled was small, the company was purchasing coal at higher prices. In this year's survey, we found that the size of coal currently being purchased has remained constant, but the price has been increasing. There has been no change in the specifications of the furnace since last year. Agricultural products are placed on the grate floor above the drying room (shown in the diagram below), coal is fed into the combustion furnace through the coal feed port, and the air heated by coal combustion is blown by a fan to dry the agricultural products (paddy, corn, etc.). It seems curl chip can replace coal, however, due to the impact of COVID-19, the demand for agricultural products has dropped, and the plant is now drying about 25 tons of corn per day, which is half the amount of coal used this year compared to last year.

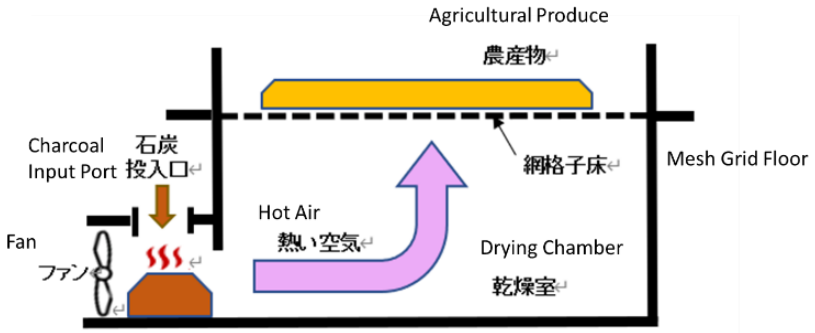


Figure 39 Structure of the agricultural product drying plant

Source: Compiled by JCOAL based on the survey results.

Figure 40

Coal feed port to the combustion furnace (left), coal placed in the coal combustion furnace (right)

Figure 41 Coal inlet to the combustion furnace (Combustion gases enter the lower part of the drying chamber.)

Figure 42 Agricultural produce dryer (upper part of the drying chamber)

The price of coal is 5,150 VND/kg and the annual consumption is 200-250 tons. The company purchases solid coal and disposes of the ash and soot discharged after burning coal by itself, either by using it to fill up ponds or dumping it on the factory site, instead of asking a company to take it away. They purchase coal once every one to two weeks from a coal distributor located about 5 km away from the plant. They used their truck to buy the coal, however, they asked coal distributor to deliver it for them from this year. There is an existing space of 15 square meters that can store about 10 tons of coal, but there is a vacant lot near the drying oven where additional storage warehouses can be built.

Figure 43 Disposal Site of Ash and Soot

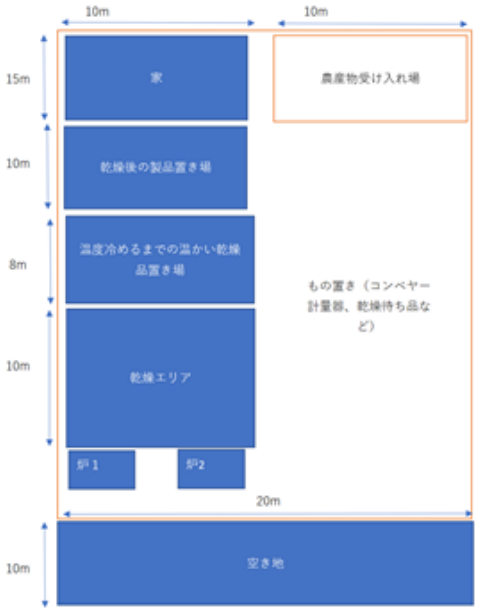


Figure 44 Plant Layout of MTV

Regarding the substitution of coal for rice husk solid fuel, the fact that the existing coal boiler drying equipment can be used is an advantage, however new employment and a place to store the rice husk solid fuel will be required. If a certain amount of profit can be expected for these initial investments, the company would like to consider introducing the system.

(3) AGTEX28

AGTEX 28 is a state-owned enterprise under the jurisdiction of the Ministry of National Defense, located in Ho Chi Minh City, established in 1975, with offices throughout the country, expanding its business from the main business of cloth and clothing manufacturing to real estate and fuel business, and using coal boilers in its cloth and clothing manufacturing plants. It had signed a contract with an external party to manage boiler operation in 1999, however, in 2010, it founded another company (THANH DAT TIEN Co., Ltd.) that AGTEX28 owns the boiler, land, and building, and THANH DAT TIEN Co., Ltd. is in charge of boiler operation. AGTEX28 has 90,000 ㎡ of land and 1,800 employees, while THANH DAT TIEN has 1,500 ㎡ of controlled land (only the boiler operation site) and 20 employees..

The price of coal is not stable and fluctuates between about 930~1,700VND/kg. The price at the time of the survey was about 1,200VND/kg. One of the reasons for the low price compared to the average market price is that the company is a state-owned enterprise and can cooperate with THANH DAT TIEN, which has been in the business of selling coal. AGTEX28 uses Indian coal, with an annual consumption of about 12,000 tons and a calorific value of 5,5000 kcal (the composition list of the coal used is confidential and could not be obtained). However, the coal used by AGTEX28 has an ash content of 40-45%, compared to 20-25% for a coal standard with the same calorific value. In addition, the coal used appears to be wet, suggesting the use of low-quality coal with high moisture content. The coal is transported by the supplier to AGTEX28 every night by truck in containers and then unloaded.

Regarding the substitution of coal for rice husk solid fuel, it is possible if the price is equal to or lower than the price of coal currently used. Therefore, in the case of substituting curl chips, 5,500 kcal ÷ 3,700 kcal (heat value per kg of curl chips used) = about 1.48 kg (amount of curl chips required (calorific value basis)). Therefore, if the overall cost, including the cost of purchasing 1.48 kg of curl chips and using them in the boiler, is superior to the company's cost of purchasing coal and disposing of the ash, the project is considered to be profitable.

i Boiler Specifications and Technology of AGTEX28

The plant is equipped with one thermal oil boiler and three coal boilers (one under construction).

① Thermal Oil Boiler

- Summary: Made in Taiwan, purchased in 2012.
- Specification: Use liquid oil as heat medium, circulating oil temperature: 275℃, returning oil temperature: 265℃.

Figure 45 Thermal Oil Boiler

The heat transfer medium circulating in the coiled heat transfer tubes inside the drum-shaped high-temperature, low-pressure heating furnace is heated in the furnace, sent to the dyeing equipment in the factory, and then returned to the boiler for circulation. The special arrangement of the heat transfer tubes in the furnace

allows for high thermal efficiency and fuel savings. During operation, the furnace is under negative pressure and the high-temperature combustion gas does not leak outside the furnace.

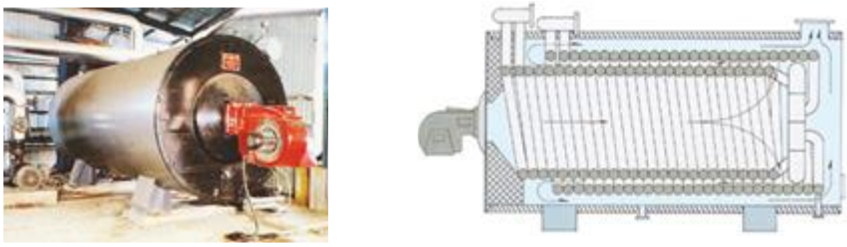


Figure 46 Example of thermal oil boiler

② Coal boiler

Summary: Out of three boilers, first two boilers were originally Taiwanese thermal oil boilers, but one of them was replaced by a Taiwanese boiler (manufacturer and model number unknown) and the other by a coal boiler manufactured by Vietnam Boiler Company in 2011 and 2019, respectively. The third boiler was also made in Taiwan when it was first installed and used large lump coal as fuel but is now being replaced with a coal-fired boiler made in Vietnam (model number unknown) that can combust small diameter coal.

- Specifications (made in Vietnam): Made by Southern Branch of Vietnam Boiler Co.
- Model number: LH10/10.GX Evaporation rate: 10t/h
- Steam condition: 10kg/㎠ x 184℃ (Max. allowable pressure: 15kg/㎠)
- Model: Single-body natural circulation boiler with moving floor stoker

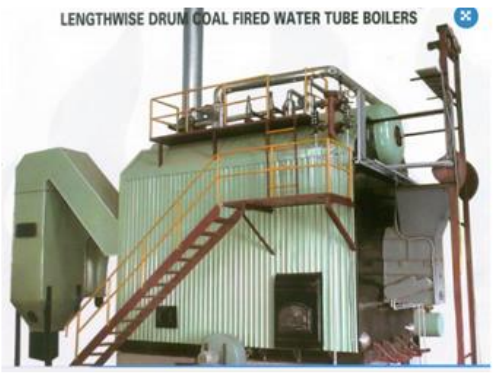


Figure 47 Standard type single-body natural circulation boiler manufactured by Vietnam Boiler Co.

ii Operation Status

- Boiler Status

Figure 48 Vietnam made single-body natural circulation boiler (moving floor stoker-fired), AGTEX28

The coal is from India, arranged by Thanh Dat Tien, and is installed together with the boiler in the building as shown in the picture below. In order to burn curl chips, it is necessary to secure a place to store them. The boiler on the left side of the lower left figure is manufactured by Vietnam Boiler Company, and the one on the right side is manufactured in Taiwan. There is a coal storage area on the right side of the boiler (lower right figure), where coal is stored in the back and ash in the front.

Figure 49 Boiler and coal storage area

Coal is moved by bulldozer, and as mentioned earlier, in the Taiwanese boiler shown in the center figure, workers use shovels to feed the coal into the boiler's fuel feed hole.

Figure 50 Coal feeding

The boilers are all stoker-fired, and the main fuel is Indian coal, but the particle size of the delivered coal is less than about 3 mm, and no grinding is required. (See Figure 51 The ash after coal combustion is disposed of by a waste disposal company.

Figure 51 Particle size of delivered coal

Figure 52 Discharge system for furnace bottom slag

(4) CJ Agri Vietnam

CJ is a member of the foreign-funded CJ Group in Korea, and built a factory in Long An Province in 1999, where it is building a feed production line for livestock, poultry, and fisheries, with a coal boiler installed. CJ's coal consumption is 29,5000 tons, and the calorific value of coal is about 4,500 kcal/kg. Assuming the same level of heat supply, it will require about 36,000 tons of curl chips, which is 22% more than the coal consumption. There is no need to build a new storage facility because there is enough space for storage as there is a 002m2 covered coal storage warehouse and the coal distributor brings in only what is needed.

i Boiler Specifications and Technology of CJ Agri Vietnam

The plant is equipped with one oil boiler and one coal boiler.

① Oil boiler (purchased in 2005): Purchased as a reserved, but rarely used.

・ Specifications (made in Vietnam): Manufacturer is unknown

・ Steam conditions: 7 Pa

・ Fuel used: DO, FO

② Coal boiler (purchased in 2005)

・ Specifications (made in Vietnam): Made by Vietnam Boiler Co.

・ Model number: LT8/10X Evaporation rate: 8t/h (max.)

・ Steam conditions: 8.5 Pa x 180°C

・ Model: External combustion chamber water tube boiler Moving floor stoker firing

The structure of this boiler is a natural circulation type boiler combined with an external combustion chamber and a water tube boiler, and the standard system diagram and external view are shown below. As shown in the system diagram, the coal boiler is a natural circulation type boiler that uses the gas generated by burning

coal in a moving bed stoker furnace to generate saturated steam in a water tube boiler.

Figure 53 Standard Exterior View

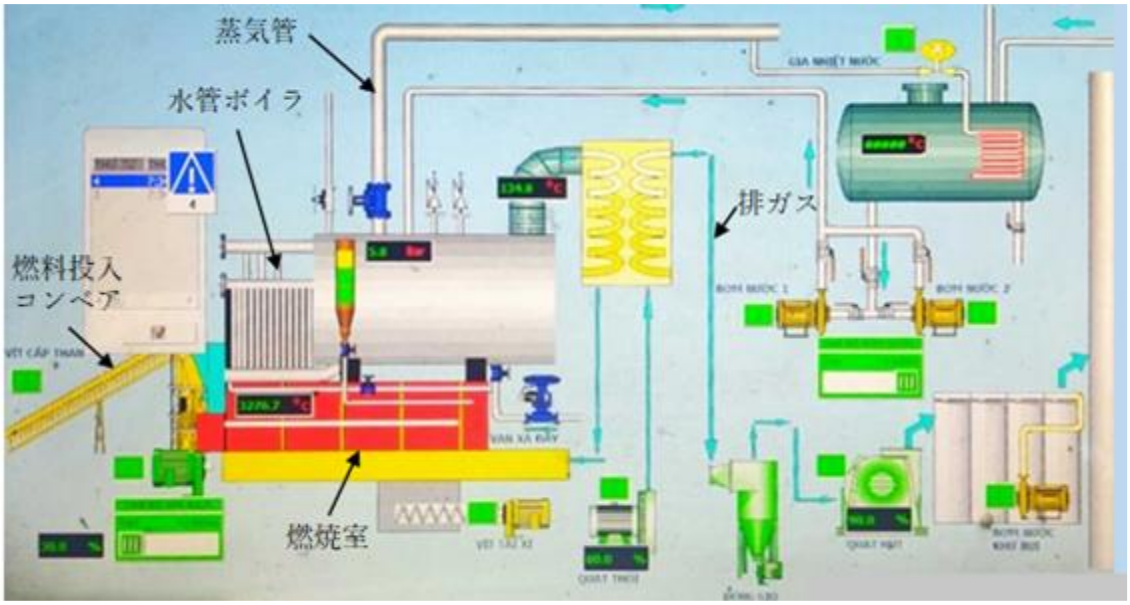


Figure 54 Standard System Diagram

ii Operation Status

① Boiler Status

The company uses Indian coal as its main fuel, but for the last three years, when the fuel price has gone up, it has been using solidified rice husk fuel (in the form of small pellets). The company has already been using rice husk pellets, so they have responded that they have no resistance to the use of curl chips.

Figure 55 Vietnam made natural circulation boiler (moving floor stoker-fired) at CJ Agri Vietnam

Basically, the company has a policy of not having coal in stock, and asks a contractor to bring in only the necessary amount (enough for one 10-ton truck) each time from a 5,000 ㎡ warehouse of a coal sales company located about 2 km away. Rice husk pellets are brought in by truck from the neighboring province of Tien Giang and placed in the coal warehouse.

The ash from the coal used is disposed of as general garbage. When the existing rice husk pellets are used, a considerable amount of ash is discharged, but some people use it as fertilizer, and it is taken away for free of charge. The boiler exhaust gas is passed through water in front of the chimney to remove only the dust, and then discharged from the chimney.


Figure 56 Combustion chamber and the section of water tube boiler

Figure 57 Slag Discharge System at the bottom of furnace (right), Conveyor to feed Rice Husk Pellet (left)

(5) Coal usage of each company

The results of the survey on coal usage of each company are summarized (Table 20).

Table 20 Summary of coal usage of each company

	MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)
Coal consumption t/year	250	12,000	29,500
Coal calorific value Kcal/kg	6200	5,500	4,500
coal price Yen/kg	25.8	6.1	10.2
coal price VND/kg	5,150	1,200	2,000
Amount of rice husk solid fuel required in terms of coal calorific value per kg (kg)	1.68	1.48	1.21
Amount of rice husk solid fuel required t/year	420	17,760	35,695

1JPY=199.5VND (as of January 14, 2022)

Curl chip calorific value = 3,700kcal/kg

4.5. Potential of adopting the project

(1) Production cost of rice husk solid fuel

Out of two companies – Chau Hung Rice Mill and Thanh Tin Rice Mill – that we surveyed in this project, having considered the amount of rice husk discharged and the possibility of installation, we assume that the Grind Mill (TRM-200CR) will be installed in Thanh Tin Rice Mill. This is based on the assumption that one

TRM-200CR will be installed and operated 20 days a month for 8 hours a day to produce 460 tons of curl chips in 12 months; we make two scenarios of free and paid rice husks.

i Scenario of free rice husk

1. Prerequisites.

Item		Quantity	Unit	Remarks
1)	Purchase of TRM-200CR Grind Mill	270	10,000 yen	CR model 2.5 million yen + 200,000yen transportation fee included
2)	Cost of constructing electrical equipment installation structure	0	10,000 yen	Assumed to be installed in an existing building.
	Total equipment cost (2.5 million yen + 200,000 yen)	270	10,000 yen	
3)	Depreciation and amortization (2.7 million yen / 7)	39	10,000 yen	Equal amortization over 7 years.
4)	Months of curl chip production	12	months	
5)	Consumable parts (per 1920 hours)	68.4	10,000 yen / 1920h	8h x 20 days x 12 months = 1920h
6)	Labor cost for production (12-month operation)	30.0	10,000 yen / 12 months	25,000yen/month refer to Thanh Tin Rice Mill labor cost
7)	Amount of electricity used (12 months)	57,600	kwh/12 months	30kw×1920h=57,600kwh
8)	Electricity Bill (12 months)	40.9	10,000 yen / 12 months	7.8 yen/kWh Referred from electricity rates for Thanh Thin Rice Mill (normal unit price is applied)
9)	Curl chip production rate (1 hour operation)	240	kg/h	Assumed 240 kg/h.
10)	Curl chip production (12 months 1920 hours operation)	460.8	t/1920h	12-month production volume

2. Production Cost Estimate

Item	Cost	Unit	Remarks
Hull Husk Procurement cost	0.0	10,000 yen	Assumed to procure rice husks at 0 yen/kg/use own emissions
Depreciation of Grind Mill equipment	39	10,000 yen	2.7 million ÷ 7
Labor cost (12 months)	30	10,000 yen	25,000 yen per month x 12 months
Electricity charges (for 12 months)	44.9	10,000 yen	7.8 yen/kWh Referred from Thanh Thin Rice Mill's electricity rates (normal unit price is applied)
Cost of consumables	68.4	10,000 yen	Parts unit price x 1920h
Total	181.9	10,000 yen	

3. Production Cost per Ton of Briquette

Item	Quantity	Unit
Curl chip production volume	460.8	t
Production cost of 460.8 tons of curl chip	181.9	10,000 yen
Production cost of 1 ton of curl chip	0.39	10,000 yen/ton
Production cost of 1 kg of curl chip	3.9	yen/kg

1 dong = 0.005 yen as of January 14, 2021

ii Scenario of Rice Husk is paid for

1. Prerequisites

Item		Quantity	Unit	Remarks
1)	Purchase of TRM-200CR Grind Mill	270	10,000 yen	CR model 2.5 million yen + 200,000 yen transportation fee included
2)	Cost of constructing electrical equipment installation structure	0	10,000 yen	Assumed to be installed in an existing building.
	Total equipment cost (2.5 million yen + 200,000 yen)	270	10,000 yen	
3)	Depreciation and amortization (2.7 million yen / 7)	39	10,000 yen	Equal amortization over 7 years.
4)	Months of curl chip production	12	months	
5)	Consumable parts (per 1920 hours)	68.4	10,000 yen / 1920h	8h x 20 days x 12 months = 1920h
6)	Labor cost for production (12-month operation)	30.0	10,000 yen / 12 months	25,000/month refer to Thanh Tin Rice Mill labor cost
7)	Amount of electricity used (for 12 months)	57,600	kwh/12 months	30kw×1920h=57,600kwh
8)	Electricity Bill (for 12 months)	40.9	10,000 yen / 12 months	7.8 yen/kWh Referred from Thanh Thin Rice Mill's electricity rates (normal unit price is applied)
9)	Curl chip production rate (1 hour operation)	240	kg/h	Assumed 240 kg/h.
10)	Curl chip production (12 months 1920 hours operation)	460.8	t/1920h	12-month production volume

2. Production Cost Estimate

Item	Cost	Unit	Remarks
Rice Husk procurement cost	92.2	10,000 yen	Assume rice husk is procured at 2.0yen/kg (400 dong/kg)
Depreciation of Grind Mill equipment	39	10,000 yen	2.7 million ÷ 7
Labor cost (for 12 months)	30	10,000 yen	25,000 yen per month x 12 months
Electricity charges (for 12 months)	40.9	10,000 yen	7.8 yen/kWh Referred from Thanh Thin Rice Mill's electricity rates (normal unit price is applied)

Cost of consumables	68.4	10,000 yen	Parts unit price x 1920h
Total	274.1	10,000 yen	

3. Production cost per Ton of Briquette

Item	Quantity	Unit
Curl chip production volume	460.8	t
Production cost of 460.8 tons of curl chips	274.1	10,000 yen
Production cost of 1 ton of curl chips	0.59	10,000 yen/ton
Production cost of 1 kg of curl chips	5.9	Yen/kg

1 dong = 0.005 yen as of January 14, 2022

If one TRM-200CR is installed in Thanh Tin rice mill, the cost of production will be 3.9 yen (780VND)/kg if the price of rice husk is not set. On the other hand, if the price is set for the husk, the production cost will be 5.9 yen (1,180VND)/kg.

(2) Transportation cost of rice husk solid fuel

In the case of using rice husk solid fuel (curl chips) as a substitute for coal by the coal boiler users, the transportation cost from Thanh Tin Rice Mill to each user should be included. Based on the results of the field interview survey, the cost of transportation to each coal boiler user is as follows

Table 21 Cost of Transporting Curl Chips to Each Coal Boiler User Company

	MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)
Transportation expenses VND(JPY)/kg	435 (2.18)	337.5(1.69)	287.5(1.44)
Means of transport Land transportation or canal	Canal + Land Transportation	Canal + Land Transportation	Canal + Land Transportation
Transport distance km	340	250	275
Maximum amount of coal that can be replaced (t/year)	250	12,000	30,000

(3) Cost calculation when rice husk solid fuel is used instead of coal

Including the transport costs of Table 21, the following table shows a simulation of the case where each

company replaces coal with rice husk solid fuel (curl chips).

Table 22 Simulation of Substituting Coal for Curl Chip

Item	Unit	MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)
Purchase price of curl chip (when rice husks are free)	VND/kg	1,220	1,120	1,080
Curl chip purchase price (when rice husks are paid for)	VND/kg	1,620	1,520	1,480
Purchase price of curl chip (when rice husks are free)	Yen/kg	6.1	5.6	5.4
Curl chip purchase price (when rice husks are paid for)	Yen/kg	8.1	7.6	7.4
Amount of required rice husk solid fuel	t/year	420	17,838	36,486
Annual cost of purchasing curl chips (when rice husks are free)	VND/year	512,400,000	19,978,560,000	39,404,880,000
	JPY/year	2,568,421	100,143,158	197,518,195
Annual cost of purchasing curl chips (when rice husks are paid for)	VND/year	680,400,000	27,113,760,000	53,999,280,000
	JPY/year	3,410,526	135,908,571	270,673,083

1JPY=199.5VND (as of January 14, 2022)

The purchase price of curl chips is set based on the manufacturing cost.

If the coal user replaces coal they are currently using with curl chips, the cost of the raw material – rice husks – would be between 4.9 yen (978VND) ～ 5.2 yen (1,037VND)/kg per kilogram, and if the rice husks are paid for, the cost would be between 6.9 yen(1,377VND)～7.2 yen (1,436VND) per kilogram.

(4) Calories of coal used by coal boiler users

According to the results of the survey, the caloric value of the coal used is 6,200 kcal/kg for MTV, 5,500 kcal/kg for AGTEX28, and 4,500 kcal/kg for CJ Agri, respectively, so it can be inferred from the Table 23 that powdered coal 4a, 5a and 6a are used, respectively.

Table 23 Coal Quality Used (estimated from grades of the coal)

Business	Grade	Ash content (%)	Moisture (%)	Volatile matter (%)	Sulfur content (%)	calorific value (kcal/kg)
MTV	4a	21.00	8.00	6.50	0.65	6,400
AGTEX28	5a	29.00	8.00	6.50	0.65	5,600
CJ Agri	6a	37.5	8.00	6.50	0.65	4,800

AGTEX28 and CJ Agri are storing coal in roofed warehouses and have already established a system to accept curl chips on a regular basis when they replace coal with curl chips. In addition, AGTEX28 disposes of combustion ash for a fee of 2,500 yen/t, but curl chips have less than half the ash content of coal, so the disposal cost is expected to be reduced.

(5) Possibility of using rice husk solid fuel with coal boilers

The MTV's Produce-drying plant can use it as is, but the impact of fuel conversion would be small due to its low usage. The boilers of AGTEX28 are all stoker-fired and use coal with a particle size of about 3 mm or less, which can be used in the same way as coal without the need for pre-processing, including the shredding of curl chips. The boiler structure used by CJ Agri is a natural circulation boiler that combines an external combustion chamber and a water tube boiler, and the coal boiler uses the gas generated by burning coal in a moving bed stoker furnace to generate water tube boiler saturated steam. Recently, rice husk solidified fuel (in the form of small pellets) is fed into the furnace using a rice husk pellet feed conveyor only when the price of coal, the main fuel, rises, so there is no need to introduce new equipment to replace curly chips. However, since rice husk contain a large amount of silicic acid, which is essential for the healthy growth of rice, when they are burned in a boiler, a mass of crystalline silica called clinker is formed in the combustion furnace of the boiler, and this must be taken into consideration. In the case of a stoker type boiler, it is necessary to take care of the high temperature inside the furnace due to excessive combustion, to protect the walls of the combustion furnace with refractory materials or linings, and to prevent blowing through the grate or, conversely, blockage.

(6) Possibility of fuel replacement by rice husk solid fuel

From the results of the survey on coal use, it can be seen that the entire surveyed companies can use curl chips by using their existing facilities as they are, which does not involve any new capital investment and there are few technical obstacles to coal substitution. Therefore, we estimate the cost incurred when using coal and the cost incurred when using curl chips for all coal users surveyed.

Table 24: Cost Estimate of Using Curl Chips to Each Coal User

			MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)	Remarks
coal	Coal consumption	t/year	250	12,000	29,500	
	Coal calorific value	kcal/kg	6,200	5,500	4,500	
	coal price	VND/kg	5,150	1,200	2,000	
		JPY/kg	25.8	6.0	10.0	

	Annual coal purchase cost	VND/year	1,287,500,000	14,400,000,000	59,000,000,000	
		JPY/year	6,453,634	72,180,451	295,739,348	
	Boiler maintenance costs	VND/year	0	2,970,000,000	0	
		JPY/year	0	14,887,218	0	
	Annual running costs when using coal	VND/year	1,287,500,000	17,370,000,000	59,000,000,000	
		JPY/year	6,453,634	87,067,669	295,739,348	
curl chip	Amount of curl chip used	t/year	419	17,838	35,878	
	Curl chip heat value	kcal/kg	3,700	3,700	3,700	
	Curl chip unit price	VND/kg	1,220	1,120	1,080	When Rice Husk is free
		JPY/kg	6.1	5.6	5.4	
		VND/kg	1,620	1,520	1,480	When Rice Husk is free
		JPY/kg	8.1	7.6	7.4	
	Annual curl chip purchase fee	VND/year	511,180,000	19,978,378,378	38,748,648,649	When Rice Husk is free
		JPY/year	2,562,306	100,142,248	194,228,815	
		VND/year	678,780,000	27,113,513,514	53,100,000,000	When Rice Husk is free
		JPY/year	3,402,406	135,907,336	266,165,414	
	Boiler maintenance costs	VND/year	0	1,485,000,000	0	
		JPY/year	0	7,443,609	0	Since the amount of ash is halved, estimated as 50% of coal boiler maintenance cost
	Annual running costs when using curl chips	VND/year	511,180,000	21,463,378,378	38,748,648,649	When Rice Husk is free
		JPY/year	2,562,306	107,585,857	194,228,815	
		VND/year	678,780,000	28,598,513,514	53,100,000,000	When
		JPY/year	3,402,406	143,350,945	266,165,414	

						Rice Husk is free

In addition, the following table shows the cost savings if the users were to replace all coal use with curl chips.

