FY2018 Project for Ministry of the Environment Japan

FY2018
City-to-City Collaboration Programme for Low-Carbon Society

(Project to realize low carbonization in Mandalay region in the field of Waste & Energy〔City of Kitakyushu-Mandalay City Cooperation Project〕)

Report

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City of Kitakyushu

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Chapter 1 Overview and context of work

1.1 Overview of work

(1)Purpose

At the 21 Conference of the Parties to United Nations Framework Convention on Climate Change (COP21) held in December, 2015 in Paris (France), Paris Agreement - legal framework on equitable and effectivere sponses to climate change after 2020 - was adopted with the approval of all participating countries. Paris Agreement states that all the parties will endeavor to limit the Earth's temperature rise by not more than 2 degree Celsius compared to pre-industrial revolution period and will try to bring this figure back to 1.5 ^{0}C; at the same time requests the parties to promote efforts to escape from the use of fossil fuels. In addition, at COP21, the participating parties decided to recognize activities of non-state actors, including cities, applauded efforts of all the non-state actors (cities, other local public organizations, etc), called for scaling up these efforts.

At COP22 held in November, 2016 in Marrakesh, Morocco, "Marrakech action proclamation for climate and sustainable development" was adopted.The proclamation reiterates that the climate is warming up at an unprecedented level, the parties have to be urgent to cope with this situation at recognized that global actions of not only governments but also of local government are necessary, the economic transition is a positive opportunity for prosperity and sustainable development.

Urban areas are places of taking place socio-economic development; living places of many people.Although urban areas account for less than 2% the world's land area, up to 50% the world's population live in urban areas and this percentage is projected to rise to 70% by 2050.At the time of 2006, it was estimated that over 70% the world's CO2 emission was emitted from urban areas.Urban areas played a major role in restraining climate change. The stable step-by-step implementation of measures to combat climate change and reduce greenhouse gas emission in surrounding urban areas is very important to achieve goals of the Paris Agreement.

In this project, we cooperate with Kitakyushu city, which is highly experienced and knowledgeable about the development of a low carbon society - to survey for the development of a JCM subsidized project in Mandalay area belonging to the Federal Republic of Myanmar.In addition, through workshops held in Mandalay city, we will support the formation of a low carbon society of Mandalay city based on a linkage program between the twin cities. Furthermore, we will promote the development of the Mandalay city government's capacity (MCDC (Mandalay City Development Committee)) needed for the formation of a low carbon society.

(2) Tasks

In this survey, the following activities are carried out for the purpose of reducing greenhouse gas emissions and forming JCM projects contributing to the reduction in greenhouse gas emissions in the two fields (Energy filed and Waste Management field) which is highly demanded area by Mandalay city.

＜Energy Fields＞

- Promote large-scale buildings to switch to low carbon operation mechanism
- Feasibility study on introducing low-carbon technology for Primary Industry

＜Waste Management Fields＞

- Environment improvement for the improvement of waste disposal facilities through comprehensive support in Kitakyushu city
- Feasibility study on introduction of biogas recovery / utilization facility at southern disposal site in Mandalay city

(3) Survey contents

(3) - 1.Energy Fields

a) Survey to consolidate low carbonization project

- Directly discuss facility owners which has high potential for low carbonization
- Held workshop at Mandalay and conduct knowledge sharing and capacity building

b) Consideration of applied techniques

- Consideration of applied technology suitable to target facility
- Calculate the amount of CO2 reduction and cost-effectiveness of JCM support
- Consideration economic viability of the project

c) Consideration of project implementation collective

- Survey to select a representative investor, a joint investor and partner enterprise (EPC contractor, O&M contractor, etc) to establish a project implementation
- Consider the project implementation collective and the form of contracting.

d) Grasp the issues for project implementation

- Confirmation of legal system and licenses / approvals (ex; establishment of corporation, permission of electric power business, environmental standard etc.) and examination of approval procedures
- Grasp of the other issues (additional investigation items, schedule of each company's company, financing etc.)

e) Consideration of project implementation schedule

Discuss representative, joint venture companies and cooperating companies, decide implementation schedule of JCM subsidized project.

(3) – 2. Waste Management Field

a) Support of proper waste treatment in Mandalay city

Support the promotion of waste management optimization in Mandalay city through the supporting program conducted by Institute for Global Environmental Strategies (IGES).

b) Grasp the municipal waste and quality of garbage in Mandalay city

Grasp the quality of municipal waste which transported to land fill site at south of Mandalay city

c) Grasp the municipal waste management plan in Mandalay city.

Survey the waste management plan in Mandalay city. (Conduct hearing Mandalay City Development Committee (MCDC))

d) Formulation of proposal business and commercialization plan

Creation of project concept based on regional case (LFG recovery project in Thailand) (Including cost estimation)

e) Confirmation of legal system and licenses / approvals related to project execution

Collection and arrangement of basic information on related laws, regulations, institutions, investment, company establishment

f) Confirmation of RDF demand, utilized facility, and status of facility maintenance

Survey on sales channels of RDF when implementing biogas utilization project

Survey on latent users such as cement factories survey, survey on the assumed transaction price, needs etc.

g) Environmental Regulation

Survey on Environmental Regulation applied to project

(3) – 3. Other Common Tasks

a) Monthly report (by mail: in an optional form including items below)

Report monthly survey progress in a prepared form. At the same time, report expected survey and events. Reports are sent via mail.

b) Domestic discussions (Progress meetings)

Hold discussions with the Japanese Ministry of the Environment for 4 times/year (once in every 3 months after signing the contract), report the project progress.Implement work based on the results of discussions with the Ministry of Environment in progress meetings.

c) Arrival and organization of field workshops

We will arrive the field - Mandalay city for approximately 4 times/ year to survey for the

development of a JCM subsidized project.In addition, while arriving in Myanmar, we will hold approximately 2 workshops to raise awareness, strengthen activities for the government related to the application, generalization of low carbon emission techniques such as energy saving, energy saving equipment. Also seek to apply and generalize low-carbon emission techniques for businesses in Mandalay and surrounding areas

d) Preliminary meeting of workshops etc at the survey site to be held in the local municipalities

In order to hold a local workshop, preliminary consultations will be held with stakeholders about twice a year in Japan (Kitakyushu city). In the preliminary consultation, discuss the date of the workshop, the agenda, the contents of the presentation, attendants, and request for administration to the Mandalay municipal administration and other matters, arrangements for organizing workshops, etc.

f) Speech at conferences as designated by the Japanese Ministry of Environment

(3) Implementation Time

From 23th-April-2018 to 28th-Fec-2019

(4) Survey Organization

Divide roles of Kitakyushu, Nikken Sekkei Civil and NTT DATA Institute of Management Consulting as in the table below.

Table 1.1.1 Implementation organization

Organization	Role
Kitakyushu City	- Adjust talks with Mandalay City Development Committee (MCDC) - Name of workshop
NTT DATA Institute of Management Consulting	- Survey for the development of a JCM subsidized project (energy project group) - Organization of workshop - Summary of this work -
EX Research Institute Ltd.	- Survey for the development of a JCM subsidized project (waste management project group) -

(5)Survey Schedule

The survey schedule of this project is shown in Figure 1.1.1.

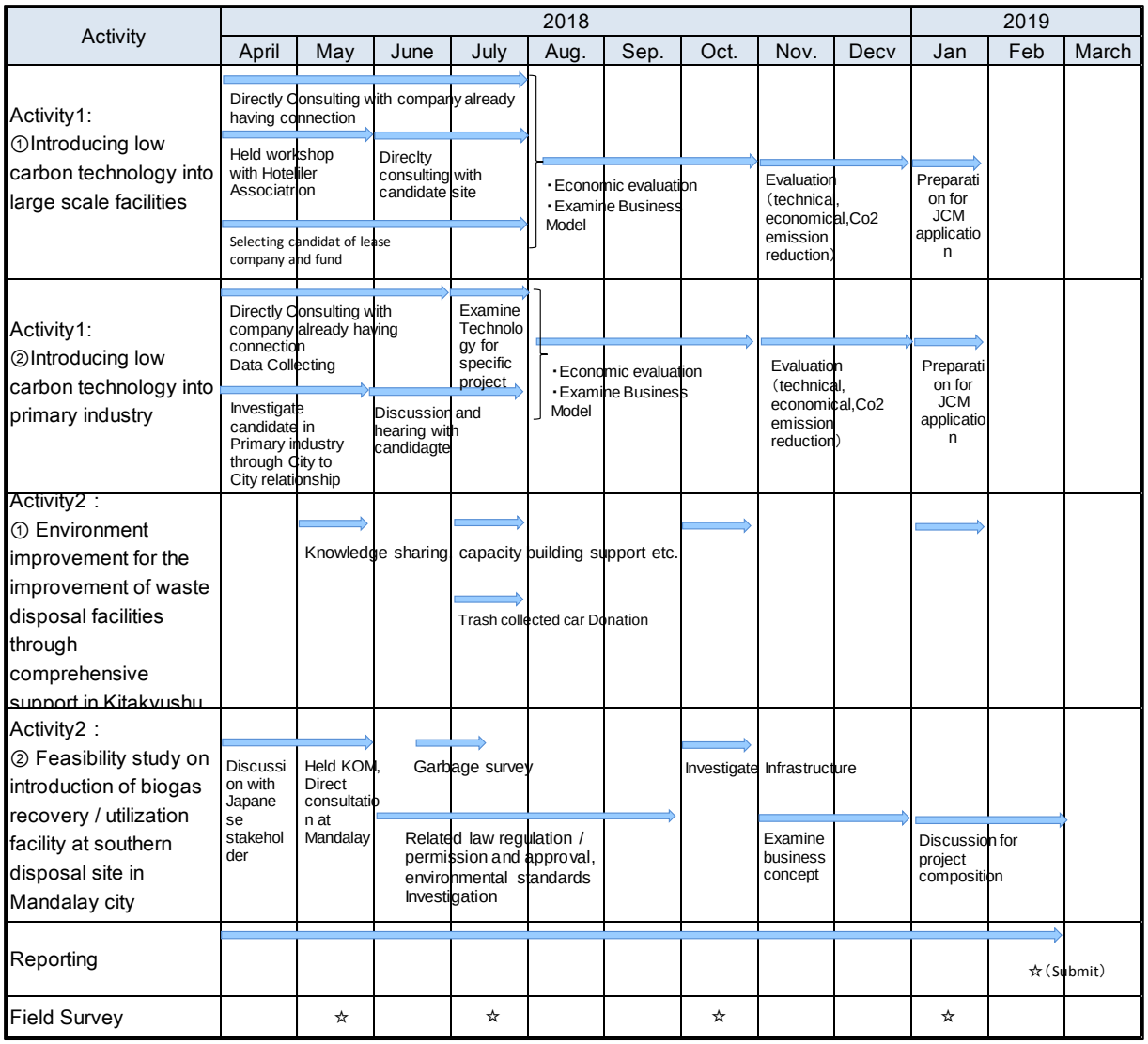


Figure 1.1.1 Survey Schedule

1.2 Background of work

1.2.1 Overview of Mandalay city

Mandalay city is the capital of Mandalay region with population of 1.28 million people, which is the second largest population in Myanmar and the economic, Buddhist and cultural center in the north central of Myanmar and occupies an important position in Myanmar.

This city is 716 km far from Yangon to the north and includes 6 townships with area of approximately 314.7km^2. To implement administrative services effectively, these 6 townships are subdivided into smaller administrative units (wards) with total 97 wards.

The administrative organization of this city is Mandalay City Development Committee (MCDC), which is in charge of planning as well as implementing services of the city.The head of MCDC is the mayor of the city and the mayor of the city is also a person who acts as the minister of development of Mandalay region's government.

Figure1.2.1 Overview map of Mandalay region, location map of Mandalay city[1]

1.2.2 Measures to reduce greenhouse gas emissions by the Myanmar government

(1) Related law system

（Environmental related law）

In Myanmar, the Environment Protection Law stipulate the environmental standards related to the promotion of installation of waste disposal facilities and waste management, and monitoring the waste management. Table 1.2.1 shows the environmental legal system. Detailed information on environmental conservation related laws and regulations is described in Chapter 3.

Table 1.2.1 Law and Regulations related to Environment[2]

	The name of law	Promulgation date	Law number
1	Environmental Conservation Law	30/03/2012	9/2012

[1] Department of Population Ministry of Immigration and Population, The 2014 Myanmar Population and Housing Census Mandalay Region Census Report Volume 3-1, May 2015

[2] JETRO Yangon (March-2017)

2	Protection of New Plant Varieties Law	20/01/2016	15/2016
3	Protection of New Plant Varieties Law	26/08/2013	28/2013
4	Natural Disaster Management Law	31/07/2013	21/2013
5	Conservation of Water Resources and Rivers Law	02/10/2006	8/2006
6	The Protection of Wildlife and Conservation of Natural Areas Law	08/06/1994	6/1994
7	Law relating to Aquaculture	07/09/1989	24/1989

(Power and Natural Resource related law)

Table 1.2.2 shows the main legal system of electricity / resource relation. By the power law, regulations on the development of electric power infrastructure, such as power development, power generation, transmission, distribution and safety inspection are stipulated.

Table 1.2.2 Law and Regulations related to Power and Resource[3]

	The name of law	Promulgation date	Law number
1	Electricity Law	27/10/2014	44/2014
2	Atomic Energy Law	08/06/1998	8/1998
3	Oil Resources (Development Regulation) Act	21/10/1957	55/1957
3-1	Amending Law of Oil Resources (Development Regulation) Act, 1969	23/09/1969	2/1969
4	Petroleum Act	30/03/1937	30/1937
4-1	Law Amending the Petroleum Act, 1934	31/12/2010	33/2010

(2)Efforts on reducing greenhouse gas emissions

（National Energy Policy）

Describe Myanmar's energy policy. Myanmar councils concerned with electrification and energy have the following two organizations.

- National Electrification Executive Committee (NEEC)
- National Energy Management Committee (NEMC)

NEMC has formulated the "National Energy Policy" in 2014. Under the policy, the following nine points

[3] JETRO Yangon (March-2017)

are cited.

(1) Implementation of short-term and long-term comprehensive energy development plan based on energy resource survey data, taking into account the influence of minimum source on natural environment
(2) Establish laws, institutions and rules to encourage private participation and privatization of state-owned organizations according to national restructuring policy
(3) Implementation of systematic statistics on supply and demand of various kinds of Myanmar energy sources
(4) Implementation of programs that can also benefit from people in rural areas by securing the energy of the land
(5) Establish laws, institutions and regulations to encourage private participation and privatization of state-owned organizations according to national restructuring policy
(6) Implementation of systematic statistics on supply and demand of various kinds of Myanmar energy sources
(7) Implementation of programs that can also benefit from people in rural areas by securing the energy of the land
(8) Implementation of renewable energies such as wind, solar, hydropower, geothermal and bioenergy for sustainable energy development in a wide area
(9) Promotion of energy conservation and energy conservation
(10) Establishment of research and development institutions to promote energy development in harmony with international standards
(11) Promotion of international cooperation on energy issues
(12) Composition of an appropriate policy on the price of energy products to ensure the economics of energy producers and customers

（Investment of Power Infrastructure）

The new Myanmar government, launched in March 2016, aimed at "fair economic development between states and regions" in the economic policy announced in July, said, "The rapid development of basic infrastructure such as electric power "As one of the policies.

Since Myanmar is not equipped with electricity transmission network and the electrification rate is lower than those of Southeast Asian countries, Myanmar government aims to domestic 100% electrification rate by 2030 (Fig. 1.2.2).

The electrification rate in 2006 was 16%, but it improved to 26% in 2011 and 34% in 2015. The electrification rate in Yangon city is the highest at 78%, followed by Kaya 46%, Mandalay 40%, and Naypyidaw 39%. On the other hand, rural electrification rate is less than 20%. Karen and Taninthary are less than 10%.

In 2013, the first economic city Yangon consumes about 50% of the nation's electricity consumption. Next,

Mandalay, the second economic city, accounts for less than 20%, and Yangon and Mandalay occupy about 70% of the total electricity consumption.

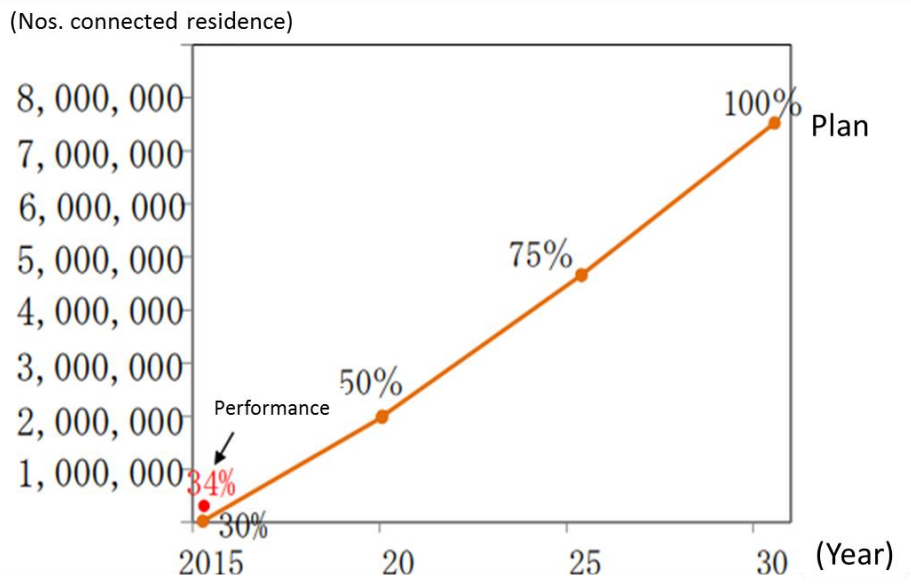


Figure 1.2.2　Plan for trends in electrification rate of Myanmar until 2030[4]

Regarding Myanmar's renewable energy policy, according to Myanmar Renewable Energy Policy[5] (draft version) published in September 2014, the main goals in Myanmar's energy mix are as follows.

- Became a major element of Myanmar's diversification of energy
- Contribute to the sustainable development of Myanmar
- Account for 27% of the power supply by 2030
- Promotion of public and private partnerships according to the target
- Development of subsidiary financial, legal and administrative framework

The plan for specific power supply composition of renewable energy in 2030 is as shown in Table 1.2.3. The total power generation output is 14.9 GW, of which 3,995 MW, which is 26.8%, is planned to be renewable energy (excluding large scale hydroelectric power).

Table 1.2.3　Renewable energy composition plan for 2030[6]

[4] JETRO「ミャンマーのエネルギー分野に関する調査(Survey on Myanmar's energy field)」（May-2017）

[5] *http://www.technosol.de/Down/1408MYA-RE_PolicyD.pdf　ADB Myanmar Renewable Energy Policy (Sep-2014)*

[6] Myanmar Renewable Energy Policy

Total		26.8 %	3,995 MW
Hydro Power	off-grid	1.3 %	198 MW
Wind Power	grid connected	3 %	446 MW
Solar Power	grid connected	17.8 %	2,658 MW
	off-grid	3.7 %	544 MW
Biomass	grid connected	1 %	147 MW
(biogas, gasification)	off-grid	0.02 %	3 MW

- Biofuel for non-electric use such as transportation and production is anticipated to reach a share of 5 % of the national consumption.

（Energy Conservation Policy）

Regarding energy conservation policies, according to the INDC submitted to the United Nations in August 2015, Myanmar will reduce electricity by 20% by 2030. In April 2016 Myanmar signed the Paris Agreement and ratified in September 2017.

National energy efficiency and conservation policy, Strategy & Roadmap for Myanmar[7] was announced in December 2015, and energy conservation potential for each industry is summarized. As the target within the roadmap, 12% in 2020, 16% in 2025 and 20% in 2030 are listed as compared with 2012.

1.2.3 Cooperative relationship between Kitakyushu City and Mandalay City

Kitakyushu City and Mandalay City have been building cooperative relationships in the environmental field and water supply and sewerage fields since fiscal 2012.

①Main cooperation in environmental field

The beginning of relationship in the environmental field is acceptance of the staff officer from Mandalay City Cleaning Department in JICA program "Citizen Participatory Waste Training" in 2012.

In November 2014, collaborative workshop “Kitakyushu-Mandalay Joint Workshop on Sustainable Solid Waste Management towards a Model City of Myanmar and ASEAN” was held in Mandalay city, which is based on the request by Mandalay city about "Human resource development on environmental education and waste disposal". Through the workshop, the importance of "further improvement of 3R citizen awareness" and "cooperation among stakeholders" are recognized.

In October 2015, Mandalay City Cleaning Bureau executives inspected environment-related facilities in Kitakyushu City as a member of the "Overseas Local Government Executive Exchange Cooperation Seminar" hosted by the Local Government Internationalization Association.

In November 2015, in order to promote environmental learning at elementary and junior high schools in Iran, IGES launched an environmental educational material "Kita Kyushu's educational

[7] https://www.adb.org/sites/default/files/project-documents/46389/46389-001-tacr-en.pdf
National energy efficiency and conservation policy, Strategy & Roadmap for Myanmar P61

material" in Mandalay City "Ecology Note" with a focus on 3R. In addition, Kitakyushu city held a workshop with faculty members selected from local environmental education pilot schools (3 schools) in order to make contents more suitable for the local situation.

In addition to the use of "Ecology Note" at the educational site, the exchange meeting using Skype between the middle school in Kitakyushu city (UNESCO school) and the school of Mandalay city (ASEAN eco-model school) have been conducted

In June 2016, in collaboration with UNEP, IGES, Kitakyushu city held "First National / City Workshops for Developing the National / City Waste Management Strategies in Myanmar" in Naypyidaw and Mandalay City. Staff was dispatched from Kitakyushu city to have a lecture of waste management strategy.

In August 2018, as a project to promote environmental education in Mandalay City, Kitakyushu city dispatched experts on environmental education and provided classes for parent-child workshops and elementary school.

In January 2017, Kitakyushu city invited Mandalay City Cleaning Department Director by the Ministry of the Environment "Intercity Collaboration Strengthening Project", and introduce the waste policy of Kitakyushu City, and discussed future cooperation.

②Main cooperation in the field of water supply and sewerage

In March 2012, Kitakyushu City conducted a water supply situation survey in three major cities including Mandalay in order to develop overseas water business. At that time, there was a request for water technology cooperation from Kitakyushu city from Mandalay City.

From December 2013 to March 2014, in the project of JICA grass-roots technical cooperation project "Improvement of water purification plant operation management capability in Mandalay City", Kitakyushu city provide technical guidance on proper operation of chlorine injection facility, operation of water purification plant. Kitakyushu city accepted trainees of MCDC for technical guidance concerning maintenance guidance and water quality analysis.

In August 2014, using JICA grass-roots technical cooperation project, Kitakyushu City started a technical cooperation project to Mandalay city for 3 years. Mayor of Mandalay City visited Kitakyushu City on August 25, and held a discussion (kick-off · seminar) on the current state of the water supply business in Mandalay City.

From September to October 2014, 5 person from MCDC including Deputy Director of the Department of Water and Sanitation had visited Kitakyushu City as trainees Kitakyushu City lectured such as water purification treatment theory, slow filtration operation procedure, inspection of water purification plant facilities, job report Presentation, etc.

As written above, in the two fields of waste management and water supply, Kitakyushu city has steadily accumulated exchanges with Mandalay City.

In this project, based on the relationship of 2 cities, research team investigate the proper waste management and the possibility of forming a waste power generation business, and build a model of a low carbon society with high efficiency energy use in Mandalay City.

Chapter 2　JCM project investigation ＜Energy saving and Renewable Energy＞

2.1 Project Overview

2.1.1. Survey Scope

In activities in the energy field, the two activities are carried out as shown in Table 2.1.1. One is aiming for low carbonization of large facilities by introducing energy conservation of chillers etc. and solar power generation system for large hotels, airports, hospital, etc. The other is to introduce highly efficient facilities to the primary industrial field, aiming to realize a project leading to the reduction of CO2 emission.

Table 2.1.1　Activities in the Energy Filed Survey

Activity Item	Overview
Item 1 : Low carbonization for large scale facilities	· Introduction of high efficiency type chillers to large facilities, introduction of air conditioning with inverter function, installation of solar panels · solar hot water system · Create smart areas by utilizing distributed power supply × energy management for hotels in the city and off grid areas.
Item 2 : Low carbonization for primary industries	· Introducing high efficiency equipment into farm aquaculture business that requires temperature control and water treatment and pastoral livestock business that needs heat treatment. · Realize low carbonization and safe food supply in the primary industrial field by introducing distributed power supply × fishery / agricultural production equipment × energy saving equipment as a set.

2.1.2. Result of Field Survey

4 local trips were conducted and had discussion with the municipal officials, local hearings, consultation on individual projects, held workshop. Table 2.1.2 shows the period of each travel and destination. Detailed traveling minutes are summarized in reference materials

Table 2.1.2　Field Survey trip in Energy Field

	Period	Activities	Main Destination
1	21th-May to 25th-May-2018	【1st Survey】 ・Explanation of JCM survey to Mayor of Mandalay city and MCDC. ・Consultation with candidate facilities	・MCDC ・Mandalay Airport ・Hotel Association ・Construction Corp.

			・Food Manufacture ・Developer ・Off-grid village
2	29th-July to 3rd –Aug. -2018	【2nd Survey】 ・Held Workshop (for Hotel Association) ・Consultation with candidate facilities	・Hotel Association ・Construction Crop. ・Food Manufacture ・Aquaculture demonstration site ・Developer ・Cement Corp.
3	17th to 21th Dec.-2018	【3rd Survey】 ・Held Workshop (for Restaurant Association) ・Consultation with candidate facilities	・Hotel Association ・Rubber Maker ・Restaurant Association ・Construction Corp. ・Major Retailor
4	4th- 8th- Feb.-2019	【4th Survey】 ・Consultation with candidate facilities	・Hotel Association ・Rubber Maker ・Restaurant Association ・Construction Corp. ・Air-Conditioning Maker and Retailer ・Cement Corp.

Table 2.1.3 shows the interview results of the major projects that conducted individual consultations toward JCM project formulation. Among them, the introduction technology, the CO2 reduction effect, the JCM equipment subsidy project for the two projects "introduction of photovoltaic power generation equipment into multiple hotels" and "Introduce waste oil BDF production facilities to restaurant association" The cost effectiveness and business profitability of the project were examined.

表 2.1.3 Result of consultation for JCM subsidized project application (Energy Field)

No	Facilities, Organization	Overview of organization	Project Overview	Result of consultation
1	Mandalay International Airport	・MC-JALUX operates from 2015 by concession scheme.	Installation of high efficiency chiller system	・Abandonment of JCM application (It is difficult to obtain cooperation from construction companies due

				to lack of drawing information)
2	Myanmar Hotel Association (Mandalay Branch)(MHA)	・Mandalay region brunch of Myanmar hotel association. ・Approx. 500 hotels (including guest house) are registered	Introduction of solar power generation system into multiple hotels	・MHA is positive to apply JCM subsidized project. ・Project scale and economic estimation are under conducting. ・Continue discussion.
3	YOMA TOP Co., Ltd. (Rubber Manufacture)	・Rubber Manufacture which obtained the technical support from Japanese company through METI's project. ・YOMA Top invest a hotel in Yangon and it is under construction.	Introduction of high efficiency package air-conditioning system.	・YOMA TOP Co,. LTD is eager to apply JCM subsidized project. ・Discuss Local sales agent of Daikin and try to scale up project.
4	Myanmar Restaurant Association (Mandalay Branch)(MRA)	・Mandalay region brunch of Myanmar hotel association. ・Approx. 2,000 restaurant (except small stalls) are registered in Mandalay region.	Utilize Waste oil as Bio Diesel Fuel	・MRA is interested in BDF technology. ・MRA try to install it If business profitability is positive ・Continue discussion
5	ANAWA DEVI DAIICHI JV CO., LTD. （Fisheries Processor）	・Joint ventures between local fisheries processor and transportation service company originating from Kitakyushu city.。 ・Conducting Aquaculture demonstration with Yangon University and planning business	Introducing Renewable energy into aquaculture business	・Project consideration is postponed due to the management matter. ・Continue discussion because the management of JV is positive to JCM subsidized project
6	MBC Corporation （Local company）	Local chaebol group company develop multiple business (construction, electricity, logistics service, etc.)	· Introduction of energy conservation and renewable to Smart City · Improve efficiency of	· MBC shows interest in JCM subsidized project. · There are multiple candidate projects ・Continue discussion on a continuous basis.

			existing power plants · Small hydroelectric power generation business	
7	Southland Myanmar Rubber Co., LTD （Rubber Maker）	· A Thai company with a 22% share of world natural rubber production. · It advanced to Myanmar in 2015 and plan to invest large factories.	・Introduction of low carbon technology into new factory.	・Interested in JCM subsidy project. ・Continue discussion for apply JCM subsidy project to new large rubber factory started from 2020.
8	Myota Industrial Town	・Industrial town developer located in the south of Mandalay city. ・The industrial town is in the phase introducing infrastructure.	Introduction of solar power generation system.	・the installation of solar power generation system is under discussion with company in Kitakyushu city. ・try to apply JCM subsidy program.

(1) Introduction of solar power generation system for multiple hotels

The number of registered hotels in Myanmar Hotelier Association (Mandalay branch) is about 200 at the end of FY 2017 and about 200 at the guest house. There are about 100 newly applying hotels during the year 2018, and it is an organization that supervises accommodation facilities totaling nearly 500.

According to the association, electricity charges account for 40 to 50% of the total cost in hotels, and many executives are interested in energy conservation. Almost all hotels use diesel private power generators in preparation for periodic power outages. They are considering introducing photovoltaic power generation facilities as there is concern about suppressing diesel purchase costs for private generators and raising the price of future electricity charges.

Mandalay is the second largest city in Myanmar, and although it is one of the leading tourist destinations in the country, however, there are many small and medium-sized hotels excluded except for some large foreign hotels. For the application of JCM subsidy program, scaling the project by introducing equipment for multiple hotels of Mandalay Hotel Association. Table 2.1.4 shows the hotel presented by the Mandalay Hotel Association as a target for installing solar power generation facilities. The examination results are shown in 2.2.1.

In addition, the Hotel Association is also interested in introducing lighting with dimming function, energy management system, and high efficiency air conditioning. However, with regard to air conditioning system,

generally packaged air conditioners are installed rather than chillers at general hotels. The member of hotel association already introducing air-conditioning with inverters in hotels. The introduction of the air conditioning system was excluded from consideration.

Table 2.1.4 Hotels considering to introduce solar power generation systems

No	Hotel Name	Nos Room
1	Eastern Palace Hotel	140
2	Ayarwaddy River View Hotel	63
3	Gold Leaf Hotel Mandalay	60
4	Amayar Nadi Hotel	38
5	Perfect hotel	48
6	The Hotel Emperor	23
7	Stone Inn Hotel	10
8	Aung Myint Mo Hotel	42
9	New Hotel under construction (In Bagan, Mandalay reasion)	32

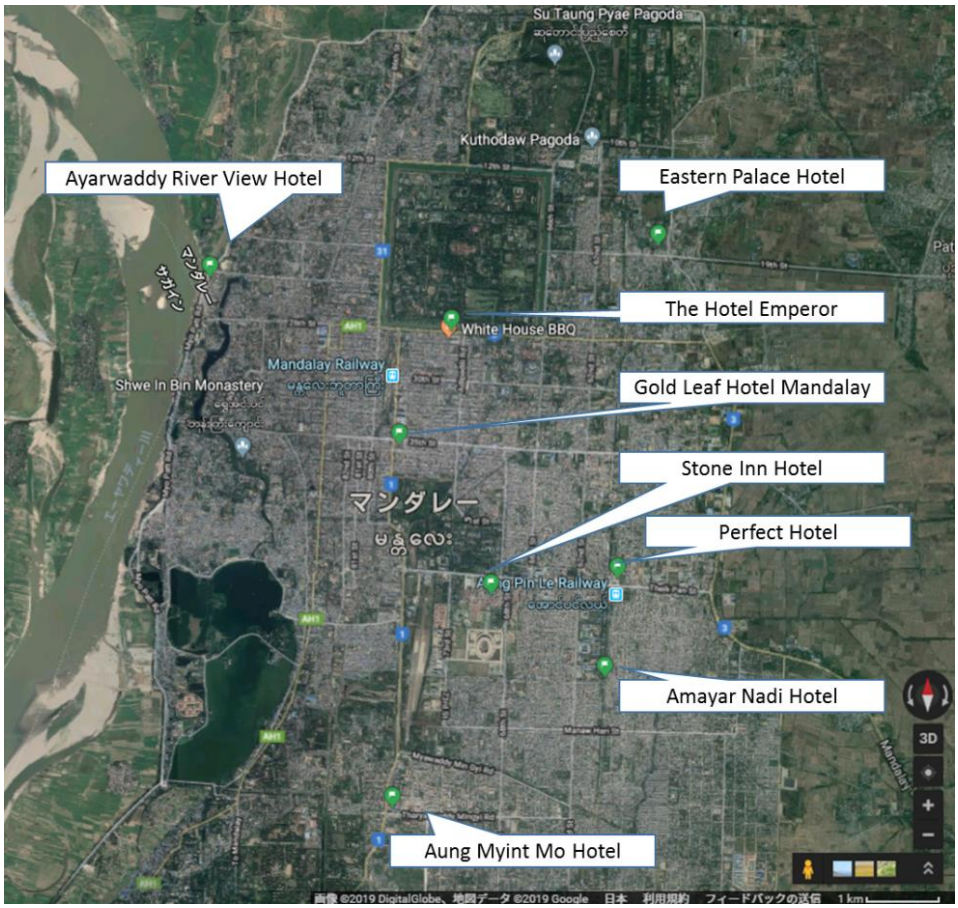


Figure 2.1.1. The location of hotels plan to install solar panels

Figure 2.1.2. Workshop and Discussion with Hotel Association

(2) Introducing BDF plant in Restaurant Association

About 2,000 restaurants are registered in the Mandalay branch of Myanmar Restaurant Association. Among them, there are over 200 restaurants in Mandalay City except for small stalls etc. Many restaurants are providing waste cooking oil almost free of charge to soap companies and diesel fuel manufacturing companies, or they are discharging without treatment. According to a restaurant association member, in Mandalay, overseas diesel fuel is expensive, so purchasing inexpensive but poor quality diesel made by domestic enterprises from the domestic crude is purchasing, deterioration due to sulfur problem I am looking.

Therefore, utilizing BDF (Bio Diesel Fuel) from the waste oil discharged from the city restaurant as fuel for private power generation and fuel for vehicles such as truck (Figure 2.1.3) was discussed. The examination results are shown in 2.2.2.

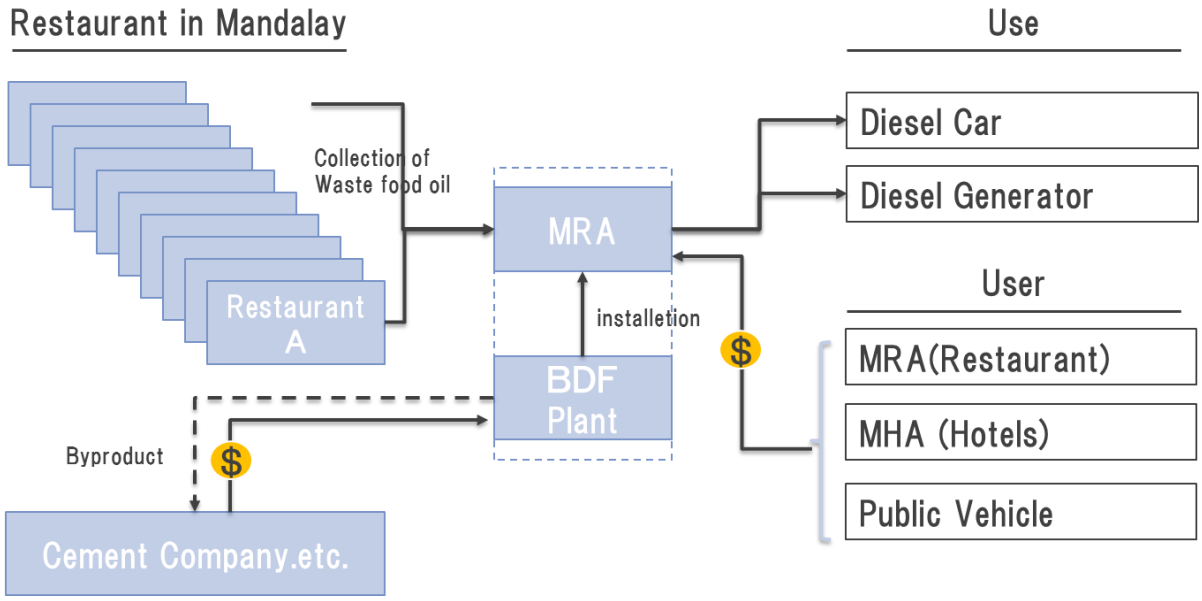


Figure 2.1.3 Image of business introducing BDF plant in Restaurant Association


Figure 2.1.4　Discussion with Restaurant Association and Polytank to collect waste oil

2.2 Examination of Introduction Technology

2.2.1. Introduction of solar power generation system for multiple hotels

(1) Overview of Examination

Introduce photovoltaic power generation system into the vacant space of the roof of the hotel in Mandalay City and consume the electricity generated by renewable energy at hotels and neighboring facilities to reduce CO2 emissions by reducing purchases from grid electricity. Unlike Japanese buildings of earthquake-resistant design, there is a concern in the strength of structure in existing hotels in Mandalay City. Therefore, in this study, we assumed the use of lightweight panels and lightweight gantry. The assumed product specifications are shown in Table 2.2.1.

Table 2.2.1　Equipment specification[8]

Type	LW660P-275
Nominal maximum output（Pmax）	275W
Nominal maximum output operating current（Imp）	8.90A
Nominal maximum output operating voltage（Vmp）	30.9V
Nominal short circuit current（Isc）	9.35A
Nominal release voltage（Voc）	38.2V
Module conversion efficiency	16.90%
Nominal mass	13.7kg
Nominal Size	W992mm × H1640mm × D25mm

Table 2.2.2 shows the area that can be installed in the panel, the number of panels that can be installed, and the output in the panel installation target hotel. Because the target hotel is a small to medium size hotel, the panel output that can be installed for each hotel's panel is on the scale of tens of kilowatts. The total output

[8] Next energy and resource corporation website

of each is about 540 kW. Figure 2.2.1, Figure 2.2.2 shows the photos of the Perfect Hotel, which has the largest panel installation area at existing hotels, and the Gold Lead Hotel, which has a relatively large installation area and a relatively high hotel floor height.

The Perfect hotel has a main building with four stories and an annex building with a flat store on the north side of the main building. Panels can be installed on each lodging and on the roof of the parking space.
On the other hand, for the hotel planned to be built in the Bagan area of the Mandalay District, approximate the area that can be installed based on the construction drawing. In addition to 16 bungalow type lodging houses, the hotel is planning construction of reception building etc. Because the area is the world's three largest Buddhist remains, there are many tourists from home and abroad. It is also located in the southern part of Mandalay City, characterized by good sunshine conditions.

Table 2.2.2 Survey result of hotels

No	Hotel Name	Nos of room	Rooftop area (able to install solar panel) (m2)	Nos of solar panel modules installed into the hotel roof	Output (kW)
1	Eastern Palace Hotel	140	76	46	14
2	Ayarwaddy River View Hotel	63	180	110	34
3	Gold Leaf Hotel Mandalay	60	180	110	34
4	Amayar Nadi Hotel	38	129	79	24
5	Perfect hotel	48	854	524	160
6	The Hotel Emperor	23	28	17	5
7	Stone Inn Hotel	10	72	43	13
8	Aung Myint Mo Hotel	42	186	114	35
9	New Hotel in Bagan (Under construciton)	32	1,189	731	223
			2,892	1,774	541

(a) Perfect Hotel picture

(b) Overview of hotel main building

(c) Roof of hotel main building

(d) Hotel annex

(e) Hotel parking lot

(f) Supporting structure of hotel parking lot

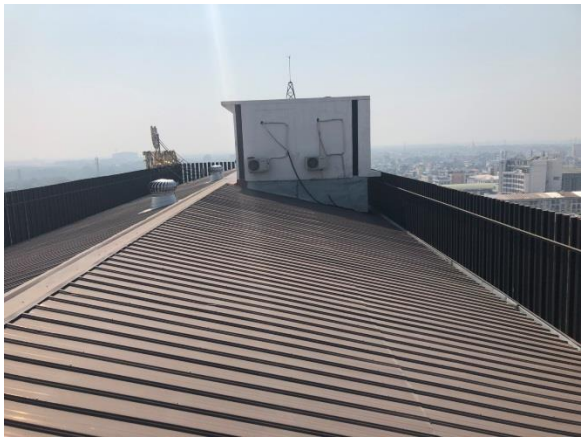
Figure 2.2.1 Picture of Perfect Hotel

As shown in Figure 2.1.4 (d), the roof of the Perfect Hotel annex has a fan for waste heat behind the ceiling, but by installing a solar panel, insulation effect due to blocking of solar radiation is expected. Therefore, those fan can be removed and panel can be lay entire building. The base of the roof of the bicycle park uses a simple iron pipe, and even if a person pushes a column with a hand, the base is so weak that the entire roof shakes. When installing the panel, it is necessary to install new structures, but it is also possible to enlarge the roof even in the space without the roof now.

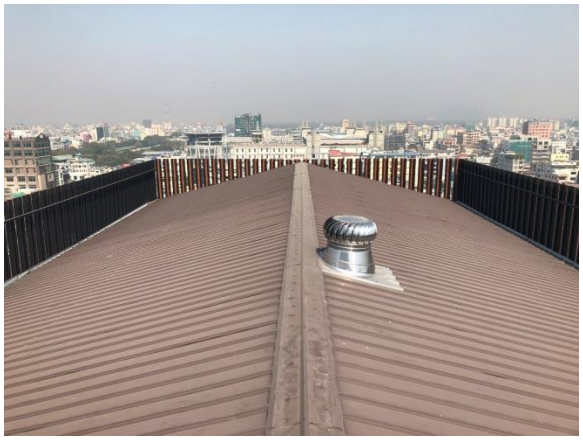
As shown in Figure 2.2.2. (B), the Gold Leaf Hotel is a relatively high, 12-storey hotel in Mandalay, which has few high buildings. Since the roof has become a gabled roof and it can rise above the roof rising from the facility room on the 12th floor, it can be considered that construction is possible without building a foothold from the ground at the time of panel installation work.

(a) Hotel location

(b) Hotel overview



(c) Hotel roof facing south



(d) Hotel roof facing north

Figure 2.2.2　the picture of Gold Leaf Hotel

(2) Calculation of the amount of CO2 reduction

Plan to reduce CO2 emissions by reducing the amount of electricity purchased from the electric grid by introducing solar power generation system. Calculation was made using the published worksheet published by Institute for Global Environmental Strategies (IGES) to calculate the annual estimated effective total power generation of the photovoltaic power generation system and the CO2 reduction effect. The average daily solar radiation for each month in Mandalay is calculated based on the survey report conducted by Myanmar University of Technology. Table 2.2.2 shows the calculation result of the total value of the annual estimated effective power generation amount when introduced to each hotel to be considered. As shown in the same table, the annual estimated power generation amount is 599,332 kWh.

Table 2.2.2 Calculation of estimated amount of annual estimated effective power generation

	Jan.	Feb,	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Average daily solar radiation per day (value at implementation site: kWh / ㎡ · day)	4.50	5.65	6.06	6.33	5.97	5.45	4.88	4.64	4.70	4.34	4.07	3.99
Average effective daily solar radiation per day for each month (Correction value at azimuth, inclination angle: kWh / ㎡ · day)	4.50	5.65	6.06	6.33	5.97	5.45	4.88	4.64	4.70	4.34	4.07	3.99
Temperature correction factor of module (when there is no loss = 1.0)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Loss factor by shadow (1.0 if not)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Degradation loss (when not present: 1.0) (Module dirt, aged deterioration, etc.)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Power conditioner conversion efficiency (rated load power efficiency)	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Other loss (if nothing: 1.0) (Transmission loss etc.)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Estimated generated electric energy per day	1465.38	1839.86	1973.37	2061.29	1944.06	1774.73	1589.12	1510.96	1530.50	1413.27	1325.35	1299.30
Actual effective days	31	28	31	30	31	30	31	31	30	31	30	31
Monthly estimate surplus electric energy (kWh / month)	45,427	51,516	61,175	61,839	60,266	53,242	49,263	46,840	45,915	43,811	39,761	40,278
Estimated effective total generated electricity per year	599,332	kWh/year										

The electricity CO2 emission coefficient of Myanmar was calculated as 0.319 tCO2 / MWh. As a result of the calculation, the annual CO2 emission reduction amount is 191.2 tCO 2. Since the statutory useful life is 17 years, if the project period is assumed to be 17 years, the CO2 emission reduction amount of this project is 3,250 tCO2.

（Calculation equation　for CO_2 emission reduction）

Annual CO_2 Emission reduction = Annual forecast generation Ep　599,332 kWh　×　Grid emission factor 0.319

= 191.2　ton- CO_2

【Review of MRV methodology】

The methodology on the solar power generation system can be referred to as a methodology approved in other countries (ID_AM 001 "Installation of Solar PV System" etc.). The methodology is described below.

➢ **Calculation of reference emissions**

$$RE_p = \sum_i EG_{i,p} \times EF_{RE}$$

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

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

EF_{RE}　: Reference CO_2 emission factor of grid electricity and/or captive electricity [tCO_2/MWh]

➢ **Calculation of project emissions**

$PE_p = 0$

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

➢ **Calculation of emissions reductions**

$$\mathbf{ER_p = RE_p - PE_p}$$

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

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

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

➢ **Data and parameters fixed ex ante**

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
EF_{RE}	Reference CO_2 emission factor of grid and/or captive electricity, calculated based on the power generation efficiency of 61.2% using natural gas as the power source. The default value for EF_{RE} is set to be 0.319 tCO_2/MWh.	Additional information The default emission factor is derived from the result of the survey on the generation efficiency of major natural gas-fired power plants in Thailand. The default value should be revised if necessary from survey result which is conducted by the JC or project participants.

(3) Examination of cost effectiveness and business profitability

Initial investment of photovoltaic power generation system varies depending on construction company, but it was calculated assuming it to be 180,000 yen / kW. The amount of JCM subsidy calculated from the annual CO2 emission reduction amount by the product of the expected cost-effectiveness of JCM equipment subsidies of 4,000 yen / ton-CO 2 is shown below.

Initial Investment

= Power generation output 541 kW × Unit cost of investment 180,000 yen/kW

= 9.378 million yen

The amount of subsidy calculated from cost effectiveness (assuming project period 17 years)

= (191.2 ton-CO_2/year × 17year) × 4,000 yen/ton-CO_2

＝ 13 million yen （13.3% of initial investment）

2.2.2. Introducing BDF plant in Restaurant Association

(1) Overview

By collaborating with the Myanmar Restaurant Association, generating BDF (Bio Diesel Fuel) from waste oil discharged from restaurants in Mandalay City and utilize it as fuel for in-house power generation and trucks such as trucks consider.

（Feature of technology）

BDF is a fuel that is purified mainly by treating oils derived from plants and animals with an alkali catalyst and methanol and processing such as methyl esterification and is widely used all over the world as a substitute fuel for diesel (light oil) Has been done. Because rapeseed and other plants absorb CO2 in the atmosphere through photosynthesis during its growth process, even if CO2 is generated by burning BDF, the amount of CO2 in the atmosphere does not change throughout the life cycle, so it is called carbon neutral.

（Overview of equipment）

BDF is required to strict quality standards as fuel, and companies that manufacture refining equipment are required to develop technologies that can stabilize quality and can easily check the quality In addition to the fact that dry equipment that does not drain wastewater is used in the manufacturing process, the quality stabilization technology and the efficient refining method of BDF (continuous batch type) are the strengths of the equipment adopted for this study. Also, because it is a container type plant, construction on site can be minimized. Table 2.2.3 shows the device information, Figure 2.2.3 shows the outline drawing, and Figure 2.2.4 shows the plant flow sheet[9].

Table 2.2.3 Information of BDF container type plant

Provider	BDF Corporation
Body dimensions	6,058L × 2,438W × 2,896H
weight	5,000 kg (By specification)
Manufactureing capacity	400ℓ/10hr
Manufactureing method	Continuous batch type
Simple inspection technology	Exist
wet dry type	dry type

[9] BDF Corporation

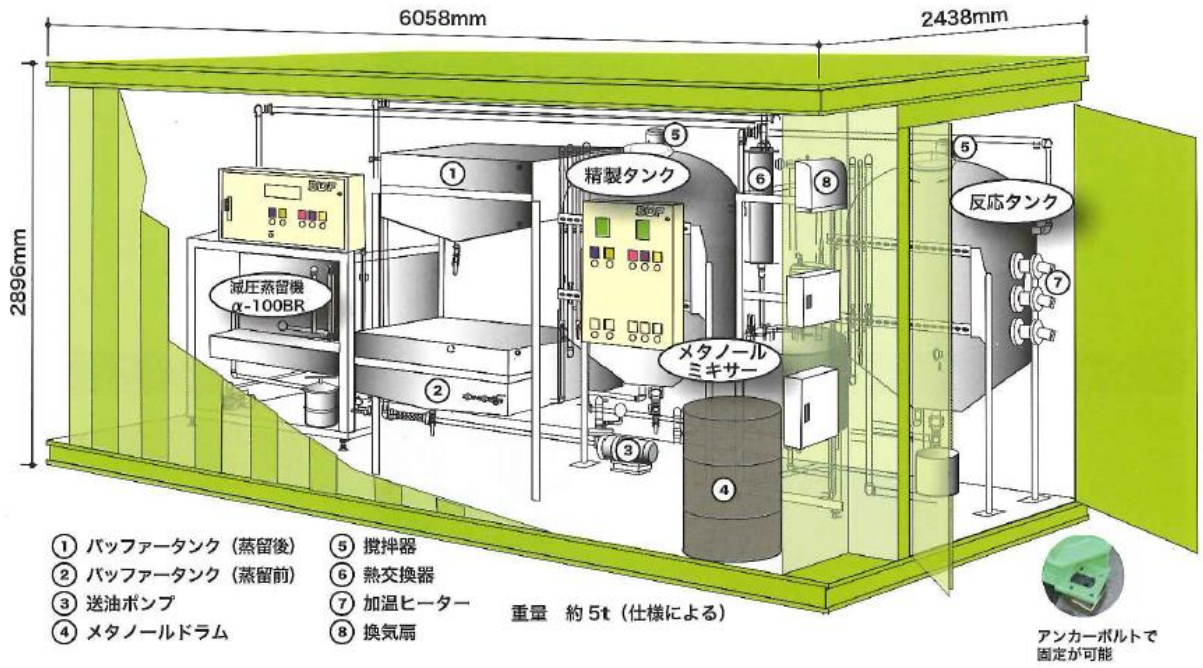


Figure 2.2.3　Overview of BDF Plant

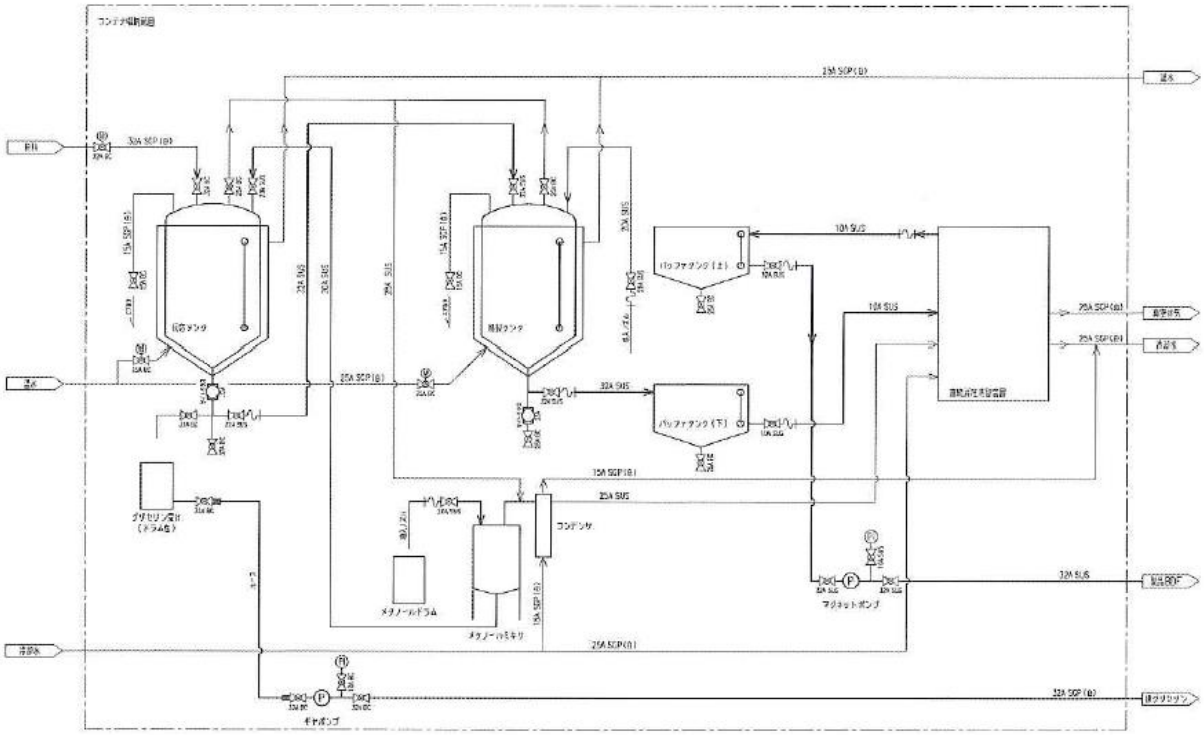


Figure 2.2.4　Flow sheet of BDF Plant

There are more than 200 restaurants in Mandalay City, and according to the restaurant association, there are 3 to 9 liters of waste oil per day at each store. If the restaurant association works, it means that it is possible to collect waste oil near 1,000 liters a day.

In this study, the installation of 400-liter scale processing plant in one place are assumed in Mandalay City and MRA collect waste oil from each restaurant in Mandalay City at the installation site. In carrying out the calculation, 50 restaurants cooperated with waste oil collection, and the amount of waste oil generated per store was assumed to be 6 liters / day. The number of working days of facilities is 330 days. The calculation result of BDF generation amount is shown in Figure 2.2.5. In this calculation, 270 liters of BDF can be generated every day.

Nos of Restaurant	50				
waste oil per restaurant	6	L/day			
Input				Output	
waste oil volume	300	L/day		BDF ourified amoun	270 L/day
Methanol amount	53.8	L/day		Waste glycerin	77.7 L/day
Caustic potash	4.6	kg/day			
Processing agent	46.4	L/day			

Figure 2.2.5 Calculation result of BDF generation amount when introducing BDF plant into city restaurant

(2) Calculation of CO2 emission reduction

Reduced emissions are calculated after referring document "EN-R-004 Ver.1.0: Replace fossil fuels or grid power with liquid biofuel (BDF, bioethanol, bio oil)", which is approved J credit methodology. Note that glycerin is an arisen byproduct, a valuable substance used effectively for external systems and will not be considered here according to the above methodology.

1) Reference emission amount

In the reference scenario, calculate carbon dioxide emissions in case cars in the restaurants use diesel.

$$RE_y = Q_{R,heat,input} \times CEF_{R,fuel}$$

$$= 3{,}389 \times 0.0187 \times 44/12$$

$$= 233.5\ tCO2e/year$$

In Which、

RE_y ： Emissions in the reference scenario in y year (tCO2e/year)

$Q_{R,heat,input}$ ：Heat used in the object equipment of the reference scenario in y year (used heat: GJ/year)

$CEF_{R,fuel}$ ：CO2 emission factor over each unit of arisen heat of a fuel used in the reference scenario. (=0.0187 tC/GJ)

$$Q_{R,heat,input} = F_{R,fuel} \times HV_{R,fule}$$

In which,

$F_{R,fule}$ ： Amount of fuel consumption of the object equipment in the reference scenario (KL/year)

$HV_{R,fuel}$: Unit of arisen heat when the object equipment in the reference scenario uses fuels (GJ/kL)

$Q_{R,heat,input}$=270×330×$\frac{1}{1,000}$×38.04＝3,389（GJ/year）

2) Project emission amount

a) Project emission amount

$$PE_y = PE_{y,M} + PE_{y,S}$$

$$=0.00+1.94$$

$$=1.94\ tCO2e/year$$

In which,

PE_y ： Emissions of the project in y year (tCO2e/year)

$PE_{y,M}$ ： Main emissions of the project in y year (tCO2e/year). In this review, this indicator meaning the emissions used by the system will be applied.

$PE_{y,S}$ ：Incidental emissions in the project in y year (tCO2e/year). Here, it corresponds to methanol based emissions, emissions by power used in BDD production process and emissions caused by the use of diesel fuel when collecting and transporting waste edible oil.

b) Main emissions of the project

CO2 emissions when using BDF as carbon neutral as below .

$$PE_{y,M} = 0.0tCO2/年$$

c)Incidental emissions in the project

i) Emissions after implementing the project due to the collection and transportation of waste edible oil ($PE_{ys,trans}$)

$$PE_{y,s,trans} = F_{PJ,trans} \times VH_{PJ,trans} \times CEF_{PJ,trans}$$

In which,

$F_{PJ,trans}$: Fuel consumption due to the collection and transportation of waste edible oil after the project (KL/year)

(Assume 3% the current amount of use)

$HV_{PJ,trans}$: Unit of heat arisen when using fuels for the collection and transportation of waste edible oil after the project (GJ/KL)

$CEF_{PJ,trans}$: CO2 emission factor over each unit of heat arisen when using fuels for the collection and transportation of waste edible oil after the project (0.0187tC/GJ)

Therefore,

$$PE_{y,s,trans} = 270 \times 330 \times 0.01 \times \frac{1}{1,000} \times 38.04 \times 0.0187 \times \frac{44}{12}$$

＝0.09 (tCO2e/year)

ii) Emissions after implementing the project from the use of power in BDF production process ($PE_{y,s,process}$)

$$PE_{y,s,process} = EL_{PJ,process} \times CEF_{electricity,t}$$

In which,

$EL_{PJ,process}$： The amount of power after implementing the project (kWh/year)

$CEF_{electricity,t}$： CO2 emission factor from the use of power (0.319 tCO2e/MWh)

Therefore,

$$PE_{y,s,process} = 46.4 \times 330 \times \frac{1}{1,000} \times 0.319$$

≒4.9 (tCO2e/year)

iii) Emissions after implementing the project due to use of methanol ($PE_{y,s,MeOH}$)

$$PE_{y,s.MeOH} = MC_{PJ,MeOH} \times \frac{12}{32} \times \frac{44}{12}$$

In which,

$MC_{PJ,MeOH}$：Volume of methanol when producing BDF (t/year)

（$\fallingdotseq 53.8 \times 330 \times \frac{1}{1,000} \times 0.7918 = 17,750$ (t/year)）

Methanol density: 0.7918 (t/m^3)

$$PE_{y,s.MeOH} = 17,750 \times \frac{12}{32} \times \frac{44}{12}$$

＝19.3 (tCO2e/year)

As above, the random emissions of the project ($PE_{y,S}$) are

$PE_{y,s} = PE_{s,trans} + PE_{s,process} + PE_{s,MeOH}$

= 0.09+4.9+19.3

= 24.3 (tCO2e/year)

3) Emission reduction amount

Reduced emissions are the difference between the reference emissions and the emissions of the project.

$ER_y = RE_y - PE_y$

$=233.5 - 24.3 = 209.2$ *tCO2e/year*

Reduced emissions in the project implementation time ER_p

$ER_p = ER_y \times P$

$= 209.2 \times 8$

$\fallingdotseq 1,673.7\ tCO2e$

In which,

P : Project time. The legal use years of the equipment used for the restaurants = 8 years

From the above, the amount of CO2 emission reduction during the project period in this setting is 1,673.7 t-CO2.

(3) Examination of cost effectiveness and business profitability

（Cost effectiveness）

The cost effectiveness is calculated by dividing the JCM subsidy for equipment introduction cost (initial cost) by the emission reduction amount during the project period. The initial investment amount of this project was estimated to be 42 million yen in consideration of tariffs. As shown below, the cost-effectiveness of subsidies when receiving 50% facility assistance is 12,547 yen / t-CO 2. On the other hand, since the calculated CO2 emission reduction amount is 1,673.7 t - CO 2, when back calculation is made from 4,000 yen t - CO 2 which is the cost - effectiveness target value, the subsidy rate is about 16% .

Calculation of initial investment		
Equipment cost	28	mmilion yen
Tariff etc.	50%	
Initial investment amount	42	mmilion yen

●Calculate cost effectiveness of subsidies		
Subsidy amount when back calculation from 4,000 yen/t-CO2	6,695	1,000 yen
Subsidy ratio	15.94%	
Cost benefit in case subsidy ratio is 50%	12,547	yen/t-CO2

In other words, when collecting waste oil of 6 liters per day from 50 restaurants, the cost effectiveness will be 3 times higher than the target value of 4,000 yen / t-CO 2, and the subsidy rate will be low. Therefore, we analyzed the sensitivity of the impact on the cost effectiveness of the equipment cost project by changing the amount of waste oil generated per store and the number of cooperating restaurants. The analysis results are shown in Table 2.2.4.

As shown in Table 2.2.4, in order to meet the cost-effectiveness target value of 4,000 yen / t-CO2 and achieve the subsidy rate of 50%, it is necessary to collect waste oil of 941 liters per day. If the amount of waste oil that can be gathered from each store is on average about 6 liters, it is necessary to cooperate with 150 or more restaurants.

Table 2.2.4 Cost effectiveness sensitivity analysis result

Target amount of collected waste oil　941 L/day

Cost Effectiveness yen / t-CO2		Collected oil per restanrant（L/day）					
		4	5	6	7	8	9
Nos of Restaurant	40	23,525	18,820	15,683	13,443	11,763	10,456
	50	18,820	15,056	12,547	10,754	9,410	8,364
	60	15,683	12,547	10,456	8,962	7,842	6,970
	70	13,443	10,754	8,962	7,682	6,721	5,975
	80	11,763	9,410	7,842	6,721	5,881	5,228
	90	10,456	8,364	6,970	5,975	5,228	4,647
	100	9,410	7,528	6,273	5,377	4,705	4,182
	150	6,273	5,019	4,182	3,585	3,137	2,788

（Review of business profitability）

The income from the BDF project is obtained by (1) selling proceeds generated by selling the generated BDF as fuel for diesel cars and private generators, and (2) selling by-product glycerin as a fuel to the cement company. Expenditure includes materials procurement costs (methanol, caustic potash etc.) necessary for BDF production and electricity bill for equipment operation.

Figure 2.2.6 shows the results of calculation of business profitability in the case where waste oil of 6 liters / day can be collected from 50 restaurants. Considering the legal service life of the facility for 8 years as the project period, two patterns with no subsidy and with 50% subsidy were considered.

Without subsidies, the payback period was 7.8 years, NPV was -10 million yen, IRR = 0.5%, which resulted in no business. If there was subsidy of 50% of the initial investment, the payback period was 3.9 years, NPV was 11 million yen, IRR = 19.3%. If there is a 50% subsidy, it should definitely be implemented.

From the results of the study on cost effectiveness, we analyzed the sensitivity of project profitability (payback period and IRR), because the amount of waste oil that can be collected greatly affects the business performance, and the waste oil amount and subsidization rate as variables. The results are shown in Figure 2.2.7. Depending on the IRR expected by the project entity, if it is possible to collect 500 liters of waste oil per day, IRR = 14% without subsidy.

Calculating the subsidy rate when collecting 500 liters per day, it will be 26.57%, IRR = 21 to 25%, payback period will be 3.8 to 3.3 years, and sufficient profitability can be expected.

Without Subsidy MM yen

	Yr.0	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	Yr.6	Yr.7	Yr.8
Initial Investment	-42.00								
Operation & Maintenance cost		-0.91	-0.91	-0.91	-0.91	-0.91	-0.91	-0.91	-0.91
Revenue from fuel sales		6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28
FCF	-42.00	5.36	5.36	5.36	5.36	5.36	5.36	5.36	5.36

Discount ratio	7%	Pay back period	7.8 year
NPV	-10		
IRR	0.5%		

With Subsidy MM yen

	Yr.0	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	Yr.6	Yr.7	Yr.8
Initial Investment	-42.00								
Operation & Maintenance cost		-0.91	-0.91	-0.91	-0.91	-0.91	-0.91	-0.91	-0.91
Subsidy	21.00								
Revenue from fuel sales		6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28
FCF	-21.00	5.36	5.36	5.36	5.36	5.36	5.36	5.36	5.36

Subsidy ratio	50%	Pay back period	3.9 year
Discount rate	7%		
NPV	11		
IRR	19.3%		

Figure 2.2.6 Analysis result of business profitability of BDF project

Sensitivity analysis - Change in IRR

Change in IRR		Total amount of collected waste oil (liter / day)						
		300	400	500	600	700	800	900
Subsidy Rate	0%	0%	7%	14%	19%	25%	30%	35%
	10%	3%	10%	17%	23%	29%	34%	40%
	15%	4%	12%	19%	25%	31%	37%	42%
	20%	6%	14%	21%	27%	34%	40%	46%
	30%	9%	18%	25%	33%	40%	46%	53%
	40%	14%	23%	32%	40%	47%	55%	63%

Sensitivity analysis - Change in Pay back period

Change in Pay Back Period		Total amount of collected waste oil (liter / day)						
		300	400	500	600	700	800	900
Subsidy Rate	0%	7.8	5.9	4.7	3.9	3.4	2.9	2.6
	10%	7.0	5.3	4.2	3.5	3.0	2.6	2.3
	15%	6.7	5.0	4.0	3.3	2.9	2.5	2.2
	20%	6.3	4.7	3.8	3.1	2.7	2.3	2.1
	30%	5.5	4.1	3.3	2.7	2.3	2.1	1.8
	40%	4.7	3.5	2.8	2.3	2.0	1.8	1.6

Figure 2.2.7 Sensitivity analysis results with variable waste oil collection amount and subsidy r

2.3 Examination of project implementation scheme

(1) Implementation scheme in introduction of solar power generation system into multiple hotels

Figure 2.3.1 shows the image of the project implementation scheme when promoting JCM subsidy project in the introduction of solar power generation system into multiple hotels. For local companies of the international consortium, we assume special purpose entities (SPVs) voluntarily established by the hotel association or hotel owner of the installation site. It is assumed that this organization procures the system all at once and introduces it to each hotel. The EPC contractor is supposed to be a construction company owned by the president of the Hotel Association.

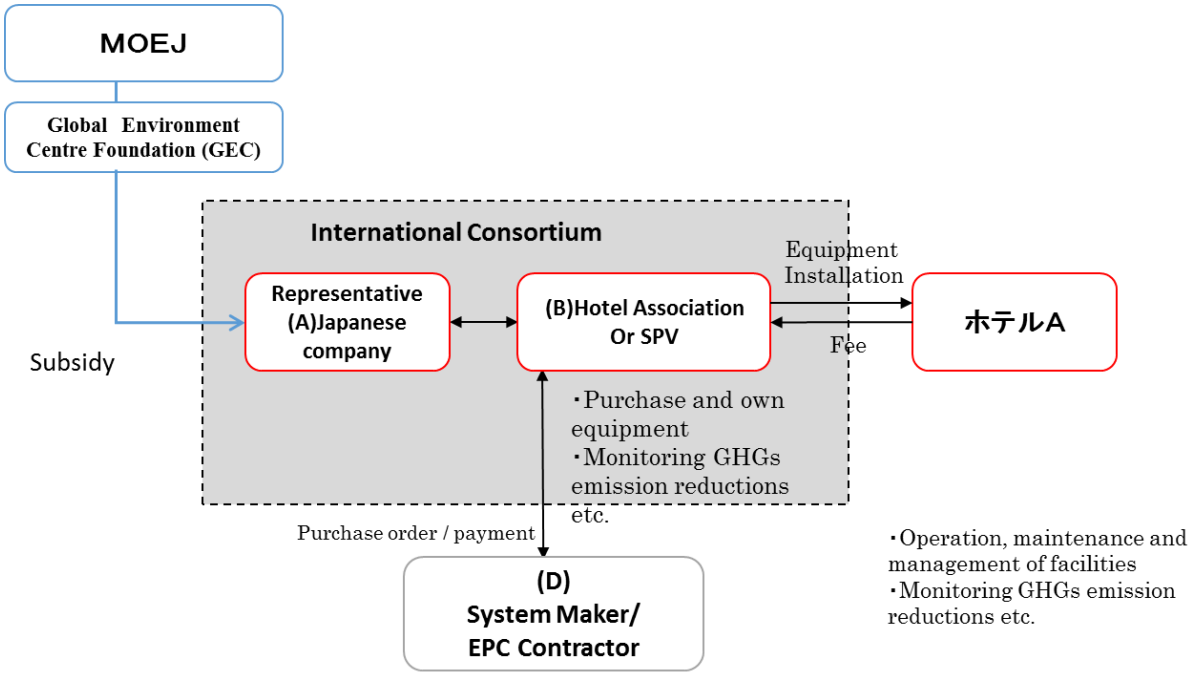


Figure 2.3.1 Project Implementation scheme ①

(2) Implementation scheme in introduction of waste oil BDF manufacturing equipment to restaurant association

Image of waste edible oil BDF production facility introduction business to restaurant association Image of the implementation scheme is shown in Figure 2.3.2.