Table 25: Fuel cost savings when curl chip is used by MTV, AGTEX28, and CJ Agri Vietnam

			MTV (dried produce)	AGTEX28 (cloth dyeing)	CJ Agri Vietnam (feed manufacturing)	Remarks
Comparison	Cost savings achieved by switching from coal to curl chips as boiler fuel.	VND/year	776,320,000	-4,093,378,378	20,251,351,351	When Rice Husk is free
		JPY/year	3,891,328	-20,518,187	101,510,533	
		VND/year	608,720,000	-11,228,513,514	5,900,000,000	When Rice Husk is paid for
		JPY/year	3,051,228	-56,283,276	29,573,935	
	Percentage reduction in annualized cost of using curl chips compared to annualized cost of using coal.	percentage	60.3	-23.6	34.3	When Rice Husk is free
		percentage	47.3	-64.6	10.0%.	Hulled rice paid for

Therefore, the cost savings will vary depending on whether the rice husk is priced free of charge or paid for, but MTV is expected to save 3,051,228yen (608,720,000VND) ~ 3,891,328 yen (776,320,000VND) per year, which is 47.3% ~ 60.3% of the cost of using coal. In addition, CJ Agri is expected to save 29,573,935yen (5,900,000,000VND) ~ 101,510,533yen (20,251,351,351VND) per year, which is 10.0% ~ 34.3% of the coal consumption. On the other hand, when AGTEX28 substituted coal with curl chips, the cost increased by 23.6%~64.6% compared to the annual cost incurred when using coal. This is mainly due to the extremely low unit cost of coal procurement for AGETEX28. Therefore, with the exception of AGTEX28, we believe that MTV and CJ Agri have a high potential for substituting curl chips. The feasibility of this project will be further enhanced if it is possible to (1) ensure the profitability of the rice mills while securing expected profits of rice mills from which the curl chips will be sold and (2) ensure the economic advantage of the users to whom the chips will be purchased compared to the use of coal. The survey on the above two points could not be conducted this year due to the many restrictions such as, travel restrictions to the site and cross-province travel caused by COVID-19; continuous survey for next year is being planned.

(7) CO2 reduction and cost effectiveness (solar power generation system)

i Overview

The GHG emission reductions associated with fuel switching at existing manufacturers (non-energy applications) were evaluated. The project focused on the fuel switching from coal to rice husk-derived curl chips. As a result of the study on the "potential of curl chips as an alternative fuel" in Soc Trang Province, it was suggested that producing curl chips at Thanh Tin Rice Mill and utilizing the curl chips as an alternative fuel for boiler at two corporations, namely, CJ Agri Vietnam and MTV was suggested to be feasible. In this section, GHG emission reduction potentials and Cost-effectiveness were evaluated for the following two cases:

1) All coal used at CJ Agri Vietnam is switched to curl chips supplied by Thanh Tin Rice Mill
2) All coal used at MTV is switched to curl chips supplied by Thanh Tin Rice Mill

ii MRV methodology

The CDM methodology “AMS-III.AS.: Switch from fossil fuel to biomass in existing manufacturing facilities for non-energy applications (Version 2.0)” was referred to as an MRV methodology. The methodology is applicable to complete or partial fuel switching projects (Figure 58).

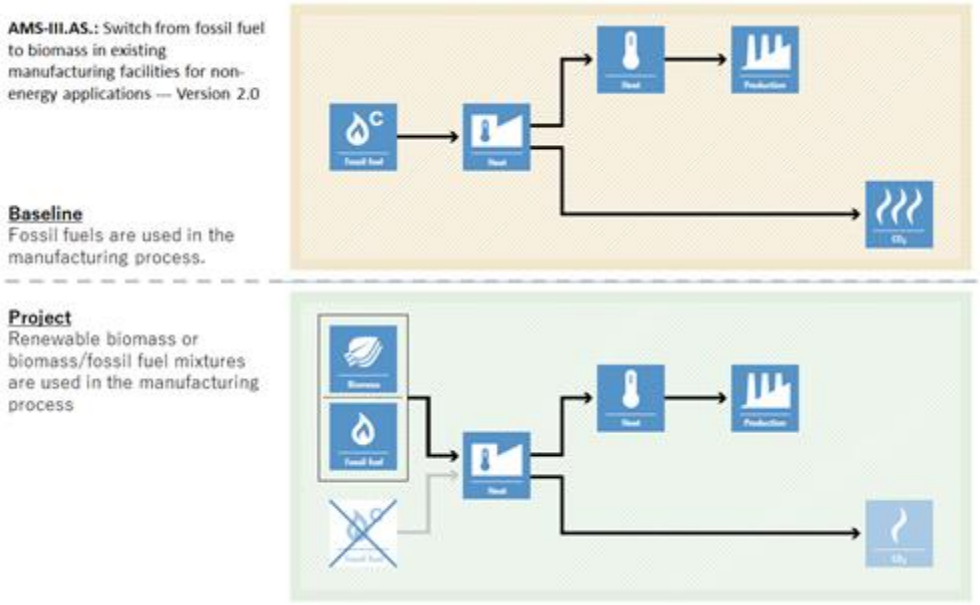


Figure 58 Image of a fuel switching project subject to CDM methodology AMS-III.AS.
Source: UNFCCC “CDM Methodology Booklet - Eleventh edition”, Nov. 2019.

The eligibility requirements (applicability) of the project is as follows. The project under consideration was assumed to meet all the requirements.

<Applicability>

(a) The baseline fossil fuel and the project biomass are consumed in thermal energy conversion equipment (e.g. furnaces, kilns, dryers) that are used in the manufacture of products (e.g. steel, ceramics, aluminium, lime, clinker). This is referred to as an element process in this methodology;

(b) It shall be demonstrated, with historical data, that at least for the immediate prior three years to the start date of project, only fossil fuels (no renewable biomass) were used in the production systems, which are being modified, retrofitted or replaced. In cases where small quantities of biomass were used for experimental purposes then this can be excluded;

(c) Regulations do not restrict the use of the baseline fossil fuel or require the use of project biomass and low carbon energy sources unless widespread noncompliance (less than 50 per cent of manufacturing production activities comply in the country) of the local regulation is evidenced;

(d) The production process where the fuel switch takes place shall have a distinct energy input (i.e. specific fuels) and distinct output (i.e. intermediate or finished product). The output of each element process shall be an output for which an appropriate international/national standard or industrial norm exists;

(e) This methodology is not applicable to project activities where primary output of the processes is energy (e.g. heat, electricity) that can be directly measured;

(f) The product(s) (e.g. ceramic insulators, tiles, steel ingots, lime, aluminium cookware) produced in the industrial facility throughout the crediting period shall be equivalent to the product(s) produced in the baseline. For the purposes of this methodology, equivalent products are defined as products having the same use, the same general physical properties, and which function in a similar manner. In addition, products produced in the industrial facility throughout the crediting period shall provide the same level of service, or better, and be of the same level of quality, or better than the product(s) produced in the baseline. When national or international product standards apply to the product(s), product quality shall be as defined in such standards, otherwise the relevant industrial norms are to be followed;

(g) The type of input materials used in the project shall be homogeneous and similar to the input material that was used in the baseline and any deviation during the crediting period of input material type, composition, or amount used per unit of product output shall be within the range of ±15 per cent of the baseline characteristics and values;

(h) The facilities involving modification, retrofit and/or replacement shall not influence the production capacity beyond ±15 per cent of the baseline capacity.

iii Project boundary

The project boundary is generally assumed to be a physical, geographical site where the switching of energy sources takes place. It includes all installations, processes or equipment affected by the fuel switching.

In the project under consideration, CO2 emissions from electricity consumption for curl chip production from rice husks and fuel consumption for transporting curl chips in a project scenario were the subject of estimation; while, in the reference scenario, CO2 emissions from electricity consumption for briquette production from rice husks and fuel consumption for transporting briquettes were not accounted for in order

to ensure conservativeness.

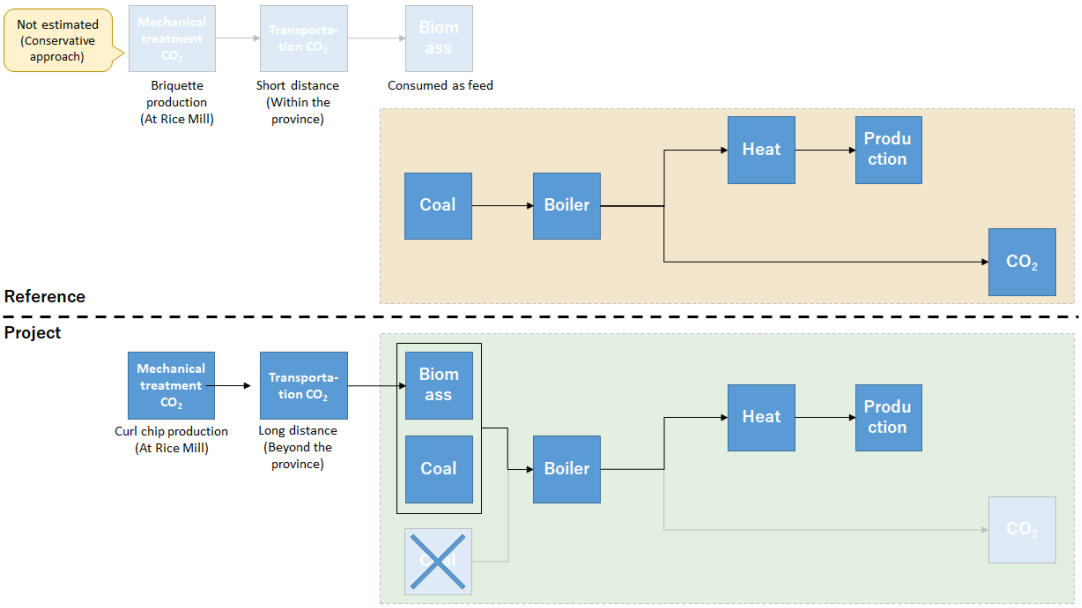


Figure 59 Boundary of the project

Table 26 GHGs and emission sources subject to estimation

	Emission source	GHG	Subject of estimation	Note
Reference	Coal consumption at boiler	CO_2	Yes	Emission source
		CH_4,N_2O	No	Negligible. Excluded for the sake of conservativeness.
	Electricity consumption for boiler	CO_2	No	Excluded for the sake of conservativeness, assuming that it is consumed only by limited equipment.
	Electricity consumption for biomass production	CO_2	No	Excluded for the sake of conservativeness
	Fuel consumption for biomass transportation	CO_2,CH_4,N_2O	No	Excluded for the sake of conservativeness
	Decomposition by biomass dumping	CO_2,CH_4,N_2O	No	Consumed as animal feed. Not applicable.
Project	Coal consumption at boiler	CO_2	Yes	Emission source
		CH_4,N_2O	No	Negligible. Excluded for the sake of simplicity.
	Biomass consumption at boiler	CO_2	No	Carbon neutral
		CH_4, N_2O	No	Negligible. Excluded for the sake of simplicity.
	Electricity consumption for boiler	CO_2	No	Excluded for the sake of simplicity, assuming that it is consumed only by limited equipment.
	Electricity consumption for biomass production	CO_2	Yes	Emission source

	Fuel consumption for biomass transportation	CO_2	Yes	Emission source
		CH_4,N_2O	No	Negligible. Excluded for the sake of simplicity.
	Biomass storage	CO_2	No	Carbon neutral
		CH_4,N_2O	No	Excluded for the sake of simplicity, assuming that it is not stored for more than one year and that the amount generated is small.

iv Formula for estimating GHG emission reduction amount and the results

GHG emission reductions at CJ Agri Vietnam and MTV were calculated using the following formula. Assuming that both companies switched all of their coal with curl chips, CJ Agri Vietnam and MTV were expected to reduce their CO_2 emissions by about 48000 tonnes and 560 tonnes per year, respectively.

$ER = E_{Reference} - E_{Project}$

ER:	GHG emission reduction amount (t CO_2 eq./y)
$E_{Reference}$:	GHG emissions for the reference scenario (t CO_2 eq./y)
$E_{Project}$:	GHG emissions for the project scenario (t CO_2 eq./y)

GHG emissions for the reference scenario

$E_{Reference} = M_{Coal} * NCV_{Coal} * EF_{Coal}$

$E_{Reference}$:	GHG emissions for the reference scenario (t CO_2 eq./y)	
M_{Coal}:	Consumption amount of coal (t/y)	Measured value
NCV_{Coal}:	Calorific value for coal (GJ/t)	Measured value
EF_{Coal}:	Emission factor for coal (t CO_2/GJ)	IPCC default value for coal: 94.6 kgCO_2/GJ

GHG emissions for the project scenario

$E_{Project} = (M_{Coal} * NCV_{Coal} * EF_{Coal}) + (M_{Electricity} * EF_{Electricity}) + (M_{Transport} * EF_{Transport})$

$E_{Project}$:	GHG emissions for the project scenario (t CO_2 eq./y)	
M_{Coal}:	Consumption amount of coal (t/y)	Subject of monitoring Note: Zero if fully substituted.
NCV_{Coal}:	Calorific value for coal (GJ/t)	Same as for the reference scenario
EF_{Coal}:	Emission factor for coal (t CO_2/GJ)	Same as for the reference scenario
$M_{Electricity}$:	Electricity consumption for curl chip production (kWh/y)	Subject of monitoring
$EF_{Electricity}$:	Emission factor for electricity (kgCO_2/kWh)	Data for Viet Nam: 0.9130 kgCO_2/kWh
$M_{Transport}$:	Fuel consumption for biomass transportation (L/y)	Subject of monitoring (It can be estimated based on transportation distance, maximum loading capacity of trucks, and fuel consumption. In this case, the

		transportation distance is the subject of monitoring.)
ρ	Fuel density (kg/L)	Diesel: 0.85 kg/L (source: Science Direct)
$EF_{Transport}$:	Emission factor for fuel ($kgCO_2/GJ$)	IPCC default value for diesel: 74.1 $kgCO_2/GJ$

v Cost-effectiveness

The estimation results of cost-effectiveness for the case where the entire amount of coal used at CJ Agri Vietnam and MTV were replaced by curl chips are shown in Table 2. According to the guidelines for submitting proposals of JCM Model Project, it states that the Cost-effectiveness of financial support necessary to reduce 1 tonne of GHG emissions should be 4,000 JPY/tCO2eq or lower. It was confirmed that if the minimum subsidy rate (30%) was applied, the Cost-effectiveness would be 190-250 yen/tCO2, which is far less than 4,000 yen/tCO2.

Table 27 Cost effectiveness

Item	CJ Agri Vietnam	MTV	Note
Number of equipment installed	78	1	Curl chip producing equipment
Initial cost (Yen) (1)	210.6 Million	2.7 Million	2.7 Million Yen/Equipment
Product lifetime (y)	7	7	For "Agricultural Equipment" in the Ministerial Ordinance concerning the Useful Life, etc. of Depreciable Assets
GHG emission reduction amount (tCO_2) (2)	340,000	3,900	Performance for the entire period of product lifetime
Cost-effectiveness (Yen/tCO_2)	620	690	(1)/(2) Note: No subsidy is considered.
Cost-effectiveness (Yen/tCO_2)	190	210	Subsidy/(2) Note: Formula for the JCM Model Project is used. Subsidy rate at 30% is assumed.

vi Implementation system for monitoring

The parameters shown in Table 28 needs to be monitored when implementing the project. The monitoring implementers are also indicated in the table. When applying for the JCM Model Project, MRV reporting is required for the period of legal product lifetime for the installed equipment, so the implementation system for MRV needs to be established. A possible implementation system is shown in Figure 60. Although most of the data can be obtained at the rice mill factory, the data related to fuel consumption for biomass transportation in the project scenario needs to be obtained from the transporters. In order to do so, it is necessary to coordinate with other parties involved in the project, such as by signing cooperation agreements in advance.

In this report, it was assumed that all coal would be replaced by curl chips; however, in the case of partial switching (mixed firing), coal consumption amount should also be a subject to monitoring. In this case, it would be necessary to obtain cooperation from boiler user companies.

Table 28 Monitoring parameters

Parameter	Monitoring implementer
Amount of coal consumed (t/y)	Recorded by the curl chip manufacturer (CJ Agri Vietnam, MTV).
Amount of curl chip supplied (t/y)	Note: Monitoring is not required if the entire amount of coal is replaced.
Electricity consumption for curl chip production (kWh/y)	Recorded by the curl chip manufacturer (Thanh Tin Rice Mill).
Fuel consumption for transportation (L/y), or transportation distance (km/y)	Recorded by the curl chip manufacturer (Thanh Tin Rice Mill).

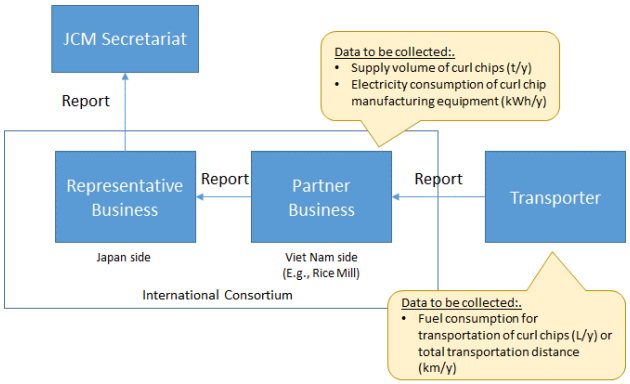


Figure 60 Draft implementation system for monitoring

vii Further considerations

Data needs to be updated as necessary when there are changes in the project content.

5. Survey on energy creation and energy saving projects by introducing solar power generation systems and BEMS

A feasibility study was conducted through a local expert to investigate the feasibility of introducing a photovoltaic power generation system and BEMS (Building Management System) to the site, which would be developed by Hirokawa Enath Co., Ltd., a company in Hiroshima Prefecture.

5.1. Technologies / products proposed

(1) Solar power generation systems

The photovoltaic power generation system to be introduced is basically for in-house consumption in factories, etc., but surplus power will be generated during non-operating hours such as nighttime, Saturdays, and Sundays. Depending on the handling of the surplus power, the output setting of the solar power generation system is an issue to be considered. In addition, there are restrictions on where the solar panels can be installed depending on the amount of power generated. Possible locations for the installation of solar power generation equipment include vacant lots on the premises, factory roofs, and building rooftops.

Fixed mounts are often used as panel mounting mounts for solar power generation equipment installed on the ground. Fixed mounts are installed at the optimal tilt angle determined for each installation site, with the panels facing almost due south to receive the most energy from the sun, but because they are fixed, high power output can be expected from around 11:00 a.m. to 2:00 p.m., but during the rest of the day. However, during other times of the day, due to the angle of the sun, the amount of energy that the panels can receive decreases, and therefore, a large amount of power generation cannot be expected.

Recently, in order to receive more energy from the sun, there are two types of solar panels: the "single-axis" type that tracks east to west, with the panels facing east at sunrise and moving with the movement of the sun, and the "single-axis" type that faces west at sunset. In addition to the "single-axis" type that tracks east-west, the "two-axis" type that tracks all directions (east-west, north-south, and south-south) by changing the tilt angle of the panels as the seasons change is gradually being adopted for solar power generation facilities. These tracking mounts are said to increase the total annual power generation by about 1.2 to 1.5 times compared to fixed mounts under the same conditions. On the other hand, the disadvantage is that the installation cost increases.

Since the latitude of Vietnam is not very high, we considered installing a single-axis tracking rack that tracks east to west in addition to the fixed rack (Figure 61).

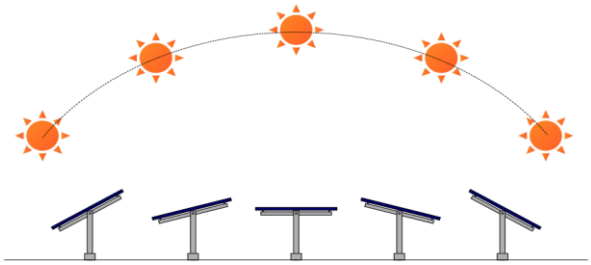


Figure 61 Single-axis tracking rack

As the novel coronavirus pandemic continued this year, it was extremely difficult for the local collaborators to enter the Soc Trang Province and to obtain cooperation from the survey sites themselves. Therefore, although it was difficult to make optimal studies and proposals at a stage when field confirmation and information collection were insufficient, we prepared a solar panel layout plan with 720 kW solar panels installed on the ground and on the roof (Figure 62).
In addition, the materials and equipment to be provided to the site include solar panels (which can be procured locally), solar panel mounts, power conditioners, and interconnection equipment. For the installation, it is assumed that a local construction company will be used to provide technical guidance.

Regulations on the Incentive Mechanisms for Photovoltaic Power Generation in Vietnam (Summary)" and "Regulations on the Development of Photovoltaic Power Generation Projects and the Format of Power Purchase Agreements (Summary)" are attached at the end of this document.

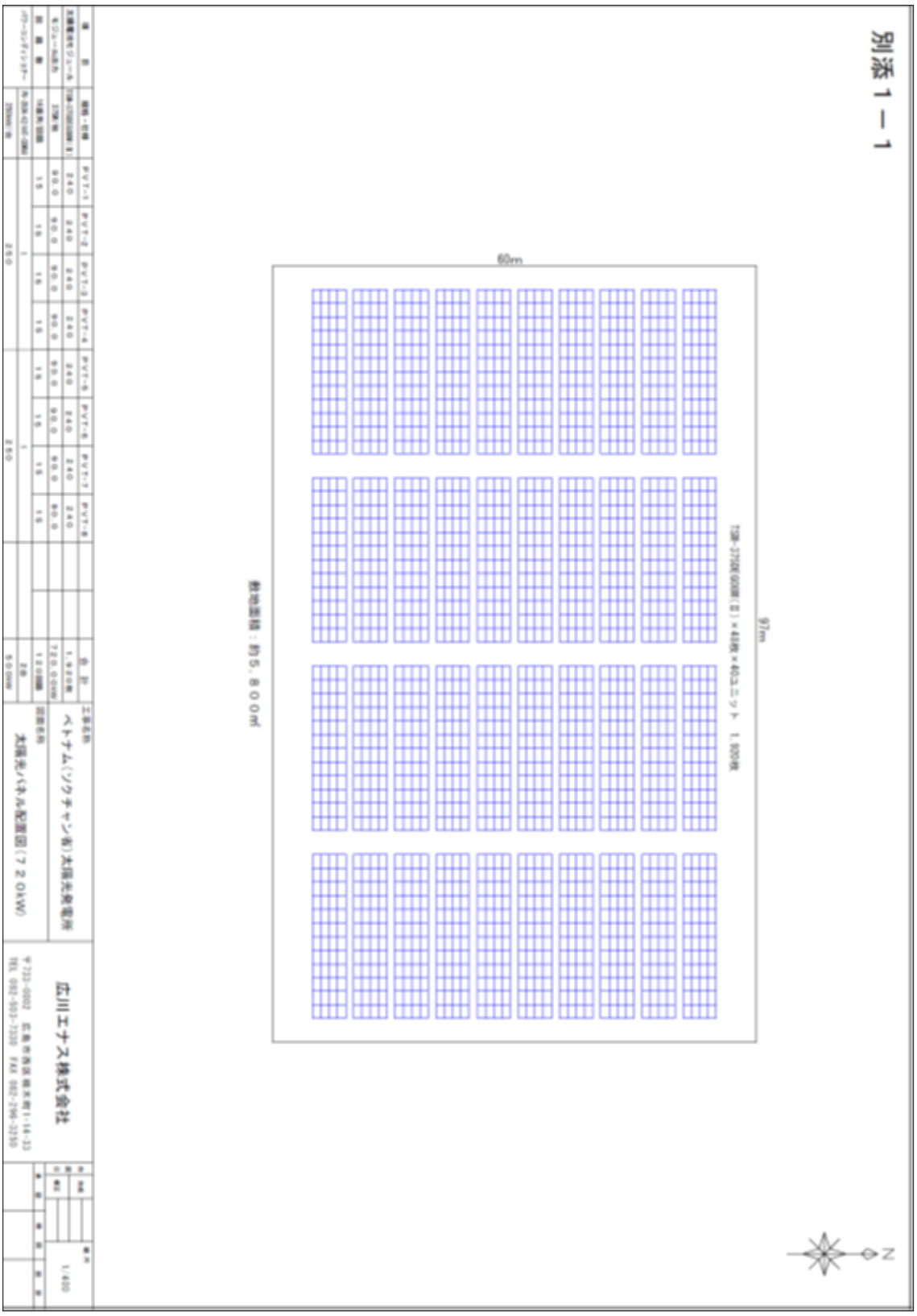


Figure 62 Layout of the solar power generation system (720kW)

(2) BEMS

A system for managing energy is called an EMS (Energy Management System), but for commercial facilities and other buildings it is called a BEMS (Building Energy Management System). BEMS is a system that reduces energy consumption by efficiently managing the operation of equipment and facilities in buildings. BEMS is a system that reduces energy consumption by efficiently managing the operation of equipment and facilities in a building. It uses methods such as demand control, automatic pattern control, and alarm functions to reduce energy consumption.

The BEMS (Building Energy Management System) proposed in this study is an energy-saving system based on the output control of air conditioning that has been installed at Hirokawa Enath Co., Ltd. This is a system in which temperature sensors are installed in each room and the output of the outdoor units is controlled in order to adjust the temperature optimally and reduce the amount of electricity used. Specifically, we are planning to introduce the PN-XERO series from Palcosmo Co., Ltd (Nagano Prefecture).