While discussing with the restaurant association, since the burden of initial investment is high, we propose a scheme that the restaurant association will not bear the initial investment.

The local joint venture company established a special purpose entity (SPV) in cooperation with an investment fund that is actively investing in the low carbonization business, and the SPV, which was established, owns the facilities and sends it to the restaurant association We assume a lease-type scheme that lends equipment.

In addition, since the assumed container type BDF plant is manufactured in Japan, and installation work is simply conducted at site. It is assumed that local construction is enough for local work to appoint local companies.

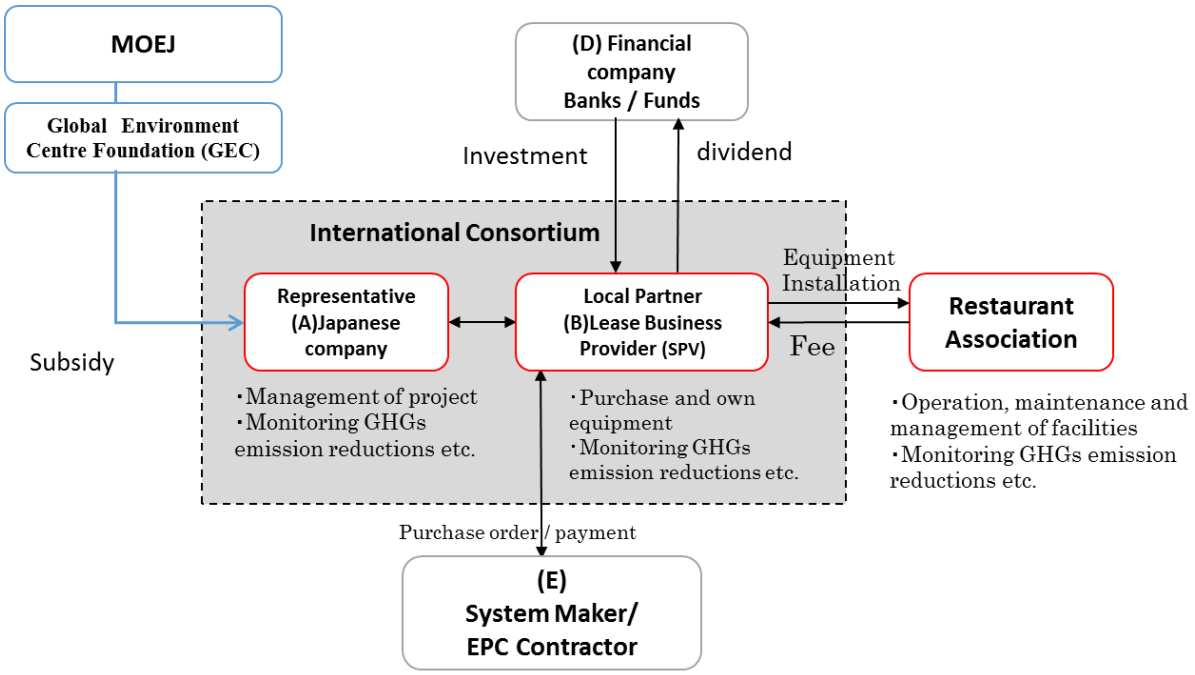


Figure 2.3.2 Project Implementation scheme ②

2.4 Extraction of issues for project composition

(1) Study for expansion of project scale

Both of the two projects above are small in scale and we can not expect a large reduction in CO2 emissions. With regard to considering introduction of solar power generation facilities in cooperation with Hotel Association, it is also possible to increase the number of hotels to cooperate and to introduce it to other businesses and facilities owned by hotel owners. We are pursuing consultation on an ongoing basis in an increasing direction.

Regarding the BDF facility introduction to the restaurant association, the equipment price is less than 50 million yen which is the minimum standard of the project scale of the JCM subsidy project. It is not practical to increase the base of BDF equipment in Mandalay City because it is unlikely that a significant expansion of the amount wasted oil in Mandalay City, it is necessary to consider introducing it together with other facilities. Or, it is necessary to increase the scale of facilities separately in a manner to procure jointly with major private enterprises that are advancing consultations for introducing the BDF facilities.

(2) Detailed examination of collection flow of waste oil, sales destination, sales scheme etc.

In this survey, rough estimation was conducted based on the contents of consultation with the restaurant association, but as described above, the amount of collected waste oil greatly affects the business performance.

The amount of waste oil that can actually be collected and the sales system of collection / BDF need to be discussed while identifying cooperating shops.
As for the glycerin which is a by-product generated in the generation of BDF, it is confirmed from the management of the cement company 200 km away from the city that it can be accepted, but a detailed study on transportation method etc. It will be necessary next time.

(3) Collaboration with MCDC

In the case of Hotel Association and Restaurant Association, we negotiated on a B2B basis without going through MCDC, but in order to expand the scale of both businesses and to smooth projects, cooperation with MCDC is necessary.

In the case of considering the project of solar power generation facilities, since there are multiple large buildings owned by the city at positions adjacent to the hotel, by utilizing the roof of such city owned facilities, installation of photovoltaic power generation facilities can be expanded the scale.

Regarding the project to introduce BDF equipment, proper disposal of waste oil is important for improving water quality pollution, and by cooperating with MCDC, it is also possible to receive waste oil recovery support from the institutional side. In addition, since MCDC is the organization that owns the most diesel vehicles in Mandalay city, collaboration is important from the viewpoint of securing the use destination of BDF.

(4) Financing

As mentioned above, in the case where it is difficult for the local company side to raise funds, it is assumed that a lease type scheme is used in which SPVs launched as joint venture companies purchase facilities and lend them to installers. Therefore, the local company does not need a large initial investment and pays a fixed monthly lease fee to the SPV during the project period. Ownership of equipment after project completion is assumed to move to the local company side.

On the other hand, we are considering utilization of local banks and funds regarding SPV financing. In particular, it is supposed to procure funds through collaboration with infrastructure funds that invest only in projects that contribute to CO2 emission reduction.

(5) Selection of representative company

It is necessary to select representative business candidate. There are few Japanese-affiliated companies entering Mandalay City. Also, since all businesses considering introduction of equipment in this survey are local small and medium-sized organizations, large foreign companies and local branches of Japanese companies Compared to Japanese companies, it is considered that they are considered high risk as partner partners for international consortiums. Continue to find company grasping the situation in Myanmar and considering business in Mandalay over the long term.

2.5 Review of project implementation schedule

After coordinating with representatives / joint venture companies and cooperating companies, the schedule of implementation of JCM equipment auxiliary project to be decided, but firstly continuous consultation to solve the above problem to be conducted.

Regarding the BDF manufacturing facility, design works takes about three months, from procurement to installation, commissioning requires a half year to one year period.

2.6 Future study

In this section, projects that we will continue consultation in the future, expecting particularly great development in the future are described.

(1) Collaboration with construction project of smart city in Myanmar

By cooperating with MBC Corporation described in item 6 of the individual interview results in Table 2.1.3., aiming at project composition which is applicable to JCM subsidy program.

The project is mainly conducted by the Ministry of Construction of Myanmar, and the plan is being advanced at the Hlegu Township in the northern part of the Yangon Province. The development cost is 2 billion USD, covering 1453 acres along the Yangon-Mandalay expressway. The project period is ten years, and it is planned to develop infrastructure such as bus terminals, parks, shopping malls, luxury houses, roads, etc. during the first phase of the construction project from 2018 to 2023.

MBC Corporation is a member of the Star Group Alliance, which promotes projects with the Ministry of Construction with JV, and is positive for introducing facilities by utilizing JCM within the area. In the future, we plan to discuss the area developed in this project so that cooperative activities such as introduction of low-carbon technology utilizing JCM equipment assistance project and sharing know-how of eco industrial town in Kitakyushu city will be possible is there.

Figure 2.6.1　Conceptual drawing of Eco Green City Project[10]

[10] Myanmar Times 14th-Fec-2019 https://www.mmtimes.com/

(2) Introduction of low carbon technology into large rubber factory in collaboration with Myanmar Rubber Association

Survey team was able to have a connection with the Natural Rubber Association during the research activity. Among the plurality of rubber manufacturers, Southland Myanmar Rubber Co., LTD described in item 7 of Table 2.1.3 is planning large-scale capital investment and conducted consultations for JCM subsidy application.

The production process of natural rubber is classified into three stages: (1) a "compounding process" in which raw rubber is selected according to the use and conditions of use of the product, and (2) the type and amount of various compounding agents are determined; "Processing process" of mixing raw material rubber and compounding agent, rolling, extruding, forming a compound and shaping it into the required shape, (3) putting the molded material in a mold and applying heat with a press or vulcanizing can or the like, A "vulcanization step" that forms an elastic body.

In the manufacturing process, use of large amounts of water for washing rubber, heat for drying rubber, and use of electric power to operate various devices at each step, introduction of energy saving and energization facilities The possibility is considered high.

(Company Outline and Investment Plan)

Southland is a Thailand-based company and boasts a 22% share of the world's natural rubber production. The Myanmar branch office was founded two years ago and this factory took half a year to start up, so it's been a year and a half since it started running. The factory in Myanmar procures natural rubber raw materials from domestic and overseas, conducts dry processing, and exports it to foreign countries. The employee is operating every day for about 150 people, 20 hours a day.

There are two future capital investment plans. It is a new factory in BaGo Province and TaNinThaYi Province. TaNinThaYi Province is scheduled to start operation in April 2019, and 3 units of 700 kVA diesel generator will be introduced. Since he has already purchased equipment, it is difficult to utilize JCM equipment assistance projects. Since the application is only electricity use, it is an area where natural gas can not be used, so diesel generators was purchased.

The factory in the BaGo Region will be in operation around April 2020. It assumes twice the equipment scale of TaNinThaYi Province. There is a possibility that this area can use natural gas pipeline. Although factories are both rubber manufacturing methods that do not use steam, they are assumed to consume large power. According to the company's investment rules, since the period of one project is up to two years, it is consistent with JCM's project period (within three years), and it was positive for JCM facility subsidy application. Since the company has many factories in Southeast Asia, it shows the intention to laterally develop examples made by JCM including Myanmar, and we plan to continue consultation in the future.

Figure 2.6.2　Picture of meeting

Figure 2.6.3　Ovreseas branch of Southlad Rubber Group[11]

(3) Introducing mega-solar power generation system into industrial town in Mandalay city

MMID Public Co., Ltd, which operates the Myota industrial park described in item 8 of the individual interview results in Table 2.1.3, is a company that has introduced contacts and has contacted the JCM program in the 2017 survey. The company has developed a Myota industrial park with the Mandalay Province administration since 2012. Although the environmental impact assessment has been completed in 2016, it is in the stage of infrastructure development such as substation equipment and water supply piping network, and there are about 6 enterprises in the beginning of 2018. They expect the Japanese companies to move in, but unlike industrial parks in Yangon, infrastructure development is not enough to be a bottleneck. In the future, not only industrial parks but also town planning are planned, and a master plan has already been

[11] Southland rubber group website

created. Image diagram of the master plan of Myota Industrial Park is shown in 2.6.4.

The company is considering the possibility of introducing mega solar and storage battery as the main power supply for supplying electricity to future housing complexes and is currently pursuing consultation with EPC companies such as photovoltaic power generation in Kitakyushu city. We are planning to discuss this project with the aim of commercializing auxiliary facilities for JCM facilities.

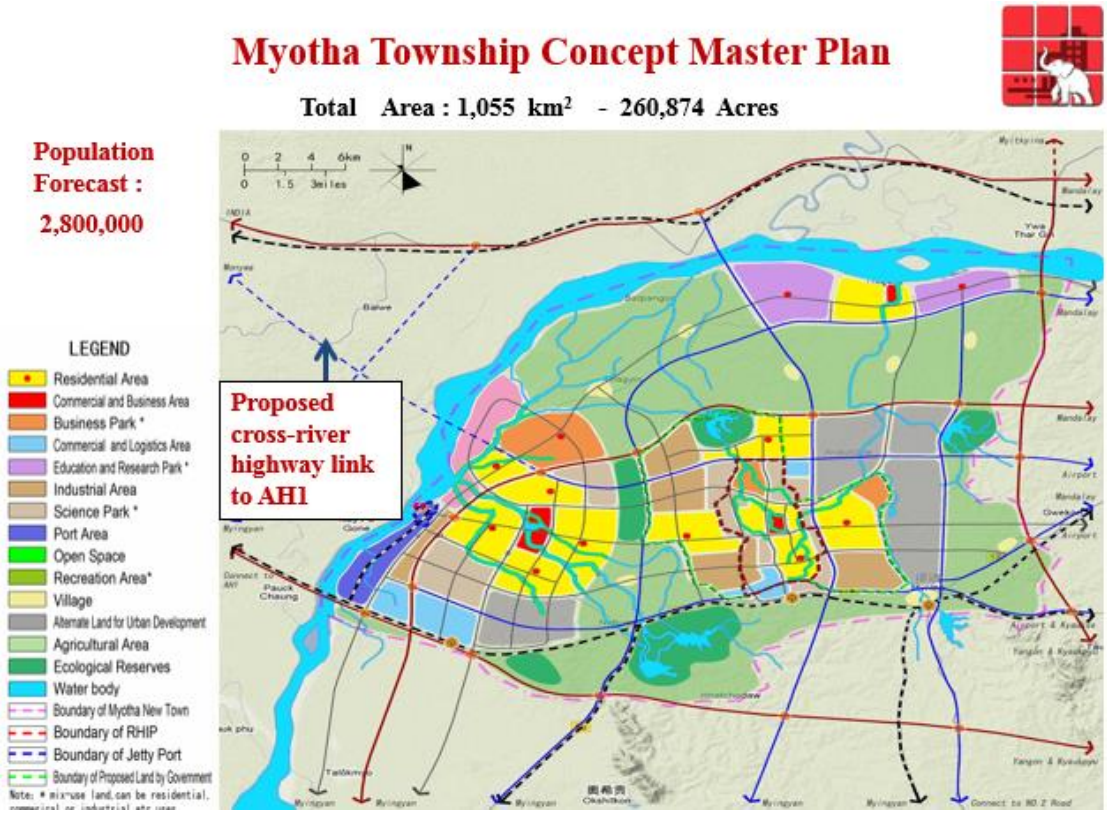


Figure 2.6.3 Parts of Master plan of Myota Industiral Town[12]

[12] Material provided by MMID

Chapter3 JCM Project Development Study＜Waste Management＞

3.1. Background of the Study

3.1.1. Waste Management in Myanmar

As far as Municipal Solid Waste related data & information in Myanmar, which the Study Team could find, there is a report titled "What a Waste (2018)" issued by IBRD-IDA is the latest. The report is 2nd edition of "What a waste (2012) with updated date after publication of 1st edition and published on August 2018. Summary of the report is as per Table 1 below.

Table 3-1 Summary of What's a Waste 2.0 with comparison of 1st edition (2012)

Description	【What's a Waste （2012）】	【What's a Waste 2.0（2018）】
Area	EAP (East Asia & Pacific)	
Income	Low（GNI < US$975.-）	Low（GNI <US$1,025.-）
Data source for Waste Generation	As per Report published by IPCC (2006) *estimated in 2000	As per Presentation at workshop for greenhouse gases inventory in Asia in 2010
Data source for Waste Collection & Transportation	Not Available	Not Available
Data source for Waste Processing & Disposal	Not Available	Not Available
Date source for Waste Analysis	Published Data in 2009（as a result of a research conducted in 2000）	

Source: http://datatopics.worldbank.org/what-a-waste/

Table 2 below shows amount of waste generated in the past & estimated to be generated in future. The amount of waste is estimated to be increased 25 percent by 2030 and 50 percent by 2050 in comparison with that generated in 2016.

Table 3-2 Amount of Waste generated and to be generated in Myanmar shown in "What's a Waste 2.0"

Description	2000[13]	2016	2030	2050
GNI		－	－	－
Population	46,095,462			
Amount of MSW generated / to be generated （ton / year）	4,677,307	7,451,835	9,315,917	11,207,310

[13] Thein, M. 2010. "GHG Emissions from Waste Sector of INC of Myanmar." Paper presented at the Eighth Workshop on GHG Inventories in Asia (WGIA8), Vientiane, Lao PDR, July 13–16.

Amount of MSW generated / to be generated (kg/person/day)	0.101	0.386	0.433	0.492

Source: http://datatopics.worldbank.org/what-a-waste/

World Bank Group explained as for methodology to estimate amount of waste to be generated in future in "What's a Waste 2.0" as follows;

- Amount of waste to be generated was estimated from GNI and Population
- Estimated values for population & GNI, which the World Bank Group adopted are those published by World Bank and United Nation
- Adopted most reliable value for Amount of waste to be generated (estimated value) at present
- Correlation between GNI and Amount of Waste generated is as per shown in the chart below. It shows that Lower correlation between GNI and Amount of waste generated once GNI reach to some level, while GNI and amount of waste generated are in direct proportion before GNI reaching to such level)

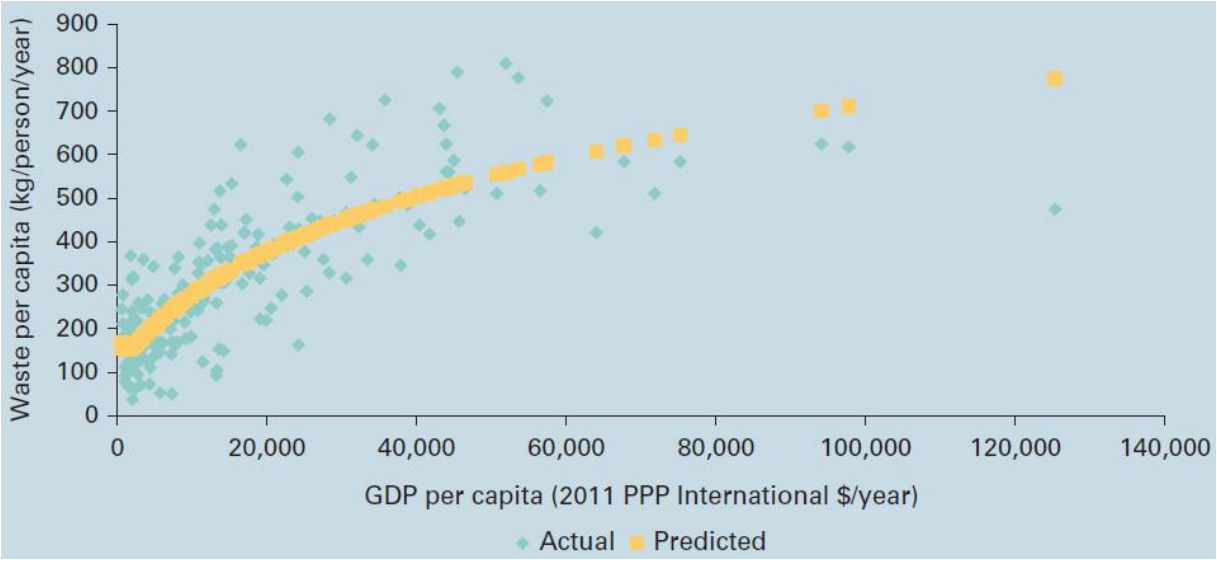


Figure 0.1 Correlation between GNI and Amount of Waste generated

Source: http://datatopics.worldbank.org/what-a-waste/

Other than the report mentioned above, The *IGES* Centre Collaborating with UNEP on Environmental Technologies (hereinafter referred as "*CCET"*) published a report titled "Waste Management in Myanmar Current Status, Key Challenges and Recommendations for National and City Waste Management Strategies)(2018)". CCET referred to "What's a Waste (2012) of IBDA-IDA and reported that 56.16million tons per year as amount of waste generated and 0.44kg as an amount of waste generated per person per day in Myanmar in 2012. There also another description stated that 1.981 ton/day from Yangon. 955 tons/day from Mandalay and 160 tons/day from Naypyidaw as amount of waste generated by city, and amount of waste generated at these three cities covers 55.1% of total municipal solid waste generated in

Myanmar.

3.1.2. Waste Management in Mandalay city

Mandalay city is the second largest city with its population of 1.225million in urban area and 2.15 million including surrounding area. Mandalay City Development Council announced that amount of municipal solid waste generated in the area reaches to more than 1,000 tons/day in 2017 from less than 300 tons/day in 2005.

Parts of municipal solid waste generated in the area is transported and open-dumped at solid waste disposal sites (hereinafter referred as "SWDS") located in southern & northern parts of the city. However residential areas come close to the SWDS located at the southern part of the city, due to rapid development of the city and become nuisance, in terms of environmental & health impact, in addition to less capacity left to receive waste.

Mandalay city, therefore, a part of 'enhancement of municipal solid waste management' which is one of the most critical issues that the city is tackling with, considers to develop waste management related infrastructure, to say exactly, "waste segregation units" to segregate 500 tons/day of municipal solid waste to utilize its components, and reduce its amount to be landfilled, and "sanitary landfill" to be newly developed at both at Kyar Ni Kan SWDS (hereinafter referred as "Northern SWDS") and Taung Inn Myount Inn SWDS (hereinafter referred as "Southern SWDS") . Mandalay city regards PET, can, PVC, PP & Organic Waste as recyclable waste and promote to utilize organic waste as raw material for composting and/or biogas collection for thermal use.

3.1.3. City-City Cooperation between City of Kitakyushu & Mandalay City (Waste Sector)

City of Kitakyushu, with cooperation among government, citizen and private sector, has been engaging various environmental conservation activities in Asia since early stage.

By initiation of Economic & Social Committee for Asia and Pacific (ESCAP) "Kitakyushu Initiative Network" has been established in 2000, then 'Kitakyushu Modal" has been introduced to many cities at seminar and/or workshop organized by various government agencies and organization including ESCAP, while City of Kitakyushu boosts up their activities in the area. City of Kitakyushu provided technical support for water supply sector for four years started from 2012 and, received trainees from Cleansing Dept. of Mandalay city office, and dispatched experts to support public awareness raising and 3Rs in waste management sector in Mandalay city.

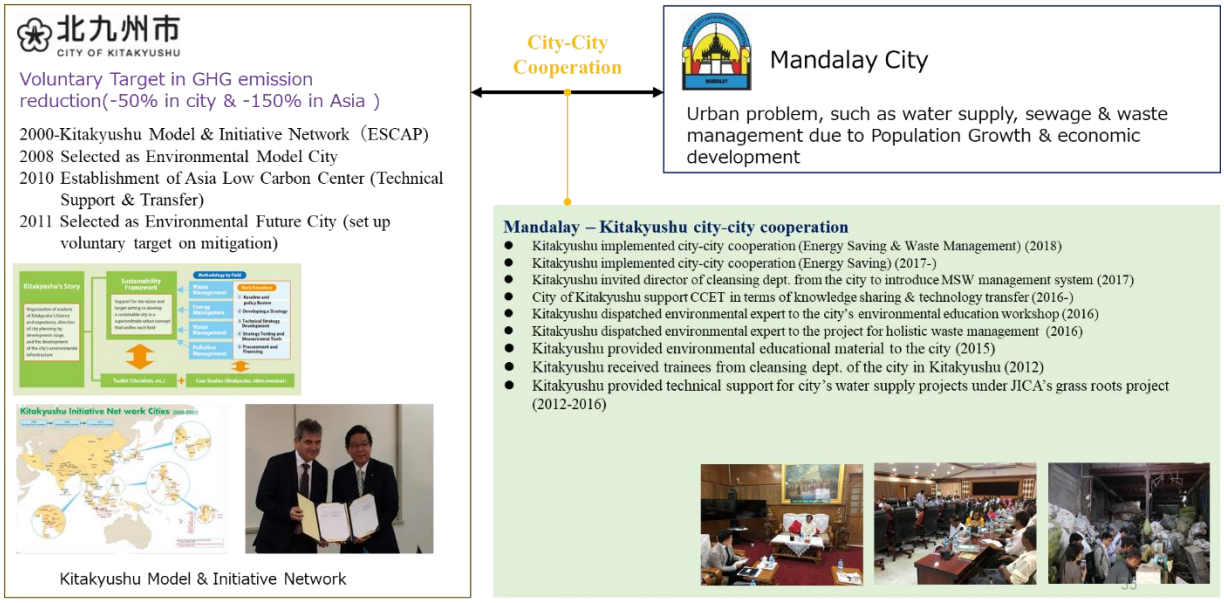


Figure 0.2 City-city cooperation between City of Kitakyushu & Mandalay city

Mandalay city, with highly respected City of Kitakyushu's knowledge and experience in the field of Waste Management, strongly requested City of Kitakyushu to expand its support to Waste Management under city – city cooperation. Upon receipt of the request placed by Mandalay city, City of Kitakyushu decided to conduct this study as a part of city-city cooperation.

3.2. Objective, Content and Organizational Structure for the Study

3.2.1. Objective(s) of the Study

Objectives of the Study are as follows;

- To enhance waste management in Mandalay city by sharing and transferring knowledge and technologies in the field of waste management owned by City of Kitakyushu (under City-City Cooperation)
- To study possibility of development of waste management related infrastructures as a part of enhancement of waste management in Mandalay city &.
- To study possibility to register the project mentioned above as a JCM project (JCM project development & feasibility Study)

3.2.2. Contents of the Study

EX Research Institute aims to participate in the project as a consultant in international consortium and Japanese technical providers might participate in the project as EPC. Thus, it is quite important for both Japanese party who will be a member of International Consortium as well as EPC to understand related laws & regulations, other than feasibility of the project. With understandings mentioned above, The Study team conducted following research &

activities in this study

(1) Environment related Laws & Regulations applicable for the targeted project in Myanmar

The study team reviewed laws & regulations as well as Policy applicable for the targeted project in Myanmar as well as those in Mandalay is one of the most important tasks when parties involved in consider developing the project. In this study, the study team collect relevant data & information and make those in order

(2) Current situation, challenges, policy on waste management in Mandalay city

The study team collected data & information and policy for municipal waste management generated in Mandalay city and surrounding areas and identified challenges in municipal solid waste management.

(3) To support on enhancement of municipal solid waste management in Mandalay city

Mandalay city regards municipal solid waste related issues as one of the most important issues and is tackling with those. As stated, CCET provided technical support for awareness raising for 3R promotion, but no parties provide comprehensive approach covering waste processing & disposal.

City of Kitakyushu, with understandings of "comprehensive approach is necessary in realization of waste related infrastructure development and to strengthen relationship between City of Kitakyushu and Mandalay is sure to contribute promotion of package export of infrastructure, which the Government of Japan promote as national policy, including registration of any of such project as JCM project, supported "Mandalay city's project on enhancement of waste management" by sharing knowledge & transferring technologies as for "waste management by local government authority". Since CCET kicked off their project, in advance of implementation of the study, The Study team exchanged ideas with CCET as for roles in the project on enhancement of waste management in Mandalay city, of which details is as per shown in Chart 3 below.

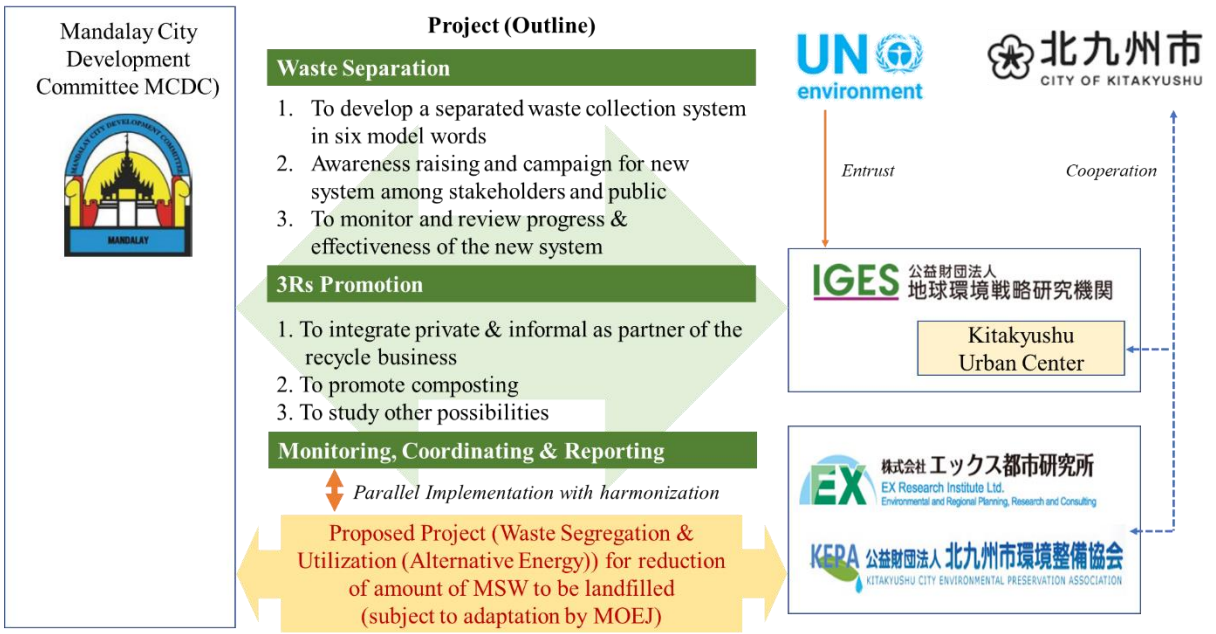


Figure 3.3 Correlation among parties involved in waste related projects in Mandalay City

(4) To study feasibility of the targeted project (as solution for better waste management in Mandalay city)

The study team proposed solution to enhance Mandalay city's waste management and set up a plan for project implementation. In addition, the Study team conducted literacy researches for Business establishment related laws & regulations applicable for the targeted project, together with licenses, environmental assessment, business flow & feasibility

(5) To study possibility for the targeted project to register as JCM project

Mandalay city recognize necessity of financial support to be provided by central government or others in process of waste related infrastructure development and this is completely met with the policy, to contribute global warming issues by promoting JCM project, set up by the Government of Japan (if all other conditions matched). The Study team studied possibility of registration of the targeted project as JCM project

3.2.3. Organizational Structure for the Study Implementation

The Study team consist of Ryoshin Co., Ltd. as technical provider for Waste Segregation Unit, Chiang Mai University for Biogas, Yangon Technology University as local facilitator under framework of city-city cooperation between Mandalay city & City of Kitakyushu. EX Research Institute also participated in the Study to support city of Kitakyushu and their activities under the Study. Ryoshin Co., Ltd., with plan to expand their business operation to overseas, participated in the project to study feasibility of being EPC for the targeted project. Correlation among the parties involved in the Study is as per shown in Figure 3-4 below.

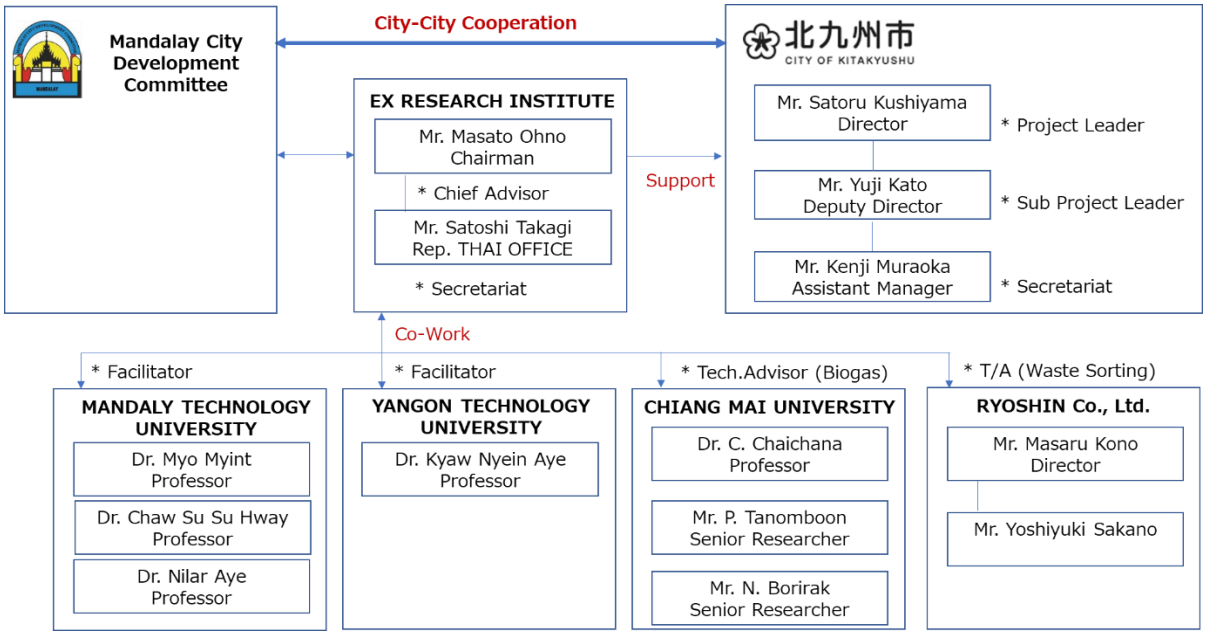


Figure 0.4 Organizational Structure for the Study Implementation

3.3. Findings from the Study

In this study, the Study Team conducted research focusing on 5 items stated in 2-2 above. Findings from the Study is as below;

3.3.1. Law, Regulation & National Policy related to the targeted project (Environment)

Environment related laws, regulations & policy in National level in Myanmar are as per shown in Table X below. First Environment related National Policy was published in 1994, then followed by "Myanmar Agenda 21" published in 1997. Then 10 years after publishing of "Myanmar Agenda 21", the Government of Myanmar published "National Strategy for Sustainable Development", then "National Waste Management Strategy & Action Plan" as its latest Environment related National Policy in 2018. As for laws & regulations, Environmental Conservation Act was enacted in 2012, then Rules on Environmental Conservation was noticed in 2014. In 2015 both "Guideline for Environmental Assessment" & "Environmental Standard" were published by the Government.

Table 0-3 Environment related Laws, Regulations & National Policy in Myanmar

Year	Laws & Regulations	National Policy, Plan & Strategy
1994		Environment related Policy
1997		Myanmar Agenda 21
2009		National Strategy for Sustainable Development
2012	Environmental Conservation Act	
2014	Environmental Conservation Rule	

2015	Guideline for Environmental Assessment	
	Environmental Standard	
2018		National Waste Management Strategy & Action Plan

Outline of laws, regulations & national policies mentioned above are as follows;

(1) Myanmar Agenda 21 & National Strategy for Sustainable Development

Myanmar Agenda 21(1997) is first national policy indicates policy on waste management in Myanmar.

The Government of Myanmar, then published "National Strategy for Sustainable Development" with support given by United Nation Environment Programme in 2009, with which the Government of Myanmar make its policy stated in "Myanmar Agenda 21" more explicitly. Table 3－4 below shows contents related to waste management in "Myanmar Agenda 21"

Table 0-4 Content of Myanmar Agenda 21

Chapter	Content
I	Introduction
II	Development Process for National Sustainable Development
III	Comprehensive Goal
IV	Actions to be taken
V	Monitoring & Assessment

Source: National Strategy for Sustainable Development (Myanmar Agenda 21)

As far as waste management concern, there is a description of "waste disposal of which amount is over environmental allowance capacity is one among three major causes, along with depletion of resource and deterioration of bio diversity" in Chapter 1. Other than the description above, there is following description in one among three goal of "sustainable development of natural resources", while other two goals are "economical sustainable development" & "social sustainable development"

- Water pollution is occurred by industrial & domestic activities. Water Pollution in urban area is caused by waste water untreated and discharged to public water area & disposal of waste from domestic & industrial sectors.
- Solid Waste includes sludge generated at domestic, commercial facility hospital, road, public area, construction debris and septic tank. Solid waste is mainly generated in urban areas
- With other environmental issues, it is necessary (i) to strengthening legislation, (ii) to introduce Generators' pay principal, (iii) to improve of waste management & disposal by

awareness raising in community level, (iv) to provide Environmental Education for establishment of material sound society including 3Rs, (v) to establish of hazardous waste management system & (vi) to promote on private investment in waste management related business

Referring to the description in Chapter III, the Government proposes (i) introduction of environmental related laws & regulation and system, (ii) strengthening environmental conservation including hazardous waste management as challenges in future in Chapter IV. However, as the Government stated, National Strategy for Sustainable Development is a kind of concept paper covering wide range of issues from the points of views of national sustainable development.

(2) Environmental Conservation Act (Myanmar)

One of the remarkable turning point in Environmental related administration in Myanmar is to enact Environmental Conservation in 2012. Upon enactment of the Act, the Government of Myanmar restructured administrative organization by changing Ministry of Forest into the Ministry of Environment and Forest, centralized environmental administration at the Ministry, then established National Environmental Conservation Committee as advisory body to the cabinet & coordination body among the government authorities. Environmental Conservation Act, regarded as Environmental Principal Act in Myanmar consist of 42 Articles in 14 Chapters, of which details are as per shown in Table X below.

Table 0-5 Contents of the Environmental Conservation Act (Myanmar)

Chapter	Article	Provision
I	1-2	Name of the Act and Definition
II	3	Objective
III	4-6	Establishment of Environment Conservation Committee
IV ‘	7-8	Competent Minister, its Authorities & Obligation
V	9	Urgent issue in Environmental Management
VI	10-12	Environmental Standard
VII	13-16	Environmental Conservation
VIII	17	Conservation of Urban Environment
VIIII	18-20	Conservation of Natural Resource & Cultural Heritage
X	21-25	Advance Permission
XI	26-27	Insurance
XII	28-30	Prohibition
XIII	31-34	Protection & Penalty
XIIII	35-42	Miscellaneous Provisions

Source: Environmental Conservation Act Myanmar

From the point of view of establishment of the targeted project, summarize and listed related Articles in Environmental Conservation Act as per Table 3-6 below.

Table 0-6 Articles might applicable for the targeted project in Environmental Conservation Act

Article	Provision
2-(h)	To define "Waste" as follows Waste is defined as "under this Act, solid or liquid or gas which amount-wise, structure-wise caused pollution as a result of disposal or discharge or emit to environment, including those contain radioactive substances
3	To prescribe the objectives of enactment of the Act as follows; ● To implement National Environmental Conservation Policy of Myanmar ● To set up standard and prepare guideline for sustainable comprehensive environmental conservation ● To realize good environment for live and conservation of natural & cultural heritage ● To restore eco-system at the edge of crisis of extinction ● Effective & consecutive utilization of natural resources under reduction in existing amount or extinction ● To promote environmental program for awareness raising & improvement of environmental related conscious ● To promote International, Regional & Bilateral Cooperation in the field of environmental conservation ● To cooperate with government authorities, international organization, non-governmental organization and individual in the field of environmental conservation
4	Establishment of National Environmental Conservation Committee
6	To stipulate authority of National Environment Conservation Committee as follows; ● To implement systematic education for environmental conservation & related activities ● To upgrade educational program for environmental conservation based on discussion with relevant government authorities ● To receive donation from both internal & external source of finance for environmental conservation and utilization of such fund, material & technology ● To submit environmental conservation related proposals to related

	government agencies. ● To request relevant government agencies to submit proposal to strengthen environmental conservation ● To request government agencies with activities might give negative impact on environment to stop their activities ● To implement national environmental policy upon approval of the Government and making environment related policy & implementation
7	Authority & Obligation of competent organization ● Implementation of environment -related policies ● Environment related Policymaking in both National & Regional levels ● To set up monitoring program for environmental management, conservation & pollution control & implementation ● To set up Environmental Standard ● To submit proposal on environmental management mechanism based on economic incentive ● Arbitration on environmental related issues ● To classify hazardous and non-hazardous substances ● To promote & realize construction of solid waste, liquid waste & gas processing facilities ● To set up standard for discharged waste water at Industrial Zone ● To cope with environmental related issues under International or Regional or Bilateral Treaties Conventions and/or Agreement ● To evaluate environmental & social impact assessment ● To draft guideline for ODS, Bio Diversity, Coastal Environmental Conservation & Climate Change ● To manage Environmental Fund including donation from beneficiaries from environmental conservation or compensation from environmental polluters ● Others specified by the Government
10	Environmental Standard Competent government agency shall set up environmental standard for the items listed below subject to approval to be given by the Government ● Inland Public Water (River, Cannel, Lake, Reservoir & Others) ● Coastal Water ● Underground Water ● Ambient ● Noise & Vibration ● Emission ● Waste Water

	● Solid Waste ● Others specified by the Government
13	Environmental Conservation ● Implementation of environmental conservation related policies ● To set up environmental management plan in both national & regional levels ● To plan, implement and manage (i) environmental conservation & (ii)hazardous waste disposal which might cause pollution ● To set up environmental standard ● To submit proposal on environmental management mechanism based on economic incentive to the Committee ● To Arbitrate environmental related issues, including setting up negotiating parties ● To classify hazardous and non-hazardous substances to be generated from industry, agriculture, mining sanitation and etc. ● To specify substance, give large impact on environment both in short term & long term ● To promote introduction of hazardous solid waste, liquid waste & gas processing facilities ● To set up standard for discharged waste water from Industrial Zone and other area and condition & system, of emission from auto-vehicles ● To cope with environmental related issues under International or Regional or Bilateral Treaties Conventions and/or Agreement ● To fulfill environmental conservation based on guideline approved by the Government of Myanmar and/or Committee in accordance with agreement of the Government of Myanmar
21～25	Environmental Impact Assessment ● Competent government agencies shall specify type of business which might give impact on environment and the applicant shall obtain pre-approval subject to approval given by the Government Party intends to engage in the business operation in this category shall obtain pre-approval

Source: Environmental Conservation Act (Myanmar)

(3) Environmental Conservation Rule

Environmental Conservation Rules[14] was published by the Government of Myanmar as

[14] 出典：http://www.burmalibrary.org/docs21/2014-06-

Ministerial Order of the Ministry of Natural Resource & Environment No. 50/2014, under the provision in the Article No. 42 of the Environment Conservation Act, on June 5, 2014. Content of the rules is as per shown in the Table 3-7 below.

Table 0-7 Content of Environmental Conservation Rules

Chapter	Article	Provision
I	1-2	Name of the Act & Definition
II	3-6	Acceptance of Environmental Conservation related policies
III	7-26	Environmental Conservation
IV	27-28	International or Regional or Bilateral cooperation for environmental conservation
V	29-35	Environmental Fund
VI	36-37	Urgent issues in environmental conservation
VII	38-39	Environmental Standard
VIII	41-46	Environmental Management of urban areas
VIIII	47-50	Conservation of Natural Resources & Cultural heritages
X	51-25	Environmental Impact Assessment
XI	62-68	Pre-Approval
XII	69-30	Prohibition
XIII	70-74	Miscellaneous Provisions

Detail of the Articles, which might be applicable for the targeted project are as follows;

Articles	Provision
7～26	Environmental Conservation The National Environmental Conservation Committee shall ● implement environmental education and environmental conservation projects ● to advise & promote environmental conservation to educational institutes and monitor progress ● transfer authority to the Ministry of Natural Resources and Environment as for monitoring on advising, promoting activities of relevant government agencies. ● Issue a warning to improve activities, which might give negative impact on environment or have possibility to given negative impact on environment, within the appointed date. And annulment of business

Environmental_Conservation_Rules-en.pdf

	license for the case of failure in improvement of situation. The Ministry of Natural Resources & Environment shall ● Implement environmental management program covering whole country, in cooperation with other relevant government agencies ● Introduce program, assign Environmental Conservation Dept. as competent department and monitor its' activities ● Advice government agencies and private sector as for environmental conservation and pollution control ● Order Environmental Conservation Dept. to submit proposal for "Less Environmental impact & sustainable growth model based on economic incentive" and assess the proposal submitted by the Dept. ● Classify hazardous waste which the Government of Myanmar agreed in International treaties and etc. not to import, manufacture, store and deal in accordance with the Article 7 of the Environmental Conservation Act. ● Assign Environmental Conservation Dept. to make policy, set up regulation & prepare guideline for ODS, Bio Diversity, Marine Environment, Climate Change & etc. ● Assign Environmental Conservation Dept. to coordinate among the related governmental agencies. Environmental Conservation Dept. shall ● Plan short, medium & long-term plan for environmental conservation for nation & selected areas, implement & monitor ● Make data & information as for hazardous waste in order and cope with requests placed by related government agencies ● conduct environmental conservation related research and make date & information as for training program in order ● set up a plan for climate change ● to spread environment related information and engage in environmental awareness raising activities ● engage in environment related education & public relation ● set up system, including preparation of guideline for environmental impact assessment
38～39	**Environmental Standard** Ministry of Natural Resources and Environment shall set up Environmental Standard, revise, if necessary, and promote obeyance of standard in accordance with the Article No. 7 of the Environmental Conservation Act.

40	**Environmental Management for Urban Areas** Ministry of Natural Resources and Environment shall advice to relevant government agencies for environmental conservation in accordance with the Article No. 17 of the Environmental Conservation Act.
41～46	**Waste Management** Ministry of Natural Resources and Environment shall ● Define hazardous substance generated from industry, agriculture, forestry, Animal Husbandry waste disposal and others ● Promote development of processing facilities for solid waste, liquid waste & gas containing hazardous substance (The Government of Myanmar transfer its authority to supervise temporary operation ● Transfer authority to Environmental Conservation Dept. to manage & monitor temporary business operation and/or internal processing, which business operators has already started before notification of rules. ● Prescribe standard for waste water quality from specific places, such as industrial zone, economic special zone and others, if necessary, machineries and mobile units ● To separate, store, safety management, transport and import & export and revise standard, if necessary, ● Introduce recycling of natural resources and waste from business operation and cleaner productions. ● Environmental Conservation Dept. shall draft provision, submit it to the Ministry, assess cleaner productions & recycling and report their findings to the Ministry.
51～	**Environmental Impact Assessment** The Ministry of Natural Resources & Environment shall ● Transfer administration of implementation of environmental impact assessment to Environmental Conservation Dept. ● Prescribe type of business applicable for environmental impact assessment ● Conduct Initial Environmental Examination (IEE) for the business operations other than specified above and judge whether or not to conduct environmental impact assessment ● Any parties who intend to establish business operation applicable for Environmental Impact Assessment shall conduct environmental impact assessment and submit a report to the Ministry. Any party who conduct Environmental Impact Assessment shall receive approval on

	implementing organization in advance. ● Environmental Impact assessment shall be conducted by third party or organization approved by the Ministry and the Ministry shall assess the report and inform result to the applicant. ● The Ministry shall form up an organization with experts for evaluation of Environmental Impact Reports ● The Ministry shall approve Environmental Impact Assessment

There is only a description of "The Ministry & The Department shall provide advice, if necessary" for Municipal Solid Waste, which might be included into Environmental Management for Urban Areas, while paid more attention on appropriate management of hazardous waste.

(4) Environmental Impact Assessment[15]

Process of Environmental Impact Assessment is published by Notification of the Ministry of Natural Resources and Environment regarding Process of Environmental Impact Assessment Notification No. 616/2015 dated on December 29, 2105, of which content is as per shown in the Table 3-8 below.

Table 0-8 Content of Notification regarding process of Environmental Impact assessment

Chapter	Article	Provision
I	1-2	Name of the Act and Definition
II	3-22	Process of Environmental Impact Assessment
III	23-30	Screening
IV	31-43	Initial Environmental Examination
V	44-70	Environmental Impact Assessment
VI	71-75	Exception
VII	76-82	Environmental Management Plan
VIII	83-105	Environmental Consideration in Project approval
IX	106-122	Monitoring
X	121-124	Strategic Environmental Assessment
XI	125-131	Administrative Disposition
Appendix1	-	Initial Environmental examination & Environmental Impact Assessment
Appendix2	-	Workflow

[15] Source: http://www.myanmar-responsiblebusiness.org/components/com_content/plugins/download/includes/dl.php?c=VzAAL141A2UEY1B7W2QLJVRjVSxSf19tBGFUM1ZmADIEYlFpBGlWaA==&m=0

Appendix3	-	Penalties

Source: Ministry of Natural Resources & Environment

The Government of Myanmar prescribed conditions applicable for 141 type of business, which Initial Environmental Examination and Environmental Impact Assessment would be required in Appendix 1. As far as our targeted project concerns, provision given in the Appendix is as per Table 3-9 below;

Table 0-9 Types of Business applicable for IEE or EIA (among targeted project in the study)

	Type of Business	IEE	EIA
4	Natural gas or Biogas Power Plant	Power Generation Capacity ≧5MW <50MW	Power Generation Capacity ≧50MW
6	Waste to Energy Power Plant	Power Generation Capacity ≦50MW	All project ordered by the Ministry
23	Oil & Gas Distribution System	Distance <10KM	Distance ≧10KM
24	Filling Station/Plant (including LPG, CNG)	Capacity ≧10m3(10,000l)	All project ordered by the Ministry

In addition, there are business code of waste related business, e.g., 103 for final disposal facility, 104 for Incinerator, 105 for Recycling facility, 106 for final disposal facility for hazardous waste, 107 for recycling facility for hazardous waste, 108 for central waste water treatment facility and 109 for drainage system. And for the case the Government of Myanmar regard waste segregation facility would be categorized 105 or 107, the targeted project would be requested to conduct either IEE or EIA depending on the amount of waste handled at the facility (more or less than 50tons/day for 105 and more or less than 10tons/day).

To check whether or not the business to be established would be applicable for environmental assessment

Based on items in Chapter 3. Screening as first step, of which details are shown in Chart 3-5 below.

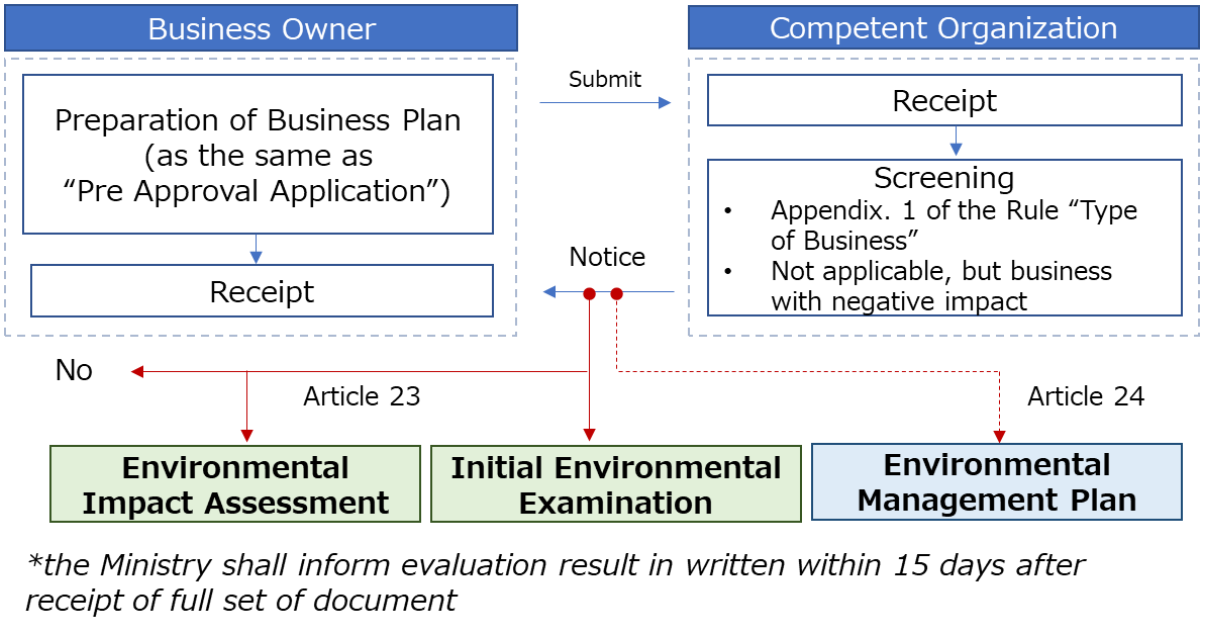


Figure 0.5 Screening Process for Environmental Assessment

Source: Created by the Study Team based on Environmental Assessment (Myanmar)

The Government of Myanmar prescribed in Article No. 23 that the Ministry upon receipt of business plan submitted by the applicant, examine the report to judge whether or not necessary to conduct environmental assessment, then for the case the business would be required to conduct environmental assessment, then judge either Initial Environmental Examination or Environmental Impact Assessment would be applicable for the planned business in accordance with Appendix 1 of the Rules and inform to the applicant (within 15 days after the receipt of application). The competent government agencies shall judge whether or not Environmental Management Plan would be required for the planned business or not and inform to the applicant (Article No. 24)

Other points in the Article 28 shall be considered are (i) Countermeasures for Emergency Cases, (ii) health & safety, (iii) National Security,(iv) business operation period, (v) cultural & religious criterion & heritage, (vi) areas with vulnerable eco-system, (vii) vulnerable area against natural disaster, such as typhoon, cyclone, flooding and earthquake, (viii) water resource, (ix) areas for recreation or pearl culture, (xi) conservation areas for bio diversity, (xii) introduction of exotic species, (xiii) introduction of new technology, (xiv) population density, (xv) climate change, (xvi) transboundary, (xvii) impact after the end of business operation and (xiii) others prescribed by the Ministry.

As a result of screening mentioned above, applicant for any business judged necessary to conduct Initial Environmental Examination shall bear all the cost & expenses (the Article No. 44), conduct Initial Environment Examination. Process Flow for Initial Environmental

Examination prescribed in the Article No 31 to 42 are as per shown in the Figure 3-6 below.

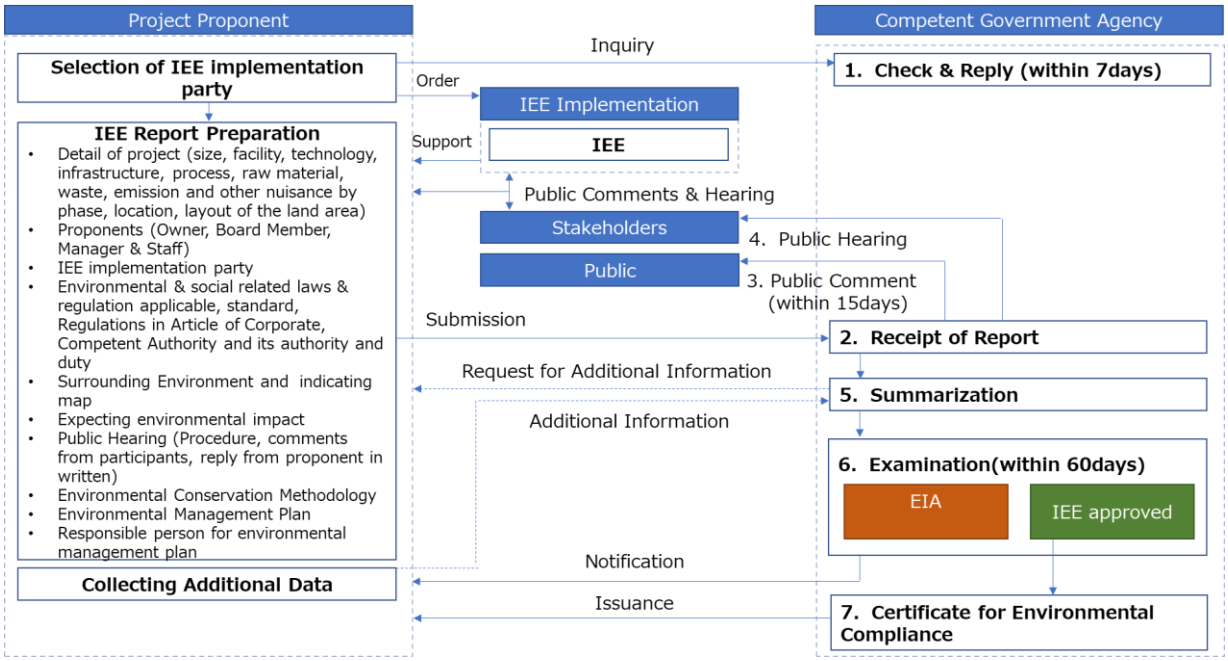


Figure 3.6 Process flow for Initial Environmental Examination

Source: Created by the Study team based on Environmental Assessment (Myanmar)

Any business plan, which is judged being applicable for conducting Environmental Impact Assessment, as a result of conducting Initial Environmental Examination shall go for Environmental Impact Assessment. There are four stages in Environmental Impact Assessment, i.e. (i) to selected items for assessment, (ii) to prepare terms of reference for Environmental Impact Assessment for approval, (iii) to conduct Environmental Impact Assessment, then (iv) to submit Environmental Impact Assessment Report for approval

At the stage of (i) to select items for assessment, the applicant shall select party to conduct Environmental Impact Assessment and report selected party to the Ministry. The Ministry, upon receipt of report from the applicant, shall inquire selected party with registers' list and inform whether or not the Ministry approve the selected party as the party to conduct Environmental Impact Assessment.

After receipt of approval from the Ministry, the Applicant shall select items for Environmental Impact Assessment with consultation with the selected party who will conduct Environmental Impact Assessment, then prepare terms of reference for Environmental Impact Assessment to be submitted to the Ministry for examination. The Ministry shall announce result of examination within 15 days after the date of full set of documents received. Process flow for the Environmental Impact Assessment is as follows;

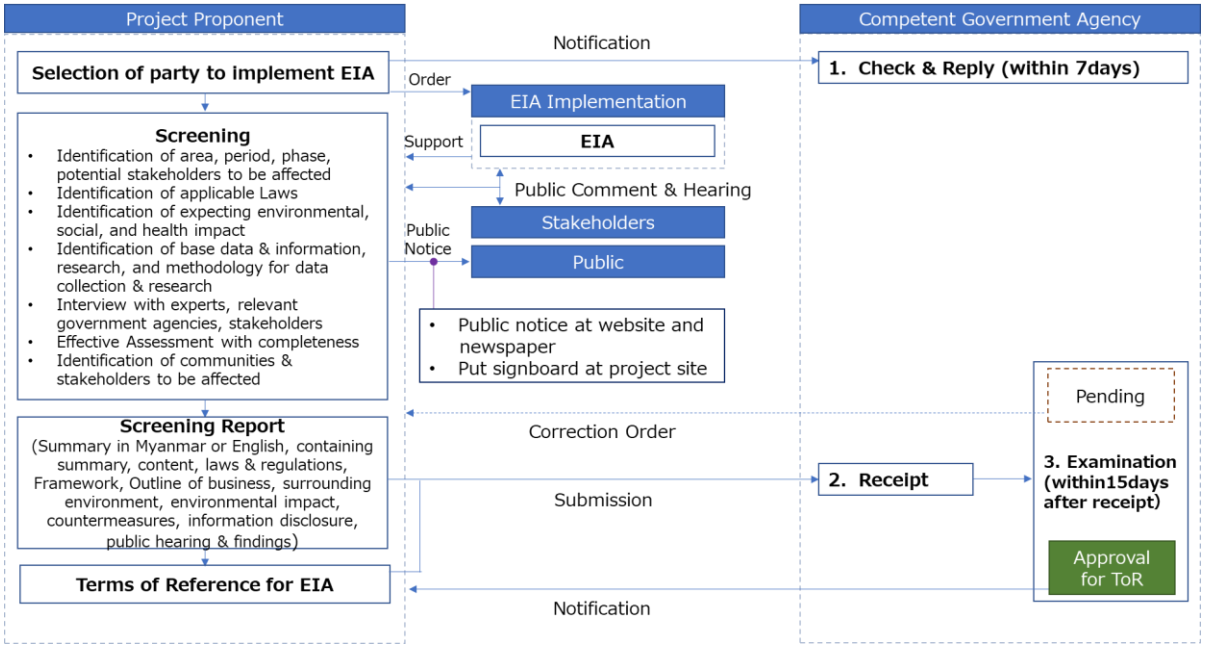


Figure 0.7 Process Flow for Environmental Impact Assessment (1)

Source: Created by the Study Team based on Environmental Assessment (Myanmar)

The applicant, then conduct Environmental Impact Assessment comply with terms of reference for Environmental Impact Assessment approved by the Ministry, submit report for examination. Process flow for conducting Environmental Impact Assessment to receive examination is as per shown in Figure 3-8 below.

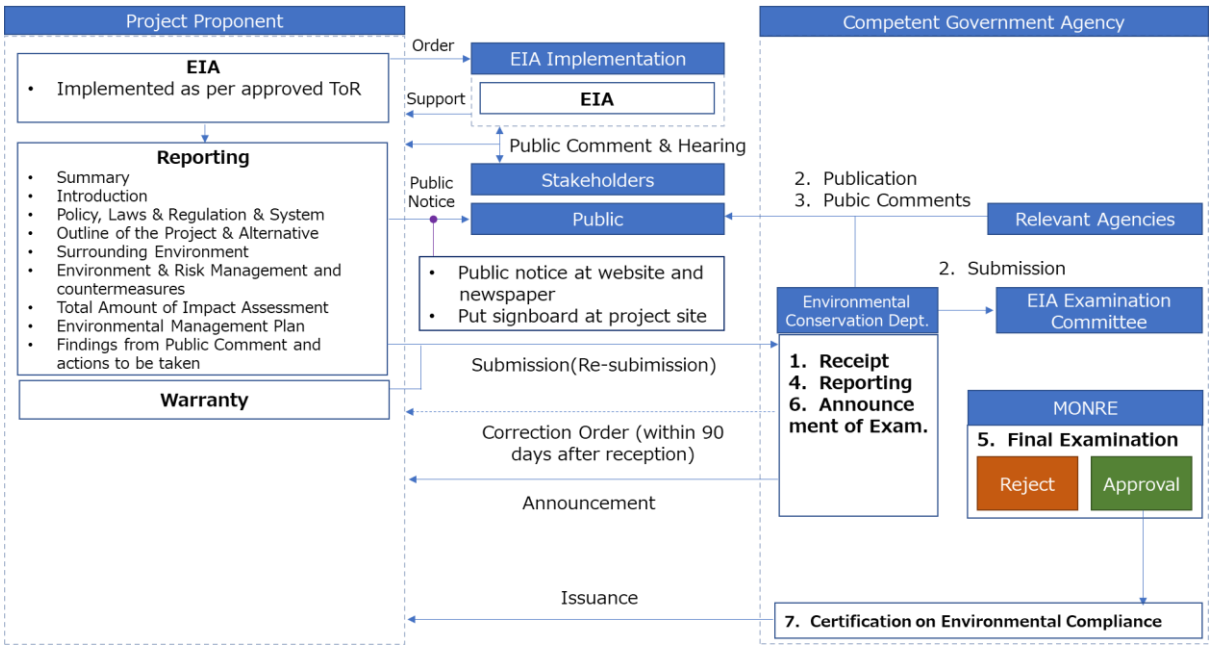


Figure 0.8 Process Flow for Environmental Impact Assessment (2)

Source: Created by the Study Team based on Environmental Assessment (Myanmar)

(5) Environmental Standard

National Environmental Standard (Emission Guideline) is an environmental standard set up in 2015, consist of main part and appendix with 72 pages in total. There are 2 chapter with 13 articles in main part, covering objectives, definition, applicability & implementation process, while general emission standard and emission standard by industrial type are in Appendix 1.

Table 0-10 Contents of Environmental Standard

Chapter	Article	Provision
I	1	Objectives
II	2	Definition
III	3-8	Applicability
Appendix 1	Category I	General Environmental Standard (Flue gas, Waste Water, Noise & Odder)
	Category II	By Industrial Type (7 categories (large) : (1) Energy Industry, (2) Agriculture, Forestry & Fisheries, (3) Manufacturing, (4) Waste Management, (5) Water Supply, (6) Infrastructure Development & (7) Mining)

Source: The Ministry of Natural Resources & Environment, Myanmar

General Environmental Emission Standard is as follow;

Table 0-11 Emission Standard (1) (General Standard)

Substance	Period	Standard (μg/m3)
NOx	1 year	40
	1 hour	200
Ozon	Less than 8 hours per day	100
PM10	1 year	20
	24 hours	50
PM2.5	1 year	10
	24 hours	25
Sox	1 year	20
	10 minutes	500

Table 0-12 Emission Standard (1) (General Standard, Small Scale by Fuel)

Combustion Technology/Fuel	Particulate matter PM_{10}[a]	Sulfur Dioxide	Nitrogen Oxides

Gas	-	-	200[b] mg/Nm^{3G} 400[d] mg/Nm^3 1,600[e] mg/Nm^3
Liquid	100	3%	1,600 - 1,850[f] mg/Nm^3
Natural gas (3-<15 MW[g])	-	-	90[h] mg/Nm^3 210[i] mg/Nm^3
Natural gas (15-<50 MW)	-	0.5% sulfur	200[h] mg/Nm^3 310[i] mg/Nm^3
Fuels Other than natural gas (15-<50 MW)	-	0.5% sulfur	150 mg/Nm^3
Gas	-	-	320 mg/Nm^3
Liquid	150 mg/Nm^3	2,000 mg/Nm^3	460 mg/Nm^3
Solid	150 mg/Nm^3	2,000 mg/Nm^3	650 mg/Nm^3

Table 0-13 Waste Water Discharge Standard (1) Operation Period

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/l	50
Ammonia	mg/l	10
Arsenic	mg/l	0.1
Cadmium	mg/l	0.1
Chemical oxygen demand	mg/l	250
Chlorine (total residual)	mg/l	0.2
Chromium(hexavalent)	mg/l	0.1
Chromium (total)	mg/l	0.5
Copper	mg/l	0.5
Cyanide (free)	mg/l	0.1
Cyanide (total)	mg/l	1
Fluoride	mg/l	20
Heavy metals (total)	mg/l	10
Iron	mg/l	3.5
Lead	mg/l	0.1
Mercury	mg/l	0.01
Nickel	mg/l	0.5
Oil and grease	mg/l	10
pH	S.U.[a]	6 - 9
Phenols	mg/l	0.5
Selenium	mg/l	0.1

Silver	mg/l	0.5
Sulphur	mg/l	1
Temperature increase	°C	<3[b]
Total coliform bacteria	100 ml	400
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50
Zinc	mg/l	2

Table 0-14 Waste Water Discharge Standard (1) Construction Period(In addition to the General Standard above)

Parameter	Unit	Maximum Concentration
Biological oxygen demand	Mg/l	30
Chemical oxygen demand	Mg/l	125
Oil and grease	Mg/l	10
pH	S.U.	6-9
Total coliform bacteria[4]	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

Table 0-15 Noise

Receptor	One Hour LAeq (dBA)[a]	
	Daytime 07:00 - 22:00 (10:00 - 22:00 for Public holidays)	Nighttime 22:00 - 07:00 (22:00 - 10:00 for Public holidays)
Residential, Institutional & Educational	55	45
Industrial & Commercial	70	70

Provision for odder (extract) is as follows:

Business operator shall manage odder, which resident nearby do not feel uncomfortable and disgust (shall be controlled under 5-10 odder unit at the boundary. Environmental Assessment for odder will be required for any business operation with multiple sources of odder.

(6) National Waste Management Strategy & Action Plan

Waste Management in Myanmar is rather focusing on hazardous waste management in

compliance with Environmental Conservation Act and Environmental Conservation Rules. National Waste Management Strategy & Action Plan prepared by CCET[16] under the project on "Holistic Waste Management in Myanmar & Mandalay city", as well, is one of the guideline for waste management in Myanmar at national level.

Outline of The Strategy & Action Plan published in their website is as follows;

- Project Implementation: 2016-2017
- Organized a workshop to present "Strategy & Action Plan" to the Government of Myanmar at Naypyidaw on August 7, 2017 for approval, and H.E. Mr. Ohn Win, Minister of Natural Resources & Environment, Mr. Htay Aung Permanent Secretary for the Ministry of Natural Resources & Environment participated in the workshop.
- "Strategy & Action Plan" has been approved by Environmental Conservation Dept. and distributed to relevant government agencies for their comments, then will be submitted to the Cabinet for approval.
- Comments obtained from the participants from the Government of Myanmar were; "Will utilize "strategy & action plan" as guideline for waste related policy making"," Strategy & action plan is for mainly municipal solid waste, thus refer to the "strategy & action plan", the Government of Myanmar expand target to others, such as industrial waste & medical waste" and etc.

Source: CCET Website
https://www.ccet.jp/events/Final%20Workshop%20for%20Developing%20the%20National%20Waste%20Management%20Strategy%20and%20Action%20Plan%20of%20Maynmar

"Strategy & Action Plan" seems not yet been approved by the Government, and therefore still not yet been published in website. Although it might take time to know all details, parts of it has been disclosed by government officers at workshop and/or forum. Summary of one of such presentation done by Mr. Min Maw, Director of Pollution Department at 8th Regional 3R Forum held in India during April 9-12 is as per explanation below.