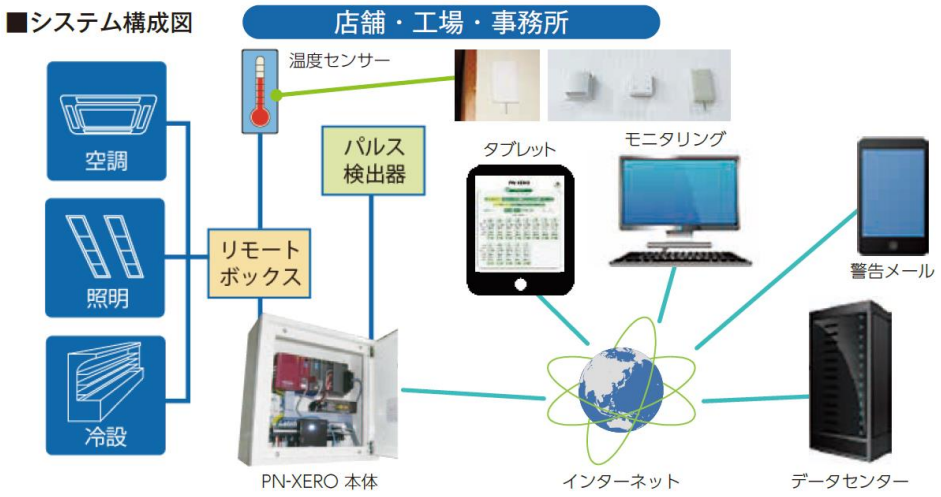


Figure 63 PN-XERO System configuration diagram of the series

Source: Palcosmo Co., Ltd website.

Figure 64 System configuration example for BEMS air conditioning controlFigure 64 shows an example of a system configuration for air conditioning control.

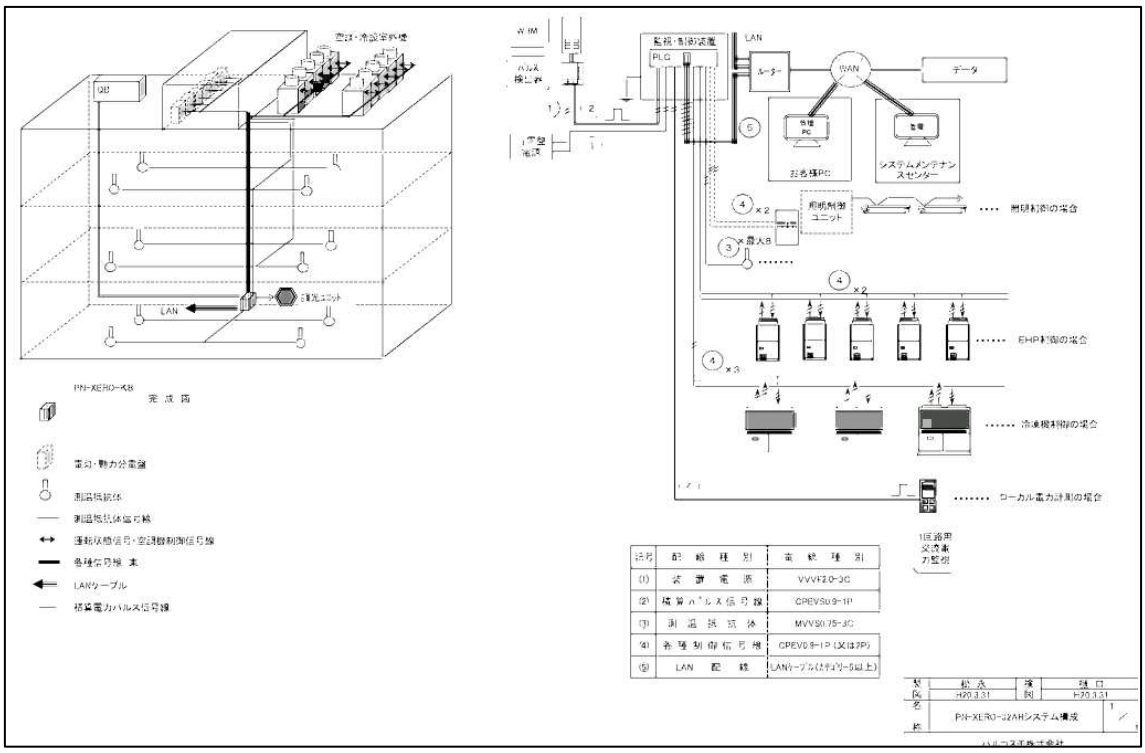


Figure 64 System configuration example for BEMS air conditioning control
Source: Palcosmo Co., Ltd

This system has a track record of several thousand cases in Japan, and has been successful in saving energy and reducing costs.

The output control of the air conditioners is managed and controlled centrally by the equipment manufacturer (Japan), so data communication between Vietnam and Japan via the Internet is necessary.

Basically, the models that can be controlled by this system are those manufactured after 2000, but a detailed field survey is needed to confirm this.

Last year's survey revealed that SOC TRANG HOSPITAL has an annual electricity bill of about 45 million yen. If we assume that 50% of the electricity is used for air conditioning, the total cost will be 22.5 million yen, and if we assume that BEMS will reduce the electricity bill by 10%, we will be able to save 2.25 million yen per year, and if we assume that the cost of BEMS equipment will be 10 million yen, we will be able to recover the cost within 5 years.

This year, we sent questionnaires to SOC TRANG HOSPITAL to request a detailed survey of air conditioning equipment, etc. However, we were unable to conduct the survey this year due to the fact that they are extremely busy due to their response to the new coronavirus epidemic and basically refuse to accept visits from outside.

SAOTA FOODS (a fish processing company), which was able to cooperate in the energy survey, does not use air conditioning in the shrimp ponds, but uses air conditioning in the entire processing plant (50 units of GUNTNER 3kW). However, because the processed marine products are affected by the temperature

fluctuations of the air conditioners, the company would like to postpone considering the introduction of BEMS. For this reason, carrying out a study on the introduction of BEMS was not possible this year.

5.2. Survey on energy intensive businesses in Soc Trang Province

A survey was conducted on two energy-intensive businesses in Soc Trang Province. The two companies surveyed were SAOTA FOODS (a seafood processing company) and Thanh Tin Rice Mill. Both companies are interested in installing solar power generation systems, and although further field surveys are needed to finalize the detailed capacity, based on their land holdings and operating load capacity, there is a possibility of installing a 720kW solar power generation system.

Table 29 Companies with the potential to introduce solar power generation systems and BEMS

	SAOTA FOODS	Thanh Tin
Business Type	Fishery processing industry	Rice milling
Service System	7:00～17:00 24 days/month	7:00 ～ 17:00 (other than Saturday, Sunday, national holidays)
Commercial Air Conditioner	GUNTNER 3kW×50	None
Electricity consumption (2021)	21,603MWh ／ Year (excluding December 2021)	16,200MWh／Year
Electricity bill (2021)	40,141,669,860VND(excluding December 2021)	24, 000, 000, 000VND
Interest in introduction of PV system	Interested	Interested
Availability of land, etc.	6,000 ㎡	Depends on future plans for new factory construction
Assumed scale of introduction	Approx. 720 kW	Approx. 720 kW

Source: Prepared by E-Square based on field survey results.

5.3. Potential of adopting the project

(1) Profitability (SAOTA FOODS)

i Solar power generation facility output

The results of the survey showed that the power usage was divided among several aquaculture ponds, and that the fluctuations in usage were large in some areas. Therefore, the model for the installation of the photovoltaic power generation equipment was set at an area with a certain amount of usage and relatively small fluctuations (average monthly usage: 250,000 kWh/month).

The power output was set at 500 kW, which is equivalent to approximately 50% of the average hourly usage, where reverse power flow is unlikely to occur[7].

ii Percentage of usage by time of day

The annual power generation by the photovoltaic power generation facilities is assumed to be 1.2 million kWh/year, 15% of which is consumed during peak hours, and the remaining 85% during normal hours.

iii Purchased Electricity

Business feasibility was examined for purchased electricity at the aquaculture farm at a peak hourly rate of 2,871 VTD/kWh (13.0 yen/kWh) and a normal hourly rate of 1,555 VTD/kWh (= 7.1 yen/kWh).

iv Construction cost of solar power generation facilities

The installation cost of a 500 kW solar power generation facility (panel output of 720 kW) shall be 10,000,000 yen, reflecting the standard construction price obtained from a local construction company.

v Simplified payback period

The amount equivalent to the cost of purchased electricity for in-house power consumption is

Peak hour: 1.2 million kWh/year x 0.15 x 13.0 yen/kWh = 2.34 million yen/year

Normal time: 1.2 million kWh/year x 0.85 x 7.1 yen/kWh = 7.24 million yen/year

and the annual amount is 9.58 million yen (2.34 million yen + 7.24 million yen).

The payback period for the construction cost, not considering maintenance and management costs, interest rates, etc., would be 10 million yen / 9.58 million yen=10 years.

Additional research into maintenance costs, interest rates, etc. is needed, but the business feasibility of the project is considered to be challenging. If subsidies and other public supports are available for the installation of solar power generation facilities, the payback period for construction costs can be expected to be shortened.

(2) Profitability (Thanh Tin)

i Solar power generation facility output

As a result of the survey, the operation of the rice mill is divided into a high operation period (2,000 MWh/month) and a low operation period (700 MWh/month). Therefore, the average hourly electricity consumption, considered at a rate that takes into account the operating days (302/365 days) and operating hours (7:30-11:30 and 12:00-15:00) of the rice mill in the low operation period is 3,900 kWh/h[8].

ii Photovoltaic facility output determined from site area

If the photovoltaic power generation facility is to be installed on the site of a rice mill expansion at the detached site, and 25% equivalent (6,000 m2) is to be utilized because there are plans to construct a warehouse, the photovoltaic power generation facility will have an output of 500 kW (approximately 5,800 m2) based on the site area, and the photovoltaic power generation facility output will be 500 kW.

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[7] Time period when solar power can be generated 7:00-17:00 (10hr) 250,000 x 0.5/(31 days x 10hr) = 400kW ⇒ 500kW

[8] 700,000/(7hr×31 日×302/365)≒3,900kWh/h

iii Own consumption rate and surplus electricity sales rate

The electricity generated is mainly used for own consumption, and surplus electricity is sold when in-house consumption is low, such as on holidays. The annual power generation of 1.2 million kWh/year from the photovoltaic power generation facilities is allocated as 80% for in-house consumption (based on the same operating day rate as that of the rice mill) and 20% for surplus electricity sales.

iv Purchased electricity and surplus electricity sales charges

The ratio of peak and normal rates to own consumption is 15% during peak hours (15% is considered to be the time when solar power generation is possible, from 7:00 to 17:00, taking into account the time and day of the week when peak hour electricity rates are applied), and the remaining 85% during normal hours.

The electricity rate is 2,871 VTD/kWh (13.0 yen/kWh) for peak hours, 1,555 VTD/kWh (=7.1 yen/kWh) for normal hours, and 1,644 VTD/kWh (=7.5 yen/kWh) for surplus electricity sales.

v Construction cost of solar power generation facilities

The installation cost of a 500 kW solar power generation facility (panel output of 720 kW) shall be 10,000,000 yen, reflecting the standard construction price obtained from a local construction company.

vi Simplified payback period

The equivalent cost of purchased electricity for own consumption is

Peak hour: 1.2 million kWh/year x 0.8 x 0.15 x 13 yen/kWh = 1.87 million yen/year

Normal time: 1.2 million kWh/year x 0.8 x 0.85 x 7.1 yen/kWh = 5.79 million yen/year

The amount of surplus electricity sales income is: 1.2 million kWh/year x 0.2 x 7.5 yen/kWh = 1.8 million yen/year.

The projected annual income would be 9.46 million yen (1.87 million yen + 579 yen + 1.8 million yen).

The construction cost payback period without considering maintenance and management costs, interest rates, etc., is 10 million yen/9.46 million yen ≈ 11 years.

Although additional research on maintenance and management costs, interest rates, etc. is necessary, the business feasibility of the project is considered to be severe. If subsidies and other public support can be used to install solar power generation facilities, the payback period for construction costs can be expected to be shortened.

(3) CO2 reduction and cost effectiveness (solar power generation system)

i Overview

The GHG emission reductions associated with the installation of a solar power generation system and a building energy management system (BEMS) in Soc Trang Province are evaluated.

The GHG emission reduction potentials and cost-effectiveness were evaluated for the installation of a solar power generation system in the rice mill company and/or the shrimp farming company. The results of the survey suggested that it was difficult to install solar power generation systems in a rice mill company and/or a shrimp farming company as a JCM model project.

The project to install BEMS in SOC TRANG HOSPITAL, which was continuing survey from last year, was

out of scope for this fiscal year, as it was difficult to obtain the cooperation from the hospital due to the spread of COVID-19 infection in Soc Trang Province.

ii MRV methodology

The GHG emission reductions associated with the installation of a 500 kW solar PV system (720 kW output) to substitute grid electricity and self-generated electricity. For the rice mill company, a scenario of 80% self-consumption and 20% surplus electricity sales was assumed. The shrimp farming company was assumed to be 100% self-consumption. The MRV methodology “VN_AM007: Installation of Solar PV System (Version 1.0)”, which was approved by the JCM Joint Committee between Japan and Viet Nam, was referred to as an MRV methodology.

The eligibility requirements (applicability) of the project are as follows. The project under consideration was assumed as meeting all the requirements.

<Applicability>

(a) The project newly installs solar PV system(s).
(b) The PV modules are certified for design qualifications (IEC 61215, IEC 61646 or IEC 62108) and safety qualification (IEC 61730-1 and IEC 61730-2).
(c) The equipment to monitor output power of the solar PV system(s) and irradiance is installed at the project site.

For estimating the amount of electricity generated by the solar PV systems, the "Emission Reduction Calculation File: 01 Photovoltaic Power Generation" available on the website for the FY2020 Open Call for JCM Model Project was used.

iii Project boundary

The project boundary is generally assumed to be a physical, geographical site where the switching of energy sources takes place. However, such description was not provided in the MRV methodology. Therefore, the estimation was made by simply focusing on the information provided in Table 30.

Table 30 GHGs and emission sources subject to estimation

	Emission source	GHG	Subject of estimation	Note
Reference	Consumption of grid electricity and/or captive electricity	CO_2	Yes	—
Project	Generation of electricity from solar PV system(s)	CO_2	Yes	—

iv Formula for estimating GHG emission reduction amount and the results

GHG emission reductions through the introduction of a 720 kW solar PV system at a fish processing company and/or a shrimp farming company were calculated using the following formula. As a result, about 408 tonnes of reduction amount annually was estimated.

$ER_p = RE_p - PE_p = RE_p$

ER_p:	GHG emission reduction amount in the project period p (tCO_2/p)
RE_p:	GHG emissions in the project period p for the reference scenario (tCO_2/p)
PE_p:	GHG emissions in the project period p for the project scenario (tCO_2/p)

GHG emissions for the reference scenario

$RE_p = \Sigma_i (EC_{j,p} * EF_{RE,i})$

RE_p:	Reference emissions during the period p (tCO_2/p)	
$EC_{j,p}$:	Quantity of electricity consumed or sold to the power company from electricity generated by the project solar PV system i during the period p (MWh/p)	Subject of monitoring
$EF_{RE,i}$:	Reference CO_2 emission factor for the project solar PV system i (tCO_2/MWh)	Emission factor in Viet Nam：0.333 kg CO_2/kWh Source: FY2020 JCM Model Project Application Guidelines, Attachment "List of CO_2 Emission Factors", Emission factors for renewable energy in cases other than "Replacing on-site power generation only".

GHG emissions for the project scenario

$PE_p = 0$

PE_p:	Project emissions during the period p (tCO_2/p)	Project emissions are not assumed in the methodology as electricity consumption by any PV system is negligible.

v Cost-effectiveness

The estimation results for the case where the solar power generation system installed at the rice mill company and shrimp farming company are shown in Table 5. According to the guidelines for submitting proposals of JCM Model Project, it states that the Cost-effectiveness of financial support necessary to reduce 1 tonne of GHG emissions should be 4,000 JPY/tCO2eq or lower. It was confirmed that if the minimum subsidy rate (30%) was applied, the cost-effectiveness would be 4,300 yen/tCO2, which exceeds the 4,000 yen/tCO2 threshold.

Table 31 Cost-effectiveness

Item	Fish processing companies, etc.	Note
Number of panels installed	1800	
Capacity of solar PV system (kW)	720	Module output: 400W/module
Total annual power generation (kWh/y)	1,225,550	
Initial cost (Yen) (1)	100,000,000	
Product lifetime (y)	17	For "Equipment for the electrical industry, mainly made of metal" in the Ministerial Ordinance concerning the Useful Life, etc. of Depreciable Assets
GHG emission reduction amount (tCO_2) (2)	6,900	Performance for the entire period of product lifetime
Cost-effectiveness (Yen/tCO_2)	14,400	(1)/(2) Note: No subsidy is considered.
Cost-effectiveness (Yen/tCO_2)	4,300	Subsidy/(2) Note: Formula for the JCM Model Project is used. Subsidy rate at 30% is assumed.

vi Implementation system for monitoring

The parameters shown in Table 32 need to be monitored when implementing the project. The monitoring implementers are also indicated in the table. When applying for the JCM Model Project, MRV reporting is required for the period of legal product lifetime of the installed equipment, so the implementation system for MRV needs to be established. A possible implementation system is shown in Figure 65.

Table 32 Monitoring parameters

Parameter	Monitoring implementer
Quantity of electricity consumed or sold to the power company from electricity generated by the project solar PV system i during the period p (MWh/p)	Recorded by the solar PV system installers in Japan via the Internet.

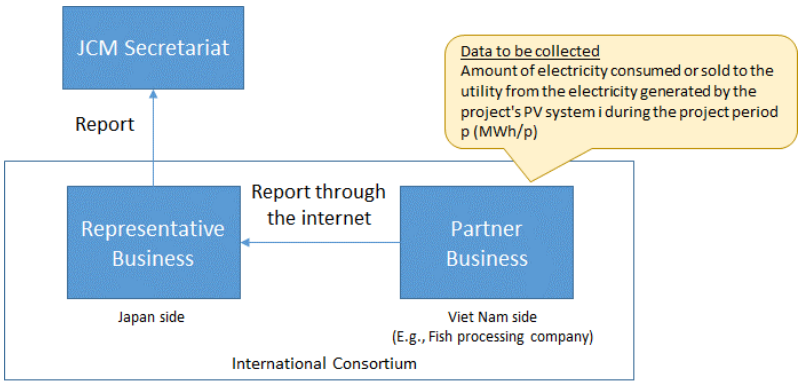


Figure 65 Draft implementation system for monitoring

vii Further considerations

Although the current calculations clearly show that the cost-effectiveness does not come under the criteria for JCM model project, there is room to consider using more efficient and less expensive PV panels or combining multiple devices to redefine the project boundary when aiming to obtain JCM model project.

5.4.

As a result of this year's survey, it was found that SAOTA FOODS (a seafood processing company) and Thanh Tin Company (a rice milling company) have a certain degree of potential to install solar power generation systems.

However, in addition to visual confirmation of the electrical grid facilities of the local companies, travel to the site is essential for more detailed profit analysis, including the accumulation of construction costs of solar power generation systems, and discussions with local partners for the formation of an international consortium. At the time of writing this report, the pandemic of COVID-19 has not yet subsided, and travel to the site is not foreseeable in the next fiscal year, and the public support scheme after the FIT program ends has not yet been announced in Vietnam. Hirokawa Enath will end the feasibility study this year and consider resuming the study after site visit becomes possible.

6. Survey on an alternative energy to fossil fuels through the use of solidified waste fuel (RPF)

6.1. Trend in the volume of waste and waste management

(1) Understanding waste type classification

According to Decree 09/VBHN-BTNMT on management of waste and discarded materials, waste types can be classified by features (Solid/Non-solid, Hazardous/Ordinary), and sources of wastes (Daily-life/Industrial/Medical/ Construction/Agricultural).

- Solid waste means waste in solid or paste form (also called waste sludge) discharged from production, business, service, daily life or other activities. The remaining is non-solid waste, in form of wastewater, liquid/gas waste, etc.
- Hazardous waste includes explosive, flammable, oxidizing, corrosive, toxic and infectious categories. In contrast, ordinary waste isn't in the list of hazardous waste or in the list of hazardous waste of which risk factors are below hazardous waste level.

Source of wastes include Daily-life, Industrial, Medical, Construction, Agricultural

(2) Waste discharge situation by type

Not all waste types have available data statistics from public sources. And, Data of Province/City is the lowest level which can be obtained. The main sources of waste in Vietnam are solid wastes from daily life, industry, and medicine. In addition to these major wastes, other types of wastes such as wastewater, if any, will also be mentioned.

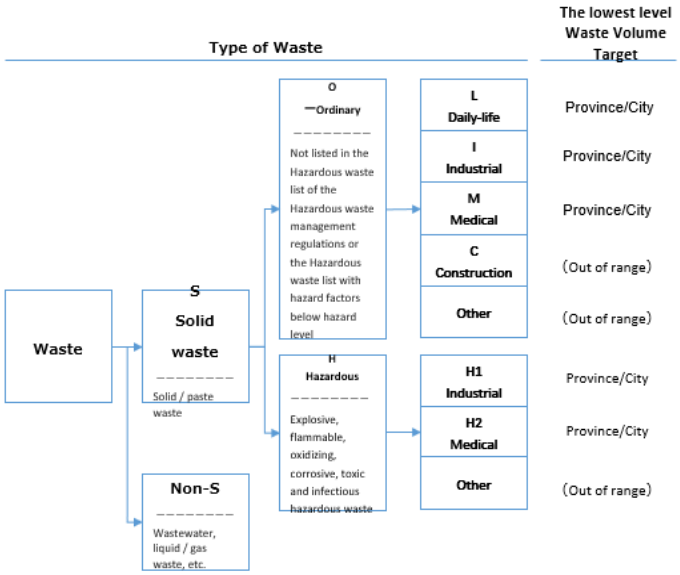


Figure 66 Waste classification

Level (top down)	Quant.	Explanation	
Country	1	Vietnam	
Region	6	Name/Type	No. of Province/City
		Northern Midlands and Mountains* (Northern East/Northern West)	14
		Red River Delta	11
		North Central and Central Coast*	14
		Highlands	5
		South East	6
		Mekong Delta	13
City (municipality)/Province	63	City	5
		Province	58
District (Urban district/District-level town/ Rural district/Provincial city)	712	Number of districts in each province/city is ranging from 6 (Ha Nam) to 30 (Ha Noi). Full list in excel file	

Administrative Level Map (from City/Province level)

City (municipality) | Province

Urban district | District-level town | Rural district | Provincial city

An below level exists but it is not mentioned in this report

*: MONRE merges two regions (in term of data) to create a new one due to regions' similar features

Figure 67 Local administrative divisions used in this research

i Solid Daily-life waste

According to the National State of Environment Report in 2011, the total volume of daily-life solid waste is generated about 44,400 tons per day. By 2019, the figure would be 64,658 tons per day (urban areas are 35,624 tons per day and rural areas are 28,394 tons per day), which is 46% higher in comparison to this figure in 2011. In 2019, 15/63 provinces/cities have more than 1,000 tons of daily-life solid waste per day (including Hanoi and HCMC generating over 6,000 tons/ day)

The volume of daily-life solid waste increases significantly in areas with high levels of urbanization, industrialization, and tourism such as HCMC (9,400 tons/ day), Hanoi (6,500 tons/ day), Thanh Hoa (2,175 tons/day), Hai Phong (1,982 tons/ day), Binh Duong (2,661 tons/day), Dong Nai (1,885 tons/ day), Quang Ninh (1,539 tons/day), Da Nang (1,080 tons/day) and Binh Thuan (1,486 tons/day).

Table 33 The volume, the average daily-life solid waste generation index per capita of provinces (2010 - 2019)

No	*Area*	**Generated volume* (tons/day)**				**Generated index (kg/person/day)**			
		2010	2015	2018	2019	2010	2015	2018	2019
Red River Delta									
1	Ha Noi	5,000	5,515	6,500	6,500	0.95	0.76	0.86	0.81
2	Vinh Phuc	-	-	830	830	-	-	0.76	0.72
3	Bac Ninh	-	-	870	900	-	-	0.7	0.66

4	Quang Ninh	-	805	1,397	1,539	-	1.02	1.1	1.17
5	Hai Duong	-	-	1,072	1,072	-	-	0.59	0.57
6	Hai Phong	1,250	1,000	1,715	1,982	0.67	0.51	0.85	0.98
7	Hung Yen	-	-	650	650	-	-	0.55	0.52
8	Thai Binh	-	-	950	950	-	-	0.53	0.51
9	Ha Nam	-	-	275	305	-	-	0.34	0.36
10	Nam Đinh	-	-	860	880	-	-	0.46	0.49
11	Ninh Binh	-	-	422	487	-	-	0.43	0.5
Northern Midlands and Mountains									
12	Ha Giang	-	-	705	316	-	-	0.83	0.37
13	Cao Bang	-	-	367	134	-	-	0.68	0.25
14	Bac Kan	-	-	191	191	-	-	0.58	0.61
15	Tuyen Quang	-	-	178	181	-	-	0.23	0.23
16	Lao Cai	-	-	434	456	-	-	0.62	0.62
17	Yen Bai	-	-	473	473	-	-	0.58	0.58
18	Thai Nguyen	-	-	785	818	-	-	0.62	0.64
19	Lang Son	-	-	422	424	-	0.26	0.53	0.54
20	Bac Giang	-	-	754	754	-	-	0.45	0.42
21	Phu Tho	-	-	704	710	-	-	0.5	0.48
22	Dien Bien	-	72	264	253	-	0.13	0.46	0.42
23	Lai Chau	-	-	280	193	-	-	0.61	0.42
24	Son La	-	-	360	282	-	-	0.29	0.23
25	Hoa Binh	-	-	507	507	-	-	0.6	0.59
North Central and Central Coast									
26	Thanh Hoa	-	-	2,246	2,175	-	-	0.63	0.6
27	Nghe An	-	-	1,629	2,464	-	-	0.52	0.74
28	Ha Tinh	-	197	640	640	-	0.16	0.5	0.5
29	Quang Binh	-	-	345	466	-	-	0.39	0.52
30	Quang Tri	-	-	345	368	-	-	0.55	0.58
31	Thua Thien Hue	225	-	559	550	0.21	-	0.48	0.49
32	Da Nang	805	900	1,168	1,100	0.83	0.87	1.08	0.97
33	Quang Nam	198	-	920	920	-	-	0.61	0.62
34	Quang Ngai	262	-	625	848	0.21	-	0.49	0.69
35	Binh Dinh	372	-	850	890	0.25	-	0.55	0.6
36	Phu Yen	142	-	510	510	-	-	0.56	0.58

37	Khanh Hoa	486	-	869	1,068	-	-	0.71	0.87
38	Ninh Thuan	164	-	604	604	0.28	-	0.99	1.02
39	Binh Thuan	594	-	1,485	1,486	-	-	1.2	1.21
Central Highlands									
40	Kon Tum	166	189	212	212	0.38	0.38	0.4	0.39
41	Gia Lai	344	-	697	697	0.26	-	0.48	0.46
42	Dak Lak	246	-	1,444	1,370	0.14	-	0.75	0.73
43	Dak Nong	69	-	311	311	0.14	-	0.48	0.5
44	Lam Dong	459	-	338	338	0.38	-	0.26	0.26
South-East									
45	Binh Phuoc	158	-	518	518	0.18	-	0.53	0.52
46	Tay Ninh	134	-	412	412	0.12	-	0.36	0.35
47	Binh Duong	378	-	1,838	2,661	0.22	-	0.85	1.1
48	Dong Nai	773	-	1838	1885	0.28	-	0.6	0.61
49	Ba Ria - Vung Tau	456	700	912	914	0.44	0.65	0.82	0.8
50	HCMC	7,081	8,323	9,128	9,400	0.96	1.02	1.06	1.05
Mekong Delta									
51	Long An	179	-	1,086	1,086	0.12	-	0.72	0.64
52	Tien Giang	230	-	502	216	0.14	-	0.28	1.22
53	Ben Tre	135	-	493	270	0.11	-	0.39	0.21
54	Tra Vinh	124	-	372	401	0.12	-	0.35	0.4
55	Vinh Long	137	159	378	813	0.13	0.15	0.36	0.79
56	Dong Thap	209	-	1,060	800	0.13	-	0.63	0.5
57	An Giang	562	-	1,128	1,128	0.26	-	0.52	0.59
58	Kiên Giang	376	-	1,300	481	0.22	-	0.72	0.28
59	Can Tho	876	846	605	599	0.73	0.68	0.47	0.49
60	Hau Giang	105	-	525	782	0.14	-	0.68	1.07
61	Soc Trang	252	-	916	917	0.19	-	0.7	0.76
62	Bac Lieu	207	-	505	307	0.24	-	0.56	0.34
63	Ca Mau	233	-	357	356	0.19	-	0.29	0.3

Note: (*) Daily-life solid waste includes both urban and rural areas

(-) Lack of statistics.

Generating daily-life solid waste in urban areas

According to socio-economic development region, the South-East area generates the largest amount of daily-

life solid waste with 4,613,290 tons/year (accounts for 35% of total daily-life solid waste generated in all nationwide urban areas), followed by the Red River Delta region with generated daily-life solid waste at 3,089,926 tons/year (accounts for 24%). Urban cities in the Central Highlands region have the lowest amount of daily-life solid waste, at 542,098 tons/year (accounts for 4%)

Generating daily-life solid waste in rural areas

The source of daily-life solid waste generated in rural areas comes from households, markets, warehouses, schools, hospitals, and office buildings. Rural daily-life solid waste mainly consists of easily degradable organic components (waste food, garden waste) with moisture percentage at above 60%; however, persistent organic matter, inorganic matter (such as glass, crockery, metal, paper, plastic, broken electrical appliances...) and plastic bags appear more. Most daily-life solid waste is not sorted at the source, therefore, the recovery rate of recycled and reused waste such as waste paper, metal, plastic... is still low and spontaneous. Following statistics, the volume of daily-life solid waste generated in rural areas is 28,394 tons per day (approximately equals to 10,363,868 per year). The largest volume of rural daily-life solid waste is generated from the Red River Delta region with 2,784,494 tons per year (accounts for 27%), which is followed by the Northern Central area and Central Coastal area at 2,690,517 tons/year (accounts for 26%). The Central Highlands region has the smallest figure, only 526,586 tons/year (accounting for 5%).

Table 34 The volume, Index of daily-life solid waste in urban and rural areas (by region, 2019)

No.	Region	Discharged volume (ton/day)		Population (person)		Discharged index (kg/person/day)	
		Urban	Rural	Urban	Rural	Urban	Rural
1	Red River Delta	8,466	7,629	7,904,784	14,638,823	1.07	0.52
2	Northern midlands and mountain	2,740	2,949	2,282,809	10,250,057	1.20	0.29
3	Northern Central and Central coastal	6,717	7,371	5,720,313	14,466,980	1.17	0.51
4	Central Highlands	1,485	1,443	1,676,030	4,166,651	0.89	0.35
5	South East	12,639	3,150	11,196,480	6,632,427	1.13	0.47
6	Mekong River Delta	3,577	5,852	4,342,132	12,931,498	0.82	0.45
	All Country	**35,624**	**28,394**	**33,122,548**	**63,086,436**	**1.08**	**0.45**

ii Solid Industrial waste

Ordinary type

Industrial solid waste arises mainly from industrial facilities located in industrial parks and export processing zones, high technology zones and production facilities located outside the industrial parks with the volume

of about 25 million tons/year. In addition, the amount of industrial solid waste generated from craft village activities is incomplete at about 14-17 tons/day.

Table 35 Volume of industrial solid waste* generated in 2018 - 2019

Province/city	2018 (tons/day)	2019 (tons/day)
Ha Noi	646	653
Hai Phong	7,342	7,342
Quang Ninh	2,749	2,749
Hai Duong	3,765	3,322
Hung Yen	291	295
Bac Ninh	660	685
Vinh Phuc	452	500
Thai Nguyen	1,206	1,500
Ha Tinh (mainly from Formosa company)	10,929	10,959
Da Nang	49	46
Quang Ngai (mainly industrial zones)	167	98
HCMC	-	2,000
Long An	-	1,300
Dong Nai	1,091	-
Binh Duong	2,645	2,342
Ba Ria - Vung Tau	1,280	1,280
Can Tho	408	-
An Giang	62	74
Kien Giang	147	149
Ca Mau	126	130

Note: (*) Daily-life solid waste includes both urban and rural areas

(-) Lack of statistics.

Hazardous type

According to reports of provinces/cities, the amount of industrial hazardous waste generated in 2019 is about 1,133,077 tons (an increase of 258,688 tons compared to 2018), mainly concentrated in light, metallurgy and chemical industries. In addition, a source of hazardous waste generation is from violations of the law in importing scrap for use as raw production materials. Some organizations and individuals, taking advantage of the import of scrap, have sent hazardous wastes mainly metal scraps, plastic, waste rubber tires and tubes, car shells, uncleaned marine vessels, waste lead batteries, used electronic products (computer monitors, electronic circuit boards, etc.) to Vietnam. The key areas where this activity takes place is the Northern border line (Cao Bang, Lang Son, Lao Cai provinces), Southwest (Tay Ninh, Kien Giang provinces) and sea border

gates (in Hai Phong, Quang Ninh and HCMC).

iii Solid medical waste

Ordinary type

According to the report on environmental protection work in 2019 of the Ministry of Health, the volume of medical solid waste normally generated is about more than 96,000 tons/year. The rate of collection and treatment of medical solid waste has increased gradually over the years. Most of the medical facilities at central, provincial and district levels have collected and treated medical solid waste. However, in remote and remote medical facilities, where small-scale medical facilities generate little waste, the collection and treatment of medical solid waste faces difficulties.

Hazardous type

The total volume of hazardous medical solid waste generated nationwide is about 24,000 tons/year (Ministry of Health, 2020). By region, the Southeast region generates the largest amount of hazardous medical solid waste, accounting for 32% of the total amount generated nationwide, followed by the Red River Delta (21%). Provinces/cities with large emissions (> 500 tons/year) include Hanoi, HCMC , Thanh Hoa, Dong Nai, Vinh Phuc, Da Nang, Khanh Hoa, Thua Thien Hue, An Giang, Can Tho, Nghe An, Phu Tho, Hai Phong, Long An.

(3) Waste collection and treatment

i Solid Daily-life waste

According to statistical results in the period 2016 - 2019, the rate of urban solid waste collection and treatment increased by an average of 2%/year. In rural areas, the average collection rate is about 63%, most of the waste is treated by landfilling (accounting for 70% of treated waste).

According to provincial reports, some special-grade urban areas[9], grade I cities have a high collection rate in the central areas such as Da Nang (100%), Hai Phong (98-99%), Ha Noi. Noi (93 - 94%), HCMC (91%). Grade II and III cities have also improved significantly, most of which have collection rates in the central areas reaching over 80-85%. In urban areas of grades IV and V, the collection work has not been improved much due to limited resources, most of the collection work is done by cooperatives or private collection teams, so there is a lack of capital to invest in equipment.

Table 36 Rate of urban daily-life solid waste collection in some provinces/cities in 2019

No.	Province/city	Rate	No.	City/province	Rate

[9] Being classified according to Resolution No. 1210/2016/UBTVQH13

1	HCMC	91%	8	Bac Ninh	83%
2	Da Nang	100%	9	Dong Nai	99%
3	Hai Phong (urban)	98%	10	Nghe An (urban+rural)	50%
4	Ha Noi (urban+ suburban)	93%	11	Quang Nam	90%
5	Thua Thien Hue (urban)	83%	12	Kien Giang (urban+rural)	60%
6	Ha Tinh	88%	13	Ba Ria - Vung Tau	94%
7	Long An	90%			

In urban areas, the collection and transportation of waste is carried out by urban environment companies or urban construction companies. Most of waste has not been classified at the source, but remains being mixed and transported to landfill.

In rural areas, the collection and transportation of waste is largely done by cooperatives and private collection teams using collection costs contributed by households. Currently, about 40% of villages and communes form self-managed garbage collection groups and teams with operating funds contributed by households, such as in Binh Xuyen and Yen Lac district (Vinh Phuc province), Thanh Tri district (Ha Noi), Yen Phong district (Bac Ninh province). However, the efficiency of solid waste collection is still low.

- The garbage classification and recycling system does not work well or does not exist.
- The collection and transportation in rural areas usually only stops at the transshipment point, thus it doesn't solve the entire problem of solid waste collection in this area.

Currently, there are 1,322 solid waste treatment facilities nationwide, including 381 solid waste incinerators, 37 composting production lines, 904 landfills, many of which are unsanitary.

Table 37 Rate of Sanitary landfill in accordance with standards in 2018 by province

No.	**Region**	**Province/City**	**% of Sanitary landfills**
Total:	**6**	**63**	**31%**
1	North Central and Central Coastal	Thanh Hoa	9%
2		Quang Tri	45%
3		Ninh Thuan	11%
4		Nghe An	53%
5		Quang Nam	36%
6		Binh Thuan	23%
7		Quang Ngai	58%
8		Binh Dinh	75%
9		Ha Tinh	45%

10		Khanh Hoa	18%
11		Thua Thien Hue	60%
12		Quang Binh	78%
13		Phu Yen	11%
14		Da Nang	100%
15	Red River Delta	Vinh Phuc	3%
16		Hai Duong	100%
17		Quang Ninh	38%
18		Hai Phong	67%
19		Ha Nam	20%
20		Nam Dinh	80%
21		Ha Noi	100%
22		Hung Yen	67%
23		Ninh Binh	50%
24		Bac Ninh	100%
25		Thai Binh	100%
26	Mekong Delta	Soc Trang	0%
27		An Giang	7%
28		Kien Giang	17%
29		Ca Mau	18%
30		Dong Thap	20%
31		Long An	0%
32		Ben Tre	13%
33		Tra Vinh	25%
34		Tien Giang	29%
35		Bac Lieu	17%
36		Can Tho	75%
37		Vinh Long	25%
38		Hau Giang	100%
39	Northern Midlands and Mountain	Bac Giang	13%
40		Son La	0%
41		Cao Bang	33%
42		Lao Cai	100%
43		Yen Bai	10%
44		Dien Bien	22%
45		Hoa Binh	22%
46		Lai Chau	100%
47		Bac Kan	25%
48		Ha Giang	29%
49		Lang Son	100%
50		Thai Nguyen	33%
51		Tuyen Quang	20%
52		Phu Tho	75%

53	Central Highlands	Gia Lai	29%
54		Dak Lak	13%
55		Lam Dong	23%
56		Dak Nong	22%
57		Kon Tum	14%
58	South East	Binh Phuoc	17%
59		Dong Nai	100%
60		Ba Ria - Vung Tau	67%
61		HCMC	100%
62		Tay Ninh	50%
63		Binh Duong	100%
Note: Although definition is not clearly mentioned, the main difference between sanitary and non-sanitary landfill is stated by Ministry of Natural Resources and Environment (MONRE). A sanitary landfill has a daily covering on waste, while non-sanitary landfill doesn't.			

Of the total volume of collected waste, about 71% is treated by landfill method (excluding waste from composting facilities and ash generated from incinerators); 16% is treated at composting plants; 13% is treated by burning method.

MONRE has coordinated with ministries, provinces/cities to review, evaluate, and propose to choose suitable waste treatment technology to Vietnam's practical conditions in the direction of reducing buried waste percentage, increasing recycled and reused waste percentage. The review results in 2019 showed that, out of 381 waste incinerators, only 294 incinerators (about 77%) had a capacity of over 300 kg/h, meeting the requirements of QCVN 61-MT:2016/BTNMT. With the orientation of large-scale concentrated solid waste treatment, many provinces/cities have invested in a methodical and effective treatment system at district and inter-district scale, such as Nghia Dan (Nghe An province), Cam Xuyen, Can Loc (Ha Tinh province), Hung Yen, Uong Bi (Quang Ninh province), Tam Diep (Ninh Binh province), Thanh Liem (Ha Nam province)... Typically in Dong Nai province, the landfilling rate of solid waste is remaining at 43% (lowest in the country). Up to now, the whole country has 59/63 provinces/cities approved the solid waste management planning in the area. Nearly 100% of communes have completed the formulation and approval of new rural planning, of which the locations of waste transfer/collection points or small-scale landfills have been identified. 42/63 provinces/cities have plans for centralized waste treatment in rural areas, of which a number of provinces/cities have implemented it on a province-wide scale (such as Nam Dinh, Dong Nai, Ha Tinh provinces...).

ii Solid Industrial waste

Most of the enterprises in industrial zones and export processing zones have taken measures to classify and temporarily store solid waste before collecting and transporting it to the treatment place. Some industrial zones and export processing zones have organized centralized collection and treatment of solid waste. For

production and business establishments outside industrial zones and export processing zones, solid waste is basically collected and transferred to units with transport and treatment functions. The rate of industrial solid waste collection and treatment is quite high, reaching over 90% of the generated volume.

Nearly 90% of current industrial parks and export processing zones have centralized wastewater treatment plants meeting environmental standards. North Central and Central coastal region is remaining at 70%, the lowest in whole country. Meanwhile, the highest rate belongs to Red River Delta (92%)

Table 38 Industrial parks and export processing zones with a centralized wastewater treatment plant meeting environmental standard by region (2020)

	Total number of industrial parks and export processing zones put into operation (Zones)	Number of industrial parks and export processing zones with centralized wastewater treatment plants meeting environmental standards (Zones)	Percentage of industrial parks and export processing zones with a centralized wastewater treatment plant meeting environmental standards (%)
WHOLE COUNTRY	**285**	**255**	**89**
Red River Delta	74	68	92
Northern midlands and mountain	21	18	86
North Central and Central coastal	46	32	70
Central Highlands	6	5	83
South East	99	97	98
Mekong River Delta	39	35	90

By the end of 2020, there were 117 hazardous waste treatment facilities nationwide that have been licensed by the Ministry of Natural Resources and Environment, with a total capacity of about 2 million tons/year. The rate of hazardous wastes collected and treated in accordance with regulations reached 85% (an increase of about 6 percentage points compared to 2017); In which, there are 04 provinces/cities reaching 100%, Thai Nguyen and Bac Giang with the rate lower than 85%, the remaining provinces/cities reach >85%. In addition to domestic hazardous waste collection and treatment, Vietnam has initially exported hazardous waste abroad (in 2019, MONRE approved 09 enterprises to export hazardous waste with a total volume of more than 3,958 tons), contributing to reduce the pressure on waste treatment in the country.

iii Solid medical waste

In the period 2016 - 2020, the collection and treatment of medical solid waste has been significantly enhanced. However, the investment has not been synchronized in provinces and cities. According to data reported by

the Department of Environmental Management (Ministry of Health) on the management of medical solid waste, more than 90% of hospitals carry out daily collection and classify waste at source. For local medical examination and treatment facilities managed by the Department of Health, the collection, storage and transportation of solid waste have not been focused, especially the classification and storage of waste at source.

According to the Ministry of Health (2020), more than 80% of the emission analysis samples of 87 medical solid waste incinerators in 19 provinces/cities meet QCVN 02:2012/BTNMT. Some provinces/cities have approved plans to collect, transport and treat hazardous medical solid waste in the area, in which priority solutions are given to concentrated medical solid waste treatment in a cluster model to limit/replace on-site incinerators, which do not guarantee the standard exhaust gas treatment.

Currently, the use of non-burning, environmentally friendly technology in medical solid waste treatment has been encouraged and prioritized for development. Typically, medical solid waste treatment technology by autoclaving and microwave sterilization is effective in terms of economy and environment, because it is used at temperatures below 400°C, so no emissions are generated (especially dioxin/furan) and reduce energy consumption.

6.2. Trends in waste business

Water supply. sewerage. waste management and remediation activities have been receiving an increasing attention in Vietnam. In 2020, 32,638 BVND (~ 1.4 BUSD) was in investment record, 1.6 times higher than that in 2015. Until 2020, 81 FDI projects have been in licensed, valuing 2.9 BUSD, of which to include new registered capital and supplementary capital to licensed projects in previous years.

Table 39 Index of industrial production[10]

	2015	2017	2018	2019	2020 (prel.)
Waste collection. treatment and disposal activities; materials recovery (*)	107.5	112.4	103.5	104.9	106.2
(*) Data of 2015 is in accordance with base year 2010; from 2017 is in accordance with base year 2015					

Table 40 Investment at current prices (BVND)

	2015	2017	2018	2019	2020 (prel.)

[10] The index of industrial production (IIP) is calculated as a percentage between the volume of industrial production generated in the current period to the volume of industrial production in the base period. IIP quickly reflects the development situation of the industry

Water supply. sewerage. waste management and remediation activities	22,137	26,723	27,392	29,606	32,638

Table 41 Foreign direct investment projects licensed (Accumulation of projects having effect as of 31/12/2020)

	Number of projects	Total registered capital (*) (MUSD)
Water supply. sewerage. waste management and remediation activities	81	2,926
(*) Including new registered capital and supplementary capital to licensed projects in previous years. Since 2016 including contributing capital and purchasing shares of foreign investors		

According to statistics by B&Company Vietnam sourced from a survey by government authorities, more than 2,300 waste related businesses are in operation. Most of them are in small size with revenue under 3 BVND. In term of profit situation in general, medium and large businesses gained a slight profit margin of 4% on average, while micro and small businesses experienced a loss in 2019 on average.

Table 42 Waste related business statistics

VSIC-Level 5	**Main Industry**	**No. of Companies**	**Total net revenue, 2019 (BVND)**
37002	Wastewater treatment	465	4,780.3
38110	Collection of non-hazardous waste	1,244	18,428.0
38121	Collection of medical waste	4	2.6
38129	Collection of other hazardous waste	34	889.8
38210	Treatment and disposal of non-hazardous waste	217	4,376.7
38221	Treatment and disposal of medical waste	5	115.6
38229	Treatment and disposal of other hazardous waste	49	3,122,4
38301	Recovery of metal waste	110	6,606.7
38302	Recovery of non-metal waste	183	4,165.1
TOTAL		**2,311**	**42,487.3**

Revenue size	**No. of Companies**	**Total net revenue, 2019 (BVND)**	**Total profit before tax, 2019 (BVND)**	**Profit margin (%)**
Micro (<3 BVND)	1,586	898.8	(133.2)	-15%
Small (3-50 BVND)	532	7,008.9	(110.7)	-2%

Medium (>50-200 BVND)	151	15,218.0	603.3	4%
Large (>200 BVND)	42	19,361.6	795.4	4%

Some waste related companies are addressed during the research as below

Table 43 List of some companies in waste treatment business

No	Company Name (EN)	Website	City/Province	Est. year	Legal Form (*)	Industrial Waste Treatment				
						Metal Recovery	Waste water Treatment	Incineration	Sludge Landfill	Others
1	Citenco Co., Ltd	http://www.citenco.com.vn/	HCMC	2010	SOE		o	o		o
2	Hoa Binh IRT JSC	http://www.moitruonghoabinh.vn/	Hanoi	2008	JSC	o	o	o		o
3	Hung phat Urban Environment Co., Ltd	http://hungphat.org.vn/	Bac Ninh	2010	Ltd	o	o	o		o
4	Sonadezi JSC	http://news.sonadezi-sdv.com.vn/	Dong Nai	2007	JSC		o	o	o	o
5	Phu Ha Environment Company Limited	http://moitruongphuha.com/	Phu Tho	2007	Ltd	o	o	o	o	o
6	Hue Phuong VN Green Environment Co., Ltd	http://huephuongvn.com/	Tay Ninh	2011	Ltd	o	o	o	o	o
7	Viet Star Environmental JSC	https://vietstarjsc.com/en/home/	Ba Ria-Vung Tau	2008	JSC		o	o		o
8	Tai Tien Co., Ltd	http://taitien.vn/	Dong Nai	2009	Ltd	o	o	o	o	o
9	Green Idea Co., Ltd	http://moitruongcongnghiepxanh.vn/	Vinh Phuc	2007	Ltd	o	o	o		o
10	GE Vietnam Co., Ltd	https://moitruongxanhvn.com/	Tay Ninh	2007	JSC	o	o	o		o
11	Thanh Tung 2 Co., Ltd	http://thanhtung2.com/default.gss	Dong Nai	2000	Ltd	o		o		o
12	Green Earth JSC	http://moitruongtraidatxanh.com/	Long An	2011	JSC	o	o	o		o

(*) JSC: Joint stock company; Ltd: Limited company; SOE: State-owned enterprise

Company Selecting Criteria:

- Main business activity is Waste Treatment
- Treated wastes include industrial waste
- In top waste treatment companies in term of revenue
- Have valid website

Source of information:

- B&Company Enterprise data
- National Business Registration System (NBRS)
- Companies' official websites
- Companies' hazardous waste treatment licenses (if available)

Table 44 List of some corresponding waste treatment plants with hazardous license

No.	Name of plant	Province	Treatment*1 (tons/day)	Processing Method*2				
				Incineration	Intermediate process (tons/day)	Recycle	Landfill (m3)	Pre-treatment (tons/day)
Total	14		①+②+③	①	②	③	④	⑤
1.1	HCM Hazardous Waste Treatment Station at Dong Thanh Construction Site	HCMC	21	21	0	0	27,909	0
1.2	HCM Hazardous Waste Treatment Station at Industrial and Hazardous Solid Waste Treatment Complex	HCMC	7	7	0	0	0	0
2	Industrial Waste Treatment and Scrap Recycling Factory	Bac Giang	155	20	67	68	1,500	1
3	Hung phat Urban Environment Co., Ltd	Bac Ninh	>305	×		×		
4.1	Quang Trung Waste Treatment Complex	Dong Nai	3,218	8	3,210	0	206,236	0
4.2	Liquid Waste Physicochemical Treatment Plant	Dong Nai	2	0	0	2	0	0
5	Industrial Waste and Heath-care Waste Treatment Plant	Phu Tho	37	12	5	20	0	0
6	Hue Phuong VN Green Environment Co., Ltd	Tay Ninh	85	16	24	45	11,536	4
7	Sao Viet Hazardous Waste Treatment Plant	Ba Ria - Vung Tau	28	8	9	10	0	4
8	Hazardous Waste and Daily-life Solid Waste Treatment Plant	Dong Nai	88	9	50	29	214,900	0
9	Recycling and Waste Treatment Center	Vinh Phuc	91	32	4	55	0	4
10	Waste Treatment Plant	Tay Ninh	52	6	23	23	0	1
11	Industrial Waste and Hazardous Waste Recycling and Treatment Factory	Dong Nai	19	5	2	12	0	1
12	Green Earth Environment Technology JSC	Long An	23	6	10	7	0	0

Note:

- Same No. to Figure 12 (plant operation companies), if a company with >1 plant, it will be addressed as 1.1, 1.2 etc.
- × means "We have information about processing method, but we don't have access to information about their processing capacity".

*1: Landfill is not included because the unit of treatment capacity is different from other treatment methods. Pretreatment is not included because it is an intermediate step in other treatment methods.

*2: There are five categories of solid waste treatment methods. (1) incineration, (2) intermediate treatment, (3) recycling, (4) landfill, and (5) pretreatment (treatment methods for liquid waste are

	omitted)

6.3. Policies, Laws and Regulations

(1) Key points of national policies related to waste management

i General regulations on waste management

It can be seen at first in Chapter IX Law No. 55/2014/QH13[11] on Environment Protection-Chapter IX, key points include:

- Requirements applied to waste management
  - Wastes must be managed throughout the process of generation, minimization, classification, collection, transport, recycling, and destruction.
  - Conventional wastes that contain hazardous wastes beyond permissible limits and cannot be classified shall be managed in accordance with hazardous waste.
  - The Government shall elaborate regulations on waste management[12].
- Minimization and recycling of wastes
  - Wastes that can be recycled and used as energy must be classified.
  - Owners of manufacturing and business organizations that produce wastes are responsible for minimizing, recycling wastes, or transfer wastes to the organizations capable of recycling such wastes.
- Collecting and treating discarded products
  - Owners manufacturing and business establishments must collect and treat discarded products.
  - Users are responsible for taking discarded products to proper places.
  - The People's Committees and environment authorities shall facilitate manufacturing and business establishments to collect discarded products[13].
  - Discarded products shall be collected and treated in accordance with decisions of the Prime Minister.
- Responsibilities of the People's Committees for waste management

The People's Committees, within the area of their competence, are obliged to:

- Formulate, approve and implement planning for local waste treatment infrastructure.
- Invest in and operate public works serving local waste management.
- Introduce incentive policies to support waste management as prescribed by law.