Concept	To realize sustainable, green, clean healthy environment for bright future in Myanmar
Duties	To have Strategic plan for Holistic & Integrated waste management stand for zero waste, zero emission & circular economy for realization of sustainable, green, clean healthy environment for bright future in Myanmar

Objective	Description	Period[17]		
		Short	Medium	Long

[17] Short:2017-2020, Medium:2021-2025 & Long:2026-2030

A	To collect all municipal waste to be generated in the area and stop open dump & open burning				
	(1)	To realize collection of all municipal solid waste to be generated in the area by eco-friendly collection system	70%	85%	100%
	(2)	To stop open dump & open burning & operation of landfill by eco-friendly management system	MC[18]	50%	100%
B	To expand sound material management system to both industrial waste & medical waste				
	(1)	To mandate separate collection of hazardous waste & medical waste and eco-friendly processing & disposal	MC	50%	100%
	(2)	To mandate eco-friendly collection, processing & disposal of industrial waste	MC	50%	100%
C	To reduce amount of waste through 3R promotion and establish sound material society				
	(1)	To set up strategic & action plan for waste management with numeric targets by the City Development Committee and Township Development Committee	25%	50%	80%
	(2)	To mandate setting up target for recycling of leftover and/or food residue to be transported to landfill	15%	35%	60%
	(3)	To mandate setting up target for segregation & recycling of industrial waste, medical waste and/or other wastes to be transported to landfill	15%	35%	60%
D	To establish sustainable financial mechanism				
	(1)	All local authority provides waste related services	50%	75%	100%
	(2)	All local authority set up cost-based tariff for waste related services	50%	75%	100%
E	Awareness Raising, diffusion & Capacity Building				
	(1)	Number of Local Authority implement awareness raising will increases	25%	50%	100%
	(2)	Number of Local Authority implement environmental education will increases	25%	50%	100%
F	Compliance, Monitoring, Enhancement & Acknowledge				
	(1)	All local authorities set up benchmarks	50%	75%	100%
	(2)	No of countermeasures against illegal processors & disposers taken by City Development Committee	50%	75%	100%

[18] MC : Major City

		will increase			

Priority in Implementation of Strategy & Action Plan & Mechanism

Approval & Start Up	● Approval & commitment at central level ● Public hearing
Resource Mobilization	Capital, Manpower, Technology, Private Investment, Promotion of waste reduction & 3R promotion
Laws & Regulations	Standard & Tool and Guideline for Expanded Producers' Responsibility, Legislative basis, Processing & disposal, license & permission, charge, inspection
Management & Assessment	Mechanism for inter-governmental cooperation
Commitment & establishment of partnership	Coordination Committee, Government, Private Sector, Informal Sector, NGO, Academic Institute & International Organization
Technology selection	R&D & Technology Transfer
Awareness Raising & Education	Discipline for Manufacturers, Shop Owners, Labors, Consumers, Eco-Label & Student

Source: Presentation by Mr. Min Maw@8th regional 3R forum (UNCRD)
http://www.uncrd.or.jp/content/documents/6285Country-G-2-Myanmar.pdf

(7) Other Environment related activities

Japan – Myanmar Environment Week was held in Yangon on January 16, 2018 and in Naypyidaw on January 17, 2018. In the event, the Government of Myanmar announced their environment related activities other than drafting strategy & action plan as follows;

- Water Management & Capacity development related to EIS（JICA）
- Seminar on mitigation of air pollution & co-benefit（UMFCCI）
- Technology & Capacity development in waste management, water treatment, water quality monitoring and water environment management
- Technology & capacity development for air quality monitoring
- Analysis method & capacity development for laboratory for environmental quality monitoring
- Execution of environment related laws & regulation & capacity building

3.3.2. Feasibility of targeted projects

(1) Outline of the targeted project at initial stage

Outline of the projects which the Study team intended to establish is as per shown in Figure 3-9 below.

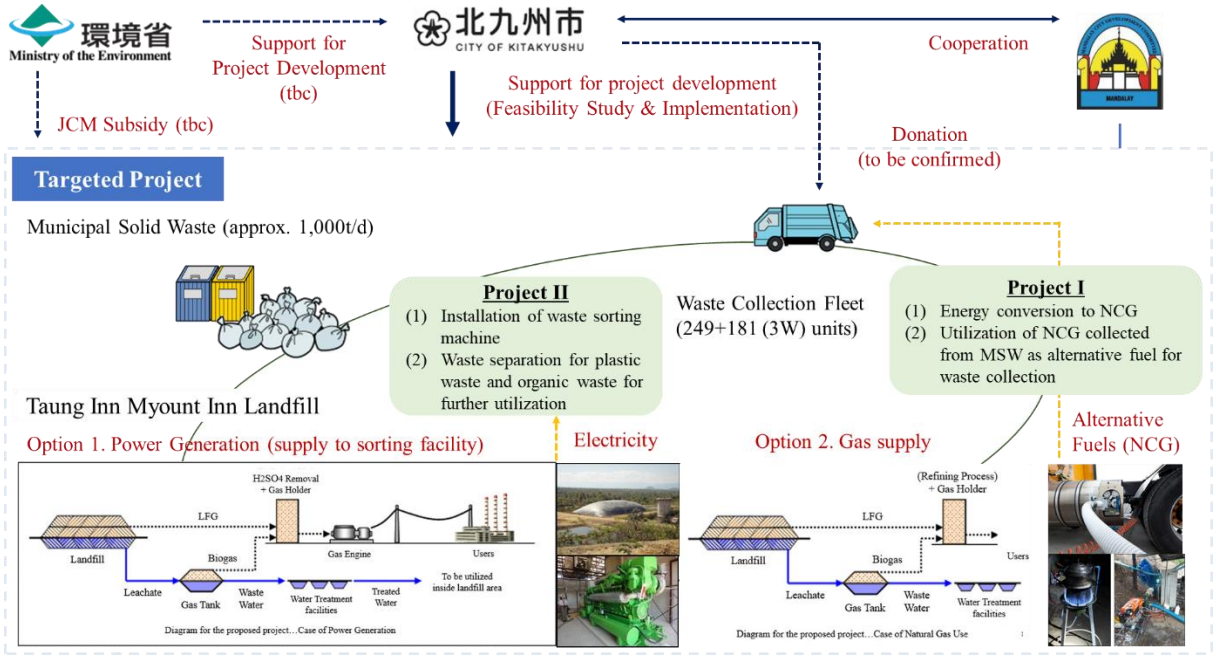
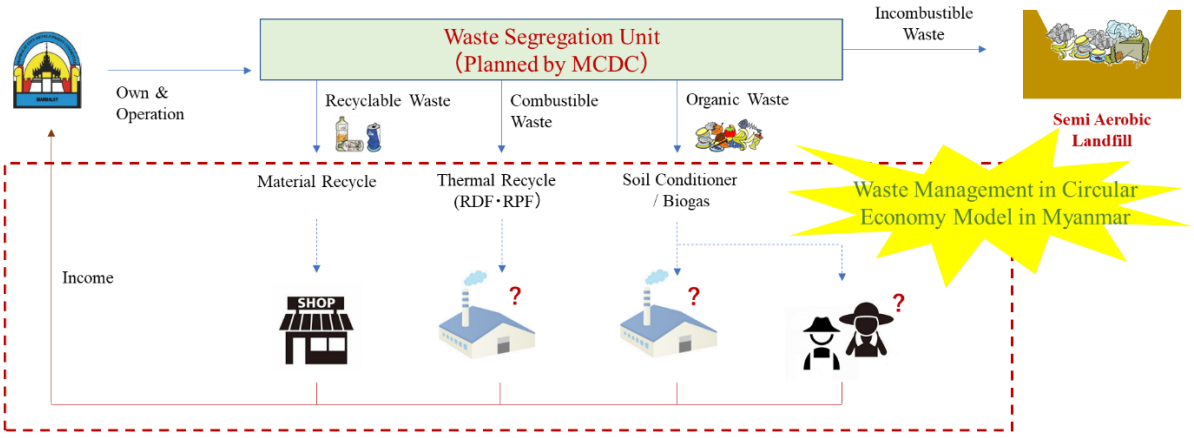


Figure 0.9 Outline of the targeted projects

The Study team intended to establish a project of collecting biogas from anaerobic fermentation of organic waste to be generated in and out of Mandalay city, then sell biogas out as alternative fuel in order to secure income from operation and reduce Greenhouse Gas emission reduction together with cut off of methane gas emitted from landfills.

After conducting site research, including interview with parties concern in Mandalay city, the Study team found that, as per understanding at the beginning, Mandalay city has a plan to establish "Waste Management in Circular Economy Model" and therefore put highest priority at installation of waste segregation unit, while They need further research to finalize waste flow, including material to be sorted out from waste segregation unit. The Study team also found that Mandalay city has already acquired land areas next to landfill located at northern part of Mandalay city for development of "Semi Aerobics Sanitary Landfill. Outline of Waste Management plan which Mandalay city consider is as per shown in Figure 3-10.



【Project under implementation & planning in Mandalay city】(project in red color = targeted projects

①	Construction of new sanitary landfill with land area of 3ha (North)	④	Planning to develop eco industrial town at the southern part of city and invite recycling company to move and set up factories' in the area, (A few confirmed to move in)
②	Pilot project of composting organic waste from market is ongoing		
③	Put first priority and developing the project (as per instruction given by the mayor) The Study team submitted concept paper to Mandalay city	⑤	Planning to develop biogas collection & utilization facility to supply thermal energy to factories in eco industrial zone etc.

Figure 0.10 Waste Management Model set up by Mandalay city

Consequently. The Study team headed by city of Kitakyushu make "high accuracy municipal solid waste segregation unit with bio digester as package and reset the package as new targeted projects to be developed at both or either southern and/or northern landfills and had continuous discussion with Mandalay city and other parties concern. In addition, as the Study team found possibility to develop biogas project at Mingalar Mandalay area, the study team added it as another potential projects to be considered under the study.

Outline of the targeted project including parties to be involved in is as per Figure 3-11

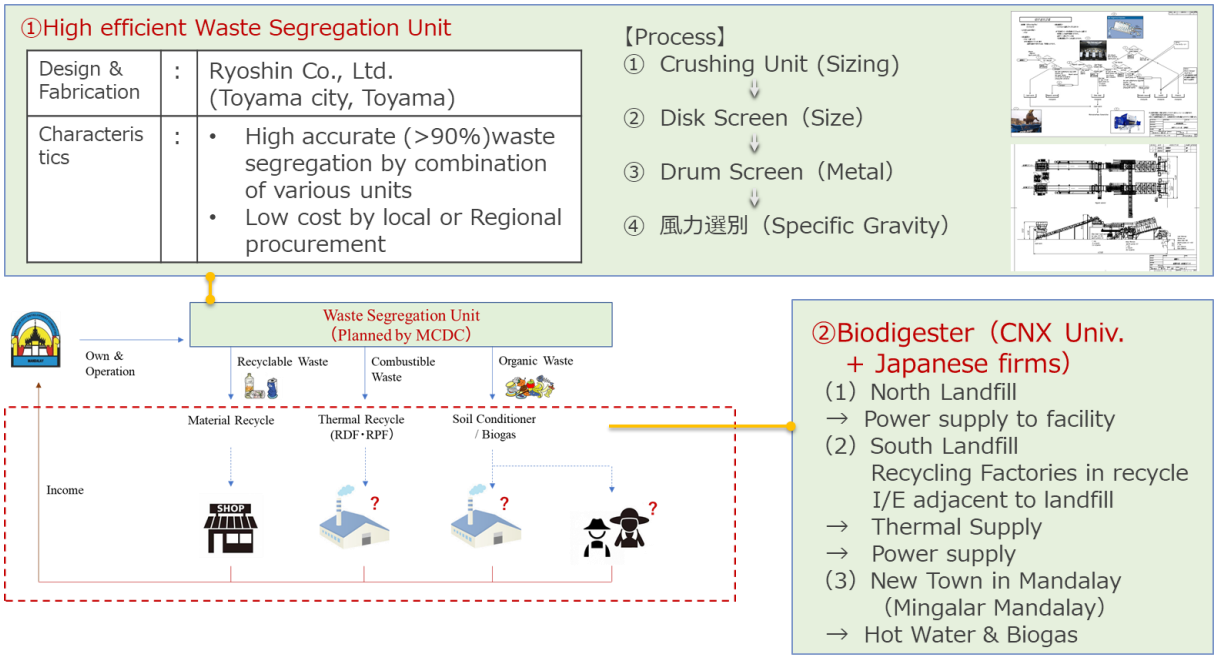
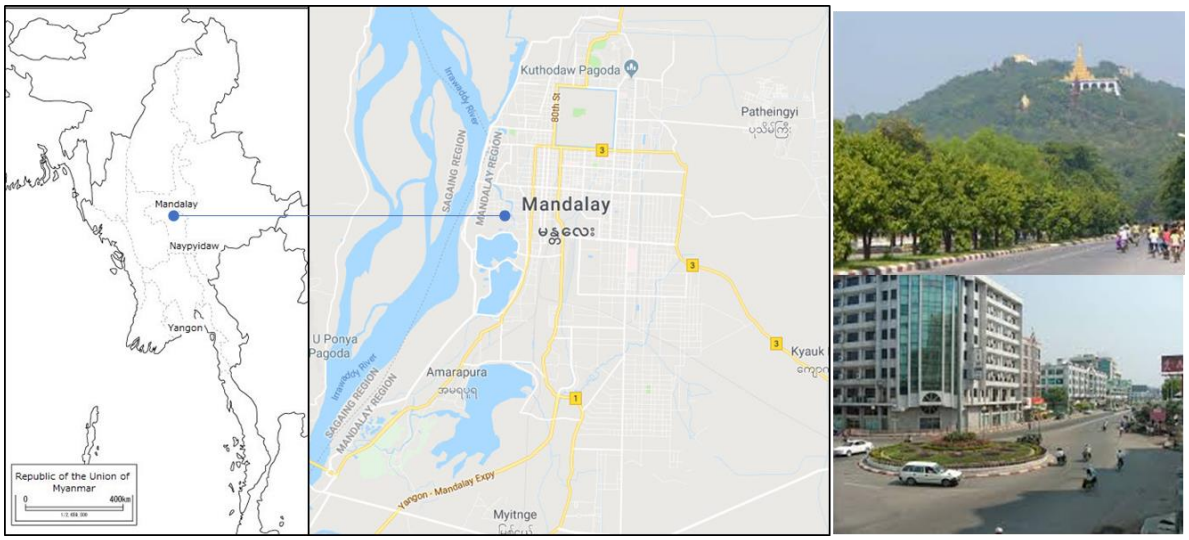


Figure 0.11 Targeted Project reset by the Study Team

(2) Feasibility Study of the targeted projects

1) General Information of Mandalay city

Mandalay city is located approximately 720km north from Myanmar's capital city of Yangon. Mandalay is second largest cities in Myanmar with land area of 163.84km2 & population of 1.32 million or 1.7 million including residence in outskirt of the city.



There are 6 townships in Mandalay city and words in each township. Land area, population of townships in Mandalay are as follows;

Table 0-16 Area, Population by Township in Mandalay city

Township	Area(km2)	Population	Density(/km2)
Aung Myay Thar Zan	28.1	265,779	9,455
Chan Aye Thar Zan	12.1	197,175	16,243
Mahar Aung Myay	15.4	241,113	15,997
Chan Mya Tharzi	30.2	183,781	9,403
Pyi Gyi Tagon	28.5	237,698	8,343
Amarapura	205.0	237,618	1,160

Source : 2014 Census

Introduced Trading Communication, Traditional Industry, Tourism & Manufacturing as major economic activities in Mandalay city

2) Waste Management in Mandalay city

Policy & Direction (Waste Management Strategy & Action Plan for Mandalay city (2017-2030))

Waste Management Strategy & Action Plan for Mandalay city is drafted by Mandalay City Development Committee & Environmental Conservation Dept. with support provided by

CCET. Public hearing for the Strategy & Action Plan was organized on August 9, 2017, then started implementation since January 2018[19].
Outline of the Strategy & Action plan is as follows;

Waste Management Strategy & Action Plan for Mandalay city consist of 37 pages in 5 chapters, i.e. (1) Introduction, (2) Background, (3) Strategic Target, (4) Objectives and (5) Process & Tool, among all there are following descriptions in (4) Strategic Target.

Table 0-17 Waste Management Strategy & Action Plan for Mandalay city (2017-2030)

Objective		Description	Period[20]		
			Short	Medium	Long
A	To collect all municipal solid waste and reduce amount of waste to be generated in the area by promoting 3 R activities				
	(1)	To increase waste collection areas	80%	90%	100%
	(2)	To separate waste at waste generating points	1-2 TS[21]	3 TS	All TS
	(3)	To improve material & recycle ratio	25%	50%	80%
B	To stop inappropriate waste disposal & open burning				
	(1)	To stop illegal dumping & open burning	50%	75%	100%
	(2)	To improve final disposal site	#1	#2	#3
	(3)	To reduce amount of waste to be landfilled	15%	35%	60%
	(4)	To introduce technologies for intermediate treatment	#4	#5	#6
C	To collect special waste, such as industrial waste, medical waste, E-WASTE, construction waste and processing				
	(1)	To improve recycle ration of special waste	25%	50%	80%
	(2)	To reduce amount of special waste to be generated	25%	50%	80%
D	To realize appropriate liquid waste management				
	(1)	To spread collection areas of liquid waste to be generated from domestic sector and promote appropriate processing	25%	50%	100%
	(2)	To spread collection areas of liquid waste to be generated from industrial sector and promote appropriate processing	25%	50%	100%

[19] Source :https://www.iges.or.jp/en/announcement/20180125.html
[20] Short :2017-2020, Medium:2021-2025, Long:2026-2030
[21] Township

	(3)	To spread collection areas of liquid waste to be generated from public sector and promote appropriate processing	25%	50%	100%
E	Awareness Raising, Spreading & Capacity Building				
	(1)	To have a greater number of local authorities to conduct awareness raising	25%	50%	100%
	(2)	To have a greater number of educational institutes conduct environmental education	25%	50%	100%
	(3)	To increase Stakeholders involvement in sustainable waste management	25%	50%	100%
F	Compliance, Monitoring, Enhancement & Permission				
	(1)	To set up benchmarks for monitoring on data collection & implementation	50%	75%	100%
	(2)	To decrease inappropriate processing & disposal	50%	75%	100%
	(3)	To increase citizen's satisfaction for waste management	50%	75%	100%

＃1: Immediate closure of existing solid waste disposal sites

＃2: Inspection on sanitary landfill with minimum requirement

＃3: Integrated operation of final disposal sites

＃4: Feasibility Study for Development for organic waste processing facilities (animal feed, compost, biogas)

& Implementation of pilot project.

＃5: To establishment of the business mentioned above and feasibility of RDF & WtE utilization

＃6: To implement pilot project mentioned 5

Source: IGES Website

https://www.iges.or.jp/files/announcement/20180125/WMSAM.pdf

Waste Management in Mandalay city

According to Mandalay city development committee, waste management plan set up by Mandalay City Development Committee is as per Figure 3-12 below. There are 6 townships in city, municipal solid waste generated in Mandalay city is collected and directly or indirectly, via transfer station, transported to northern & southern landfill sites. Amount of waste generated in northern 3 townships is approx. 500ton/day, while 400tons / day from 3 townships in southern part of the city. Mandalay city own 250 units of waste transporters and 180 units of three wheels to be used for waste collection. It cost approx. US$3.7 million for Mandalay city

to manage waste generated in the area, thus reduction of amount of waste became one of the biggest challenges for the city.

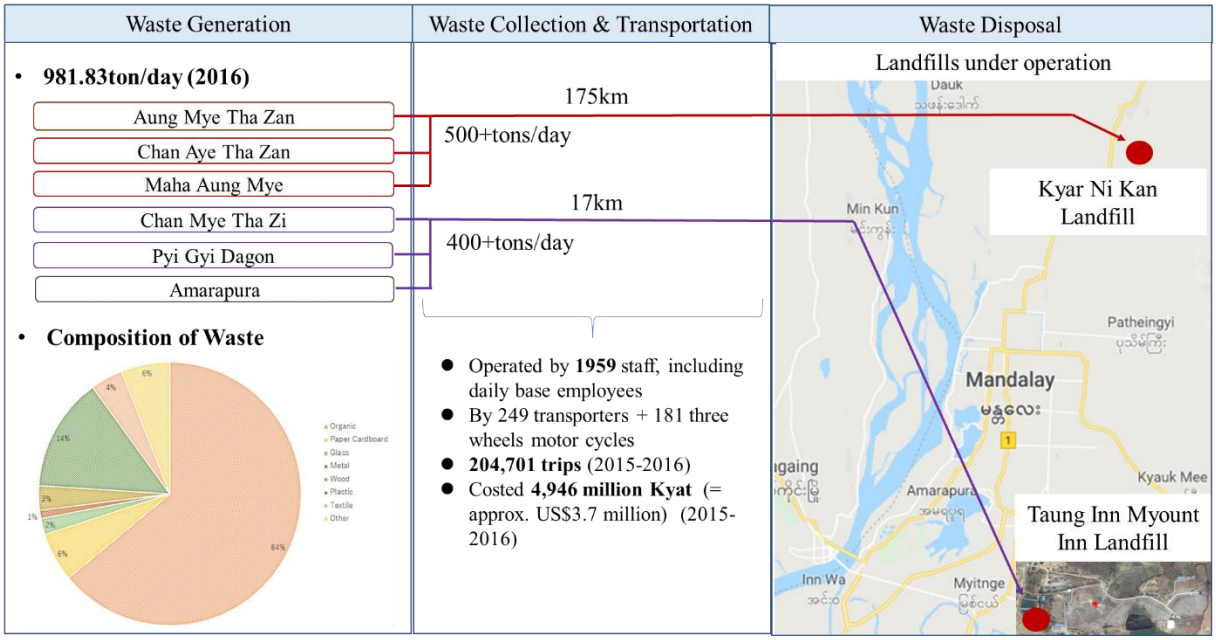


Figure 0.12 Waste Flow in Mandalay city

Source: Created by the Study team based on data & information provided by MCDC

As for waste quality, there is only data (waste composition) collected and published by EU based organization, and Mandalay city too suspects data published by the party[22], Waste composition data published is as per attached.

Kitchen Waste	Paper	Glass	Metal	Wood	Plastic	Fiber	Other
64	6	2	1	3	14	4	6

Source: Mandalay city

The study team planned to provide technical support, and let Mandalay city conduct waste sampling & analysis based on technical support to be provided by the Study team, however waste sampling & analysis was not conducted, as Mandalay city dispatched core members to training program held by central government, as well as to install new system including weight scale in their waste management system.

Management of Mandalay city, with recognition of "waste related data & information" &

[22] Mandalay City Development Committee

"planning" are base and accumulation of such data is one of the most important tasks for waste management through technical visit to Thailand organized by city of Kitakyushu on August, 2018, expressed their intention to start collecting waste related data & information (if possible with technical support to be provided by city of Kitakyushu) in 2019.

As stated, Mandalay city implements waste related projects in accordance with "Waste Management Strategy & Action Plan (2017-2030)", and projects of installation of weigh system at both northern and southern landfills, collecting data at weigh station, and equipment of GPS with waste transporters were ongoing as of October 2018. According to MCDC, once MCDC installed such system, Cleansing Dept. will be able to monitor waste transportation on real time basis. (MCDC keep record by hand on February 2019, when the study team visited the site)

3) Project Sites

The study team studied possibility to develop targeted projects, either / both land areas adjacent to Taung Inn Myount Inn, a landfill located at southern part of city and/or Kyar Ni Kan, a landfill located at northern part of city. Means the Study Team added landfill located as the northern part of the city as another potential project site through implementation of the study, as the study team found that Mandalay city would develop waste management related facilities at northern landfill area with their own budget. Potential project sites i.e. Landfills located at both north & south of the city and Mingalar Mandalay area are per shown in Figure x below.

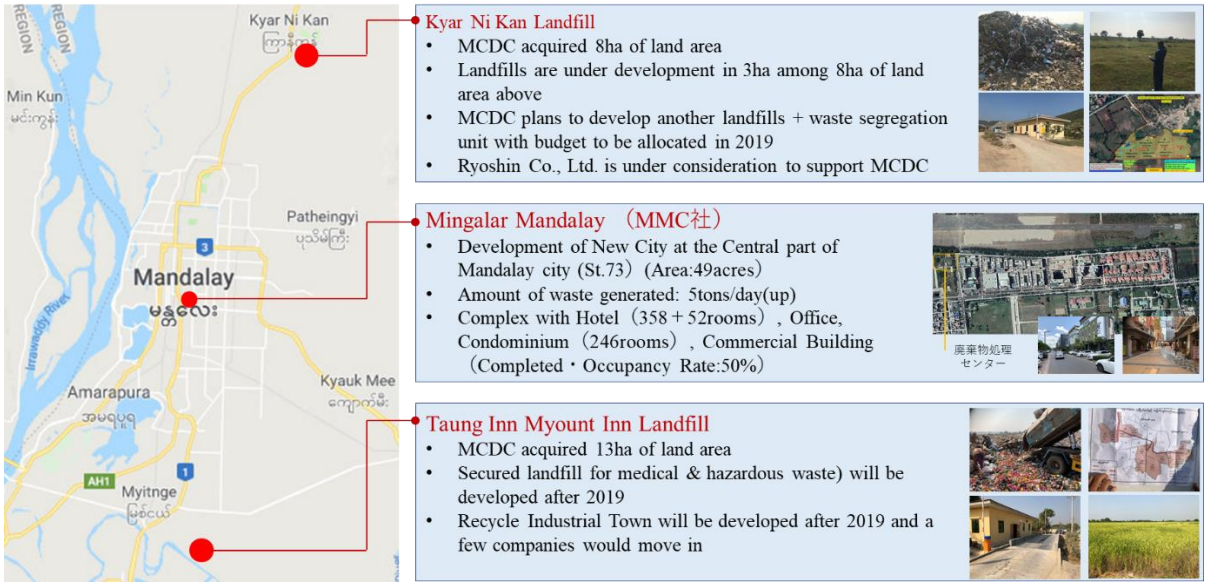


Figure 3.13 Location Map of the Targeted Projects

4) Project Implementation body (Owner of the Project)

Mandalay city has strong intention to be a project implementation body or owner of the targeted projects. However, in general, there is limitation in budget allocation for the government authorities and take long time & many steps to realize public projects. The Study team studied possibilities of establishment of the targeted projects by both Mandalay city and private sector, as the study team was not sure whether the government agencies would be able to develop waste related infrastructure in a short period or not.

Thai Biogas, one of the subsidies belong to Biogas Asia, who has experience & references in biogas related business operation in Southeast Asia, once expressed their interest in waste management in Mandalay city.

According to Mandalay city, Thai Biogas proposed a project, in which Thai Biogas collect biogas from landfill located at the southern part of city, then generate power from biogas to be procured to national grid.

However, the proposed project had been suspended, as Thai Biogas could not obtain a permission for power sale with the Ministry of Power & Energy, Myanmar. There are other organizations, such as Asian Development Bank approached them for loan, Mandalay city put priority on infrastructure development by own finance, including national budget.

<u>The case of receipt of assistance (finance/Technology) from overseas</u>

The study team conducted interview as for the captioned case with Dr. Thit Sinn, a committee member of Mandalay City Development Committee as a part of the study. Dr. Thit Sinn disclosed detailed information related to the project on introduction of incinerator for medical & hazardous waste and told that Mandalay city was under negotiation with KOICA as for the incinerator and its process was; (i) signed up MOU (Memorandum of Agreement) between the Korean Government and Mandalay city, then brought the case to regional government for approval. After getting approval from the regional government, forwarded the case to FERD (Foreign Economy Relation Dept.) for their consultation. In Myanmar, there are three authorized organization in charge of cooperation with external resources, i, e, organization & private sector. One is FERD,

another is DACU (Diplomatic Assistance Coordination Unit), and last one is EC (Economic Committee). Among three organization above, FERD is functioned as secretariat for DACU and EC as well, once any government agencies bring the case to FERD, FERD will coordinate with both DACU & EC. The study team will study more details, if Mandalay city will work with external resources.

<u>Commercialization by private sector</u>

【Permission & License】

There are at least four type of Private Investments for the targeted projects, i.e. (i) by local

company, (ii) by joint venture between or among local company & foreign company, (iii) by foreign company and (iv) Mandalay city join in either (i), or (ii) or (iii). (i), (ii), (iii) are regarded private investment, while (iv) is private and public partnership. In Myanmar, it depends on type of business, but permission or license for business operation will be required, other than business registration at Investment Management Dept.

Investment Act has been enacted on October 2016 and establishment of new company shall be either in accordance with Investment Act 2016 or Special Economic Zone Act (SEA ACT) 2014 with relevant regulations, which is applicable for company to be established at Thilawa, Dawei or Chaopyu. Thus, not applicable for the targeted projects in the study. Consequently, the study team conducted further study focusing on Investment Act, of which details are as follows;

Regulations & Notifications notified under the Investment Act are as per listed in Table below.

Table 0-18 Regulations & Notifications notified under Investment Act

Year	Regulation & Notification
2017	Investment Rules
	Notification of Myanmar Investment Committee (MIC)【Negative List】
	ditto【Invest Promotion Industry】
	ditto 【 Investment eligibility (Industry type & capital) applicable for endorsement to be granted by regional government】
	ditto【Zones applicable for tax benefit】

In Investment Law, the Government prescribed business type required for approval from Myanmar Investment Committee in Article 36, those required permission from competent government authorities in Article 42 and those required approval from the central government. The government notify more details in Investment Rule 2017

The targeted project under the study is related to (i) municipal solid waste management, (ii) recycling, (iii) gas production (LFG collection or biogas collection), refining, utilization, and/or power generation. Provisions might applicable for business types of the targeted projects are as per shown in Table 3-19 below.

Table 0-19 Type of industry required permission or approval from government prescribed by Investment Law

Article	Type of Industry required for MIC permission applicable for the targeted

	projects
3	**Major Industry in National Strategy (7 categories)** (1) Over US$20 million of Investment in technologies, infrastructure, development of new city and mass-communication (2) Over US$20 million of Investment with concession granted by the government
5	**Type of Industry impact on Environment (3 categories)** (1) Type of Industry required Environmental Impact Assessment
6	**Type of Business utilize land area or building owned by the government**

Investment Rule prescribed type of industry with condition, and as far as the targeted project in the study, manufacturing & domestic distribution of fuel in solid, liquid or gas and aerosol shall have local investment and import-export, storage, distribution & sales of oil, gas & petrochemical-products shall have approval from the Ministry of Power & Energy.

Since the targeted project will handle municipal solid waste, managed by Mandalay city, approval from MIC will be required, and permission or license from the Ministry of Power & Energy might be required for biogas collection & utilization, depending on judgement by the Government[23].

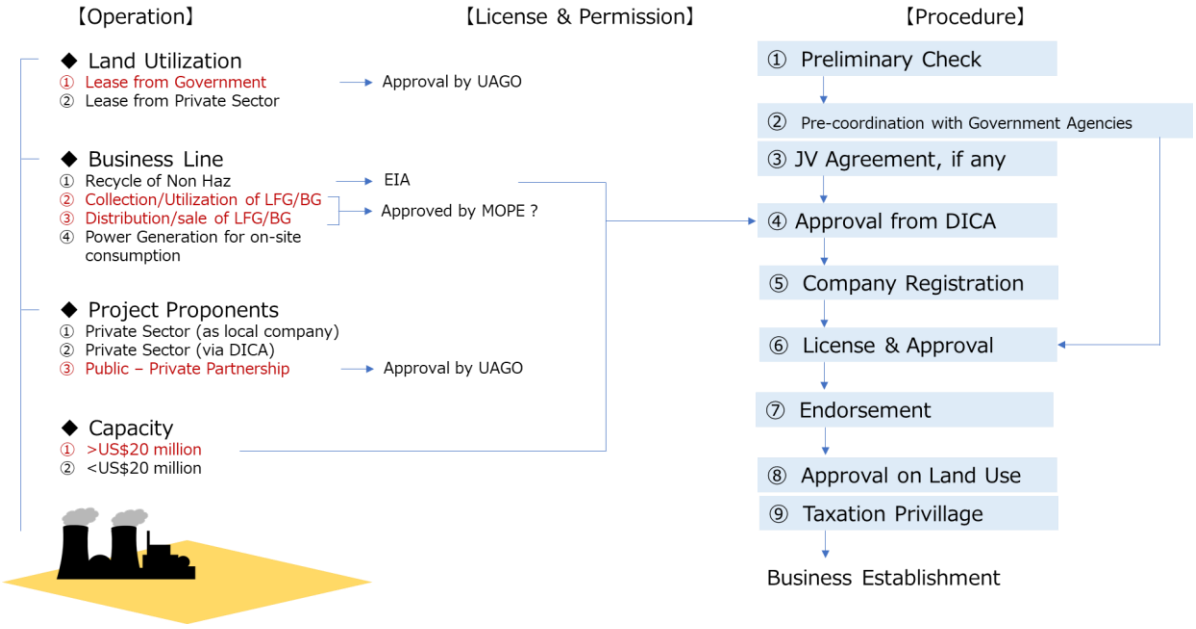


Figure 0.14 Targeted Projects and Business Development Process with Permissions

Source: Created by the Study Team based on Company Act (Myanmar)

In addition, if the targeted project will be established at sites of which land area is belong to

[23] Power generation for non-commercial purpose is not applicable for Electricity Act

the government agency, business operator shall obtain approval from URGO, or shall apply for land use permission after getting endorsement from MIC or regional government, depending on type of industry, for the case the land area utilized for business belong to private sector (as per shown in Figure 3-13). Land use permission is required for foreigner or foreign investment who will make contract for land lease contract with period of over a year. Longest period for land lease contract is 50 years and extendable for another 10 years x 2 times, i.e. 20years in total, as per provision stipulated in the Article No. 50 of the Investment Rule

【Taxations & Others】

Taxation

The Government of Myanmar granted privileges to investment promoting industry, such as reduction and/or exemption of incorporated tax, import duty and etc. Investment promoting industry covers 20 types, including agriculture, forestry & fishery, Development of new city. The targeted projects in the study falls on categories of renewable energy and/or power generation, transmission & distribution depending on business model, Tax incentive to be given by the government under the Act is as below.

Zone	Description	Period
1st Zone	Developed Area	3 years
2nd Zone	Standard Area	5 years
3rd Zone	Less developed area	7years

Import duty and domestic tax will be reduced or exempt for the raw material, semi products for manufacturing final products to be exported and machinery, equipment, tool, machinery parts, spare parts, construction material, which are not available in domestic market but limited in business preparation and construction period. Incorporate tax is 25 percent & capital gain tax is 10 percent in Myanmar.

5) Technologies considered to be introduced

In this study, the study team studied possibility of introduction of fully automated mechanical waste segregation unit and technologies to utilize material after segregation, as the Mayor of Mandalay city showed his keen interest in fully automated mechanical waste segregation unit

Mechanical Segregation Technology for mixed up municipal solid waste

There are some reference sites, where waste segregation facility including units manufactured by American/ European manufacturers, existing in Thailand. While there are, but still a smaller number of municipal solid waste segregation units installed in Japan and utilize industrial waste segregation unit instead. In this study, the who study team conducted feasibility study focusing on mechanical waste segregation unit of Ryoshin Co., Ltd.
Expressed their interest in being EPC for the targeted projects. General Information of Ryoshin Co., Ltd. is as follows;

Company Name	Ryoshin Co., Ltd.
Head Office	Toyama city, Toyama Pref., Japan
Capital	JPY50 million
Business Line	Design, Manufacturing, Fabrication, Installation maintenance of waste segregation unit & import & sales of waste related equipment
Number of employees	42

Ryoshin Co., Ltd. has dealership (including sole dealership) for international leading waste segregation units' manufacturers, such as SSI (USA), LINDNER, FOR REC (Italy) and is one of a few companies, who realized high accuracy waste segregation with combination of units manufactured by manufacturers mentioned above. Their recent sales record & reference are as follows;

Table 0-20 Ryoshin's Reference Sites

	Facility Type	Main Unit	Site
1	For Mix waste	RT700	Saitama
2	For Recyclable Waste		Okinawa
3	For Mix waste	RT700	Toyonaka, Osaka
4	For Mix waste	RT700	Yamanashi
5	For Mix waste	RT700	Gifu
6	For Paper Waste	CM2400-2U	Ota, Tokyo
7	For Mix waste	RT700	Shirai, Chiba
8	Optical Sorter	S1600-3-T-M	Akita
9	For Mix waste	RT600	Akashi Hyogo
10	For Mix waste	RT700	Saitama

Source: Ryoshin Co., Ltd.