[11] From 1/1/2022, Law No. 72/2020/QH14 on Environment Protection shall take effect in replacement of Law No. 55/2014/QH13. A significant change is to add Environmental auditing. Minister of Natural Resources and Environment shall provide technical guidance on environmental self-auditing by businesses

[12] Decree 09/VBHN-BTNMT by the Government set a more specific guide on management of waste and discarded materials, in specific to regulate Waste management including hazardous waste, domestic solid waste, ordinary industrial solid waste, liquid waste products, wastewater, industrial waste gas and other specific waste; Environmental protection in scrap import

[13] Circular No. 34/2017/TT-BTNMT by MONRE guide on recall and treatment of discarded product

- Responsibilities of investors in industrial parks, export-processing zones, hi-tech zones for waste management
    - Provide sufficient areas for gathering wastes under their management.
    - Develop and operate concentrated sewage treatment systems.

ii Permissible levels of pollutants in wastes before discharging to the environment

Treated waste quality regulations in Vietnam is applying in some levels: National, Provincial and Industrial Park

<table>
<tr><td rowspan="3">Treated Waste Quality</td><td>National Level</td><td>Permissible levels of pollutants in wastes (only wastewater, emission, waste oil) generated from industry in general or some specific industries, before discharging to the outside
New technical regulations are under creation with the reference to Korean standards</td><td rowspan="2">Regulation applying order:<table><tr><td>Less priority</td><td>More</td></tr><tr><td>National</td><td>Provincial</td></tr><tr><td>Industry in general</td><td>Specific industries</td></tr></table></td></tr>
<tr><td>Provincial Level</td><td>Some provinces have issued provincial technical regulation/regulation on permissible levels of pollutants in wastes
Compulsory within province area</td></tr>
<tr><td>Industrial Park Level
(based on survey of only some industrial parks)</td><td>Some industrial parks have issued internal standard on permissible levels of pollutants in wastes
Compulsory within industrial park</td><td>As industrial park’s internal standard is stricter than national/provincial technical regulation, applying industrial park’s internal standard ensure the compliance to provincial/national technical regulation</td></tr>
</table>

Technical regulations govern 3 waste types (wastewater, emission, waste oil) from industry in general, from some specific industries and from waste treatment. New technical regulations are under creation with the reference to Korean standards

Table 45 List of Technical Regulation-National level

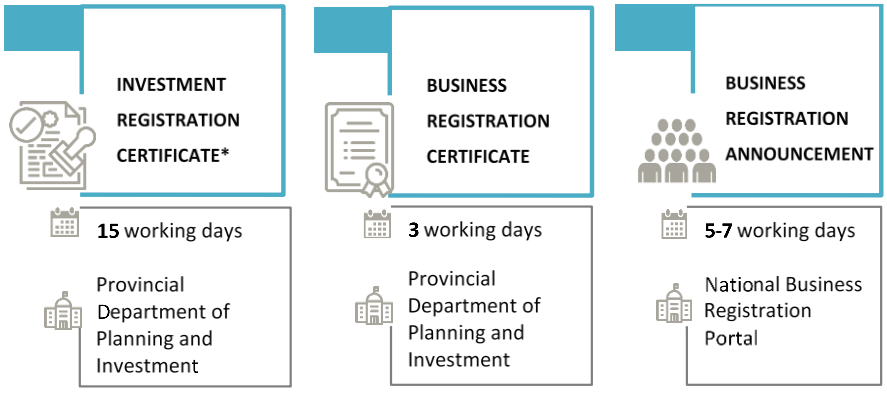
ITEM	**CONTENT**				
Management Authority	General Department of Environment, MONRE				
Waste type	**Category**	**Current QCVN**	**New QCVN plan**		
			Execution time*	Execution status	Content reference

				Start	End		
Wastewater	Industry in General		QCVN 40:2011/BTNMT	2019	2020	QCVN 40:2021/BTNMT Draft	Corresponding Korean standards
	Specific industries with high waste generation level	Natural rubber processing	QCVN 01-MT:2015/BTNMT				
		Aquatic products processing	QCVN 11-MT:2015/BTNMT				
		Pulp and paper mills	QCVN 12-MT:2015/BTNMT				
		Textile	QCVN 13-MT:2015/BTNMT				
		Steel	QCVN 52:2017/BTNMT				
		Bioethanol processing	QCVN 60-MT:2015/BTNMT				
		Cassava starch processing	QCVN 63:2017/BTNMT				
	Waste treatment method	Solid waste landfill	QCVN 25:2009/BTNMT				
Emission	Industry in General		QCVN 19:2009/BTNMT	2019	2020	Not public yet	Corresponding Korean standards
			QCVN 20:2009/BTNMT				
	Specific industries with high waste generation level	Chemical fertilizer	QCVN 21:2009/BTNMT				
		Thermal power	QCVN 22:2009/BTNMT				
		Cement	QCVN 23:2009/BTNMT				

		Refining and Petrochemical	QCVN 34:2010/BTNMT				
		Steel	QCVN 51:2017/BTNMT				
	Waste treatment method	Industrial waste incinerator	QCVN 30:2012/BTNMT				
		Co-processing in cement kiln	QCVN 41:2011/BTNMT	2021	2021	Not public yet	
		Waste oil recycling	QCVN 56:2013/BTNMT	2021	2021	Not public yet	
Waste oil	Industry in General		No QCVN				
	Specific industries with high waste generation level		No QCVN				
	Waste treatment method	Recycling	QCVN 56:2013/BTNMT	2021	2021	Not public yet	Corresponding Korean standards
(*) Execution time is expected by the state authority, reality might be different							

(2) Business registration process

i Business registration procedure – Set up a Limited Liability/ Joint-stock company



(In practice, the total length of registration may take 2-6 months)

** is required only for investments by foreign investors or deemed-to-be foreign investors (i.e. companies with more than 51% of charter capital held by foreign ownership)*

ii Apply for an operating license for conditional business lines

In case the company want to do services of treatment, recycling, co-treatment[14], recovery of energy from hazardous wastes, which may include transportation, transit, storage and pre-processing to need to get hazardous waste treatment license.

Besides hazardous waste related businesses, other establishments need to check the corresponding licenses or conditions to their business activities such as:

- Daily-life solid waste treatment facilities: No permits are required but must be certified by a competent authority to have completed environmental protection works as prescribed and must satisfy the conditions in Article 21. Decree 38/2015/ND-CP (amended and supplemented in Decree 40/2019/ND-CP);
- The discharge of industrial waste gas requires a discharge permit
- Importing scrap for use as raw production materials must have a certificate of eligibility for environmental protection;

(3) Hazardous Waste Treatment License

Conditions for being granted a license to treat hazardous waste, including but not limited to:

- Having an environmental impact assessment report approved by the Ministry of Natural Resources and Environment.
- The location of the hazardous waste treatment facility (except for the case where the production facility has hazardous waste co-treatment activities) is included in the master plans on waste management and treatment approved by a competent authority at the provincial level or higher
- Treatment systems and equipment (including preliminary processing, recycling, co-processing, energy recovery), packaging, storage equipment, temporary storage or transshipment areas, means of transport (if any) must meet technical requirements and management processes as prescribed.
- Having environmental protection works at hazardous waste treatment facilities that meet technical requirements and management processes as prescribed.
- Having a team of personnel who meet the following requirements (Although this regulation has been cancelled according to Decree 40/2019/ND-CP, the corresponding components are in Circular 36/2015/TT-BTNMT) has not been amended and repealed):
    - A hazardous waste treatment facility must have at least 02 (two) people in charge of management, administration and professional and technical guidance with professional qualifications in a major related to the environment. or chemical and be issued with a certificate of hazardous waste management according to regulations;

[14] Waste is used as raw materials, alternative fuels or is treated in an existing manufacturing process

- A hazardous waste transfer station must have at least 01 (one) person in charge of management, administration, professional and technical guidance with professional qualifications in a major related to the environment or chemistry;
- Personnel mentioned at above 2 points must pay social and health insurance premiums as prescribed by law; having a long-term labor contract in case his/her name is not listed in the Business Registration Certificate (or equivalent document) or is not part of the leadership or payroll of the organization or individual applying for a license to handle substances. hazardous waste;
- Having a team of trained operators and drivers to ensure the safe operation of vehicles, systems and equipment.

- Having procedures for safe operation of vehicles, systems, and equipment for collecting, transporting (if any) and treating (including preliminarily processing, recycling, co-processing, and recovering energy) hazardous waste. harmful.
- Having an environmental protection plan, which includes the following contents: Plan for pollution control and environmental protection; occupational safety and health protection plan; incident prevention and response plan; training plan, periodical training; program of environmental monitoring, monitoring of treatment operation and assessment of the effectiveness of hazardous waste treatment.
- Have a plan to control pollution and restore the environment when the operation is terminated.

(4) National technical standard on exhaust gas parameter of industrial waste incinerators (QCVN)

RPF is one of the energy recovery methods, and from the viewpoint of converting waste into fuel, the laws and regulations related to waste combustion and related laws and regulations were studied, and the main points are described below.

i Exhaust gas parameter standard for industrial waste incinerators (QCVN 30:2012/BTNMT)

Table 46 Exhaust gas parameter standards for industrial waste incinerators

Item	Unit	Regulation value
Total dust	mg/ Nm3	100
Hydrochloric acid	mg / Nm3	50
Carbon monoxide	mg / Nm3	250
Sulfur dioxide	mg / Nm3	250
Nitrogen oxide	mg / Nm3	500
Mercury and compounds represented as mercury	mg / Nm3	0.2
Cadmium and compounds in cadmium	mg / Nm3	0.16
Lead and compounds represented as lead	mg / Nm3	1.2

Total of other heavy metals (As, Sb, Ni, Co, Cu, Cr, Sn, Mn, TI, Zn) and compounds	mg / Nm3	1.2
Total hydrocarbons	mg / Nm3	50
Dioxins (PCDD / PCDF) incinerator with a capacity of 300 kg / h or more	ngTEQ / Nm3	0.6

The maximum permissible values in the table are for combustion furnaces built in 2015 or later.

ii Major criteria for operation of industrial waste incinerators (QCVN 30:2012/BTNMT)

- The secondary combustion zone is 800℃ or higher.
- The incineration of radioactive, explosive, and other hazardous wastes is prohibited.
- The operation log of the industrial waste incinerator should be kept and the amount and type of waste should be clearly described.
- Wastewater generated from furnace exhaust gas treatment systems may be discharged if it is treated in accordance with QCVN40:2011 /BTNMT National Technical Regulations on Industrial Wastewater.
- In order to prevent fire accidents, emergency response plans and automatic shut-off functions are necessary in the combustion zone.
- The industrial waste incinerator shall be equipped with automatic monitoring devices for continuous measurement and recording. temperature parameters of combustion zone, exhaust gas temperature after exhaust gas treatment system, etc.

Although some of the standards for industrial waste incinerators are stricter than the Japanese standards, it is necessary to confirm in the future that the combustion furnaces to which RPF is supplied are capable of meeting these requirements.

If the regulation values of the exhaust gas parameters are satisfied, it can be judged that – as far as it is not a specified hazardous waste – combustion of raw material, which is normally expected, for RPF is possible since there is no regulation on act of burning itself.

(5)National technical standard for industrial wastewater (QCVN 40:2011/BTNMT)

When paper sludge is used as a raw material for RPF, there is a possibility that wastewater is generated in the manufacturing process, so the standards for industrial wastewater were studied. The values in the table are the specified values for pollutants in industrial wastewater discharged to water sources for domestic water supply. When paper sludge with high water content is used, it should be analyzed beforehand.

Table 47 National technical standards for industrial wastewater

Item	Unit	standard value
Temperature	℃	40
Chromaticity	Pt/Co	50

pH (measure of acidity)	-	6~9
BOD5 (20°C)	mg/l	30
COD	mg/l	75
TSS (Total Suspended Solids)	mg/l	50
Arsenic	mg/l	0.05
Mercury	mg/l	0.005
Lead	mg/l	0.1
Cadmium	mg/l	0.05
Hexavalent chromium	mg/l	0.05
Trivalent chromium	mg/l	0.2
Copper	mg/l	2
Zinc	mg/l	3
Nickel	mg/l	0.2
Manganese	mg/l	0.5
Iron	mg/l	1
Total cyanide	mg/l	0.07
Total phenol	mg/l	0.1
Total mineral oil	mg/l	5
Sulfide	mg/l	0.2
Fluorine	mg/l	5
Ammonium (N equivalent)	mg/l	5
Total nitrogen	mg/l	20
Total phosphorus (P equivalent)	mg/l	4
Chloride (not applicable if discharged to a salt or brackish water source)	mg/l	500
Residual chlorine	mg/l	1
Organochlorine pesticide	mg/l	0.05
Organophosphorus insecticides	mg/l	0.3
Total PCB	mg/l	0.003
E. coli group	Bacteria/100ml	3000
Total alpha intensity	Bq/l	0.1
Total beta intensity	Bq/l	1

Various sampling and analysis should be carried out in accordance with the various methods of the national standard TCVN: TCVN 6663-1:2011 (ISO 5667-1:2006): Water quality - Guidelines for sampling programs and sampling methods, TCVN 7877:2008 (ISO 5666 -1999): Water quality - Measurement of mercury, TCVN 6658:2000: Water quality - Measurement of hexavalent chromium, etc.

6.4. Waste in Soc Trang Province

(1)Information on collection and transportation of wastes

The results of interviews with Soc Trang Province and others regarding waste collection and transportation

in Soc Trang Province are as follows.

- Global Clean Green Technology Environment (GE), a waste collector in Soc Trang Province, collects 15 tons of waste per day at one location in Cu Lao Dung District.
- We are considering a plant to process waste from four districts, including three other districts (Ke Sach, Long Phu, and Trand De), and the amount of waste generated in the four districts is 200 tons/day.
- Garbage Collection Fees in Soc Trang Province
  Sales from People's Committee: 300 million VND / year (support from one district)
  Sales from each household : 20,000-30,000 VND / 1 household / month
- The price is set by the government at about 600 VND/(Collection Fee 365VND, Transportation Fee 247VND),transportation fees are proportional to the distance. Collection fees are charges to household and transportation fees are charged to the government.
- The price of about 600 VND is set by the government, and it is almost the same throughout the country.
- Waste collector in Cu Lao Dung District, etc.
  Number of people collecting garbage: 4 (open from 3:00 a.m. to 3:00 p.m.)
  Number of vehicles: 1 car (2.4t), 1 motorcycle
  Collection volume: 15 t/day (transported from households to one collection site per district)
- Women in Soc Trang Province have been collecting, separating, and selling empty cans, cardboard, and waste plastics in order to reduce environmental pollution and increase their income at the same time. While not interfering with these activities, there is a possibility that we can secure raw materials by asking them to help us separate items that are hard to be valued.

(2)Information related to waste materials in Soc Trang Province

The following is the content of the interview with Soc Trang Province and others regarding waste management in Soc Trang Province.

- The amount of general waste per day is about 600 tons (collected).
  The collection covers about 60% of the province, mainly within the city, but not around the city.
  The discharged waste is basically not sorted and all disposal is by landfill.
- There are 8 treatment plants in Soc Trang Province, operated by the Soc Trang Urban Development Corporation, and three of them are incineration plants. Most of the waste that cannot be incinerated is disposed of at landfill, and the sewage reservoirs of the treatment plants are filled up during the rainy season.
- Some general waste is not collected and transported properly, and is not even taken to landfill sites, and is dumped into rivers. Some general wastes are dumped into rivers, where they are discharged directly into the ocean, becoming a cause of the marine plastic problem, and requiring improvement, including measures by local governments.

- There is a desire to stably dispose of hazardous and industrial wastes within the Ministry.
  Medical waste generated by the hospital is registered as hazardous waste and incinerated at three locations.
  The amount of medical waste generated by hospitals that are registered is 134 tons/year, and there is also waste from hospitals that are not registered. The cost paid by hospitals for collection and treatment is 24,600 VND/kg.
- The three incineration facilities have capacities of 60kg/h, 25kg/h, and 30kg/h, respectively, which are not enough to cover the amount of waste generated, including medical waste. Due to the corona disaster, processing is even more likely to be delayed.
- The Table 48 below shows the breakdown of industrial solid wastes generated and treated in Soc Trang Province. This table is taken from the Project on Update of Normal Industrial Solid Waste Generation and Management Status in Soc Trang Province in 2020. Of the 1,177.24 tons/day of solid waste generated, 1,057.90 tons/day, or about 90%, is recycled or reused, indicating that a fairly high level of recycling is being carried out. It seems that most of the waste is turned into compost or feed.

Table 48 Soc Trang Province 2020 industrial waste emissions and breakdown

Unit: t/day

Industry type	Recycling and reuse	Construction materials or roadbed preparation materials	Treatment and reclamation	Total
Seafood preparation and processing	56.25	-	26.26	82.51
Food and food processing	320.41	-	70.24	390.65
Sugar refining	512	-	-	512
Beverage Production	164.82	-	8.46	173.28
Fertilizer production	0.09	-	-	0.09
Wood and bamboo processing	1.02	-	0.21	1.23
Equipment manufacturing	1.12	-	0.49	1.61
Building material manufacturing	1.83	12.62	-	14.45
Plastic	0.13	-	0.17	0.3
Sewing	0.21	-	0.83	1.04
Energy-related	0.02	0.05	0.01	0.08
Total	1,057.90	12.67	106.67	1,177.24

- Production companies that generate large amounts of industrial waste (e.g., Vietnam Clean Fisheries Corporation, Soc Trang Saigon Brewery, etc.) sort the waste and hand it over to contractors in Ho Chi

Minh City, Can Tho City, Bac Lieu Province, Camau Province, etc., and let them dispose of it according to regulations. However, due to the distance and cost involved, it would be desirable to build a processing facility in Soc Trang Province.

- In small and medium-sized enterprises, sorting is not thoroughly implemented, and some sorting is done in order to sell saleable waste to small waste collectors in the province (e.g., metal, cardboard), but the worthless and unsaleable waste is taken to the province's landfill together with domestic waste.
- The sugar refineries in Soc Trang Province also sell electricity through biomass power generation, which generates electricity by burning bagasse, rice husks, and woody biomass, which are the dregs of sugar cane. The total output of the power generation facilities is 6,000 kW.

(3)Estimated amount of RPF usable waste

Since information on the composition of waste in Soc Trang Province is not available, we estimated the amount of waste that could be used for RPF out of about 600 tons of daily general waste generated in Soc Trang Province based on the composition[15] of waste in Hanoi City in Vietnam. The results are shown in Table 49.

Table 49 Estimated amount of waste that can be used for RPF (general waste of Soc Trang Province)

Item classification	Waste composition ratio in Hanoi, % (dry season)	Soc Trang Province			
		Daily amount (t)	Monthly (t)	Estimated coefficient (%)	Estimated usable quantity per month (t)
foodstuff	63.2	379	11,755		
plastic	**7.2**	**43**	**1,339**	**50**	**670**
coal ash	9.1	55	1,693		
paper	**5.3**	**32**	**986**	**30**	**296**
Garden-related	3.2	19	595		
glass	1.6	10	298		
fiber	**0.9**	**5**	**167**	**50**	**84**
Metal	0.9	5	167		
ceramics	0.4	2	74		
tree	**0.6**	**4**	**112**	**30**	**33**
Rubber, leather	0.2	1	37		
Other	7.4	44	1,376		
Total	**100**	**600**	**18,600**		**1,083**

There are few supplementary explanations. First of all, among the classification items, the four items that are

[15] As for the composition of waste in Hanoi, we refer to the following literature.
Grant-in-Aid for Comprehensive Environmental Research Promotion, Research Project, Comprehensive Research Report
Development of Waste Database and Evaluation of Waste Management System in Southeast Asia
(K2118 K22059 K2338)
March 2012 Principal Researcher: Masahiro Osako, National Institute for Environmental Studies (NIES)

considered to be usable as raw materials for RPF are plastic, paper, fiber, and wood. These are then multiplied by the waste composition ratio of Hanoi, and the daily (t) and monthly (t) amounts generated are first calculated. In addition, the estimated usable quantity is calculated by multiplying the amount of waste generated by the prospective factor, which is the percentage of waste that can be used as a raw material for RPF. As for coal ash, in Soc Trang Province, which is located in the southern part of the country, it is highly likely that the actual composition ratio will be quite low.

The estimated coefficient for plastic is 50%, assuming that there is a certain amount of plastic that can be used as valuable resources and plastic that cannot be used in RPF because it contains chlorine. The same is true for paper, which is estimated to have a large amount of newspapers and magazines that can be used as valuable resources, and a factor of 30% is used. As for fiber, the coefficient is set at 50%, assuming that there are some materials that are difficult to use, such as those containing water. Lastly, wood is usually pruned wood, which is difficult to use because of its moisture content, and we estimate that only 30% of the wood is actually usable.

This time, the composition of garbage in Hanoi is based on data from the dry season. In the rainy season, the amount of plastic increases a little more (1.4 times), but the estimation and calculation is based on the data of the dry season, which is less. In addition, since about 10 years have passed since the survey was conducted in March 2012, we believe that the amount of plastic used has actually increased somewhat. In addition, there are about 40% of areas where no collection has been made, and if these areas are taken into account, the amount of waste plastic is expected to be even larger, but this is not included in this estimation.

Since the estimated amount of usable raw material for final RPF is 1,083 tons per month, and the plastic ratio is 62%, we believe that we can secure sufficient amount for RPF production.

(4)Other possible waste, industrial park information, etc.

i Hospital waste

According to Decision No. 3232/QĐ-UBND(December 7, 2018) of Soc Trang Provincial People's Committee on approval of urban development projects in Soc Trang Province until 2030, environmental standards will be met in all collection and treatment of hazardous medical waste for the year 2050.

Currently, medical waste treatment in the province is in line with the area model indicated in the Soc Trang Provincial People's Committee's Plan No. 42/QĐ-UBND (April 10, 2017) on collection, transportation and treatment of hazardous medical solid waste in Soc Trang Province with a view to the stage of 2016~2020 and 2025, and Plan No. 42/KH-UBND (December 14, 2017) in line with the area model presented in Decision No. 3302/QĐ-UBND (December 14, 2018) of Soc Trang Provincial People's Committee to supplement. The following table is taken from the medical waste information of some registered medical institutions that

report their regular medical waste management status in Soc Trang Province. At most, it involves 56 tons of discharge per year.

We believe that medical waste, as mentioned earlier in the information related to waste in Soc Trang Province, can be sorted into infectious hazardous waste and non-infectious waste. We are planning to survey medical wastes that can be used as raw materials for RPF, such as used intravenous drip packs, unneeded bed sheets and X-ray films that do not contain blood.

Table 50 Amount of medical waste in Soc Trang Province (registered sites only)

Unit: kg/year

No.	Hospitals/Medical Centers	Total amount of generated waste	breakdown							
			Infectious waste				Non-infectious but hazardous wastes		X-ray film	Other hazardous wastes
			Infectious waste and sharp objects	Infectious waste and non-sharp objects	Highly infectious waste	Dissection Materials	Hazardous chemicals	Broken equipment, including mercury and heavy metals		
1	Hospital specializing in obstetrics and pediatrics	56,041	1,390	36,965		17,686				
2	Ke Sach Medical Center	3,816	318	3,251	9	238				
3	Military and Civilian Medical Hospital	1,303	65	988		29	220	1		
4	Long Phu Medical Center	7,537	80	6,610	0	826		5		16
5	Hoang Tuan Limited Liability Company	10,335	10,273					58		4
6	Seok Chan Private Ophthalmology Specialist Hospital	693		693						
7	Vinh Chau Town Medical Center	15,927	1,671	10,176		3,944			30	106
8	Nga Nam Town Medical Center	11,745	11,680					60		5
9	Thanh Tri District Medical Center	11,729	11,700					24		5
10	My Tu District Medical Center	7,736	652	7,084				1		
11	Chau Thanh District Medical Center	2,738	730	1,825	183					
12	Cu Lao Dung District Medical Center	2,008	1,460	548						

ii Industrial park information, etc.

In Soc Trang Province, agriculture and fisheries are thriving, and at the moment there are few heavy and light industry enterprises. As a ratio, tertiary industry is on the rise while primary industry is on the decline. On the other hand, there is the An Nghiep industrial park and the Tran De marine special economic zone, and it is expected that more industrial parks will be opened in the future, and the types and amount of industrial waste generated will change accordingly.

In terms of attracting factories and other facilities, provinces near Ho Chi Minh City have been attracting a lot of foreign investment, but in the southern Mekong Delta, the most likely candidate around Soc Trang Province is Cha Vinh Province, which is adjacent to Soc Trang and has already established a number of industrial parks. With the decision to establish the Hiep My Tay Industrial Park in Kaugan District, it is highly likely that the province will continue to attract companies and promote factory construction.

Hiep My Thai Industrial Park will have an area of 40ha and is expected to start operation in July-September 2023. It is expected to house companies mainly engaged in sewing, leather shoes, handicrafts, construction materials, fertilizers, electronic equipment manufacturing, food processing, and motorcycle and tractor industries.

Among the four provinces surrounding Soc Trang Province, including Chabin, Bac Lieu, Kamau, and Soc Trang, Chabin Province is the only one with a record of exports related to light industry, while the other provinces seem to have less heavy and light industry. The export value related to light industry in Chao Binh Province is larger than that of Can Tho City, which is a large city in the vicinity.

In Chao Binh Province, the number of industrial parks is increasing and the Dinh An Special Economic Zone (SEZ) is also located in the province, making it even easier to attract more companies. The SEZ's corporate income tax is exempt for the first four years after the income is generated, 5% for the next nine years, 10% for the next two years, and 25% thereafter.

In addition, Chao Binh Province has a high potential for marine transportation since it has an international port of Cai Mep Chi Vai (Ba Ria-Vung Tau Province), and therefore is considered to be an area with high international development potential. In the future, we would like to consider receiving waste generated in the area around Ho Chi Minh City in Cha Vinh or Soc Trang provinces by marine transportation and converting it into RPF. The merits of marine transportation are the avoidance of traffic congestion and the reduction of CO2 emissions, and in the case of long-distance transportation, it may lead to cost reduction. In Japan, there are many cases where waste from the Kanto and Kansai regions is transported to regional areas for disposal, and it is expected that Vietnam

will also see some level of wide-area disposal in the future.

Chabin and Soc Trang provinces are separated by a tributary of the Mekong River and are generally traveled by ferry and as such. However, the Dai Gai Bridge to be constructed between Chabin and Soc Trang provinces will bring them within 50 km of each other, and economic exchanges are expected to become more active.

Can Tho City is a large city in the vicinity of Soc Trang Province, where large industrial parks have been built, including the Tra Noc Industrial Park. In the future, the amount of waste, including hazardous waste, is expected to increase. In Can Tho City, incineration power is being generated, but the capacity is only 400 tons per day, and there are plans to incinerate landfill waste in other areas, making it difficult to significantly increase the processing capacity. On the other hand, other incineration facilities in the city have excess capacity, but it is hoped that recycling, including thermal recycling, will be increased in the future.

iii Sorting and processing plant

In Soc Trang Province, there is a solid waste sorting and processing plant built with Norwegian ODA, which has been in operation since 2015. The plant has the capacity to sort 160 tons per day. From the sorted food waste, 100 tons per day of compost is produced and 5 tons per day of recyclable (valuable) plastic is produced.

Since not all plastics can be recycled as valuable materials, we would like to discuss with the Ministry of Soc Trang whether the flow to thermal recycling can be considered from the perspective of extending the life of landfill sites.

6.5. Technologies and products to be introduced

(1)Outline of Ogawa Econos Inc's business

Founded in 1952, Ogawa Econos Inc is engaged in the collection and transportation of general and industrial waste, as well as the intermediate treatment and recycling of general and industrial waste, while engaging in the pumping of human waste and the maintenance and management of septic tanks, as well as the maintenance and management of public sewage systems. In recent years, the company has also been focusing on environmental education, accepting factory tours, giving classes at elementary schools, and providing opportunities to think about the environment in general by being certified by the Ministry of the Environment as a place for hands-on experience.

The company is also involved in environmental consulting and carbon offsetting. The company also promotes health management to maintain stable operations and the health of its employees and holds

yoga classes.

Figure 68 Environment workshop

Figure 69 Health management

Figure 70 Overseas support

(2)Products and technologies to be introduced in Vietnam

i Features of products and technologies

Ogawa Econos is engaged in the business of manufacturing solidified waste fuel (hereinafter referred to as PRF), which is widely used as an alternative fuel to coal in Japan; being one of the top producers of RPF in Japan, OGAWA Econos has the technology to ensure the quality of RPF by managing and adjusting the distribution of waste materials used as raw materials for RPF. In addition, the company has been providing technical guidance to new companies entering the market and is considering the spread of the technology in Vietnam based on technical guidance on production, rather than just introducing equipment.

① Recycling of waste materials

RPF plays a role in thermal recycling by solidifying waste materials such as waste plastics, paper, wood, and fiber scraps by adding heat to them and using them as steam in boilers or for power generation. Unlike landfill or simple incineration, the RPF method of waste solidification fuel can be used effectively as a substitute for coal and other materials, and also allows for local production and local consumption of waste within a certain area.

② Substitutes of fuels such as coal

By changing the blending ratio of waste plastics in the manufacturing process, the calorific value of RPF can be increased to the same level as coal (about 6,000 kcal/kg) or coke (about 8,000 kcal/kg), making it an alternative fuel to coal. In Japan, there are many users such as paper mills that use coal, and in Vietnam, demand from companies that use fossil fuels is expected to be high.

③ Environmental impact

RPF is easy to dispose of exhaust gas and ash because it contains less incombustible materials and less environmentally regulated substances such as sulfur, nitrogen, and ash than coal. In addition, RPF is transported in a compressed and solidified state, so unlike plastic, which tends to be bulky, CO2

emissions during transport are reduced, and CO2 emissions during combustion are about 67% of those of coal, making it a fuel that contributes to the prevention of global warming.

(3)General quality standards for products, etc.

General product specifications of RPF are shown in Table 51. RPF is currently standardized as JIS Z 7311, the Japanese Industrial Standard. Obtaining JIS certification means that the company has been certified as a manufacturer with the technical capability to manufacture products in accordance with the strict standards, and that the quality of the products has been guaranteed. Of the more than 200 RPF companies in Japan, 20 have acquired JIS certification, including three plants owned by Ogawa Econos.

Table 51 General quality standards for RPF

General quality standards for RPF	
Quality Items	Quality range
calorific value	25MJ to 33MJ/kg (6,000 to 8,000kcal/kg)
	Note: Can be adjusted by blending raw materials
chlorine (Cl)	Grade A 0.3% or less
	Grade B: Over 0.3% and under 0.6
	Grade C: Over 0.6% and under 2.0%.
(nutritional) mineral content	6% or less
moisture	10% or less (normally 5% or less)
nitrogenous content	1% or less (normally 0.1% or less)
sulfur content	1% or less (normally 0.5% or less)
externals	Cylindrical Diameter 35 mmφ
	Length 30mm to 150mm

Figure 71 shows the appearance of the RPF. The RPF manufactured by Ogawa Econos has a diameter of 35 mm and a length of around 100 mm, and there is also a smaller RPF manufactured by a molding machine called a ring die, which has a diameter of around 15 mm and a length of around 30 mm.

Figure 71 RPF samples

Figure 72 RPF storage area

(4)Product manufacturing flow

Figure 74 shows the basic manufacturing flow for RPF. Waste plastics, paper scraps, wood scraps, fiber scraps and as such, are crushed as raw materials, stored in tanks, mixed in a certain ratio of about 60% waste plastics and about 40% other raw materials, and fed into the molding equipment. After the materials are fed into the molding equipment, they are heated by heaters, etc., and molded at about 140°C to 150°C, and then transported to the storage area.

In Japan, laws and regulations require that the RPF be cooled by water or other means during transport and that the temperature be kept below about 40°C at the storage site. When conducting RPF business overseas, cooling with water and other temperature control is technically necessary, regardless of local laws and regulations. In addition, the appearance of the material is also controlled, because if there is too much water in the material, the shape will easily collapse.

Figure 73 shows a photo of the RPF being loaded. Normally, RPF is transported by trailer with a load of about 20-25 tons. The temperature is thoroughly controlled when loading for delivery.

Figure 73 RPF loading operation

The flow shown in Figure 74 is for accepting pre-sorted raw materials. When accepting unsorted raw materials, a separate sorting facility is required. When sorting is required, what kind of equipment is required is described below for reference.

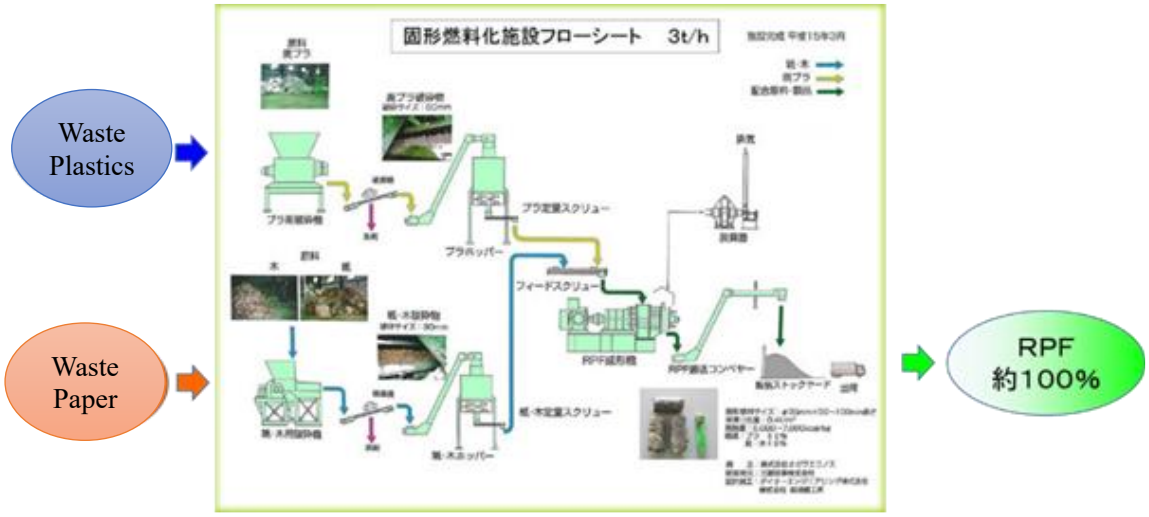
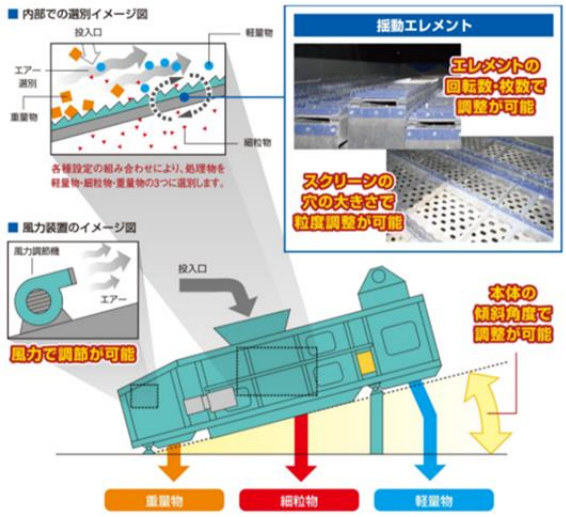


Figure 74 RPF production flow

i Vibration sorting machine

In a vibratory sorter, mixed waste such as waste plastics, wood chips, and rubble are fed in after being roughly crushed, and the crushed waste rides on plates vibrating inside the facility. An image of the inside of the facility is shown in Figure 75.　In the past, sorting by a large number of people on an earthen floor was the main method of sorting, but with the introduction of vibrating sorting machines, it is relatively easy to separate large, heavy items from lighter ones.



Source: MIIKE Inc

Figure 75 Vibration sorting machine mechanism

ii Optical sorting machine

It is used for further sorting of waste plastics and other materials that have been separated by the vibration sorter.

Materials are identified by shining near-infrared light on the waste flowing on the conveyor belt and analyzing the reflected light (spectrum analysis). The identified materials are then sorted by flicking them with air or by other means. Although it is possible to sort each type of plastic, the system is mainly used to remove chlorine when it is used in RPF production.

The conveyor speed is generally about 1 to 3 meters per second, which is a fairly high speed for sorting, so it is possible to sort a larger amount per hour than a human sorting on a conveyor.

Source: PELLENC ST

Figure 76 External view of optical sorting machine

Figure 77 Identification by reflected light in the near-infrared

Figure 78 Air removal of identified objects.

(5)Comparative advantage over competing products and technologies

The advantages that Ogawa Econos has with regard to RPF and the comparison with other waste fuels are described below.

i Chlorine management technology

Chlorine is an important control item because it causes corrosion and other effects in boiler facilities that use RPF. In particular, since many waste plastics contain chlorine, technology is required to reduce the chlorine content in RPF below a certain level by inspecting and removing it in advance.

Ogawa Econos conducts chlorine content testing of waste and RPF using X-ray fluorescence analyzers, etc., and has established manufacturing technologies such as waste mixing methods based on these tests, and has obtained JIS certification for RPF manufacturing, which includes grade A with low chlorine content (JIS Z 7311 RPF-A).

ii Comprehensive waste treatment and waste facility operation capacity

Ogawa Econos is a multifaceted waste management company that handles a wide variety of waste, including resource waste treatment commissioned by local governments, collection and transportation of general and industrial waste, intermediate treatment (including shredding and incineration) and recycling, maintenance and management of sewage treatment facilities and landfill disposal sites, and production and sales of compost. The company has been working with local governments to improve the quality of plastic containers and packaging discharged from households.

In addition, with regard to RPF, which we are planning to promote in Vietnam, we have more than 15 years of experience in operating three plants in Japan, and based on this experience, we have been providing advice to other companies and cooperating with them in supplying raw materials (waste). He has a lot of experience in manufacturing RPF of a certain quality from various wastes across areas, as well as in safety and facility maintenance management.

iii Comparison with competing fuels

As a waste-derived fuel, there is fluff fuel, which is made by crushing waste plastics into a certain size. Fluff fuel has a characteristic of higher calorific value than coal and burns faster in a combustion furnace, but it needs to be adjusted by mixing it with other fuels. In addition, from the perspective of chlorine, fluff made only from waste plastics has some limitations, such as a large variation in chlorine, which makes it difficult to use unless it is designed for high chlorine or in a combustion furnace that is not easily affected by chlorine.

In the case of RPF, it is compressed and solidified, and compared to fluff, it has the characteristic of burning gradually. Chlorine is also produced by mixing it with wood chips that do not contain chlorine, so it is easy to control the chlorine content to a certain level.

In the case of fluff fuel (RDF), which is partly popular in Southeast Asia, separation from household garbage is an issue, and even after separation, there is still moisture attached to the waste plastics, so there are problems such as high moisture content when viewed as fuel. However, depending on the combustion furnace, crush-only fluff may be more suitable in terms of shape than solidified RPF. In the case of RPF, some moisture attached to the raw material evaporates due to the heat applied during the manufacturing process, making it less susceptible to moisture.

Another waste fuel is wood chips, which are made by crushing wood into a certain size. Wood chips have a very high value as a biomass fuel, but their calorific value is low (17MJ), so a large amount is required. In terms of calorific value, the amount of CO2 emitted during transportation, including marine and land transportation, is also higher than that of RPF.

On the other hand, wood pellets, which are made by first grinding wood into powder and then pelletizing it, rather than using wood chips, can be considered as one type of fuel, but they are said to emit a lot of CO2, including during the manufacturing process, and their value per calorific value is expected to decrease. As for wood-based fuels, it is necessary to curb excessive deforestation from the viewpoint of biodiversity, as has been seen as a problem in Europe.

One of the most common waste fuels produced in Southeast Asia is oil palm kernel shell (PKS), which has a calorific value of about 17MJ like wood chips, lower than that of RPF, and has a moisture content of about 20%. PKS is also characterized by its lower calorific value than RPF and its moisture content of about 20%. Since PKS is a residue of palm oil, the production of PKS is directly affected by the production of palm oil.

Although the calorific value is not as high as that of RPF, the CO2 emissions from the manufacturing process and other processes are low, making it superior to wood chips and RPF when considered only from the perspective of CO2 emissions.

A more special type is paper sludge. Paper sludge has a high moisture content and has little value as a fuel, but if its moisture content is lowered, it can be used as an effective auxiliary fuel. Ogawa Econos is using paper sludge generated from some paper mills as a raw material. In addition, some RPF molding machines are capable of molding RPF while squeezing out the water.

6.6. Positioning of the dissemination of the RPF business in Vietnam

(1)Objectives of promoting the RPF Business in Vietnam

i As thermal recycling

As a result of the exchange between Hiroshima Prefecture and Soc Trang Province, Ogawa Econos

was given the opportunity to visit the area and hold discussions with government officials and local companies engaged in the collection and transportation of waste. In the course of these discussions, the parties concerned expressed their desire to promote full-scale waste recycling within Soc Trang Province, rather than relying on outside the province. In this context, they have shown particular interest in the RPF business, and after conducting this survey, we would like to proceed with the appropriate introduction.

In 2020 (Resolution No. 55 of the Politburo of the Communist Party), Vietnam will prioritize power system and renewable energy development over coal-fired power generation. The 8th Power Master Plan (PDP8) is also being reviewed.

Despite this situation, most of the coal produced in Vietnam is used domestically, although some is exported (7-10%). In addition, according to the development plan of Vietnam's coal industry until 2020 and the study of its prospects until 2030 (Coal Development Master Plan 2011), referred footnote1, 64% of the coal demand in 2025 is expected to be imported (demand: 175,026 kt; imports: 112.081 kt), Even if state-owned coal-fired power plants are reconsidered and switched to renewable energy sources in the future, the private sector is expected to face the challenge of securing coal and natural gas to meet the portion of energy demand that cannot be met by renewable energy sources with rapid economic growth. As of 2020, coal imports have increased by 25% year on year[16].

Although Vietnam will continue to utilize renewable energy sources and the associated investments will increase, in terms of supporting significant economic growth, the possibility of relying on coal-fired power generation will continue for the foreseeable future, while taking CO2 emissions into consideration.

In terms of renewable energy, Soc Trang Province has a windy coastal section of 72 km, and 20 wind power facilities are planned; as of 2021, the first three are operational and connected to the national power grid. The project aims to eventually generate 1,435 MW of electricity.

On the other hand, there is a point at which the shift to renewable energy sources will not be completed in time, and some projects, even within Soc Trang Province, are aiming to operate thermal power

[16] Development Plan of Vietnam's Coal Industry by 2020 and Prospect Study by 2030
(Coal Development Master Plan 2011)
FY2011 Overseas Coal Development Enhancement Study "Survey on Coal Development in Vietnam
February 2012 New Energy and Industrial Technology Development Organization (NEDO)

generation using liquefied natural gas (LNG) instead of coal-fired power generation. An overview is given in Table 52. On a commercial basis, the project aims to be operational by 2025.

Table 52 Liquefied natural gas thermal power generation plan (in Soc Trang Province)

Project Type	Total Capacity (MW)	Pipeline Capacity (MW)	Project Status	Project Location	Project Developer
Thermal	9,600	9,600	Announced	Soc Trang Province	Millennium Energy Vietnam

At present, as in Japan, we believe that there is a high demand for alternative fuels to coal, and the spread of the RPF business will contribute to this. The corporate philosophy of Ogawa Econos includes the action guideline "Think Globally, Act Locally," and the company hopes to utilize the waste treatment technology it has cultivated over the years in Japan for the effective utilization of waste materials needed overseas.

ii As chemical recycling

It also discusses what kind of derivative projects can be considered when the RPF business as thermal recycling reaches the end of its usefulness as an alternative fuel to coal and other fossil fuels in the future.

One candidate is to supply plastic as a raw material for chemical recycling. Specifically, waste plastics are molded and solidified at a facility that manufactures RPF, and then supplied to a gasification facility. At the gasification facility, the molded material is gasified using a low-temperature gasifier and a high-temperature gasifier to produce a synthesis gas of hydrogen and carbon dioxide, which is then replaced by ammonia and liquefied carbon dioxide, respectively.

In Japan, the system has already started to operate, and I assume that it will increase further in the future. In Vietnam, if the use of fossil fuels as well as coal is further controlled, the distribution and chemical recycling of waste plastics will be promoted in a wide area, especially in coastal areas. The waste plastics to be used for chemical recycling are basically the same as those used in RPF for thermal recycling.

6.7. RPF user candidate survey

Based on the case studies in Japan, paper mills and cement plants are considered to be candidates for RPF delivery. Potential users in the vicinity of Soc Trang Province are described below.

(1) Nhà Máy Giấy Lee & Man Việt Nam (Lee & Man Paper)

Type of Industry: Paper mill

Location: Hau Giang Province (adjacent to the northwestern part of Soc Trang Province).

40 km from central Soc Trang

Others: There is a possibility of using paper manufacturing sludge as a raw material for RPF, and even if it is only a small amount, we can aim for a cycle of converting waste into fuel and returning it to the paper mill.

As for paper sludge, if it has a lot of moisture, it is possible to use a molding machine that can remove the moisture from the molding equipment, and if the moisture content is low, it can be mixed in small amounts and turned into fuel.

(2) An Giang Cement Factory

Type of Business: Cement factory

Location: An Giang Province. 70 km from central Soc Trang.

Other : . There is a National Technical Regulation for the co-processing of hazardous wastes in cement kiln furnaces (QCVN 41:2011/BTNMT), but it is not considered to have a direct impact on the combustion of RPF.

6.8. RPF raw material (waste) candidates (survey of the source of RPF raw materials)

At the moment, Soc Trang Province has a thriving fishery and agriculture industry and little industrial plastic waste. Therefore, we are considering securing general waste mainly from Soc Trang Province and companies around it to be used as raw materials for RPF. We analyzed the information on the collection and transportation of waste by our potential counterpart, Global Clean Green Technology Environment (hereinafter referred to as GE), as well as the information on waste in Soc Trang Province. In January 2020, representatives of GE and other related parties visited Ogawa Econos to inspect recycling facilities, experience collection, transportation, and sorting operations, and discuss the possibility of an intermediate processing facility in Soc Trang Province. They also discussed the possibility of an intermediate treatment facility in Soc Trang Province. See also Figure 79, Figure 80.

Figure 79 Discussions with a visiting delegation from GE

Figure 80 Experience of sorting recycled paper by GE delegation

6.9. Survey of RPF competitor

We also surveyed the existence of precedents and other examples of RPF projects and waste power generation. At present, we have determined that there are no competing projects in the immediate area. The project in Can Tho City that we confirmed this time also targets waste in Can Tho City, and we have confirmed that it is not a competing project.

(1)Dai Dong Environment Solutions (ICHIKAWA KANKYO ENGINEERING)

Type: RPF production

Location: Hung Yen Province, southeast of Hanoi (about 40 km from Hanoi)

Overview: Dai Dong Environment Solutions is a subsidiary of Hanoi URENCO; established by URENCO11, a local waste management company in Nanoi with 49% investment and Ichikawa Environmental Engineering with 51% investment, and has been manufacturing and selling RPF as a joint venture company since May 2016(Prior to the joint venture, RPF production and sales started in 2014).

Waste plastics and paper sludge are used as raw materials for RPF .

The RPF is made from waste plastics and paper sludge, and since paper sludge contains a lot of water, a molding machine with a dewatering function is used. In overseas, it is difficult to secure the same level of waste materials as in Japan, so it is necessary to fully consider measures to deal with moisture content.

(2)Can Tho City

Type: Waste power generation

Location: Can Tho city (60km northwest of Soc Trang province)

Overview: In Vietnam, waste power generation is being carried out in the capital city of Hanoi and Ho Chi Minh City, but in the vicinity of Soc Trang Province, waste power generation is being carried out in Can Tho City (population: 1.2 million). The city collects about 600 tons of garbage per day, excluding hazardous and industrial wastes, and the garbage power generation facility utilizes about 400 tons per day. The facility generates 60 million kWh of electricity per year, and all of the electricity is sold, except for that used at the facility.

6.10. Potential of adopting the project

(1) Estimate of RPF business income and expenditure

To estimate the income and expenditure forecast for the RPF business in Vietnam, and to calculate the waste treatment cost and RPF selling price related to the minimum necessary sales.

The following table shows the results. First of all, the minimum cost of waste treatment is 4 yen/kg, and the minimum selling price of RPF is 5 yen/kg, which is the price required to continue the business. It is expected to take about 7 years to recover the investment.

Currently, the cost of collecting general waste alone is only equivalent to about 3 yen/kg (600VND/kg) in sales, and RPF production requires additional costs, so we would like to discuss separate treatment costs with the position that it will help extend the life of landfill sites. As for the selling price of RPF, the market price of imported charcoal is about 10-15 yen/kg, and compared to that, the selling price of 5 yen/kg is inexpensive, but we believe that discussions are necessary to make it a more stable business.

In estimating the income and expenditure, the labor cost is about 17% of that in Japan, and the portion of the utility cost that is based on a pay-as-you-go system is the same as in Japan, but there is no basic charge (fixed cost), so we can aim for inexpensive manufacturing. We have secured a used molding machine that was used at Ogawa Econos, and we estimate that the total initial investment will be 300 million yen, including 200 million yen for the equipment (excluding the molding machine) and 100 million yen for the building[17].

In addition, although not included in the current estimation, we expect to improve profitability by considering the use of JCM and securing industrial waste materials with high unit prices for treatment in the future.

[17] Electricity, labor, and freight costs are estimated using the Japan External Trade Organization's JETREO investment cost comparison and based on the actual results of the OGAWA Econos RPF plant in Japan.

Table 53 Trial balance of RPF business

Item	Unit	1st year	2nd year	3rd year	4th year	5th years	6th years.	7th years.	8th years.	9th years.	10th year
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Volume handled	t/year	6,336	13,464	21,600	21,600	21,600	21,600	21,600	21,600	21,600	21,600
Sales	**Thousands of yen/year**	**57,024**	**121,176**	**194,400**	**194,400**	**194,400**	**194,400**	**194,400**	**194,400**	**194,400**	**194,400**
Labor cost	Thousands of yen/year	4,847	10,300	16,524	16,524	16,524	16,524	16,524	16,524	16,524	16,524
Cost of consumable goods and services	Thousands of yen/year	9,757	20,735	33,264	33,264	33,264	33,264	33,264	33,264	33,264	33,264
Transport fare	Thousands of yen/year	5,930	12,602	20,218	20,218	20,218	20,218	20,218	20,218	20,218	20,218
Water, gas, and electricity charges	Thousands of yen/year	11,500	24,437	39,204	39,204	39,204	39,204	39,204	39,204	39,204	39,204
Depreciation and amortization	Thousands of yen/year	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Others	Thousands of yen/year	7,983	16,965	27,216	27,216	27,216	27,216	27,216	27,216	27,216	27,216
Total cost	**Thousands of yen/year**	**70,018**	**115,039**	**166,426**	**166,426**	**166,426**	**166,426**	**166,426**	**166,426**	**166,426**	**166,426**
Operating income	**Thousands of yen/year**	**-12,994**	**6,137**	**27,974**	**27,974**	**27,974**	**27,974**	**27,974**	**27,974**	**27,974**	**27,974**
＜Net Balance>											
Balance from previous year	Thousands of yen		-282,994	-246,857	-188,882	-130,908	-72,934	-14,959	43,015	100,990	158,964
Income	Thousands of yen/year	57,024	121,176	194,400	194,400	194,400	194,400	194,400	194,400	194,400	194,400
Expenditures (including capital expenditures)	Thousands of yen/year	-340,018	-85,039	-136,426	-136,426	-136,426	-136,426	-136,426	-136,426	-136,426	-136,426
Single-year balance	Thousands of yen/year	-282,994	36,137	57,974	57,974	57,974	57,974	57,974	57,974	57,974	57,974
Balance brought forward	Thousands of yen	-282,994	-246,857	-188,882	-130,908	-72,934	-14,959	43,015	100,990	158,964	216,938

(2) Others (technical intern training program for foreigner)

When operating a factory overseas, staff is dispatched from Japan, but it is very difficult to operate the factory while instructing all the locally hired personnel from the beginning.

In January 2021, RPF manufacturing was added as a job category to Japan's Technical Intern Training Program for Foreigners, making it possible to hire and train people from the country where the factory is scheduled to operate before operating the factory overseas. We are planning to use this system to have them come to Japan to learn RPF manufacturing before the factory is completed, and then return to Vietnam to operate the factory.

There are three levels of this system: beginner, specialist, and advanced, and trainees are required to take an exam every certain period of time. Ogawa Econos Co., Ltd. has a person who supervises the examinations, so it is possible to provide good guidance. The host company is also required to have qualifications, and Ogawa Econos satisfies all the requirements. The requirements are listed below.

① Factories that have received JIS Z7311:2010 certification or have a production capacity of 300 tons per month or more.
② A safety manager (for factories that employ 50 or more workers at any one time) or a safety and health promoter (for factories that employ less than 50 workers at any one time) has been appointed.
③ Safety and Health Committee is established and held at least once a month, and the outline of the proceedings is made known to the workers.
④ Safety and health regulations have been established in accordance with the template set by the Japan RPF Industry Association.

(3) CO2 reduction and cost effectiveness

i Overview

The GHG emission reductions through the avoidance of CH4 emissions from landfill sites by using part of the general waste generated in Soc Trang Province as a raw material for RPF (refuse derived paper and plastics densified fuel), and associated with the substitution of fossil fuels by RPF were evaluated.

ii MRV methodology and project boundary

The MRV methodology is based on the JCM methodology "Power generation and avoidance of landfill gas emissions through combustion of municipal solid waste (MSW) ver. 01.0" and the CDM methodology "ACM0022: Alternative waste treatment processes (Version 3.0)" (Figure 5). Since this project is not a waste to power generation project, the part of the JCM methodology that applies to

power generation is excluded, and instead, the process of RPF production and GHG emissions from RPF combustion are incorporated. The reference emissions are set by excluding the baseline CO2 emissions from the combustion of fossil fuels replaced by RPF to ensure the conservative calculation perspective.