Ryoshin Co., Ltd. joined to the Study from 2nd visit to Mandalay city, with purpose of being EPC for the targeted projects and introduced themselves and their products to Mandalay City

Development Committee and Cleansing Dept. of Mandalay city. Beside above, Ryoshin Co., Ltd. supported technical tour for Mandalay city and took members of staff from Mandalay city to municipal solid waste segregation facilities in Thailand. The members of staff from Mandalay city who visited the facility showed their keen interest in facility, and with other inquiries from the area, Ryoshin Co., Ltd decided to expand their business into southeast area by setting up their regional office in Thailand on January 2019.

Mr. Kono, Director from Design Dept. Ryoshin Co., Ltd. explained system at 2nd Official Meeting

Characteristics of municipal solid waste in Southeast Asia, is generally said, contain much organic waste with high moisture content. One of the reasons for high moisture contents in waste is high proportion of organic waste, leftover of soup in plastic bag from food stalls thrown and much consumption of fruits.

Mixed municipal solid could not be segregated at some waste segregation facilities as per its original design due to high moisture contents, and/or damaged or broken down because of liquid waste containing salt. Ryoshin Co., Ltd., with their best understanding on municipal solid waste in Southeast Asia, designed & proposed waste segregation unit to Mandalay city, as follows;

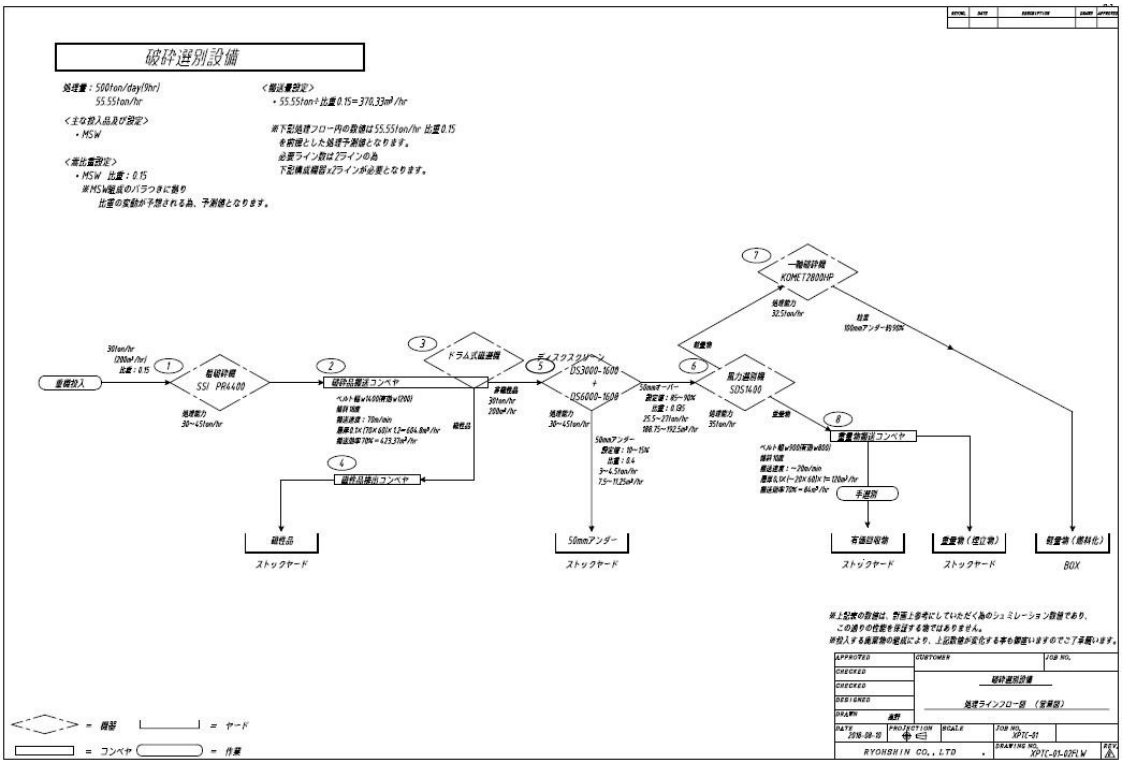


Figure 0.15 System Diagram V.1.0

Source : Ryoshin Co., Ltd.

The diagram above is designed by Ryoshin Co., Ltd. with which mixed waste would be segregated to almost pure plastic with allowance of 5%, organic waste and others. Organic waste would be sorted out at both disc screen and pneumatic separator, while other material by labor after pneumatic separator. Ryoshin explained that they have learnt waste segregation facilities designed & installed by FOR REC, one of their venders, that their facility loses some part of waste flow, as over-sized waste (over 100mm) is returned back to crushing unit.

Ryoshin Co., Ltd. submitted specification sheets for each unit, material flow and system diagram V2.0 for proposed facility to Mandalay city, but they do not allow the study team to write in a report.

The study team, then, based on the waste segregation unit which Ryoshin proposed to Mandalay city and assumption that the Mandalay city would be able to have organic waste with less foreign material, studied possibility to introduce biogas collection & utilization system.

Various data & information, especially waste quality & quantity, would be required for designing biogas collection & utilization system. Amount of waste to be delivered to both southern and northern landfills is 500ton/day each, as stated. And quality of waste is as per published date, due to postpone of waste quality analysis planned to be conducted by Mandalay

city.

The study team estimated flow of biogas collection from available data & information together with values for some parameter, which are published by public organizations.

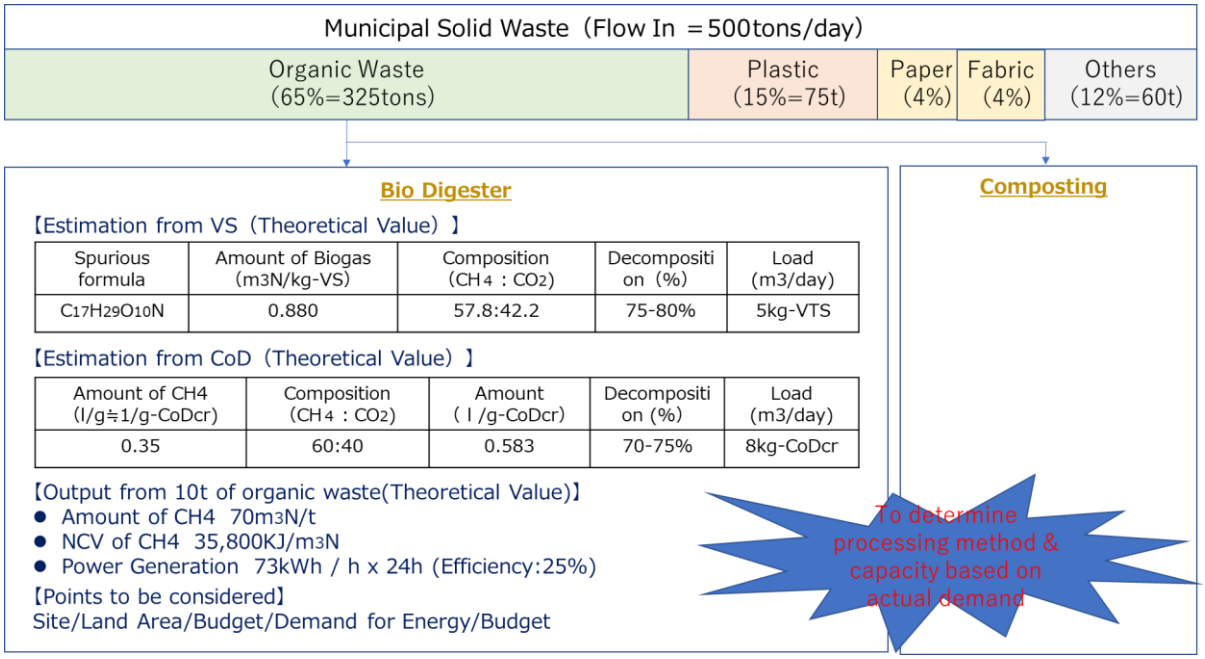


Figure 0.16 Estimation of Output from Waste Processing in Mandalay city

As per shown in Figure 3-14, operator would expect 73kwh of electricity to be supplied from anaerobic fermentation of 10 tons of organic waste, and more output with highly efficient biodigester.

The study team regard power supply to waste segregation facility as one of exit for the targeted project and since amount of electricity to be consumed at waste segregation center is estimated less than 1MWh, operator expect to have enough electricity from processing of 150tons of organic waste under anaerobic condition 150, or for the case of thermal energy, 104,000kj/h of thermal energy can be supplied to any factories in the recycling industrial zone. Biogas shall be processed depending on utilization, of which outline is as below.

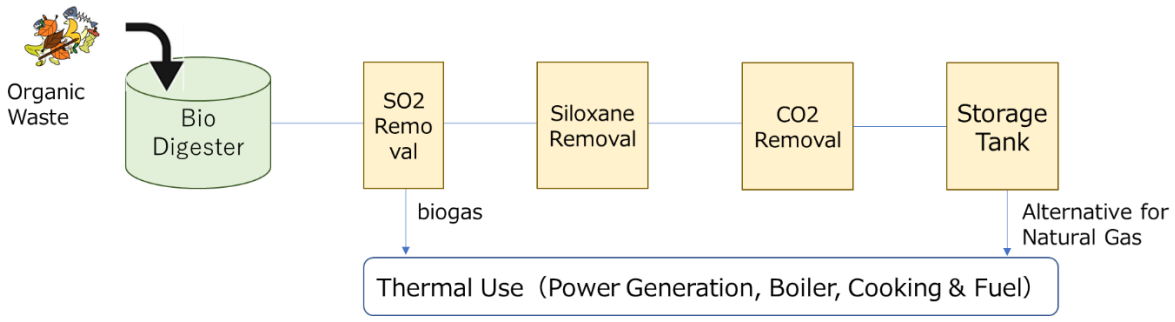


Figure 0.17 Biogas collection processing & utilization

Various processing methods, such as TSA method for siloxane removal, PSA method for CO2 removal are at practical stage, thus business owner will have choices depending on needs & feasibility. The study team assume biogas would be collected at biodigester and to be utilized as alternative fuel for boiler or power generation

6) Assumed Organizational Structure for project implementation

Ryoshin Co., Ltd. would be EPC and main contractor for the targeted project and Japanese technical provider for biogas collection & utilization together with Chiang Mai University would work as sub-contractor of Ryoshin Co., Ltd. Organizational Structure for project implementation is as per Figure 3-16 below.

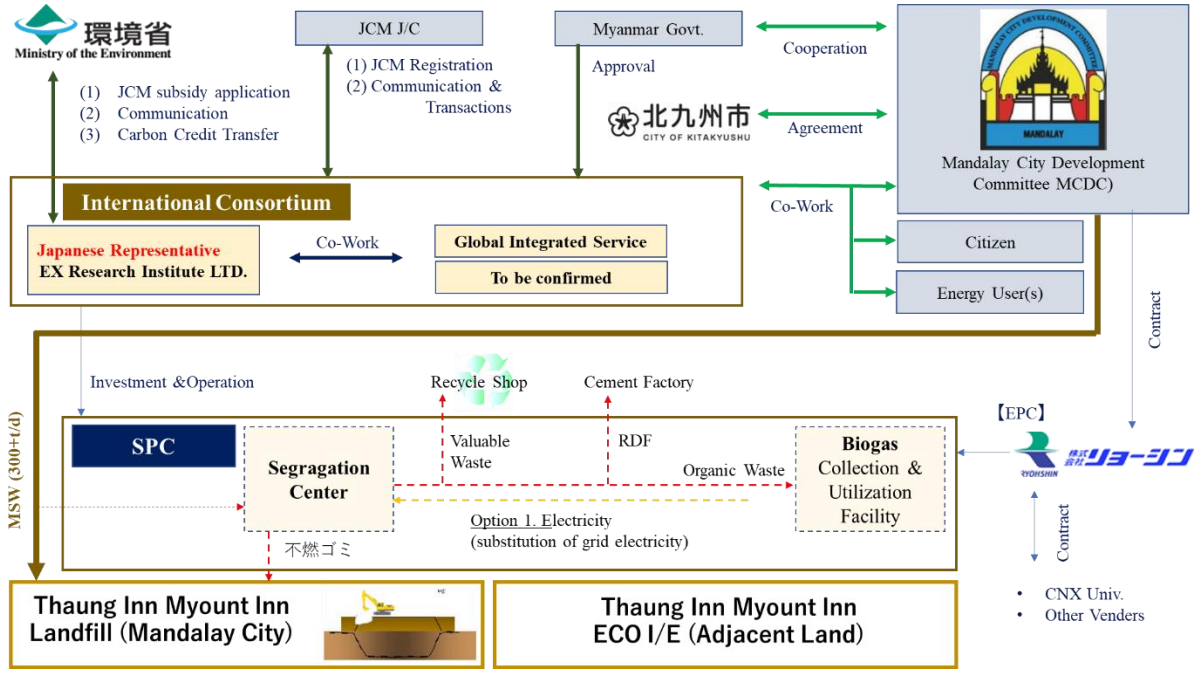


Figure 0.18 Organization Structure for Project Implementation

6) Economical Feasibility

Business model of sorting combustible waste (plastic waste) out from municipal solid waste for material recycle or thermal recycle in form of RDF/RPF at cement factories is well established in Thailand. Mandalay city understand that most of all recyclable waste and/or valuable waste is removed at waste generation sources, otherwise in the process of waste collection & transportation. Waste to be removed covers second hand used PVC pipe, PP including plastic shopping bags other than PET and cans

From the fact mentioned above, the study team assumed income from operation will be mainly from sales of RDF/RPF, biogas and digestive liquid as liquid fertilizer. RDF is sold at the price of 50-60% of that of lignite on calorific value basis, or THB0.2 / Mcal in Thailand at the beginning of 2018 with extra value for shredder into under 100MM. It is depending on the area, but liquid fertilizer is sold at the price of THB1.0-2.0/litter

7) Environment Integrity

Findings from research for Environmental Standard with purpose of securing environmental integrity is as per reported in 3-1 (5). As stated, there are two type of Environmental Standard, i.e., General Standard and Standard for specific industrial type. Business Operator shall design, introduce facility & equipment to be met with Environmental Standard, including any of those for specific industry applicable.

Industrial Types with specific Environmental Standard, which might applicable for the targeted projects in this study and their Environmental Standard is as per Table 3-15 below.

Table 0-21 Industrial Type applicable for the targeted project in the Study

Class	Type of Business	Remarks
2.1.1	Thermal Power Plant	Only for the case of power generation from collected gas
2.1.11	Gas supply & distribution	Only for the case of supply and distribute collected gas
2.4.1	Solid Waste Management Facility (Collection, Transportation, Processing, Store, Landfill and Chemical and/or biological treatment of Municipal Solid Waste and/or Industrial)	
2.4.2	Waste Water Treatment Facility (Sludge & Waste Water)	

Environmental Standard for noise & odder shall be as per general standard, while those for flue gas emission and waste water discharge shall be those for the specific industrial type applicable for the targeted project.

Waste Water Discharge Standard (Final Disposal Facility)

Parameter	Unit	Guideline Value			
		Hazardous Waste Landfills		Municipal Solid Waste Landfills	
		Daily Max.	Monthly Average	Daily Max.	Monthly Average
5-day Biochemical Oxygen demand	mg/l	220	56	140	37
Ammonia	mg/l	10	4.9	10	4.9

Aniline	mg/l	0.024	0.015	-	-
Arsenic	mg/l	1.1	0.54	-	-
a-Terpineol	mg/l	0.042	0.019	0.033	0.016
Benzoic acid	mg/l	0.119	0.073	0.12	0.071
Chromium (Total)	mg/l	1.1	0.46	-	-
Naphthalene	mg/l	0.059	0.022	-	-
p-Cresol	mg/l	0.024	0.015	0.025	0.014
pH	S.U.[a]	6-9	6-9	6-9	6-9
Phenol	mg/l	0.048	0.029	0.026	0.015
Pyridine	mg/l	0.072	0.025	-	-
Total suspended solids	mg/l	88	27	88	27
Zinc	mg/l	0.535	0.296	0.2	0.11

Waste Water Discharge Standard (Activated Sludge & Sludge Treatment Facility)

Parameter	Unit	Guideline Value
Arsenic	Mg/kg	75
Cadmium	Mg/kg	85
Chromium (Total)	Mg/kg	3,000
Copper	Mg/kg	4,300
Lead	Mg/kg	840
Mercury	Mg/kg	57
Molybdenum	Mg/kg	75
Nickel	Mg/kg	420
Selenium	Mg/kg	100
Total coliform bacteria	g[b]	1,000
Zinc	Mg/l	7,500

8) Contribution for Host Country's sustainable development

The business operation to be established under the study is to reduce negative impact on environment by introduction of appropriate processing & disposal facilities for municipal solid waste. In addition, the business operation would contribute establishment of "Municipal Solid Waste Management in Circular Economy" which Mandalay city set up as a policy in their waste management in their city. The concept mentioned above is completely matched with keywords, such as "circular economy", "resource efficiency" and etc., in environmental management in the world. Thus, to establish the business operation in Mandalay as model and spread into other areas in Myanmar & neighboring country would contribute host country's sustainable development.

3.4. JCM project registration

Reference is made to Figure 3-10, The project considered to be developed under the study are as follows;

	Technologies & Facilities to be introduced	Remarks
I	Introduction of high accuracy waste segregation unit & Collection & Supply of biogas	● To utilize biogas to be collected from operation as alternative fuel for fossil fuel (thermal energy for power generation) ● To utilize power to be generated from operation as alternative of power to be supplied by national grid ● Project sites will be land areas adjacent to both or either Northern & Southern Landfills
Ii		● To utilize biogas to be collected from operation as alternative fuel for fossil fuel (thermal energy for boiler operation) ● Project sites will be land areas adjacent to both or either Northern & Southern Landfills
Iii		● To utilize biogas to be collected from operation as alternative fuel for fossil fuel (thermal energy for boiler operation) ● Project sites will be land area (Waste Handling Center) at Mingalar Mandalay

[Consideration on GHG emission reduction]

（1）Reference Scenario

Reference scenarios for the project mentioned above are as follows;

	Reference	I	Ii	iii
1)	Municipal Solid Waste to be generated, collected and transported to the landfill will be landfilled in absence of the project activity	✓	✓	✓
2)	Business operator will utilize electricity to be supplied by National Grid for business operation, in absence of project activity	✓		✓[24]
3)	Business operator will utilize fossil fuel for business		✓	✓[25]

[24] Only for the case of power generation by utilizing biogas collected for use

[25] For the case of utilization of biogas as thermal energy other than power generation

	operation, in absence of project activity			
4)	Municipal Solid Waste to be generated will be collected at generating points and transported to the landfill			✓

(2) Reference Emission

Reference Emission will be quantified as follows;

$RE_p = RE_{elec,p} + RE_{FF,p} + RE_{CH4,p} + RE_{trans,p}$ Equation (1)

Where

RE_p = Reference emission in period 'p" (tCO_2)

$RE_{elec,p}$ = Reference emission from consumption of grid electricity in period "p", in absence of the project activity (tCO_2)

$RE_{FF,p}$ = Reference emission from consumption of fossil fuel, type "i" in absence of the project activity (tCO_2)

$RE_{CH4,p}$ = Reference emission from landfill in period "p" in absence of the project activity (tCO_2)

【GHG emitted from consumption of grid electricity in business operation ($RE_{el,p}$)】

$RE_{elec,p} = EL_p \times EF_{grid}$ Equation (2)

Where

EL_p = Amount of electricity consumed in period "p"(MWh)

EF_{grid} = Grid emission factor(tCO2/MWh)

【GHG emitted from consumption of fossil fuel in business operation ($RE_{th,p}$)】

$RE_{FF,p} = FFp \times GCVi * 10^3 \times EFi$ Equation (3)

where

FFp = Amount of fossil fuel, type "i" consumed in period "p"(t, kl, m3)

GCVi = Net Calorific Value for fossil fuel, type "i" (MJ/kg, MJ/l, MJ/m3)

EFi = Emission factor for fossil fuel, type "i" (tCO_2/TJ)

【GHG emission from landfill of municipal solid waste ($RE_{CH4,p}$)】

$RE_{CH4,p} = [\Sigma CH4generated_{i,p} - R_p] \times (1-OX_p) \times GWP_{CH4}$ Equation (4)

Where

$CH4generated_{i,p}$ = Methane gas emission from organic compound (i), in period "p"(tCH_4)

R_p = Amount of Methane gas collected in period "p"(tCH_4)

OX_p = Oxidation Factor for Methane Gas for period "p"(%)

GWP_{CH4} = Global warming potential of Methane gas

【GHG emission from transportation of municipal solid waste from collecting points to disposal points ($RE_{trans,p}$)】

$$RE_{trans,p} = FF_{i,trans} \times HCV_{FFi,trans} \times EF_{FFi,trans}$$

Where

$FFi_{,trans}$: Amount of Fossil Fuel, type "i" consumed for collection & transportation of municipal solid waste in absence of the activity, in period "p" (kl/year)

$HCV_{FFi\ ,trans}$: Net Calorific Value of Fossil Fuel, type "i" consumed for collection & transportation of municipal solid waste in absence of the activity, in period "p" (GJ/kl)

$EF_{FFi,trans}$: Emission Factor of Fossil Fuel, type "i" consumed for collection & transportation of municipal solid waste in absence of the activity, in period "p" (tCo2/GJ)

(3) Project Emission

Project emission is quantified with equation below.

$PE_p = PE_{elec,p} + PE_{FF,p}$ Equation (1)

1) GHG from electricity consumption for business operation in period "p"($PE_{el,p}$)

$$PE_{el,p} = El_{grid} \times EF_{grid}$$

Where

$Elgrid_{,}$: Amount of grid electricity consumed for operation in period "p" (Mw/year)

$EFgrid_{i}$: Emission Factor for grid electricity (tCo2/Mw)

2) GHG emission from fossil fuel consumption for operation ($PE_{th,p}$)

$$PE_{th,p} = FF_{i,th} \times HCV_{FFi} \times EF_{FFi}$$

Where

$FFi_{,th}$: Amount of fossil fuel type "i" in period "p" (kl/year)

HCV_{FFi} : Net Calorific Value for fossil fuel, type "i" (GJ/kl)

EF_{FFi} : Emission Factor for fossil fuel, type "i" (tCo2/GJ)

Both electricity and fossil fuel might be consumed in scenario (i) –(iii) above. However, as

details of the project has not yet been finalized, quantity project emission after finalization of details of the project through activities in future

（4） Emission Reduction

Emission Reduction is difficult to quantify at this stage, as details of the project has not yet finalized.

3.5. Research, Workshop, Site Survey in Myanmar & Thailand

In this study, the study team conducted two activities, i.e, study for JCM project development and supporting works to city of Kitakyushu for their city-city cooperation with Mandalay city, and therefore the study team organized seminar to share waste management related knowledge in Mandalay and site visit in Thailand. The study team also supported person in charge from Mandalay city to participate in JCM Workshop in Japan.

(1) Site Research

The study team conducted 4 times of site research in Mandalay during May 2018 – February 2019, of which details are as follows;

1) 1st visit

The study team conducted its 1st visit during May 22-25, 2018, of which details are as follows;

[Activities]

i） Organized an Official Meeting (Kick Off & 1st Meeting) with the Mayor of Mandalay city

ii） Had a meeting & discussion with a member in charge of environment from city development committee and cleansing dept.

iii） Supported Mandalay city - CCET joint workshop focusing on Composting

[Summary of the Activities]

(i) As advised by a member of Mandalay City Development Council, the Study team requested Mandalay city to organize a meeting with the Mayor for the study and could have official meeting with the Mayor on May 23, 2018. The study team explained outline of the study to be conducted and got an approval for study implementation from the mayor. The mayor appointed Dr. Thit Sinn, a committee member, in charge of environmental issue as a responsible person for the study, and Ms. San Thar Mon as focal point for the project from Mandalay city side. The mayor requested City of Kitakyushu to organize technical tour for them to Thailand with purpose of visiting waste processing facilities, especially full auto waste segregation unit and city of Kitakyushu accepted to do so. As for (ii), The study team interviewed with Mandalay City Development Council & Cleansing Dept. of the city as for municipal solid waste & waste management in Mandalay city in the meeting. Regarding iii)

above, details of the workshop organized is as per (2) below.

The Official Meeting with the Mayor of Mandalay city (R) & the Mayor (L)

2) 2nd visit

The study team conducted its 2nd visit to Mandalay city, including organizing technical tour for Mandalay city to Thailand during July 30 – August 4, 2018, of which details are as follows;

[Activities]

i) 2nd Official Meeting with Mandalay City Development Council & Cleansing Dept.
(Review on the1st visit, introduction of waste segregation unit, introduction of waste processing facilities in Thailand and free discussion)

ii) Visited Cement Factory located outskirt of Mandalay city (Utilization of RDF as alternative fuel in cement manufacturing)

iii) Visited landfill located at southern part of Mandalay city

iv) Visited a Developer of New Town in Mandalay city (Waste Management in New Town)

v) Organized technical tour (waste processing facilities) to Thailand

[Summary of the Activities]

In the 2nd Official Meeting i) above, the Study team did presentation for the project, including progress report from 1st visit, introduced biogas collection & utilization, for the case of Chiang Mai, Thailand (by Chiang Mai University), Introduced Waste Segregation Facility (by Ryoshin Co., Ltd.) and did briefing for technical tour to Thailand.

ii) to visit and discuss with Cement Factory located at outskirt of Mandalay city was arranged Mandalay city based on our discussion at the 1st official meeting. The Study team visited THAN TAW MYAT Co., Ltd. located outskirt of Mandalay city with the Committee Member & members of staff from Cleansing Department of Mandalay city. In the meeting with THAN TAW MYAT Co., Ltd., they have interested in utilizing RDF as alternative fuel for coal, while as they have their investor from mainland of China, they said they need to check with their investor whether or not to convert even a part of fuel from coal to RDF in future.

Participants from THAN TAW MYAT Co., Ltd. questioned technical issues, such as how to use RDF, which kind of facility and/or equipment will be required when they consider to utilize RDF as alternative fuel, whether or not they have to do pre-treatment or not, if so, which kind of pre-treatment they have to do with which kind of facility and/or equipment, Production line protection against chloride and sulfur, flue gas treatment system & etc.

Snap shot at the Meeting with THAN TAW MYAT Co., Ltd.

THAN TAW MYAT Co., Ltd.

iii) the Study team visited landfill located at southern part of Mandalay city to see current situation of the landfill and project site where Mandalay city planned to construct weigh house for quantify municipal solid waste to be transported to the landfill. Mandalay city explained that they will weight all municipal solid waste to be transported to the landfill and such data will be transferred to Cleansing Dept. on real-time basis by utilizing weight house with equipment under construction.

iv) details of technical visit to Thailand is reported in (3) below.

3) 3rd visit

The study team conducted its 3rd visit to Mandalay city, including organizing technical tour

for Mandalay city to Thailand during November 15-21, 2018, of which details are as follows;
[Activities]
i) The Study team specified possible business operation to be established under the study, conducted literacy research as for relevant laws & regulation, license & permission and environmental assessment for business development, then consulted with Directorate of Investment and Company Administration (DICA) under Myanmar Investment Commission (MIC).

ii) As requested Ryoshin Co., Ltd., participated in the study as a technical provider, visited JICA Myanmar office to consult as for possibility to access to any other schemes to promote their business activities in Myanmar

iii) Interviewed with a committee member of MCDC and Cleansing Dept. as for waste management plan of Mandalay city and visited project sites, such as adjacent land areas in both southern and northern landfill, where Mandalay city plan to develop new waste processing & disposal facilities in the Mandalay city

iv) Conducted knowledge sharing focusing on waste management & waste sampling & analysis with MCDC and Cleansing Dept. of Mandalay city.

The study team could confirm waste management plan of Mandalay city, have detailed discussion as for terms of reference for city-city cooperation (waste sector) including implementation schedule, confirmed Mandalay city's intention to request city of Kitakyushu to extend their support in next year, including issuance of official request letter. As mentioned, As requested by Ryoshin Co., Ltd., the Study team visited and received consultation with JICA Myanmar Office with purpose of find out alternative source of finance for Ryoshin Co., Ltd. This is because Ryoshin is an engineering company to design, fabricate waste segregation facility and for the case Mandalay city would not go for package, i.e., waste segregation unit & biodigester, then Ryoshin would not have any chance to access financial support to be granted by the Government of Japan. And therefore, Ryoshin needs to study more as for scheme to support their business expansion into the Myanmar market. The Study team welcomed action taken by Ryoshin, because introduction of waste segregation unit would help a lot in introduction of biodigester, which is one of the Study team's main target under the study.


Weight House constructed at southern landfill (L) & Waste Transporter（R）

4） 4th visit (Final)

The study team conducted its 4th visit to Mandalay city, including organizing technical tour for Mandalay city to Thailand during November 15-21, 2018, of which details are as follows;

[Activities]

i) The Study team Organized 2nd official meeting with the Mayor of Mandalay city, reported progress, achievement of the study in 2018, presented project proposal and exchanged ideas as for the project development in 2019

ii) The Study team updated data & information related to waste management in Mandalay city

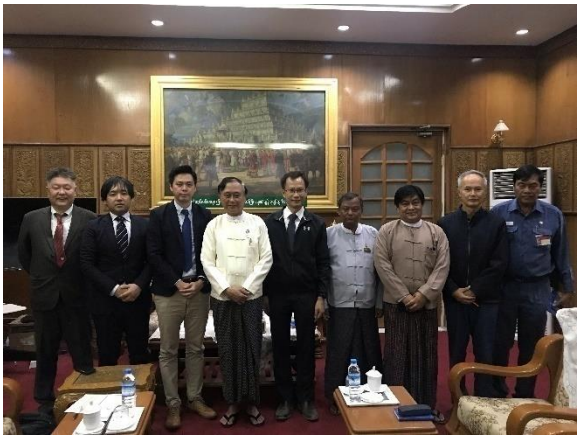
iii) The Study team visited Mandalay University to report progress of the Study in 2018 and consult for project to be proposed in 2019. The Study team confirmed with Mandalay University as for their intention to support study & project in 2019.

iv) The Study team visited Mingalar Mandalay project to report progress of the Study in 2018 and consult for project to be proposed in 2019. The Study team confirmed with the Owner of the Mingalar Mandalay project as for their intention to support study & project in 2019.

v)The Study team visited JICA Myanmar office to consult for project development for Ryoshin Co., Ltd. under ODA project development study with Private Sector, focusing on waste segregation facility to be installed in Mandalay city (Ryoshin might submit their proposal for 1st public offering in 2019).

[Summary]

The Study team had secured consent and received a commitment of issuance of a letter of intent from the Mayor of Mandalay city. The Study team also agreed with Mandalay University and Owner of the Mingalar Mandalay project to co-work for the project for improvement of waste management in Mandalay city in 2019.

The Mayor with Mr. Kato, Deputy Director from City of Kitakyushu (L) & Group Photo (R)

(2) Workshop in Mandalay

The Study team support for and participated in joint seminar on composting organized by Mandalay city and CCET and shared knowledge as for composting, then participate in group discussions.

1) General Information

Venue	Meeting Room at MCDC	Time & Date	May 23-24 Whole day
Agenda	Composting		
Program	As per 2) below		
Participants	118 in total (as per 3) below)		
Hand Out	N/A		

2) Program

Day I (May 23, 2018)		
09:00-	Opening of the Workshop & Welcome Address	Vice Mayor, Mandalay City
	Welcome Speech	UNEP/CCET(IGES)
09:45-	Composting in Waste Management	UNEP/CCET(IGES)
10:00-	Introduction of Composting (I) Mechanical	City of Kitakyushu (EX)
12:00-	Lunch	
12:50-	Composting (II) EM base	Myanmar Agricultural Service (MAS)

13:30-	Composting (III) Yeast base	Mandalay University
14:15-	Composting (IV) General	ECD
14:50-	Composting (V) How to	Mandalay City
15:30-	Closing	Committee Member of MCDC

Day II (May 24, 2018)		
09:00-	Opening of the Workshop & Welcome Address	Committee Member of MCDC
09:10-	Orientation for Group Discussion	UNEP/CCET(IGES)
09:30-	Group Discussion I	
11:00-	Lunch	
11:45-	Group Discussion II	
14:30-	Conclusion	
15:30-	Closing of the Workshop	Committee Member of MCDC

3) Participants

	Organization/Entity/Corporation	No
1	MCDC & Cleansing Department	16
2	UNEP/CCET(IGES)	2
3	Myanmar Agricultural Service	3
4	Mandalay University	3
5	ECD	3
6	City of Kitakyushu	2
7	Representative from model areas under UNEP/CCET pilot project	65
8	Others (Representative from markets, schools, women association and etc.)	24
Total		118

4) Summary

As stated above, the organizers, i.e. Mandalay city and CCET held the workshop focusing on composting Presenters other than city of Kitakyushu did presentation as for their activities in Myanmar, of which outline is as follows;

- To promote composting of organic compound contained in municipal solid waste is one of major activities conducted by Mandalay city with technical support provided by CCET
- Compost recommended by Mandalay city is those made from organic waste generated (and collected) at households, community and fresh markets
- Head of Chemical Dept. from Mandalay University reported that her group is conducting

pilot project of home composting with yeast collected in the area, like Takakura method. She added that Pilot project was so far going well.