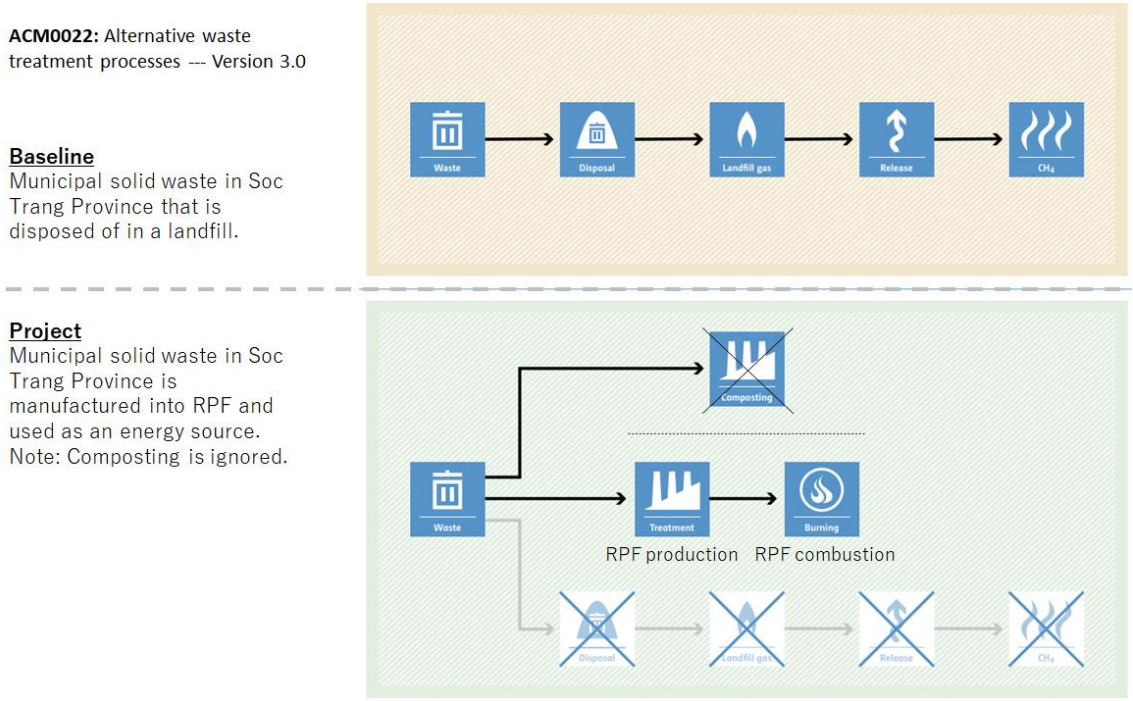


Figure 81 Image of a fuel switching project subject to CDM methodology AMS-III.AS.
Note: This is Illustrated based on the "ACM0022" within the UNFCCC's "CDM Methodology Booklet – Twelfth edition", Dec. 2020.

iii Project boundary

The project boundary is generally assumed to be a physical, geographical site where the switching of energy sources takes place. However, such description was not provided in the MRV methodology. Therefore, the estimation was made by simply focusing on the information provided in Table 54.

Table 54 GHGs and emission sources subject to estimation

	Emission source	GHG
Reference	Emissions from the decomposition of solid waste in landfills	CH_4
Project	Emissions from RPF production (assuming electricity consumption)	CO_2
	Emissions from RPF combustion (assuming combustion of plastic fraction)	CO_2
	Emissions from RPF combustion (assuming combustion of biomass fractions)	CH_4,N_2O (CO_2 is out of scope)

iv Formula for estimating GHG emission reduction amount and the results

The formula for calculating greenhouse gas emissions is as follows.

$ER = E_{Reference} - E_{Project}$

ER_p:	GHG emission reduction amount in the project period p (tCO_2/yr)
RE_p:	GHG emissions in the project period p for the reference scenario (tCO_2/yr)
PE_p:	GHG emissions in the project period p for the project scenario (tCO_2/yr)

GHG emissions for the reference scenario

$E_{Reference} = E_{CH4,y}$

$E_{Reference}$:	GHG emissions in the project period p for the reference scenario (tCO_2/year)	
$E_{CH4,y}$:	Methane emissions from the decomposition of solid waste at landfills (tCO_2 eq./year)	The first-order decay (FOD) model is used for the calculation. The default values of IPCC 2006 guidelines are used for most of the parameters, but the measured values are used for the following parameters: -Fraction of organic carbon based on the results of waste composition survey; -The amount of methane recovered from the landfill, if any. For more information on FOD models, please refer to the 2006 IPCC guidelines[18] and the JCM methodology "JCM_MM_AM001_ver01.0"[19].

GHG emissions for the project scenario

$E_{Project} = (M_{Electricity} * EF_{Electricity}) + (M_{RPF} * DC/100 * P_{plastic} * FCC_{plastic} * 44/12) + (M_{RPF} * EF_{CH4} * GWP_{CH4}) + (M_{RPF} * EF_{N2O} * GWP_{N2O})$

$E_{Project}$:	Project emissions during the period p (tCO_2/p)	
$M_{Electricity}$:	Electricity consumption for RPF production (kWh/year)	Subject of monitoring
$EF_{Electricity}$:	Emission factor for electricity ($kgCO_2$/kWh)	Data for Viet Nam: 0.9130 $kgCO_2$/kWh
M_{RPF}:	Amount of RPF combustion (t/year)	Subject of monitoring
DC:	Dry matter content of RPF (%)	Monitoring value or Country-specific value (expert judgement) or IPCC default value
$P_{plastic}$	Fraction of plastic in an RPF (%)	Monitoring value or Country-specific value (expert judgement) or IPCC default value

[18] IPCC 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste (https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html)

[19] JCM_MM_AM001_ver01.0 (https://www.jcm.go.jp/mm-jp/methodologies/75/approved_pdf_file)

$FCC_{plastic}$:	Carbon content of plastic (t C/t)	Monitoring value or Country-specific value (expert judgement) or IPCC default value
EF_{CH4}:	Emission factor for biomass burning (t CH_4/t)	IPCC default value (Case of open burning) 6500 g / t MSW
GWP_{CH4}:	Global warming potential for CH_4	Provided in the IPCC AR4: 25
EF_{N2O}:	Emission factor for biomass burning (t N_2O/t)	IPCC default value (Case of open burning) 150 g N2O / t waste
GWP_{N2O}:	Global warming potential for N_2O	Provided in the IPCC AR4: 298

v Cost-effectiveness, Implementation system for monitoring and further considerations

According to the survey results for this fiscal year, the initial investment was estimated to be 300 million yen, consisting of 200 million yen for equipment excluding molding machines (excluding sorting equipment) and 100 million yen for the building. However, the evaluation of the cost-effectiveness has yet to be completed, as the amount of RPF produced and other factors are not clear due to the limitations of the field survey. Therefore, further information needs to be collected in order to examine the cost-effectiveness and the implementation system for monitoring.

7. Attachment

(1) Provisions on the incentive mechanism for solar PV in Vietnam (Summary)

Provisions on the incentive mechanism for solar power generation in Vietnam (No. 13/2020/QD-TTg) is a regulation decided by the Prime Minister in April 2020, which stipulates the eligibility and definition of solar power generation, the price of electricity, etc.

[The definition of "Solar Power Purchaser”]

“Power Purchaser”

- Vietnam Electricity Corporation (EVN), member companies with delegated authority from EVN
- Organizations or individuals that purchase electricity from power sellers.
- Organizations that have accepted the rights and obligations of the above organizations in accordance with the provisions of laws and regulations.

“Power Seller”

- Organizations that sell electricity by using plants (power plants) and solar power generation systems.
- Organizations that accept the rights and obligations of the above-mentioned organizations in accordance with laws and regulations.
- Organizations or individuals that participate in activities in the field of power generation from individuals.

[Definition of “Solar Power Project”]

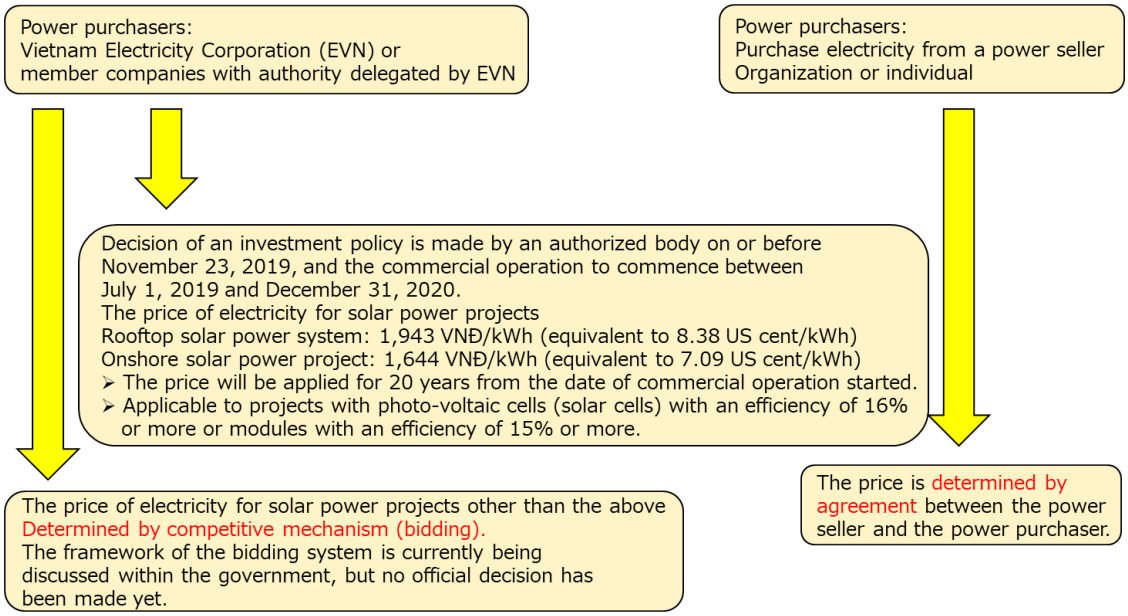
“Rooftop Solar Power System”

A photovoltaic power generation system with solar panels installed on the roof of a building with a capacity not exceeding 1 MW, directly or indirectly connected to the grid (transmission system, power grid) of a voltage level not exceeding 35 kV owned by a power purchaser.

"Onshore Solar Power Project”

A solar power project that is not a water-based solar power project and is directly connected to the national grid.

【About the Price of Electricity】



(2) Provisions on the development of solar power projects and the format of power purchase agreements (summary)

Provisions on Model Power Purchase Agreements Applicable to Project Development and Solar Power Projects (No. 18/2020/TT-BCT) is a regulation decided by the Prime Minister in July 2020, which stipulates the procedures for implementing solar power generation, the roles of each organization, and the format of power purchase agreements.

[Implementation Procedure for Rooftop Solar Power Generation System*]

*Exempted from the Electricity Business License

The power seller shall provide the power purchaser with each piece of information including the installation location, capacity scale (not exceeding 1MW and 1.25MWp), transmission lines, and planned connection points as a notification regarding the connection.

↓

If the power purchaser has any comments on the connection or transmission, it shall respond within five days from the date of receipt of the power seller's notification.

↓

The power seller and the power purchaser will implement an agreement on the connection of the PV system. The power purchaser will sign the agreement within 5 days from the date of receipt of the fulfilled documents.

↓

The power seller will implement the installation of a rooftop solar power system.

↓

The power seller shall send the power sales request documents for the rooftop solar power system. Power sales request documents (technical documents of the system): solar panels, electronic converter (inverter) from DC to AC, transmission line, transformer (if any), certificate of shipment from the factory, equipment quality certificate (copy).

↓

Each party shall conduct technical inspections, install meters to measure electricity production, read meters, sign the power purchase agreement, prepare for power supply, and operate the rooftop PV system. The power purchaser shall sign the contract within five 5 days from the date of receipt of the power seller's power sales request document.

↓

The power seller and the power purchaser shall carry out the respective works. The power seller shall install inverters, prevent any external factors from interfering with its business and operation or infringing on its monitoring rights, and comply with all standards, norms, and legal provisions regarding power quality.

【The role and implementation structure of each organization】

Electricity and Renewable Energy Agency (EREA)

- Dissemination, guidance and inspection on the implementation of the Circular.
- Dissemination, guidance and inspection of the implementation of the Circular, summarizing various obstacles and advising the Minister of Commerce and Industry to consider amendments and supplements to the Circular.

Provincial People's Committees

- Monitoring, inspection and audit of PV development in provinces in accordance with the provisions of the existing laws and regulations.
- Send reports on investment registration activities and implementation deployment status of PV projects to the Ministry of Industry and Commerce for monitoring and management by January 15 every year.

Power Purchaser

(i) The Electricity of Vietnam (EVN) will publish the application details of the agreement on connection, testing, signing of power purchase agreement and acceptance of the agreement to start operation for rooftop PV system.

(j) Every six months, a summary and report on the development status of rooftop PV systems nationwide will be conducted and sent to the Ministry of Industry and Commerce.

(k) It will be responsible for inspecting and monitoring the operation activities of each solar power plant, detecting unauthorized access from outside, and suspending the connection to the power system if the power plant activity equipment monitoring software of the power seller contains illegal content, and make a record and report to the Ministry of Commerce for processing.

Electricity sellers

(a) Comply with the regulations on power system operation and regulation, transmission system regulations, and distribution system regulations promulgated by the Ministry of Commerce and Industry.

(b) Constantly inspect the operation activities, PV equipment activity monitoring software, and have measures to prevent illegal interference and intrusion from the outside.

(c) It is required not to violate any of the provisions of laws and regulations regarding the assurance of information security.

(d) Conduct operations related to environmental protection, fire and explosion prevention, and power safety in accordance with legal provisions.

(3) Simulation of solar power generation system introduction in Soc Trang Province(720kW)

720kW 固定式架台太陽光発電システムを導入することにより、

1,226,690 ｋＷｈ／年の電力削減効果

408,488 ｋｇ-ＣＯ２／年　の二酸化炭素削減効果　　を見込むことができます。

・太陽光発電システムの発電量算出方法

太陽光発電システム　720　ｋＷｐを設置した場合に得られる電力量は、以下の通りになります。

月	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	
月日数	31	28	31	30	31	30	31	31	30	31	30	31	365
傾斜面日射量 [kWh/㎡・日]	5.73	6.51	6.76	6.78	5.43	4.86	5.01	4.94	4.58	4.33	4.75	5.03	5.39
1日の太陽電池発電量 [kWh/日]	3589.8	4056.5	4167.6	4165.3	3372.6	3051.4	3145.5	3101.6	2875.6	2718.6	2982.3	3158.1	3365.4
1ヶ月の太陽電池発電量 [kWh/月]	111,284.00	113,582.00	129,196.00	124,959.00	104,551.00	91,542.00	97,511.00	96,150.00	86,268.00	84,277.00	89,469.00	97,901.00	1,226,690

真南　傾斜角度　10°

平均傾斜面日射量　：　5.39　［ｋＷｈ／m^2・日］

１日の平均太陽電池発電量：　3365.4　［ｋＷｈ／日］

（発電量計算式）　$Q_m=(P_p\times\frac{Q_d}{P_o})\times K\times S$

Ｑｍ：太陽光発電量　［ｋＷｈ／月］

Ｐｐ：太陽電池容量　720　［ｋＷ］

Ｑｄ：傾斜面日射量　［ｋＷｈ／m^2・日］

Ｐｏ：太陽電池の基準日射量　1　［ｋＷ／m^2］

Ｋ　：システム効率（＝ Ｋ１ × Ｋ２ × Ｋ３ ）

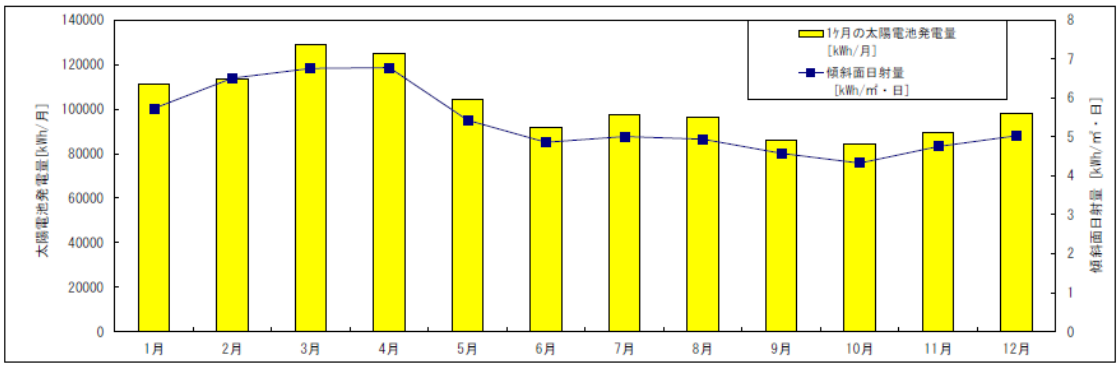
Ｋ１：太陽電池損失／温度補正係数

	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月
温度損失	0.93	0.92	0.91	0.91	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.93

Ｋ２：パワーコンディショナ効率　0.987

Ｋ３：その他の損失係数（受光面汚れ、配線・回路ロス等）　0.95

Ｓ　：月の日数　［日］



従って、年間発電量は　1,226,690　kWh/年となり、

本システムの導入によるCO_2の年間削減量は、　408,488　kg - CO_2/年 となります。

（換算係数は、0.333kg - CO_2/kWh を使用しています。）

(4) Hiroshima Prefecture's approach to renewable energy

みんなで挑戦 未来につながる
2050 ひろしま
ネット・ゼロカーボン

BIỆN PHÁP ĐỐI PHÓ VỚI SỰ NÓNG LÊN CỦA TRÁI ĐẤT CỦA TỈNH HIROSHIMA

Tháng 12 năm 2021
Phòng chính sách môi trường sở tài nguyên và môi trường tỉnh Hiroshima

1

みんなで挑戦 未来につながる
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Nội dung

1 Xu hướng về các vấn đề nóng lên của trái đất

2 Nỗ lực của tỉnh Hiroshima

2

1 Xu hướng về các vấn đề nóng lên của trái đất

■Nhiệt độ bề mặt trái đất tăng lên do sự gia tăng của khí CO2 trong không khí

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Cơ chế của hiệu ứng nhà kính

Khí hiệu ứng nhà kính hấp thụ và tái phản xạ nguồn nhiệt được phản xạ từ bề mặt trái đất do năng lượng mặt trời tỏa ra, làm ấm bầu khí quyển.

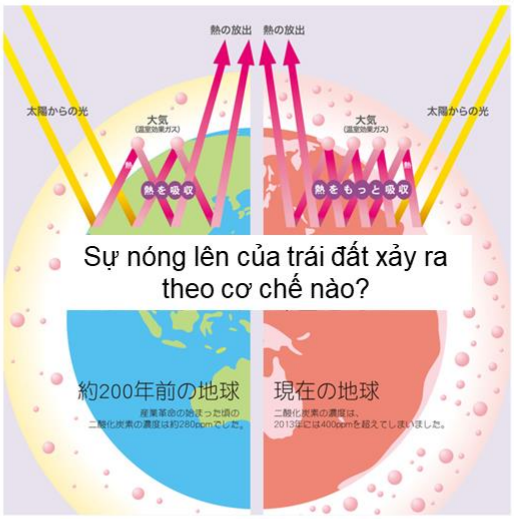
Nếu nồng độ trong khí quyển của các loại khí nhà kính như CO2 tăng lên thì…

↓

Hiệu ứng nhà kính sẽ mạnh hơn trước, và nhiệt độ bề mặt trái đất sẽ tăng lên.

↓

Đây chính là sự nóng lên của trái đất.



(出典:JCCCA)

1 Xu hướng về các vấn đề nóng lên của trái đất ~Tình hình tiến triển của sự nóng lên của trái đất~

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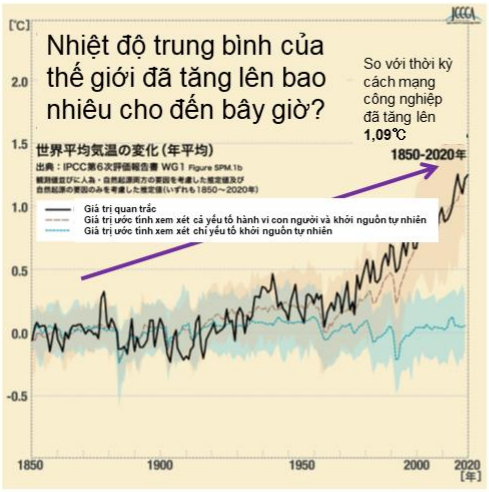
■Không còn nghi ngờ gì về việc sự ảnh hưởng của con người đã làm trái đất nóng lên

■Nguyên nhân chính của sự nóng lên của trái đất là do tiêu thụ một lượng lớn nhiên liệu hóa thạch từ sau cuộc cách mạng công nghiệp



(出典:JCCCA)

■So với thời kỳ cách mạng công nghiệp, trong một trăm mấy chục năm trở lại đây đã tăng 1,09℃

1 Xu hướng về các vấn đề nóng lên của trái đất
~Dự kiến tiến trình tiếp tục sự nóng lên của trái đất~

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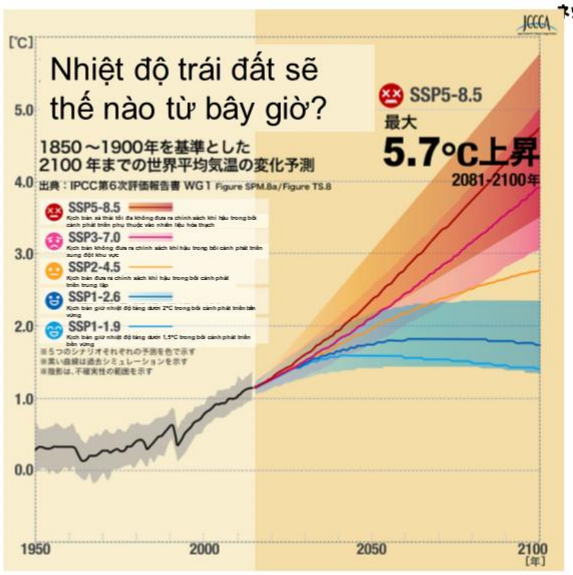
■Dự đoán cuối thế kỷ này nhiệt độ sẽ tăng lên mức cao nhất là 5,7°C nếu không có các biện pháp nghiêm ngặt.



（出典：JCCCA）

5

1 Xu hướng về các vấn đề nóng lên của trái đất

■Sự nóng lên của trái đất gây ảnh hưởng đến nhiều lĩnh vực như: lương thực, thiên tai,…

みんなで挑戦 未来につながる
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1 **Mặt biển dâng Thủy triều cao** (ven biển, hải đảo)	2 **Lũ lụt Mưa lớn** (thành phố lớn)	3 **Cơ sở hạ tầng Tê liệt chức năng** (cấp điện, dịch vụ y tế)
4 **Đột quỵ do nắng nóng** (tử vong, thiệt hại sức khỏe)	**Rủi ro chính trong tương lai là gì?** Rủi ro chính trên nhiều lĩnh vực khu vực	5 **Thiếu lương thực** (bảo đảm an toàn lương thực)
6 **Thiếu nước** (thiếu nước uống, nước tưới tiêu)	7 **Tổn thất hệ sinh thái biển** (tổn thất đối với ngành thủy hải sản)	8 **Tổn thất hệ sinh thái đất liền** (tổn thất hệ sinh thái khu vực đất liền và nội thủy)

（出典：JCCCA）

6

1 Xu hướng về các vấn đề nóng lên của trái đất ~Tỷ lệ lượng khí thải CO2 theo từng quốc gia~

みんなで挑戦 未来につながる
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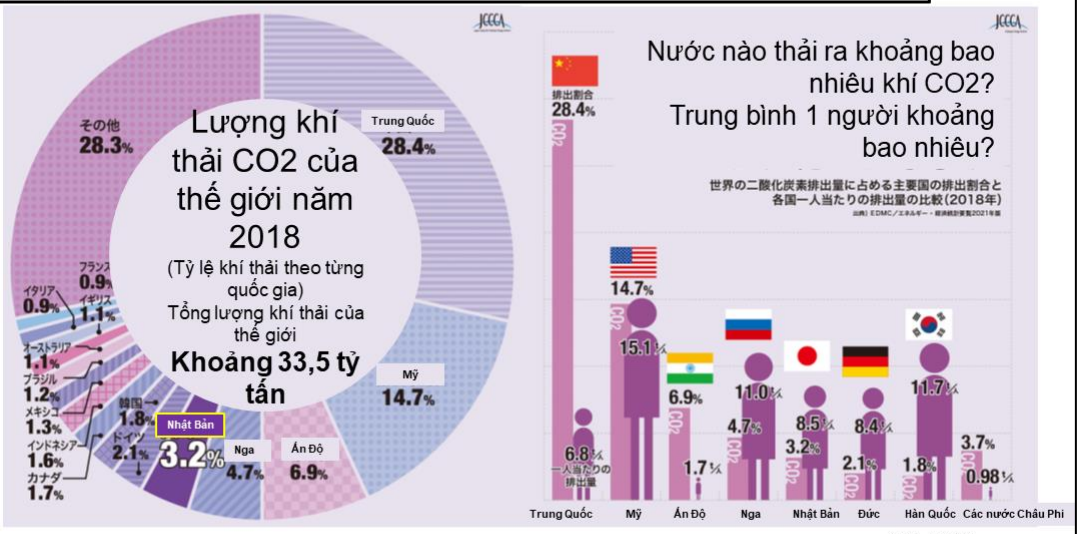
ネット・ゼロカーボン

■**Lượng khí thải theo từng quốc gia, Trung Quốc đứng thứ 1, Mỹ đứng thứ 2**

■**Nhật Bản đứng thứ 5, với 3,2%**



（出典：JCCCA）

1 Xu hướng về các vấn đề nóng lên của trái đất ~Việc thông qua và hiệu lực của Hiệp định Pari~

みんなで挑戦 未来につながる
2050 ひろしま
ロカーボン

■**Thông qua "Hiệp định Pari" tại COP21；Khuôn khổ mới cho tất cả các quốc gia tham gia**

●**Tại COP21 (Từ ngày 30 tháng 11 đến ngày 13 tháng 12 năm 2015, ở Pari, Pháp) "Hiệp định Pari" (Paris Agreement) được thông qua.**

✓ **Khuôn khổ quốc tế mới nhằm giảm thiểu lượng khí nhà kính thải ra từ năm 2020, thay cho "Nghị định Kyoto".**

✓ **Là hiệp định công bằng lần đầu tiên trong lịch sử tất cả các quốc gia tham gia.**

●**Thủ tướng Abe tham dự hội nghị thượng đỉnh.**

✓ **Năm 2020, công bố hỗ trợ tài chính khoảng 1,3 nghìn tỷ Yên, gấp 1,3 lần hiện tại.**

✓ **Giúp đạt được mục tiêu 100 tỷ đô la vào năm 2020, thúc đẩy các cuộc đàm phán nhằm đạt được thỏa thuận.**

●**Các yếu tố sau đây được đưa vào Hiệp định Pari.**

✓ **Đặt mục tiêu 2°C làm mục tiêu dài hạn chung cho thế giới. Đề cập đến nỗ lực theo đuổi hạ nhiệt độ xuống 1,5°C.**

✓ **Tất cả các quốc gia, bao gồm các quốc gia xả thải nhiều, đệ trình và cập nhật các mục tiêu cắt giảm 5 năm một lần.**

✓ **Định vị việc sử dụng các cơ chế thị trường bao gồm hệ thống tín dụng song phương (JCM) do Nhật Bản đề xuất.**

✓ **Đặt các mục tiêu thích ứng dài hạn, thực hiện các quy trình và hành động lập kế hoạch thích ứng ở mỗi quốc gia, gửi báo cáo thích ứng và cập nhật định kỳ.**

✓ **Không chỉ các nước phát triển tiếp tục tài trợ, mà các nước đang phát triển cũng chủ động cung cấp tài chính.**

✓ **Tất cả các quốc gia báo cáo tình hình thực hiện và tiếp nhận các đánh giá theo cách thức chung và linh hoạt.**

✓ **Cơ chế kiểm tra tình hình thực hiện của toàn thế giới 5 năm một lần (Global Stock Take).**

1 Xu hướng về các vấn đề nóng lên của trái đất ~COP26~

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Tổ chức COP26 (Từ ngày 31 tháng 10 đến ngày 13 tháng 11 năm 2021, tại Glasgow, Anh)

●Từ Nhật Bản, Thủ tướng Kishida đã định vị giai đoạn đến năm 2030 là "thắng thua 10 năm" và kêu gọi tất cả các quốc gia ký kết thực hiện các biện pháp đầy tham vọng chống biến đổi khí hậu, đồng thời phát ngôn về những nỗ lực của Nhật Bản trong lĩnh vực biến đổi khí hậu như mục tiêu giảm khí hiệu ứng nhà kính mới năm 2030, xúc tiến Green Inovation.