- EM is widely utilized in composting at Communities, Schools and Temples in Mandalay city.
- EM was brought to Myanmar a few decades ago and Dr. Higa is well known in Myanmar
- To share more information & knowledge might be required, as most of participants understand that organic compound + EM = Compost and utilization of compost might lead better harvest
- According to Mandalay city, there are large area for agricultural use in outskirt of Mandalay city and high demand for organic fertilizer

Deputy Mayor of Mandalay city at Workshop & Participants

(3) Technical Tour to Waste Management Facilities in Thailand

The Study team organized technical tour to Thailand focusing on waste management facilities for members of staff from Mandalay city for 2 days on August 3 & 4, 2018. Mandalay city assigned Dr. Thit Sinn, committee member in charge of Environment and Mr. Ula Myo, Director from Cleansing Dept. to participate in the technical tour. Program of the technical tour was as follows;

Place to visit	Outline
Integrated Waste Management Center in Rayong	Visited & studied Integrated Waste Management Center in Rayong, Thailand (facilities & operation)
Waste Segregation Center (GPSC)	Visited & studied fully automated municipal solid waste segregation center owned by GPSC, a subsidy of PTT, of which capacity is 500ton/day
Waste Segregation Center (TPI)	Visited & Studied details of fully automated

	municipal solid waste segregation unit installed at Integrated Waste Management Center in Rayong by TPI. TPI is one of the largest manufacturers of petrochemical products in Thailand and they have installed waste segregation unit in order to sort plastic waste out from mix waste to be utilize at their plant as alternative fuel. Capacity of the unit is 300ton/day. For Rec, one of the manufacturers, which Ryoshin has its dealership works as EPC.
Transfer Station (MAP TA PHUT)	Visited & Studied Transfer Station for Municipal Solid Waste owned by Map Ta Phut municipality in Rayong Province, where Map Ta Phut municipality collect municipal solid waste in the area to be transfer to landfill located at the Integrated Waste Management Center in Rayong by containers.
Si Racha Sanitary Landfill (Chonburi)	Visited & Studied a landfill located in Sri Racha in Chonburi, Thailand, where Ryoshin Co., Ltd. try to introduce their waste segregation unit

Technical Tour to Thailand at Integrated Waste Management Center in Rayong

3.6. Waste Management Project at Mingalar Mandalay

Singapore based New Starlight Co., Ltd. is under developing new town in the central part, i.e. area surrounded by street No. 73 & 29 of Mandalay city

New town under developing is named "Mingalar Mandalay" and plan to have international class hotel with more than 300 rooms, residential areas (luxury condominium & villas), Commercial Complex and Office Building. The New Town will be the largest & highest-class complex in Mandalay city.

According to person concern, all units in residential area has been sold out by February 2019, when the study team visited Mingalar Mandalay project site, Details of "Mingalar Mandalay" project is as below.

Right: Location Map of "Mingalar Mandalay" Project

【 Hotel 】

	Project Name	No of Room	Completion (Plan)	
			2015	2019
1	Mingalar Condominium	358	Soft Open	Under Construction
2	NGU SHWE WAH Condominium	52	Grand Open	-

【 Residence (Condominium+Villa) 】

	Project Name	No of Unit	Completion (Plan)	
			2018	2019

1	Mingalar Condominium	130	30	130
2	NGU SHWE WAH Condominium	56	56	56
3	VILLA	50	50	50

【 Commercial Complex 】

	Project Name	No of Unit	Completion (Plan)	
			2018	2018
1	Shop House (Food & Beverage)	125	20	20
2	Shop House (Others)		105	105
3	Tenant in Shopping Center (F&B)	70	16	20
4	Tenant in Shopping Center (Other)		54	50

【 Office Building 】

	Project Name	Area(m2)	Completion (plan)	
			2018	2019
1	Office Tower I		n/a	n/a
2	Office Tower II		n/a	n/a

Satellite Picture of Mingalar Mandalay Project

MMC Corporation, is one of local construction company, by consignment of New Starlight Co., Ltd. a developer of the project, manage waste, waste water generated in Mingalar Mandalay area.

Waste Collecting Points in Mingalar Mandalay

Regarding to waste generated in the area, MMC announced resident, tenants and other parties concern that 1) waste shall be separated into 3 type, i.e. recyclable, wet & dry to be disposed at waste generating points, 2) MMC arranges waste collection & transportation twice a day, i.e. at 7 am & 4 pm and collect waste at appointed waste collecting points in the area (Collecting points are indicated ☆ in satellite map above), and 3) transports to landfill belong to Mandalay city

Mr. Soe Naing General Manager of MMC said that amount of waste generated in the area reached to 3 tons/day, and expect much more in future, as there will be new comers and more customers come to commercial complex and grand opening of hotel within this year. With background mentioned, MMC requested City of Kitakyushu to support their waste management in the area at the initial meeting held on May 2018. Mr. Soe reported us at the meeting held on February 2019, that amount of waste generated in the area increased up to 4tons/day at the beginning of 2019.

However, MMC put a condition that cooperation between city of Kitakyushu and Mingalar Mandalay shall be subject to approval given by Mandalay city, since New Starlight Co., Ltd. as well as MMC is working very closely to Mandalay city, and both of them mind much as for policy & direction in waste management adopted by Mandalay city.

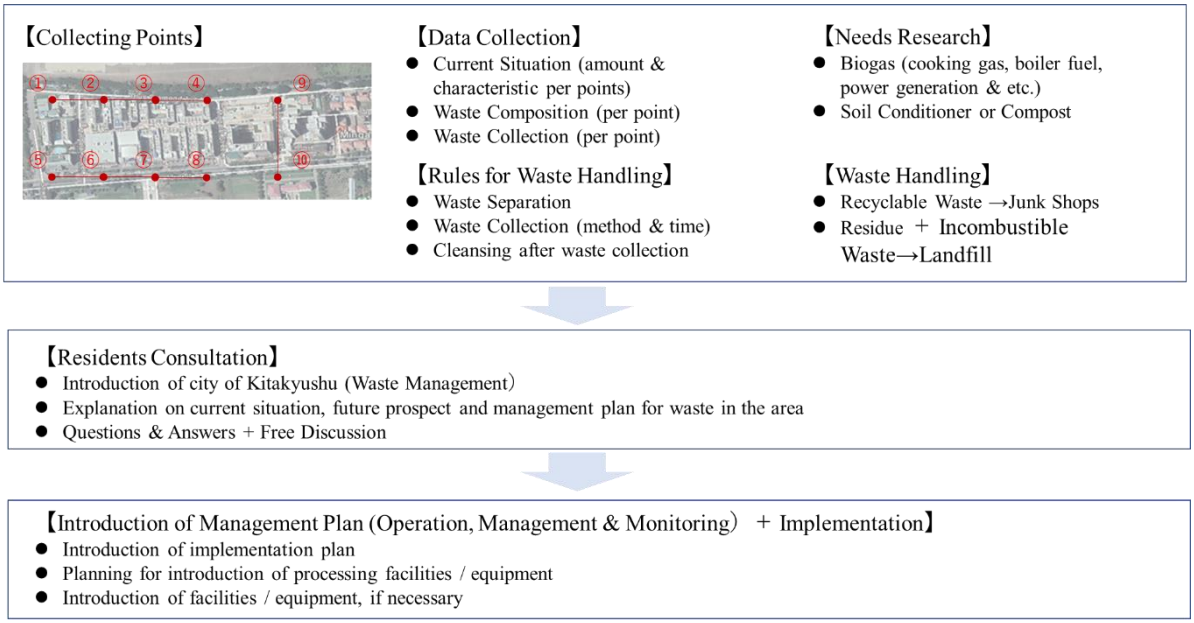
The study team have continued dialog with Mandalay city for the case of Mingalar Mandalay and finally could confirm Mandalay city's intention of "no objection & welcome for the waste management project at Mingalar Mandalay area on January 2019, after having long dialog with Mandalay city. The study team reported progress above at the second meeting with MMC held on February 2019, and confirmed with MMC that Mandalay city did same approach, i.e. consultation with MMC to improve waste management at Mingalar Mandalay area as model area for waste management in Mandalay, to MMC

The study team reported findings from activities in 2018 including dialog with Mandalay city mentioned above and explain an idea for the study, in which the Study team work for waste management project at Mingalar Mandalay area, to be conducted in 2019 subject to financial support given by the Government of Japan. The study to be conducted in Mingalar Mandalay

area will mainly focusing on organic waste with anaerobic digestion.

[Outline of the Project proposed by the Study team]

Outline of the project proposal submitted by the Study Team is as follows;



In the proposed project, the study team start collecting waste related data & information in the area, needs research, flow for waste utilization and efficient processing and/or disposal of waste, along with drafting rules & regulation for waste handling in the area. Despite of needs for thermal energy and electricity from hotel, tenants and residence, it will be necessary to conduct detailed study to carefully check feasibility of each project in size wise, etc.

The study team has already informed that support to be provided by City of Kitakyushu would be completely depending on financial support to be granted by the central government of Japan and any of such support would cover only biogas project, if source of finance would be JCM project development study. Details of New Starlight Co., Ltd., potential project owner of the project, is as follows;

General Information of Developer

Company Name	:	New Starlight Construction Co., Ltd.
Head Office	:	No.33/A, Corner of 29th St., 73rd St., Chan Aye Thar Zan Township, Mandalay
TEL	:	Tel: +95 2 24873 / +95 2 24562
Business Line	:	(1) Developer, (2) Construction & (3) Import, Wholesale of Construction Material
Projects in pipeline	:	(1) Mingalar Mandalay Project (2) Mandalay Trade & Industrial Center (3) Mandalay Convention Center & Commercial Center

		(4) Muse Central Business District

The study team regard the proposed project as one of targeted project to be developed under JCM development study next year.

3.7. Actions to be taken

The study team could confirm with Mandalay city as for their waste management plan as per shown Figure 3-10 & 3-11 above as well as implementation schedule as per Figure 18 below.

Upon receipt of official request from the Mayor of Mandalay city, City of Kitakyushu has already agreed with Mandalay city to extend their support for another year at the official meeting with the Mayor of Mandalay city on February 2019. In which the study team continue to study the possibility of the biogas related project for Mandalay city and Mingalar Mandalay area

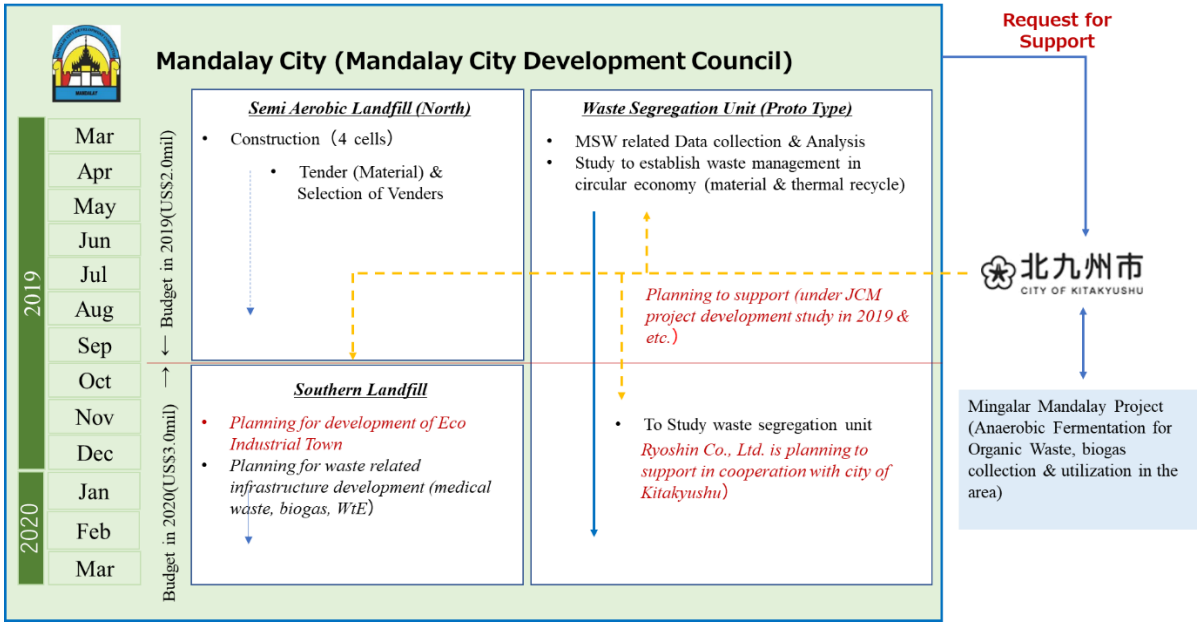


Figure 3.19 Implementation Plan for Waste Management Project in Mandalay city

Chapter4. Attending Workshop

4.1 City-to-City Collaboration Project Workshop

（1） Overview

"City to City Collaboration Project Workshop" was organized by the Ministry of the Environment, and was held in Yokohama City and City of Kitakyushu, inviting people from collaborated cities with the City of Kitakyushu.

（2） Place and Date

City of Kitakyushu: Mon. October 22 to Tue. October 23, 2018
Yokohama City: Thur. October 25 to Fri. October 26, 2018

（3） Agenda and Minutes

The minutes of the workshop are shown in attached from next pages.

（Memo 1）

Seminar on City-to-City Collaboration and Site Visit in City of Kitakyushu
Minutes of Meeting

Monday, October 22nd - Tuesday, October 23rd
At Kitakyushu, Fukuoka
Attendees : Atsushi Ajiro, Hiroshi Masuda

Before the City-to-City Collaboration Project workshop organized by the Ministry of the Environment, scheduled at Yokohama on October 25 and 26, 2018, we invited the guests, who are in collaboration with the city of Kitakyushu, to the workshop in City of Kitakyushu and site visits were conducted to introduce the city's and its enterprises' countermeasures against global warming and efforts towards a low-carbon society. NTT Data Institute of Management Consulting, Inc., which engages in collaborative projects with each city this fiscal year, also participate in the tour, so the visit reports are as follows.

■Itinerary and Invited Participants

City	Name	Company	10/21（日）	10/22（月）	10/23（火）
Chiang Mai	Ms.Pakawan Sangsree パカワン　サンシリー	Chiang Mai Provincial		《Site Visit》 (1)Kitakyushu Eco-Town Center. (2)Kogasaki Incineration Facility	《Site Visit》 Usa Biogas Power Plant / Price Management of Japan Co., Ltd.
	Mr. Thanin Wanasuthanon タニン	EA Corp.			
Davao	Ms. Marlisa Gallo	Davao City Environment and Natural Resources Office Davao City, Government	Arrived at Fukuoka		
	Mr. Lakandiwa Saliman Orcullo				
Hai Phong	Ms.Nguyen Minh Trang グエン　ミン　チャン	Hai Phong Department of Foreign Affairs			
	Mr.Phung Duc Anh フン　ドゥック　アイン				
Mandalay	Mr. Khaing Myint キン　ミン	Mandalay City Development Committee (MCDC)			
	Mr. Nyi Nyi ニ　ニ				
Phnom Penh	Mr. Nuon Samnavuth ヌオン　サムナブット	Waste Management and Environment Division, Phnom Penh Capital Hall			
	Ms. Kun Malin クン　マーリン				

■Visit report

Monday, October 22, 2018

1. 13:00-14:30 Kitakyushu Eco-Town Center

At the Eco-Town Center in Hibikinada area in Wakamatsu-ku, staff members explained to us the history of Kitakyushu, Hibikinada Industrial Park, and City of Kitakyushu Eco-Town Project.

In the city of Kitakyushu's environmental industry reconstruction strategy, they are collaborating with industry, academia and academia to comprehensively develop from education and basic research to technology and empirical research, and to commercialization.

After explanation at the Eco-Town Center, we went to a recycling factory of "Recycle Tech Co., Ltd." to recycle OA equipment. It decomposes the copying machine and separates it into gold, silver, lead, aluminum, copper, iron, plastic, etc., achieving a recycling rate of 99% in total. We took a tour of the urban mine and the actual factory situation (Photography in the factory is not allowed).

	
Eco-town Center’s presentation	OA equipment recycling factory tour

2. 15:30-16:30 Kogasaki Incineration Facility

Kogasaki Incineration Facility has garbage disposal capacity of 810 tons per day. In addition facility explanation by DVD, explanation by model, and facility tour was conducted.

The volume is reduced by one twentieth by incineration of garbage. The incinerator is completely burning at a TAKUMA stalker furnace at 800 degrees. Although it also has facilities for gas engines, they currently do not operate because the price of city gas is high, they are only conducting power generation by steam turbine. The power generation scale is 17,200 kW, electricity is sold to Kitakyushu Power Co., Ltd.

	
Kogasaki Incineration Facility explanation	Model of stalker furnace

■Visit report

Tuesday, October 23, 2018

3. 10:20-12:00 Usa Biogas Power Plant / Price Management of Japan Co., Ltd.

We visited Usa Biogas Power Station where Mirai-Power Corporation, one of a comprehensive energy company is operating. The power station has been running since July 2018. This facility is a biogas power generation facility utilizing *shochu* (Japanese distilled spirit) residues and business waste in the surrounding area, and Japan Price Management Corporation is conducting EPC cooperation. In general, *shochu* gas is unsuitable for solubilization, but solubilization is carried out with original technologist.

Equipment outline

・Total project cost: About one billion yen

・Constructed on the site of an oranges farm, its site area is about 8,000 square meters.

・Output : 600 kW (200kW×3 units)

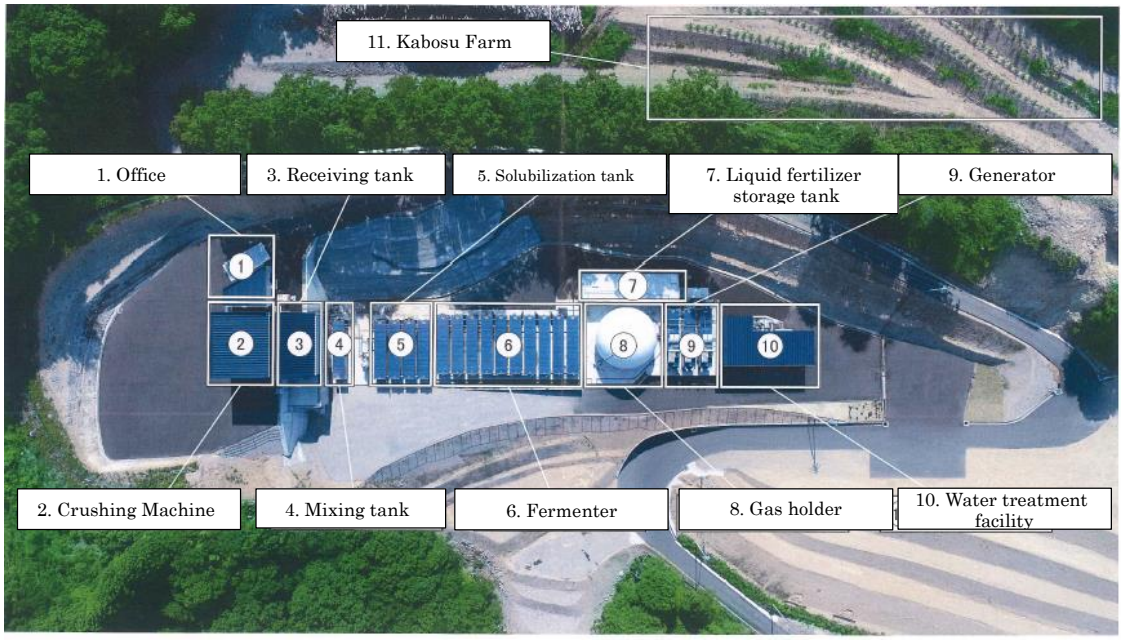
(As of October 23, 2018, 2 units already installed)

・Except for electric power used in the site, all Electricity is sell to Kyushu Electric Power Co., Inc. by FIT.

・Annual sales target is 120 million yen.

・The digestive juice after fermentation will be utilized as liquid fertilizer at *Kabosu* (a type of citrus fruit) Farm run by affiliates of the company.

・Construction work began in November 2017. March to August is the plant installation and trial operation period. Construction completion was July 27. Power sale has begun since October 2018.



Outline of plant equipment

End of Minutes

(Memo 2)

Seminar on City-to-City Collaboration and Site Visit in Yokohama City

Minutes of Meeting

Thursday, October 25th - Friday, October 26th

At Annex Hall, PACIFICO Yokohama

Attendees : Atsushi Ajiro, Hiroshi Masuda

We participated in the City to City Collaboration Project Workshop organized by the Ministry of the Environment in Yokohama on October 25 and 26. On the morning of the 25th, an open seminar was held, a private seminar in the afternoon. A site visit in Yokohama was held on 26th.

■Thursday, Morning of October 25, Open Seminar

Program:

Time	Contents
09:00	Registration
09:30	**Opening Remarks** Mr. Satoru Morishita, Director General, Global Environment Bureau, MOEJ
09:35	**Overview of the C2C Collaboration for Low-Carbon Society and Financial Supports** 1. City-to-city Collaboration for Low-carbon Society and JCM Model Projects (20 min) Mr. Ryuzo Sugimoto, Director, International Cooperation and Sustainable Infrastructure Office, MOEJ 2. Support for Overseas Development of Infrastructure Systems (10min) Mr. Yuichiro Masuda, Director International Affairs Office, City Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) 3. Support for Transportation and Urban Development Projects (10 min) Mr. Tsuyoshi Kurokawa, Deputy Managing Director, Project Department, Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development Q&A (10 min) 4. Initiatives for City-to-City Collaboration in Yokohama City to realize a low-carbon society (10 minutes) Mr. Masakazu Okuno, Director for Development Cooperation, International Affairs Bureau, City of Yokohama
10:35	Break (20 min)
10:55	**Case Study of "C2C Collaboration for Low-Carbon Society in FY2018"** 1. Collaboration with Ayeyarwady Region and Sagain Region (Myanmar) (10 min) Mr. Naoki Kato, Manager, Environment Division, Environment Department, Fukushima City / Mr. Koji Kojima, Research Director, Environment and Energy Division, Mitsubishi Research Institute Inc. 2. Collaboration with Semarang City and Bali City (Indonesia) (10 min) Mr. Masayuki Wakabayashi, Assistant Manager, Environmental Policy Division, Environmental Department, Toyama City 3. Collaboration with Jakarta (Indonesia) and Yangon City (Myanmar) (10 min) Mr. Takahiro Fukahori, Manager, International Economic Affairs Office, Economic and Labor Affairs Bureau, Kawasaki City 4. Collaboration with Batam City (Indonesia) and the Port Authority of Thailand (10 min) Ms. Yasuaki Nakamura, Deputy Director for Development Cooperation, International Affairs Bureau, City of Yokohama 5. Collaboration with Quezon City (Philippines) and Ho Chi Minh City (Viet Nam) (10 min) Mr. Toshikazu Nakaaki, Assistant Manager for International Cooperation, Environment Bureau, Osaka City Government 6. Collaboration with Chiang Mai Province (Thailand), Hai Phong City (Viet Nam), MandalayCity (Myanmar), Davao City (Philippines) and Phnom Penh City (Cambodia) (20 min) Mr. Hiroshi Yasutake, Deputy Director, Kitakyushu Asian Center for Low Carbon Society, Environment Bureau, City of Kitakyushu Q&A (20 min)
12:25	**Closing Remarks** Mr. Nobutoshi Miyoshi, Managing Director, Institute for Global Environmental Strategies (IGES)

- 09:30 Greeting Remarks: Mr. Satoru Morishita, Director General, Global Environment Bureau, MOEJ
  - ✧ 70% of CO2 emissions are generated from urban areas.
  - ✧ The projects are promoting collaboration between cities and private companies.
  - ✧ Also at COP 21, the importance of role played by cities was reaffirmed.

- 09:35 Overview of the C2C Collaboration for Low-Carbon Society and Financial Supports.
  - City-to-City Collaboration Low-Carbon Society and JCM Model Projects

    (Mr. Ryuzo Sugimoto, Director, International Cooperation and Sustainable Infrastructure Office, MOEJ)

    - ✧ To realize low-carbon business, collaboration and international cooperation is important.
    - ✧ In cooperation with low-carbon infrastructure, we are concentrating on the fields of "waste generation", "energy conservation / reenergine", "septic tank", "water and air pollution control".
    - ✧ For top sales, Japan Environment Week was held in Myanmar in January 2018. Next seminar will be held in Vietnam in 2019.
    - ✧ The importance of cities is recognized as a non-government actor about the role of the city, and focus is shifted from the national level adjustment to the urban level implementation in concrete progress of things.
    - ✧ Until now, it has been implemented in 27 cities in 10 Asian countries as City –to- City Collaboration Project.
    - ✧ There was explanation about JCM scheme and JCM financing programme.

  - Support for overseas Development of Infrastructure Systems (10 minutes)

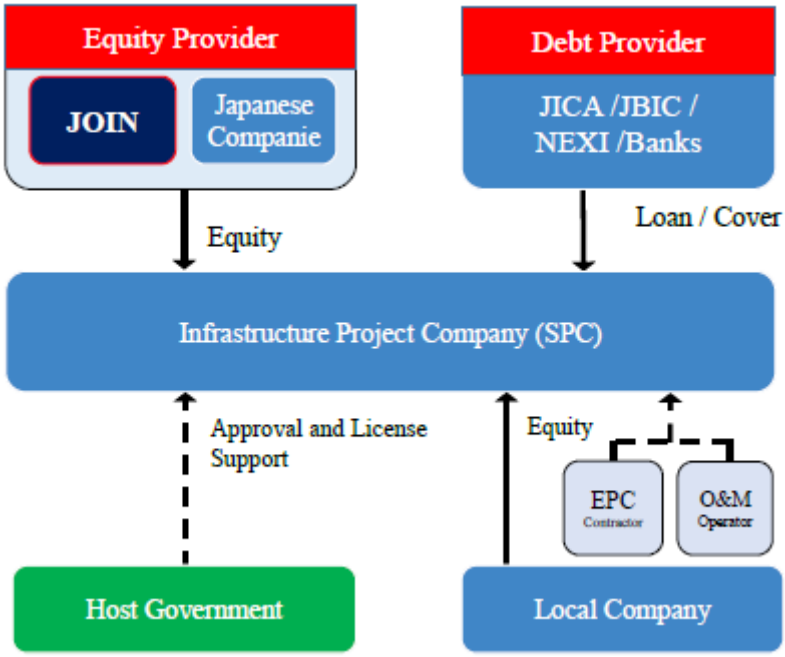
    (Mr. Yuichiro Masuda, Director International Affairs Office, City Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT))

    - ✧ Infrastructure tasks and initiatives for each phase, in the high growth period, stable long term and maturity period are explained.
    - ✧ We are developing overseas in the form of international cooperation on the know-how that Japan has experienced.
    - ✧ In Japan, urban development centering on public transportation and stations has been done. It was development that improved the value of the whole area by performing function sharing etc. TOD (Transit Oriented Development).
    - ✧ We are implementing international cooperation called J-CODE.
    - ✧ It is a characteristic of Japan that is trying to develop problem-oriented smart city development.

  - Support for Transportation and Urban Development Projects (10 minutes)

    (Mr. Tsuyoshi Kurokawa, Deputy Managing Director, Project Department, Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development)

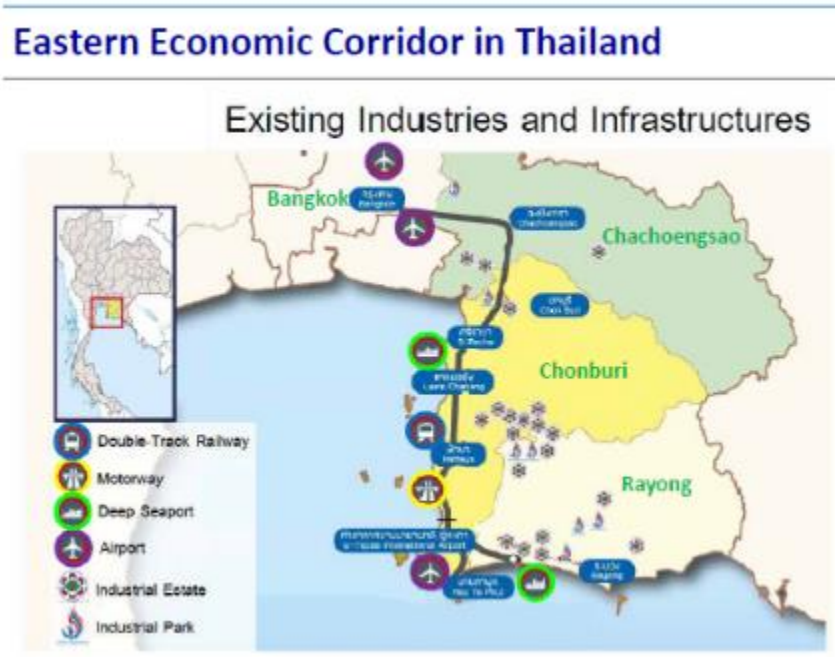
    - ✧ Introduction of support for urban development support of JOIN.
    - ✧ JOIN（Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development） was established in October 2014, is the "first" and "only" Public-private funds in Japan, specialized in overseas infrastructure investment. We are investing in developing countries and emerging countries without distinction.
    - ✧ Funds with an investment capacity of approximately 1.3 billion US dollars (126.8 billion yen) as the annual budget of the Japanese government.
    - ✧ Business fields are as follows: 1. "Transportation Project", 2. "Urban Development Project", 3. "Project to Support Transportation and Urban Development Project".
    - ✧ The project organization chart is as follows;



- Initiatives for City-to-City Collaboration in Yokohama City to realize a low-carbon society (10 minutes)

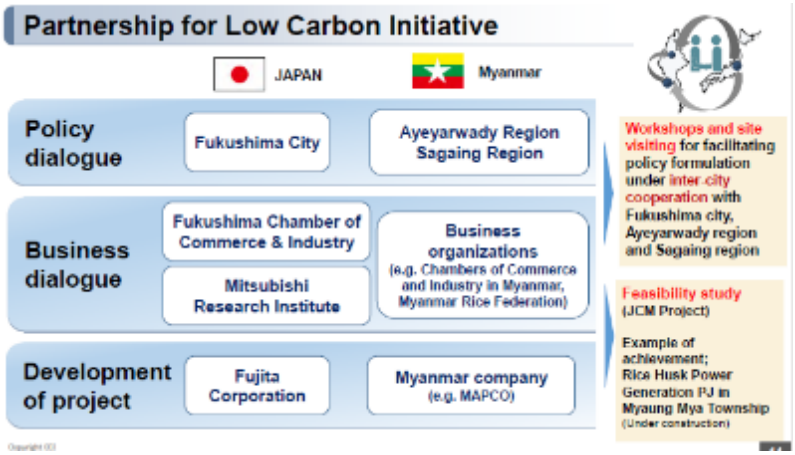
  (Mr. Masakazu Okuno, Director for Development Cooperation, International Affairs Bureau, City of Yokohama)

  - ✧ We have provided master plan development support in Cebu, Da Nang, Bangkok, Batam. Among them, Batam is carrying out using the JCM scheme.
  - ✧ The efforts of Da Nang city, Y-PORT project, JCM case cases etc. are introduced
  - ✧ We create civic cooperative offices, working on Y-PORT projects with citizen collaboration.
  - ✧ The development plan of the support project in Bangkok is shown below. We would like to advance business with B2B.



- 11:00 Introduction of adopted case of "FY2018 City-to-City Collaboration Programme for Low-Carbon Society"
  - Collaboration with Ayeyarwadi Region and Sagaing Region (Myanmar) (10 minutes)

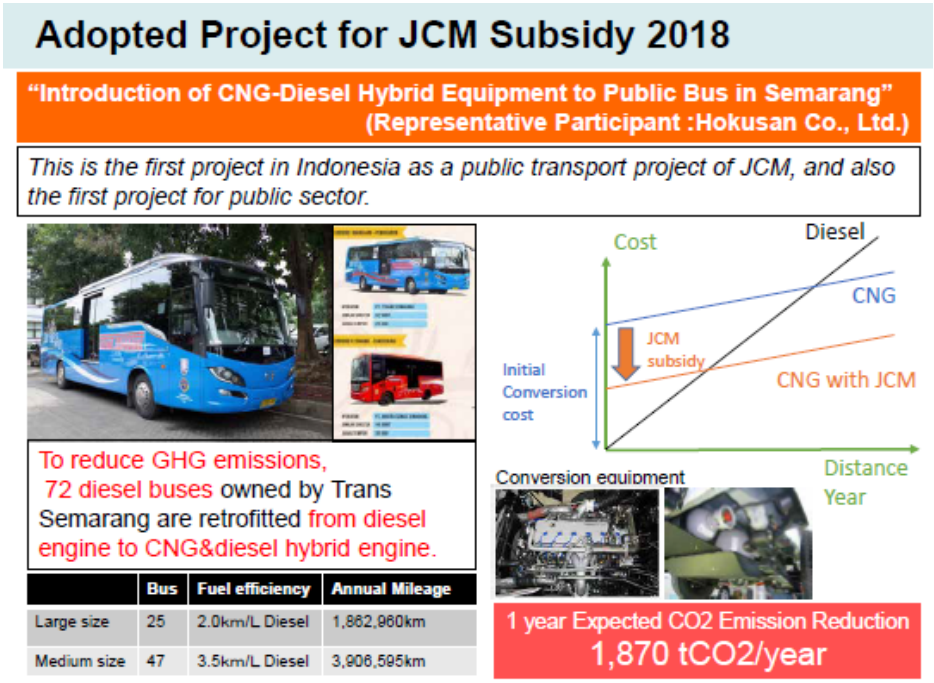
    （Mr. Naoki Kato, Manager, Environment Division, Environment Department, Fukushima City / Mr. Koji Kojima, Research Director, Environment and Energy Division、Mitsubishi Research Institute Inc.）
    - ✧ Explanation of collaboration project between Fukushima City and Ayeyarwadi Region and Sagaing Region
    - ✧ The city-to-city collaboration between Fukushima City and Ayeyarwadi Region is the fourth year. In the meantime, we have been able to achieve some results.
    - ✧ Firstly, it is educational activities through environmental education. We exchanged video letters between Fukushima City and elementary school students in Myanmar. Secondly, it is promoting sorting work at the waste disposal site to reduce waste in Pathein city.
    - ✧ We carried out to paying courtesy to the Minister for Agriculture and Livestock and approach to Ms. Aung San Suu Kyi last fiscal year
    - ✧ It is characterized by being active in three layers of examination of JCM project, business review, and policy review.



    - ✧ We are focusing on biomass power generation (rice residue power generation) as an industrial park development. Utilizing the characteristics of Fukushima City and Ayeyarwadi Region, we are considering business composition. We are planning to make heat from rice residue and supply the heat to industrial parks and local communities.

  - Collaboration with Semarang City and Bali City (Indonesia) (10 minutes)

    (Mr. Masayuki Wakabayashi, Assistant Manager, Environmental Policy Division, Environmental Department, Toyama City)
    - ✧ Introduction of Toyama city. In addition to environmental efforts, it has been selected as a SDGs model city. The two city characteristics are compact city policy and renewable energize policy.
    - ✧ In Tabanan City, Bali, small-hydropower generation is used, and in Indonesia, hybrid power generation that combines small hydraulic power and sunlight is performed. Also, in Bali, we are working on energy conservation of tourism facilities such as hotels and restaurants, and low carbonization of public transportation such as diesel and gas.
    - ✧ Introduced of JCM project in the transportation field to be advanced in Semarang city. The outline is as follows;



- Collaboration with Jakarta (Indonesia) and Yangon City (Myanmar)

  (Mr. Takahiro Fukahori, Manager, International Economic Affairs Office,

  Economic and Labor Affairs Bureau, Kawasaki City)

  - ✧ Introduction of Kawasaki city. It is an industrial area and is trying to transfer technology and know-how that we have been working on to cope with environmental problems to overseas.
  - ✧ Having a slogan called "Win-win relationship" and "Equal partnership", we are implementing city-to-city collaboration.
  - ✧ Introduction of city-to-city collaboration project with Yangon and Jakarta. In Yangon, targeting markets where large amounts of organic waste are generated, with the aim of utilizing Hitachi Zosen's methane fermentation technology, we have set up enterprises in Kawasaki City as EPC contractors and make projects. We are collaborating with local Dagon Group in Myanmar.