●Việt Nam cũng tuyên bố sẽ hướng tới mục tiêu trung hòa carbon đến năm 2050.

●Tại hội nghị này, đàm phán giữa thủ tướng Nhật bản Kishida và thủ tướng Phạm Minh Chính cũng được tổ chức, việc liên kết trong các biện pháp chống biến đổi khí hậu được xác nhận.

(出典：環境省)

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1 Xu hướng về các vấn đề nóng lên của trái đất ~Mục tiêu cắt giảm mới của thế giới~

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Mục giảm của từng quốc gia

JCCCA

Tên quốc gia	Mục tiêu cắt giảm	Mục tiêu hướng đến giữa thế kỷ này Năm đạt mục tiêu net-zero (*) (*) về lượng thể đưa lượng xả thải khí nhà kính về không
Trung Quốc	Lượng khí thải CO2 tương ứng với GDP Đến năm **2030** cắt giảm **60 - 65%** (so với năm 2005) * Mục tiêu đưa lượng xả thải khí CO2 đỉnh điểm nhất trước năm 2030	Đến năm **2060**, đưa lượng xả thải khí CO2 về 0 thực chất
EU	Đến năm **2030** Lượng xả thải khí nhà kính cắt giảm trên **55%** (so với năm 1990)	Đến năm **2050**, đưa lượng khí thải nhà kính về 0 thực chất
Ấn Độ	Lượng khí thải CO2 tương ứng với GDP Đến năm **2030** cắt giảm **45%** Tăng tỷ lệ năng lượng có khả năng tái sinh lên mức 50% điện năng Giảm 1 tỷ tấn mức tăng xả thải được dự kiến trong khoảng từ nay đến năm 2030	Đến năm **2070**, đưa lượng xả thải về 0 thực chất
Nhật Bản	Trong năm **2030** cắt giảm **46%** (so với năm 2013) * Tiếp tục thử thách nhằm đạt mức cao hơn nữa là 50%	Đến năm **2050**, đưa lượng khí thải nhà kính về 0 thực chất
Nga	Lượng xả thải khí nhà kính thực chất đã trừ đi lượng hấp thụ do rừng Đến năm **2050** cắt giảm khoảng **60%** (so với năm 2019)	Đến năm **2060** đưa về 0 thực chất
Mỹ	Đến năm **2030** Lượng xả thải khí nhà kính cắt giảm **50 - 52%** (so với năm 2005)	Đến năm **2050**, đưa lượng khí thải nhà kính về 0 thực chất

Các bản đệ trình, công bố NDC của mỗi quốc gia được đang tải nguyên trang (tháng 11 năm 2021)

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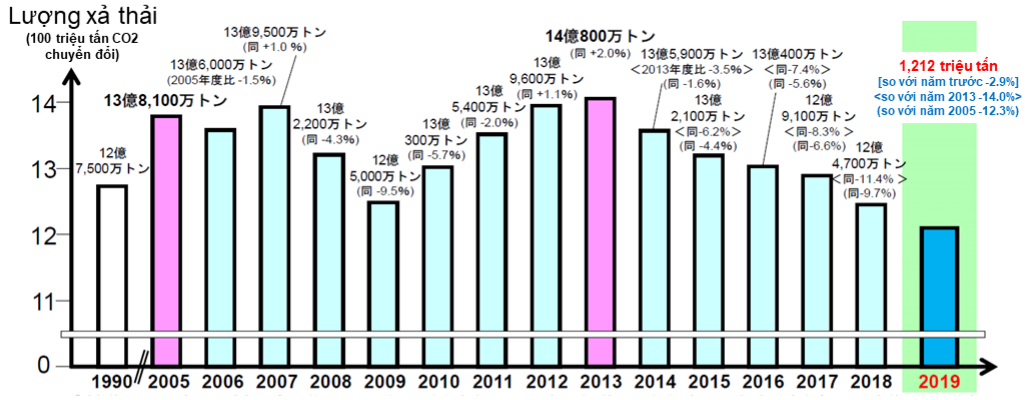
1 Xu hướng về các vấn đề nóng lên của trái đất ~Xả thải của Nhật bản~

- Tổng lượng xả thải khí hiệu ứng nhà kính ở Nhật Bản trong năm 2019 giảm 1,212 triệu tấn (-2,9% so với năm trước, -14,0% so với năm 2013, -12,3% so với năm 2005) trong sáu năm liên tiếp kể từ năm 2014, và đây là mức thấp nhất kể từ năm 1990, khi tính toán lượng xả thải.
- Nguyên nhân giảm xả thải so với năm 2018 là do lượng tiêu thụ năng lượng giảm (giảm sản lượng trong ngành công nghiệp chế tạo, …) và giảm xả thải khí CO2 từ điện năng nhờ mức độ carbon hóa thấp của điện năng (mở rộng năng lượng tái tạo) .
- Nguyên nhân giảm xả thải so với năm 2013 là do giảm tiêu thụ năng lượng nhờ tiết kiệm năng lượng,… và điện năng carbon hóa thấp.
- Nguyên nhân giảm xả thải so với năm 2005 là do giảm tiêu thụ năng lượng nhờ tiết kiệm năng lượng.



（出典：環境省）

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Nội dung

1 Xu hướng về các vấn đề nóng lên của trái đất

2 Nỗ lực của tỉnh Hiroshima

2 Nỗ lực của tỉnh Hiroshima ~Tuyên bố không carbon ròng 2050~

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広島県　ゼロカーボンシティ宣言

令和２年 10 月，「2050 年カーボンニュートラル」が宣言されて以降，国においては，その実現に向けて，「2050 年カーボンニュートラルに伴うグリーン成長戦略」の策定や「国・地方脱炭素実現会議」の開催などにより，「経済と環境の好循環」を目指した取組について，国を挙げて強力に推し進められています。

こうした中，広島県は，カーボンが様々な形で存在し，自然界や産業活動の中で循環し，持続的に共生できる社会経済「カーボン・サーキュラー・エコノミー」の実現を目指しています。

広島県は，これまでの省エネルギー対策や再生可能エネルギーの導入促進に加え，二酸化炭素を建設資材や燃料等の原材料として再利用する取組や農林水産業における利用，石油由来プラスチックからの代替促進などにより，環境と地域経済の好循環を図りながら，ＳＤＧｓへも貢献することで，日本のみならず世界から注目を集めるような広島型カーボンサイクル構築の取組を推進していきます。

このため，2050 年温室効果ガス排出量の実質ゼロを目指して，県民，事業者など多様な主体が一緒になって取組を進められるよう，「みんなで挑戦　未来につながる　2050 ひろしまネット・ゼロカーボン宣言」を行います。

令和３年３月 18 日

広島県知事 湯崎英彦

Ngày 18 tháng 3 năm 2021
Chúng tôi đã thực hiện “Tuyên bố không carbon ròng tại Hiroshima 2050, cùng nhau thử thách, dẫn dắt đến tương lai”.

Trao đổi ý kiến về tuyên bố
Thống đốc tỉnh Hiroshima Yuzaki (trái) và Bộ trưởng Bộ Môi trường Koizumi (phải)
(Tiến hành hội nghị web do sự lây lan rộng rãi của vi rút corona chủng mới)
◆ Tình hình ngoài tỉnh Hiroshima
http://www.env.go.jp/policy/zerocarbon.html

2 Nỗ lực của tỉnh Hiroshima
~Hình ảnh cho việc thực hiện xã hội không carbon ròng~

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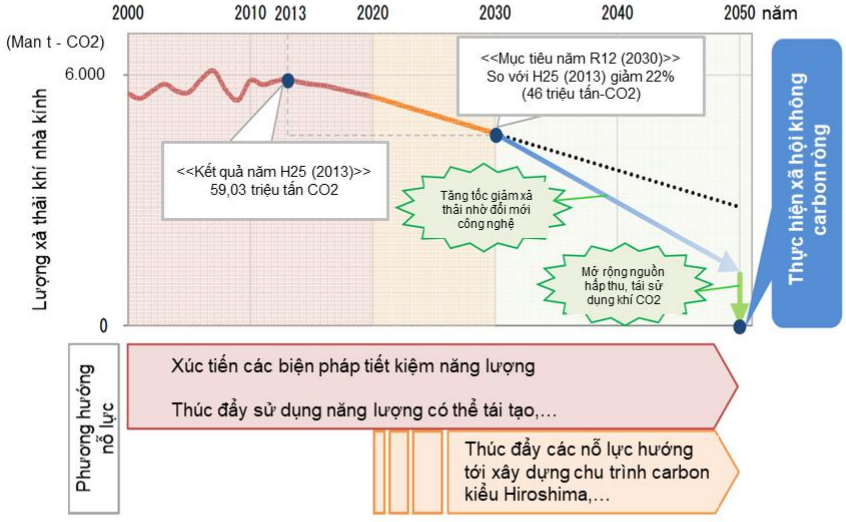

2 Nỗ lực của tỉnh Hiroshima

Kế hoạch địa phương ngăn chặn sự nóng lên của trái đất của tỉnh Hiroshima lần thứ 3

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Đặt mục tiêu đã tính toán bằng cách áp dụng mục tiêu trung hạn (giảm 26% trong năm 2030 so với năm 2013) trong “Kế hoạch đối phó với sự nóng lên của trái đất” của quốc gia (được hoạch định vào năm 2016) cho tỉnh.
[Giai đoạn] Từ năm 2021 đến năm 2030 (10 năm)
[Mục tiêu giảm] Giảm 22% trong năm 2030 so với năm 2013
Vì tỉnh Hiroshima là "tỉnh sản xuất", nơi tập trung các ngành công nghiệp sử dụng nhiều năng lượng như công nghiệp thép và công nghiệp hóa chất, nên tỷ lệ giảm mục tiêu sẽ thấp nếu áp dụng cho tỉnh.

Tại Hội nghị thượng đỉnh về biến đổi khí hậu vào tháng 4 năm 2021, chính phủ đã công bố điều chỉnh tăng mục tiêu (26% -> 46% và thách thức hướng tới 50%). Cùng với đó, dự kiến kế hoạch của tỉnh cũng sẽ được xem xét lại.

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2 Nỗ lực của tỉnh Hiroshima ~Lượng xả thải khí hiệu ứng nhà kính trong tỉnh~

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(Đơn vị: Man t-co2)

Phân loại			H25 (2013) (năm tiêu chuẩn)	R12 (2030) (năm đặt mục tiêu)		
			Lượng xả thải	Lượng xả thải sau áp dụng các biện pháp	Lượng giảm	Tỷ lệ giảm
CO2	Lĩnh vực công nghiệp		4.094	3.231	-863	-21%
	Lĩnh vực vận tải		613	522	-91	-15%
	Lĩnh vực dân sinh	Hộ gia đình	579	399	-180	-31%
		Kinh doanh	405	267	-138	-34%
	Lĩnh vực chất thải		45	47	2	5%
	Tổng phụ		5.736	4.466	-1,270	-22%
Các loại khí khác			167	134	-33	-19%
Tổng			5.903	4.600	-1,303	-22%

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Hệ thống chính sách và nội dung các nỗ lực chủ yếu

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Chỗ bôi đỏ là chính sách mới

Hệ thống chính sách	Phương hướng của các nỗ lực chủ yếu
1 Thúc đẩy các biện pháp tiết kiệm năng lượng **[Thúc đẩy các biện pháp để giảm lượng khí thải CO2]** (1) Các biện pháp cho lĩnh vực công nghiệp và dân sự (kinh doanh) (2) Các biện pháp cho ngành vận tải (3) Các biện pháp đối với lĩnh vực dân sự (hộ gia đình) (4) Các biện pháp trong lĩnh vực chất thải **[Thúc đẩy các biện pháp giảm thiểu khí hiệu ứng nhà kính khác]** (5) Các biện pháp giảm xả thải các chất loại CFC	- Thúc đẩy các nỗ lực tự chủ của các doanh nghiệp thông qua hệ thống xây dựng và công bố các bản kế hoạch giảm thiểu khí hiệu ứng nhà kính - Thúc đẩy việc sử dụng các công nghệ và thiết bị giúp hạn chế lượng khí thải CO2 - Thúc đẩy các nỗ lực của khu vực liên kết với "Trung tâm xúc tiến hoạt động ngăn chặn sự nóng lên của trái đất của tỉnh Hiroshima" - Thúc đẩy "hình dung" lượng xả thải khí thải CO2, chẳng hạn như thực hiện "chẩn đoán sinh thái ngôi nhà"
2 Thúc đẩy sử dụng năng lượng có thể tái tạo	- Thúc đẩy sử dụng năng lượng mặt trời - Thúc đẩy sử dụng năng lượng của sinh khối gỗ - Xem xét các nỗ lực tập trung vào việc sử dụng năng lượng có thể tái tạo (phía cầu)
3 **Thúc đẩy chu trình Carbon** (1) Thúc đẩy nỗ lực hướng đến xây dựng chu trình carbon kiểu Hiroshima (2) Thúc đẩy các biện pháp nguồn hấp thu rừng	- Thúc đẩy chu trình carbon kiểu Hiroshima - Thúc đẩy quản lý kinh doanh rừng

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Hệ thống chính sách	Phương hướng của các nỗ lực chủ yếu
4 Thúc đẩy các biện pháp thích ứng với biến đổi khí hậu	- Thu thập, sắp xếp, phân tích và phổ biến thông tin về thích ứng với biến đổi khí hậu (Thành lập "Trung tâm thích ứng với biến đổi khí hậu Hiroshima" vào ngày tháng 4 năm 2021) - Thúc đẩy các biện pháp thích ứng cho các hạng mục ưu tiên cao cần phải nỗ lực (nông nghiệp, hệ sinh thái tự nhiên, thiên tai, vùng ven biển, sức khỏe, đời sống nhân dân ở tỉnh, ở đô thị)
5 Thúc đẩy xây dựng nền tảng	- Thúc đẩy tạo ra một cơ chế thân thiện với môi trường - Thúc đẩy phát triển thị trấn kiểu carbon thấp - Thúc đẩy học tập, nghiên cứu và phát triển môi trường

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2 Nỗ lực của tỉnh Hiroshima ~Năng lượng có thể tái tạo~

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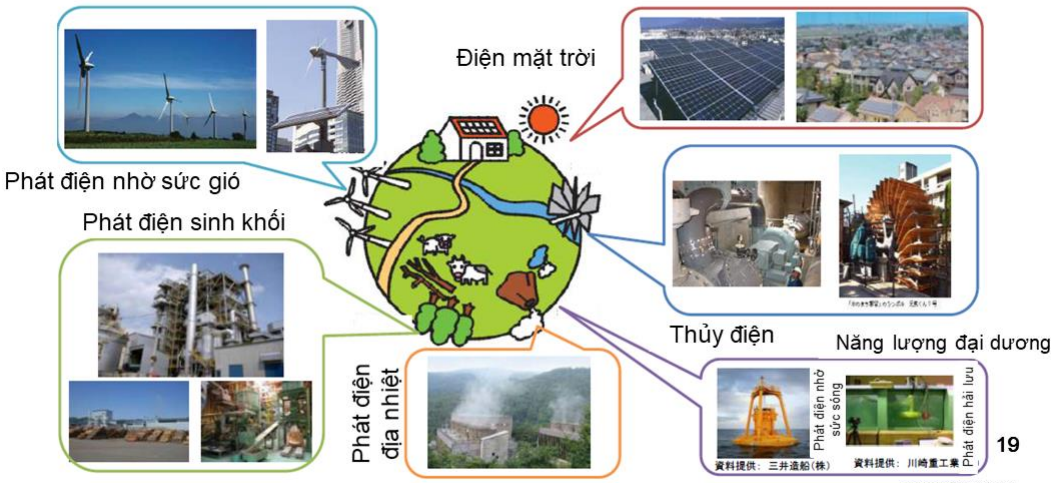
■ Ánh sáng mặt trời, sức gió và những nguồn năng lượng không hóa thạch khác được nhận định là những nguồn năng lượng có thể sử dụng vĩnh viễn.

■ Ánh sáng mặt trời, sức gió, sức nước, địa nhiệt, nhiệt mặt trời, nhiệt trong khí quyển và các nhiệt khác tồn tại trong thế giới tự nhiên, sinh khối, …

■ Năng lượng tuyệt vời có thể được sử dụng nhiều lần mà không làm cạn kiệt tài nguyên và hầu như không thải ra khí CO2 gây ra sự nóng lên của trái đất trong quá trình phát điện.



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(出典:経済産業省)

2 Nỗ lực của tỉnh Hiroshima ~Dự án giới thiệu năng lượng có thể tái tạo hoàn trả địa phương~

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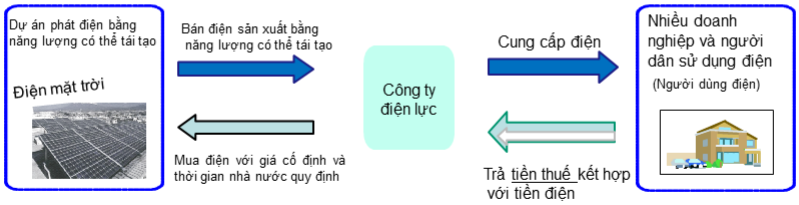
■ Tỉnh quyết tâm đi đầu trong việc phát điện năng lượng mặt trời quy mô lớn và hoàn trả lợi nhuận rộng rãi cho người dân trong tỉnh.



●Mặc dù chế độ mua với giá cố định là một phương pháp hiệu quả để mở rộng phổ biến năng lượng có thể tái tạo, song bên trong nó cũng tồn tại tính không công bằng khi nhiều người dân và doanh nghiệp (người dùng điện) phải hỗ trợ lợi nhuận cho dự án phát điện thông qua việc đóng thuế.

↓

●Tỉnh quyết tâm đi đầu trong việc phát điện năng lượng mặt trời quy mô lớn tận dụng chế độ mua với giá cố định, hoàn trả lợi nhuận thu được ở dự án phát điện cho khu vực, điều hòa tính không công bằng.

↓

●Tỉnh phối hợp với tập đoàn điện lực Chugoku thực hiện dự án phát điện năng lượng mặt trời quy mô lớn (Lần đầu tiên trên toàn quốc)

http://www.pref.hiroshima.lg.jp/site/eco/megasora.html

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Dự án giới thiệu năng lượng có thể tái tạo hoàn trả địa phương ~Khung dự án~

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■Dự án hợp tác giữa tỉnh và tập đoàn điện lực Chugoku (thành lập hiệp hội doanh nghiệp)

Hiệp hội doanh nghiệp trách nhiệm hữu hạn (LLP)

Công việc đảm nhiệm

- Tỉnh Hiroshima
  - Kế hoạch dự án, vận hành dự án
  - Quảng bá, phát triển
  - Cung cấp đất
- Tập đoàn Chuden (ESS)
  - Thi công cài đặt
  - Quản lý cơ sở
- Điện lực Chugoku
  - Hỗ trợ quảng bá/ phát triển

Đầu tư ban đầu [3,23 tỷ yên]

- Tiền vay: 2,02 tỷ yên
- Tiền vốn: 800 triệu yên
- 410 triệu yên

6 nơi trong tỉnh

Nhà máy phát điện năng lượng mặt trời quy mô lớn [10.4MW]
(Đất của tỉnh, đất của thành phố thị trấn)

Bán điện → Điện lực Chugoku

Thu nhập bán điện ← Điện lực Chugoku

[Huy động tiền vốn]

- Cho vay: Ngân hàng địa phương
- Góp vốn: Tỉnh Hiroshima
- Góp vốn: Tập đoàn Chuden (ESS*)
- Góp vốn: Điện lực Chugoku

* Công ty cổ phần dịch vụ và giải pháp năng lượng

Điện lực Chugoku (cổ phần) hoàn trả toàn bộ lợi nhuận, ESS hoàn trả 30% lợi nhuận cho khu vực.

Tên thành viên hiệp hội	Tỷ lệ góp vốn	Tỷ lệ phân chia lợi nhuận cuối cùng
Tỉnh Hiroshima	66,1%	76,8%
ESS	33,1%	23,2% (Hoàn trả 30%)
Điện lực Chugoku	0,8%	0% (Hoàn trả toàn bộ)

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Dự án giới thiệu năng lượng có thể tái tạo hoàn trả địa phương ~Cơ chế lợi nhuận~

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Pháp luật quy định các công ty điện lực lớn ở địa phương sẽ mua với giá cố định trong 20 năm

LLP

①Phát điện mặt trời
④Thanh toán kinh phí cần thiết
⑤Phát sinh lợi nhuận

②Bán điện →

← ③Thu nhập

Điện lực Chugoku

Đảm nhiệm tiền thuế ← **Người dân trong tỉnh**

⑥Cổ tức theo tỷ lệ góp vốn →

Tỉnh Hiroshima
ESS
Điện lực Chugoku

⑦Đóng góp 30% cổ tức cho tỉnh →
⑦Đóng góp toàn bộ cổ tức cho tỉnh →

Tỉnh Hiroshima (Khoảng 75% lợi nhuận là thu nhập của tỉnh)

⑧Hoàn trả lại bằng cách thực thi các dự án chú trọng vào biện pháp thúc đẩy tiết kiệm năng lượng

Tỉnh Hiroshima

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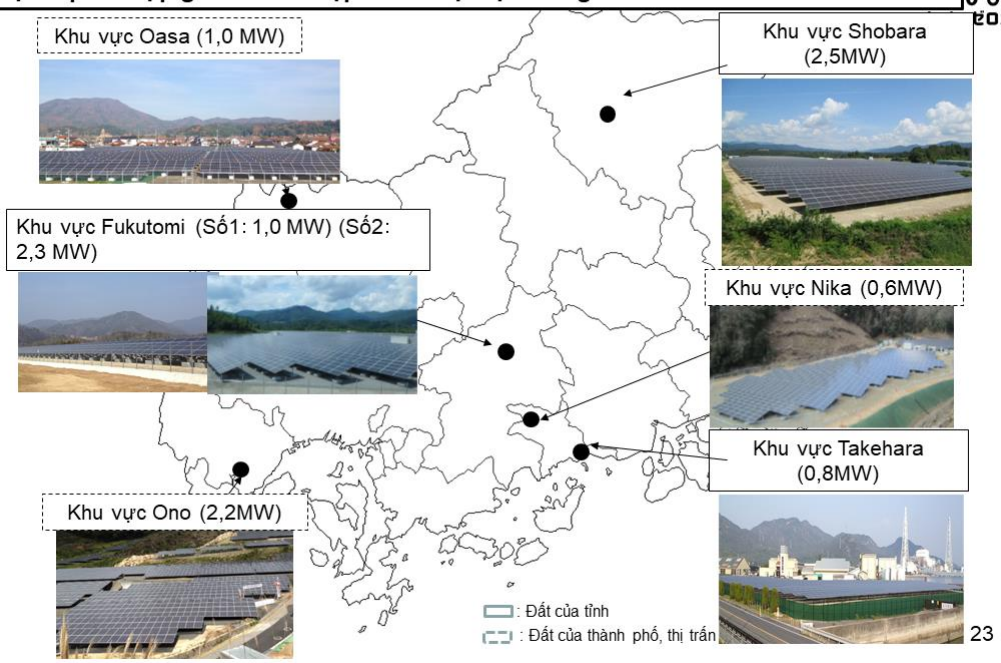
(Tham khảo) năng lượng có thể tái tạo của tỉnh Hiroshima ~Năng lượng mặt trời quy mô lớn kiểu hoàn trả địa phương~

■Lắp đặt hệ thống năng lượng mặt trời quy mô lớn kiểu hoàn trả địa phương trong dự án phối hợp giữa tỉnh và tập đoàn điện lực Chugoku



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2 Nỗ lực của tỉnh Hiroshima～Tiền hỗ trợ thúc đẩy việc giới thiệu các thiết bị sản sinh năng lượng, tiết kiệm năng lượng～

■Hỗ trợ điều hòa tiết kiệm năng lượng và lắp đặt các thiết bị phát điện mặt trời cho nhà trẻ, mẫu giáo

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2 Nỗ lực của tỉnh Hiroshima ~Tiền hỗ trợ thúc đẩy hoạt động đối phó với sự nóng lên của trái đất~

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■Hỗ trợ các hoạt động của các đoàn thể địa phương nhằm đối phó với sự nóng lên của trái đất

Đào tạo chuyên gia tiết kiệm năng lượng

Buổi học về tiết kiệm năng lượng

Tấm rèm xanh

Khóa học với khách mời

Sự kiện tiết kiệm năng lượng

Nấu ăn sinh thái

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2 Nỗ lực của tỉnh Hiroshima ~Tiền hỗ trợ thúc đẩy hoạt động đối phó với sự nóng lên của trái đất~

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Học sinh tiểu học và phụ huynh đang trải nghiệm trò chơi thẻ SDGs.

Khi thưởng thức trò chơi, sẽ cảm nhận được rằng kinh tế, môi trường và xã hội đều quan trọng, và không thể hạnh phúc nếu không cân bằng chúng.

Tại trường tiểu học này, trải nghiệm này đã trở thành động lực để bắt đầu các hoạt động giảm thiểu đồ nhựa cùng với các hiệp hội trong thành phố.

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Cảm ơn quý vị đã lắng nghe!

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