- Collaboration with Batam City (Indonesia) and the Port Authority of Thailand (10 minutes)

  (Ms. Yasuaki Nakamura, Deputy Director for Development Cooperation, International Affairs

  Bureau, City of Yokohama)

  - ✧ Introduction of examples of Batam and Bangkok from among cooperative projects with cities in Cebu, Da Nang, Bangkok, Batam.
  - ✧ In Batam, we are focusing on green industry and green building. In addition to JCM FS, METI's water business and garbage business etc. are also combined in a wide range.
  - ✧ This fiscal year we are doing FS of optimization in industrial park.
  - ✧ We are making a system to decide whether CASBEE in Yokohama can be introduced to Batam or whether it can be expanded horizontally.

- Collaboration with Quezon City (Philippines) and Ho Chi Minh City (Vietnam) (10 minutes)

  (Mr. Toshikazu Nakaaki, Assistant Manager for International Cooperation, Environment Bureau,

  Osaka City Government)

  - ✧ Introduction of city-to-city collaboration case with Quezon City and Ho Chi Minh City.

- ✧ About city-to-city collaboration with Quezon City, we have an MOU for the following four purposes:
  - Making a reference system
  - Sharing of expertise
  - Creation of public-private partnership projects
  - Capacity building
- ✧ In Quezon City project, we are considering energy conservation at factory, introduction of photovoltaic power generation equipment, improvement of garbage trucks, etc.
- ✧ In Ho Chi Minh City project, Osaka City is cooperating with the planning and promotion of a global warming countermeasure implementation plan. We are considering not only plans for mitigation measures but also adaptation measures such as weather forecasting. We also are considering introducing JCM project as an introduction of energy-saving pumps.

➢ Collaboration with Chiang Mai Province (Thailand), Hai Phong City (Vietnam), Mandalay City (Myanmar), Davao City (Philippines), Phnom Penh City (Cambodia) (20 minutes)

(Mr. Hiroshi Yasutake, Deputy Director, Kitakyushu Asian Center for Low Carbon Society, Environment Bureau, City of Kitakyushu)

- ✧ Explanation for each city is conducted.
- ✧ Phnom Penh (Cambodia): Sister city from 2016. As a pilot project supporting Phnom Penh city climate change plan formulation, this fiscal year, we are considering for the field of transportation, green production, and environmental conservation.
- ✧ Mandalay (Myanmar): We have been collaborating since 2012. Focus on waste management and energy fields. In the energy field, we will tackle the reduction of carbon at large facilities and the reduction of carbon at primary industry.
- ✧ Davao (Philippines): 2017 Environmental sister city concluded. We are assisting in formulation of climate change action plan and implementation of mitigation measures. We are also considering the field of waste power generation business.
- ✧ Chiang Mai (Thailand): Horizontal expansion of eco industrial town. Cooperating with Thai Industrial Estate Authority, we are considering low carbonization in new industrial parks.
- ✧ Hai Phong (Vietnam): 2014 sister city concluded. Formulation of Green Growth Promotion Plan and demonstration of EV bus etc. in the past. This fiscal year, support for environmentally-friendly industrial parks has started.

- 12:25 Closing remarks: Mr. Nobutoshi Miyoshi, Managing Director, Institute for Global Environmental Strategies (IGES)
  - ✧ He thanked for the supporters of the seminar, the speakers. Today's information are extremely important in implementing concrete measures in future city-to-city collaboration. IGES plays a platform function of cooperation between cities, and for further promotion, it is necessary to further disseminate information on support such as funding from planning to implementation.
  - ✧ We would like them to consider the examination toward the realization of further low carbonization project.

■**Thursday, afternoon of October 25, Private Seminar**

Program:

Time	Contents
13:30	Open venue
14:00	Opening Remarks Mr. Ryuzo Sugimoto, Director, International Cooperation and Sustainable Infrastructure Office, MOEJ
14:05	**Reports by Participants from Asian Cities** 1) Phnom Penh City (5 min) Mr. Samnavuth Nuon, Deputy Director, Waste Management and Environment Division, Phnom Penh Capital Hall 2) Jakarta (5 min) Ms. Emi Pelita Fitratunnisa, Head of Environment and Cleansing Management Division, Environment Agency, Jakarta Capital City Government 3) Batam City (5 min) Mr. Rudy Satriawansyah, Department of Environment, Batam City Government 4) Semarang City (5 min) Mr. Ade Bhakti Ariawan, Head of Trans Semarang Public Service Agency, Trans Semarang Public Service Agency 5) Bali City (5 min) Mrs. Luh Ayu Aryani, Acting Head of Environment Agency, Bali Province 6) Ayeyarwady Region (5 min) Mr. Naing Lin Maung, Regional Director, Ayeyarwady Regional Government 7) Sagaing Region (5 min) Mr. Thit Htoo Myint, Director, Sagaing Division City Development Committee 8) Yangon City (5 min) Mr. Zaw Nyunt, Deputy Head of Department, Production Department, Yangon City Development Cornrnittee (YCDC)) 9) Mandalay City (5 min) Mr. Khaing Myint, Committee Member, Mandalay City Development Committee (MCDC) Q&A (5 min)
14:55	Break (15 min)
15:10	10) Quezon City (5 min) Ms. Trissha Belle S Gollayan, Environmental Management Specialist D, Environmental Protection and Waste Management Department. Quezon City, Local Government 11) Davao City (5 min) Mr. Lakandiwa Saliman Orcullo, Head of Information Education Campaign, Davao City Environment and Natural Resources Office Davao City, Government 12) Port Authority of Thailand (5 min) Mrs. Mayuree Deeroop, Scientist, Corporate Strategy Department, Port Authority of Thailand 13) Chiang Mai Province (5 分)(Ms. Pakawan Sangsree, Environmentalist Professional Level, Office for Natural Resource & Environment, Chiang Mai Provincial Office 14) Hai Phong City (5 min) Mr. Duc Anh Phung, Specialist, Hai Phong Department of Foreign Affairs 15) Ho Chi Minh City (5 min) Ms. Au Ngoc Lien, Official, Division of Solid waste management, Ho Chi Minh City, Natural Resources and Environment Department Q&A (5 min)
15:45	Break (15 min)
16:00	**Points to be Noted and Points of Adoption of Financial Supports** 1) JCM Model Project (10 min) Mr. Osamu Bannai, Manager, Financing Programme Group, Tokyo office, Global Environment Center (GEC) 2) Support for Transportation and Urban Development Projects (10 min) Mr. Tsuyoshi Kurokawa, Deputy Managing Director, Project Department, Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development 3) Funds Available for Promoting C2C Collaboration (5min) Mr. Kohei Hibino, Programme Manager, Kitakyushu Urban Centre, IGES Q&A (30 min)
16:55	**Closing Remarks** Ms. Mahoyo Yamamoto, Researcher, International Cooperation and Sustainable Infrastructure Office, MOEJ
17:45	Reception

- 14:00 Opening remarks from the organizer
  (Mr. Ryuzo Sugimoto, Director, International Cooperation and Sustainable Infrastructure Office, MOEJ)

- Reports by Participants from Asian Cities.
  - Phnom Penh City (5 minutes)

(Mr. Samnavuth Nuon, Deputy Director, Waste Management and Environment Division, Phnom Penh Capital Hall)

- ✧ Eight Areas for Low Carbon Society; Implementation of Master Plan, Eco-City Development, Urban Transport Improvement, Flood Control, Greater Water Supply, Waste Management, Climate Change Action Plan, Green City Strategic Plan 2018-2030.
- ✧ We have created a Climate Change Action Plan. We are also visiting the mayor to the City of Kitakyushu. In addition, we are working with City of Kitakyushu on waste landfill facilities and water supply improvement project.
- ✧ We are expecting citizen's awareness about waste management in the BKK 3 area as a result of city-to-city collaboration.
- ✧ We have a sister city relationship with China, Thailand, Korea and Australia and are working towards building a green city.

- ➢ Jakarta (5 minutes)

(Ms. Erni Pelita Fitratunnisa, Head of Environment and Cleansing Management Division, Environment Agency, Jakarta Capital City Government)

- ✧ We are collaborating with Kawasaki City toward the achievement of SDGs and are conducting a feasibility study on solid waste management.
- ✧ We are also spreading renewable energy through water power generation.
- ✧ While involving multiple stakeholders, capacity building of citizens will be carried out and efforts toward low carbonization will be carried out.

- ➢ Batam City (5 minutes)

(Mr. Rudy Satriawansyah, Department of Environment, Batam City Government)

- ✧ In 2015, Batam City and Yokohama City concluded a LOI towards the development of a sustainable city. City to city collaboration has six pillars; Green planning, Green water, Green buildings, Green transportation, Green waste and Green industry.
- ✧ We promote energy conservation such as airports, large buildings, stations, offices, etc.

- ➢ Semarang City (5 minutes)

(Mr. Ade Bhakti Ariawan, Head of Trans Semarang Public Service Agency, Trans Semarang Public Service Agency)

- ✧ In 2017, we exchanged LOI with Toyama City with cooperation focusing on renewable energy and transportation. In addition, we hold business matching and conferences and deepen mutual cooperation.
- ✧ As a medium-term plan, we set goals for traffic and environmental indicators in 2016-2021.
- ✧ We procure CNG tram bus using 5.3 billion rupiah budget.
- ✧ Based on city to city collaboration, we would like to promote collaboration of B2B utilizing urban public corporation in the future.
- ✧ We will also invest in the process of industrial waste disposal. There is one company that handles industrial waste, but the processing capacity is insufficient.
- ✧ We also conduct research on science and technology towards sustainability in cooperation with the University of Toyama.

- ➢ Bali City (5 minutes)

(Mrs. Luh Ayu Aryani, Acting Head of Environment Agency, Bali Province)

- ✧ Indonesia aims to reduce CO2 emissions by 26% by 2020.
- ✧ Enacted environmental protection and management law in 2009.

- ✧ There are seven priority issues in Bali. Poverty and employment, education and health, development of agriculture, sustainable development of culture, infrastructure development and environmental protection, public service, peace and fulfillment of the public sector.
- ✧ In the fuel sector of the energy sector, we plan to reduce 38.97 million tons of CO2 emission by 2020 (gasoline and diesel).

- ➢ Ayeyarwady Region (5 minutes)

  (Mr. Naing Lin Maung, Regional Director, Ayeyarwady Regional Government)

  - ✧ Under the cooperation with Fukushima City, we are promoting efforts towards low carbonization. The field is water treatment industry, reduce carbon emissions and long-term use of the energy.
  - ✧ Ayeyarwady is a large countryside area, and the electrification rate is also low.
  - ✧ Unger Construction of 1.8 MW Gross Rice Husk Fired BTG Power Plant Project. We will continue to cooperate with Fukushima City.

- ➢ Sagaing Region (5 miniutes)

  (Mr. Thit Htoo Myint, Director, Sagaing Division City Development Committee)

  - ✧ Monywa (one of industrial zones in Segaing region) generates 130 tons of solid waste every day. Currently, we transport it by truck, and discard it to three places. There is no recycling activity at Monywa TDC (Township Development Committees).
  - ✧ In the future, we would like to promote waste generation and composting, and to reduce waste utilizing advanced technology.
  - ✧ 10 MW / day of electricity is required in the Monywa area, and we believe that sufficient power can be supplied to the area if we can generate electricity utilizing rich husks in the area.

- ➢ Yangon City (5 minutes)

  (Mr. Zaw Nyunt, Deputy Head of Department, Production Department, Yangon City Development Committee (YCDC))

  - ✧ We are promoting under city to city collaboration with Kawasaki city.
  - ✧ Utilizing the JCM scheme, we have installed a waste power plant. Of the initial of 16 million USD, 8 million USD is covered with equipment subsidies. It has a processing capacity of 60 tons / day.
  - ✧ In the future, we are considering implementing waste fueling project. For example, utilizing recycling waste tires by heat recycling or material recycling.

- ➢ Mandalay City (5 minutes)

  (Mr. Khaing Myint, Committee Member, Mandalay City Development Committee (MCDC)).

  - ✧ Collaborate with Japan to develop waste management strategy and action plan.
  - ✧ 2017 - 2030 is formulated as a short-term, medium-term, long-term plan.
  - ✧ Mandalay's waste action plan for FY2018 budget formation is approved by the province and many budgets are devoted to improvement of landfill disposal site, introduction of sorting machines and treatment of hazardous waste.

- ➢ Quezon City (5 minutes)

  (Ms. Trissha Belle S Gollayan, Environmental Management Specialist D, Environmental Protection and Waste Management Department. Quezon City, Local Government)

  - ✧ Quezon and Osaka signed an MOU in April 2018 and will carry out cooperative activities for three years.

- ✧ The cooperation areas are climate change mitigation, renewable energy and energy conservation, wastewater management, water supply, solid waste management, and environmental conservation.
- ✧ As a next step, we are planning to formulate JCM guidelines in the Philippines, implement capacity building, set goals and prioritize them.

➢ Davao City (5 minutes)

(Mr. Lakandiwa Saliman Orcullo, Head of Information Education Campaign, Davao City Environment and Natural Resources Office Davao City, Government)

- ✧ We are working on the issue of solid waste as top priority.
- ✧ In cooperation with the City of Kitakyushu, we are investigating the possibility of Waste to Energy.
- ✧ We are also cooperating with JICA's grassroots Project. We are working on proper separation of municipalities in barangays (local government equivalent to wards in Japan), reduction of waste.

➢ Port Authority of Thailand (5 minutes)

(Mrs. Mayuree Deeroop, Scientist, Corporate Strategy Department, Port Authority of Thailand)

- ✧ Regarding Green Port Development, we are developing with cooperation with the City of Yokohama.
- ✧ We are proceeding in cooperation with multiple stakeholders, including introducing solar power generation and energy saving equipment at ports and surrounding areas.
- ✧ Scheduled to update MOU between Thai port and City of Yokohama.
- ✧ We would like to consider modal shift from road to port。
- ✧ We would like to reduce energy consumption at ports.
- ✧ We are struggling to involve Thai public enterprises in JCM projects. In particular, there are difficulties in the process and approval until agreement is reached, and there is concern about schedule delay.
- ✧ We would like to deepen our understanding of the JCM system of relevant parties and to advance smoothly.

➢ Chiang Mai Province (5 minutes)

(Ms. Pakawan Sangsree, Environmentalist Professional Level, Office for Natural Resource & Environment, Chiang Mai Provincial Office)

- ✧ We would like to thank the concerned parties and collaborators
- ✧ Chiang Mai is in the northern part, the second largest city after Bangkok. It is a prefecture with a scale of 190,000 people.
- ✧ Cooperation between Kitakyushu and Chiang Mai has been ongoing since 2000.
- ✧ In FY 2017 and FY 2018, city-to-city collaboration projects are carrying out and focus on waste and conduct inspections.
- ✧ As part of Thailand 4.0, Chiang Mai has been selected as a smart city development area. We would like to consider the concept of smart city.
- ✧ We are considering Chiang Mai University as a priority area of Smart City.
- ✧ 3Rs promotion among to residents is conducted.

➢ Hai Phong City (5 minutes)

(Mr. Duc Anh Phung, Specialist, Hai Phong Department of Foreign Affairs)

- ✧ Hai Phong and Kitakyushu signed a sister city agreement in 2014.
- ✧ Kitakyushu has been supported Hai Phong to develop 15 projects in “Hai Phong City Green Growth Promotion Plan”.

- ✧ We have implemented projects so far including introducing solar power generation, high efficiency air conditioning, and EV bus.
- ✧ This fiscal year, we are focusing on Eco Industrial Park and are considering to proceed. We consider that companies that are conscious of resource utilization and clean production come into the Eco Industrial Park.
- ✧ We want to develop the concept of Eco Industrial Park to other industrial parks.

➢ Ho Chi Minh City (5 minutes)

(Ms. Au Ngoc Lien, Official, Division of Solid waste management, Ho Chi Minh City, Natural Resources and Environment Department)

- ✧ We have developed a climate change action plan from 2017 to 2020.
- ✧ We are planning multiple projects to reduce CO2 emissions.
- ✧ For public transport, we would like to consider environmentally friendly, metro, BRT, bus etc.
- ✧ The problem facing is separation at the time of discharging garbage. There is a sorting guidance of Ho Chi Minh City, but because of lack of penalties regulations and not being publicized about guidance, citizens do not necessarily properly sort out.
- ✧ We also plan to sequentially implement licenses to collectors.

➢ Q&A)

- ✧ Q） Regarding Semarang City Public Transportation Bus which is JCM Project, what made you struggle to advance as a public project?
- ✧ A) We promoted the project with the third sector as a joint venture. The point that became an issue at the time of procedure is the amount of money changes. Although it is assumed that the subsidy rate at JCM is 50%, because the amount changes due to bidding, it was difficult to adjust the budget for Semarang city.

- 16:00 Points to be noted and points of adoption of financial supports

➢ JCM Model projects (10 minutes)

(Mr. Osamu Bannai, Manager, Financing Programme Group, Tokyo office, Global Environment Centre Foundation (GEC))

- ✧ There are 130 projects adopted in 17 countries.
- ✧ Introduction of low-carbon technology to the JCM signing country and reduction of CO2 will be subject.
- ✧ Japanese companies need to propose as representatives of international consortium.
- ✧ As an international consortium, it is necessary to include the representative company in Japan, equipment holders in the country, users as members as a joint venture.
- ✧ The International Consortium is obliged to report the reduction amount of CO2 for the period of legal equipment life in Japan, and it is necessary to pay attention to the fact that the international consortium will be obligated to return the subsidy if the delivery provision is violated.
- ✧ Cooperation in methodology development, project registration and credit issuance are also necessary.
- ✧ Points of adoption at the time of appraisal.
  - Certainty of performance: evaluate by taking account of management situation, actual results, business plan, licensing / approval situation, economic efficiency, business nature, appropriateness of fund planning etc.
  - For investment recovery years, subsidies are available and over 3 years are eligible for subsidization.
  - Cost-effectiveness needs to satisfy 4000 yen / ton CO2.
  - However, for sunlight in Mongolia and Thailand, 3000 yen / ton CO 2.

- Is there a possibility of introducing introduction technology and a strategy for private enterprises to autonomously spread?
- Is the CO2 reduction calculation method and monitoring appropriate?

✧ Projects with high project certainty from the perspective of project planning, structure, financing, licensing, schedule, etc. are easier to adopt, and will proceed well after adoption.

➢ Support for transportation and urban development projects (10 minutes)

(Mr. Tsuyoshi Kurokawa, Deputy Managing Director, Project Department, Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development)

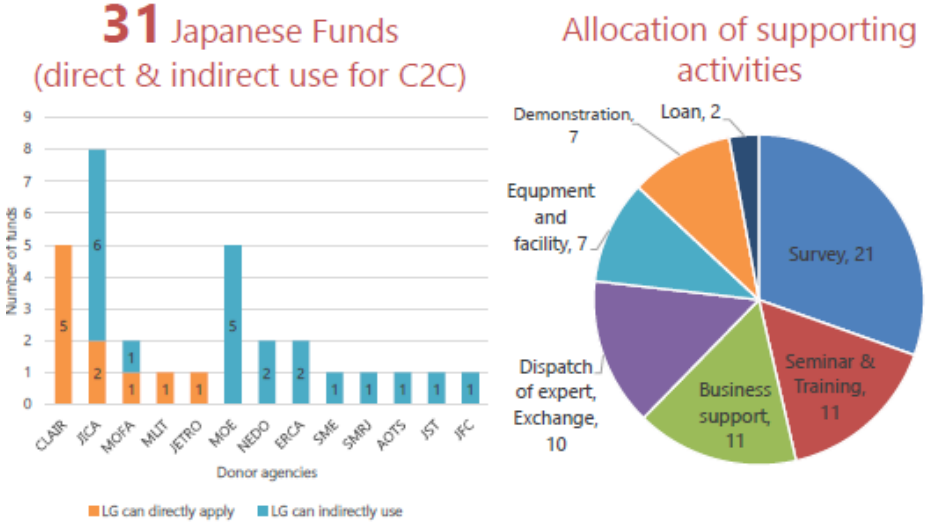
✧ JOIN（Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development）was established in October 2014, is the "first" and "only" Public-private funds in Japan, specialized in overseas infrastructure investment.
✧ JOIN is a public-private joint-stock enterprise and invests in overseas urban development projects. As an annual budget of the Japanese government, it has an investment capacity of approximately 1.3 billion US dollars (126.8 billion yen).
✧ We are hoping to promote better development in cooperation with the scheme of the Ministry of the Environment and participate in this seminar.
✧ We can participate not only in new projects but also in continuing projects.
✧ It is a major principle that Japanese companies invest in projects that are developed overseas. Participation by local companies and cooperation of local government agencies are also important.
✧ In addition to JOIN's review, JOIN's decision will require permission from the Japanese government.
✧ It will be judged on three evaluation axes: "policy significance", "private business entity's initiative" and "sustainability".
✧ Have 13 achievements. Many projects in ASEAN countries.
✧ There are also projects cooperating with JCM projects in Jakarta, Indonesia. Since it is investment, not subsidy, it is not considered as a double subsidy.

➢ Funds available for promoting C2C Collaboration (5 minutes)

(Mr. Kohei Hibino, Programme Manager, Kitakyushu Urban Centre, IGES)

✧ Refer to the distribution brochure (for Japanese local government officials). An electronic version will also be released soon.
✧ There are funds that can be utilized by related ministries and agencies. See the figure below. Funds in the execution phase such as loans and demonstration tend to be less, but we would like to consider utilization according to purpose and phase.

Japanese funds



- 16:55 Closing remarks

  (Ms. Mahoyo Yamamoto, Researcher, International Cooperation and Sustainable Infrastructure Office, MOEJ)

  - I believe that mutual communication is taking place closely, such as collaboration, needs of private enterprises, low carbon technology of Japanese companies, etc., leading to materialization.
  - I would like to engage in collaboration between cities as a trigger to project from the whole concept and mid- to long-term perspective, not from the standpoint of the project alone or a single fiscal year.

■**Friday, morning of October 26, Site visit**

Program:

<table>
<tr><th>Time</th><th colspan="4">Contents</th></tr>
<tr><td>08:30</td><td colspan="4">Departure from the Washington Hotel Participants go to the venue on foot. IGES staffs accompany.</td></tr>
<tr><td>09:00</td><td colspan="4">Overview of Yokohama City Action Plan for Global Warming Countermeasures
[Climate Change Policy Headquarters, City of Yokohama]
(Including Q&A session) Venue: TKP Garden City PREMIUM minatomirai</td></tr>
<tr><td>10:00</td><td colspan="4">Site visit Participants join one of the following groups. Buses are arranged for travelling.</td></tr>
<tr><td></td><td colspan="2">Group 1:
Hydrogen technology demonstration</td><td colspan="2">Group 2:
Green buildings</td></tr>
<tr><td></td><td>10:00</td><td>Regional Cooperation and Low-carbon Hydrogen Technology Demonstration Project
A tour of the "Hama Wing"
[Climate Change Policy Headquarters]
(Including traveling time)</td><td>10:00</td><td>Overview of the Building Energy Management System (BEMS) Project in the Yokohama City University Hospital and the Minami Ward Office Building
[Climate Change Policy Headquarters]
(Including Q&A session)
Venue: TKP Garden City PREMIUM minatomirai</td></tr>
<tr><td></td><td></td><td></td><td>10:30</td><td>BEMS Project
A tour of the Minami Ward Office building
[Housing and Architecture Bureau & Minami Ward Office, City of Yokohama]
(Including traveling time)</td></tr>
<tr><td>12:30</td><td colspan="4">Arrival at the Yokohama Sakuragicho Washington Hotel</td></tr>
</table>

- Overview of Yokohama City Action Plan for Global Warming Countermeasures
  - City of Yokohama Climate Change Measures

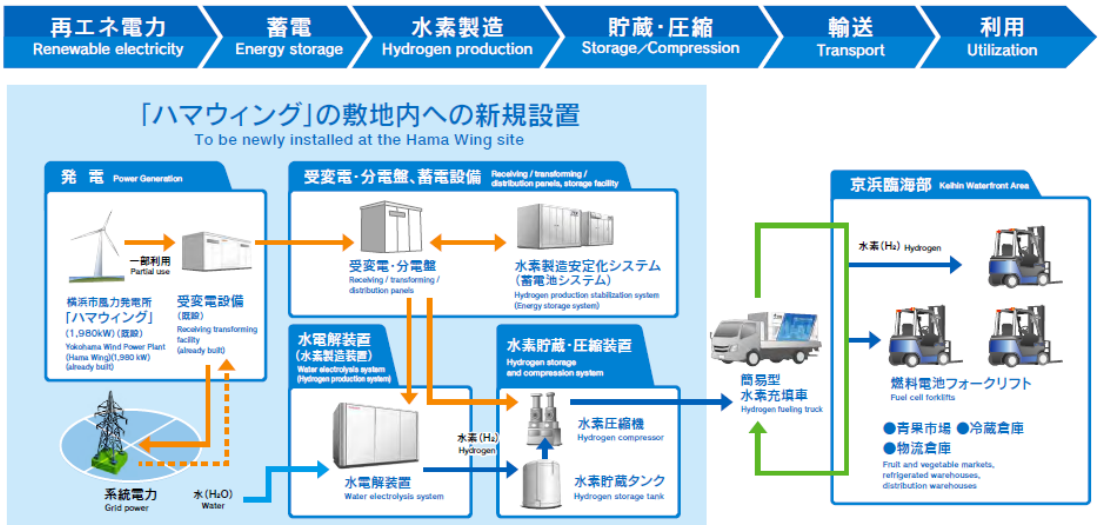
    (Mr. Suzuki, Climate Change Policy Headquarters, City of Yokohama)
    - ✧ Explain the outline and history of the City of Yokohama.
    - ✧ In Yokohama, the population rapidly increased during the period of high growth, causing problems of environmental destruction, garbage problem, road traffic, water resource problems, shortage of public land. Under such circumstances, in cooperation with citizens and business operators, we have implemented and resolved various projects.
    - ✧ As climate change, in the past 100 years rose by about 1.8 degrees. Yokohama's GHG emissions in 2016 are 18.84 million tons-CO2. As Yokohama has a population of about 3.73 million (second largest city in Japan), emissions from the household sector account for 24% compared to the whole country.
    - ✧ The city of Yokohama has set "Zero Carbon Yokohama" as a goal of countermeasures against global warming, and the three C "Choice – Creation - Collaboration" which is the strength of Yokohama of "Power of Choice" "Power of Creation" "Power of Collaboration" based on the basic policies set.
    - ✧ The goal is to reduce greenhouse gas emissions by more than 80% compared to 2013 by 2050.
    - ✧ The city of Yokohama, the only global municipality in Japan has established the Global Warming Countermeasure Headquarters and is developing global warming countermeasures activities.
    - ✧ We are also devising a financial aspect to promote the global warming project, such as by adding financial resources as a plus project to counter global warming.
    - ✧ We promote it by placing "adaptation measures" in the Yokohama's climate change adaptation policy revised in 2014.
    - ✧ We have five basic strategies: "Promotion of measures to protect the life and property of citizens", "Improvement of urban resilience", "Approach of adaptation perspective in the

policy", "A virtuous circle of the environment and the economy by promoting adaptation measures", "Promotion of collaboration between cities in Japan and overseas"

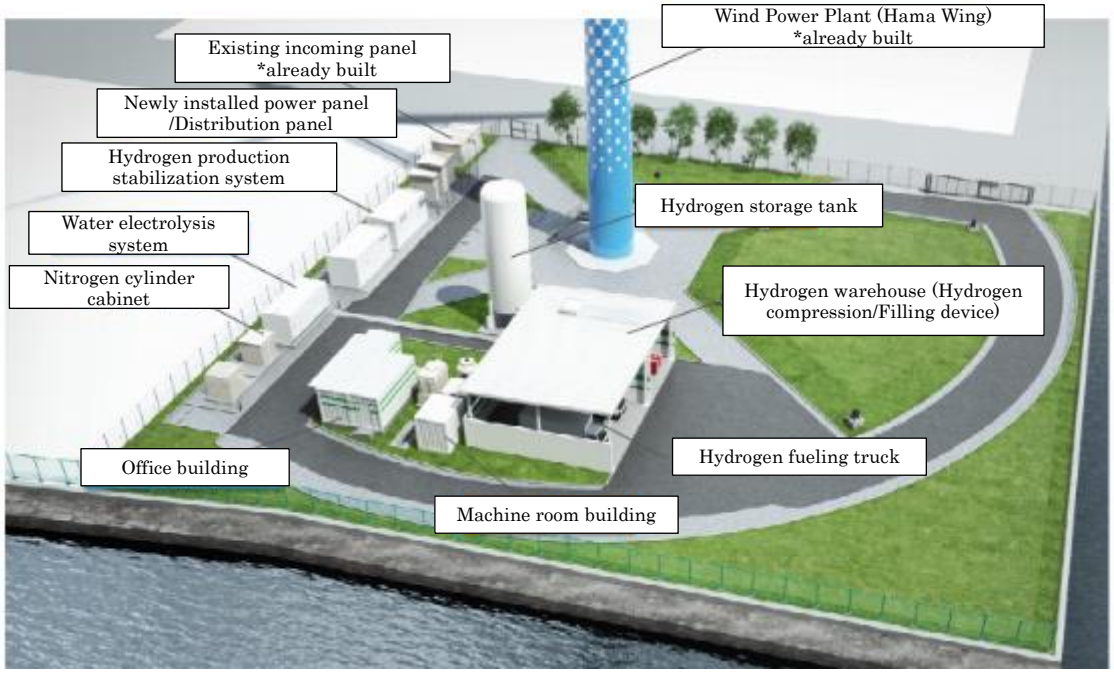
- Group 1: Hydrogen technology demonstration;

  Regional Cooperation and Low- carbon Hydrogen Technology Demonstration Project. *A tour of the "Hama Wing"* (Climate Change Policy Headquarters)

  - Overview of the project
    - ✧ In the demonstration project, a system for manufacturing, storing and compressing low-carbon hydrogen using wind power generation is installed in the Yokohama Wind Power Plant (Hama Wing) premises.
    - ✧ The hydrogen produced here was imported with a simple Hydrogen fueling truck and demonstrated Japan's first "hydrogen delivery system" to be used in fuel cell forklift introduced in Yokohama city and Kawasaki city fruit market, factory, warehouse.
    - ✧ The outline of the project is as follows. It is a trial calculation that it is possible to reduce CO2 emissions by 80% in the entire system, and this confirmation is confirmed by this demonstration.



Hama Wing Site



- Equipment outline
  - The hydrogen production stabilization system (energy storage system) is a storage system consisting of 180 used batteries (nickel metal hydride batteries) of the Toyota Prius. Electricity storage of electricity that could be generated when equipment is not working at night.
  - Water Electrolysis system: apparatus for producing hydrogen. Flexible hydrogen production that produces a large amount of hydrogen when the amount of electricity generation is large, and makes less hydrogen when it is small. Made in Toshiba.
  - Maintain the hydrogen storage tank and carry the compressed hydrogen in a Hydrogen fueling truck. This tank can store hydrogen suppliable amount of hydrogen for 12 days on 12 forklift trucks. In addition, red cards (bundled cylinders) are prepared for emergency hydrogen supply, and hydrogen which can fill 16 forklift trucks is put in a cylinder. Hydrogen packed in the curd is not generated by Hama Wing. Up to now, there has never been a shortage of hydrogen.
  - Hydrogen fueling truck: We have introduced 2 first Hydrogen fueling trucks in Japan. They are not commercially available. It is compact size that can be delivered to the factory with a small turning capacity and can store six Fuel cell forklifts. This truck itself is diesel fuel, so it is not the only carbon free in this demonstration.
  - 12 Toyota forklifts were introduced. The same fuel cells as Toyota FCV, MIRAI are introduced. Only water is discharged, it can charge in 3 minutes. Since charging is possible faster than electric, the operating efficiency has improved significantly.
  - 4 users use three forklifts at a time. They are used in Yokohama City Central Wholesale Market, Kirin Brewery Yokohama Plant, Nakamura Logistics Inc., Nichirei Logistics Group's distribution center.
  - The usage status and remaining hydrogen level are grasped in real time in the operation management center, and optimum delivery is enabled. Three people from the Iwatani Corporation are stationed. (Resident obligation is determined by law)
  - Wind power generation has an annual power generation record of 2.1 million kWh. It corresponds to 600 households of electricity supply.

- Group 2: Green buildings: Overview of the Building Energy Management System (BEMS) Project in the Yokohama City University Hospital and the Minami Ward Office Building (Climate Change Policy Headquarters)

  A tour of the "the Minami Ward Office Building" (Housing and Architecture Bureau & Minami Ward Office, City of Yokohama).

  - ✧ It was selected "Next Generation Energy and Social Systems Demonstration Area" by METI.
  - ✧ YSCP (Yokohama Smart City Project): We have been promoting many demonstration projects in collaboration with 34 business operators.
  - ✧ One of them, "Energy collaboration between Yokohama City University Medical Center and Minami Ward Comprehensive Government Building" project was introduced.
  - ✧ Although the Minami Ward Comprehensive Government Building will be a headquarters for disaster response, it has been subject to planned blackouts after the Great East Japan Earthquake and experienced confusion. We have implemented BEMS for power multiplexing and toughening and studied energy cooperation.
  - ✧ Introduced a total of five cogeneration systems. A private line is laid between the Yokohama City University Medical Center and the south ward comprehensive government building and electric power is transmitted by specific supply.
  - ✧ The cogeneration system is optimally operated automatically from the weather forecast, outside air temperature, humidity, electricity consumption, gas consumption.
  - ✧ As an effect, there are "improvement of disaster prevention", "improvement of environmental friendliness" and "improvement of economy"
  - ✧ CO2 emission reduction amount about 2400t CO2/year
  - ✧ Initial investment: approx. 700 million yen (130 million yen from the government, 10 million yen from Kanagawa prefecture)
  - ✧ Cost reduction of approximately 68 million yen/year
  - ✧ The hospital has heat demand due to sterilization and sterilization, and the heat generated in the generation system is used in the hospital.

■Photos

	
City of Kitakyushu's presentation at Open Seminar	Presentation at Closed Seminar
	
Presentation of City of Yokohama's initiatives	Site visit of Group 2
	
Reuse battery system	Site visit of Group 1

End of Minutes

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   1-1. Basic Concept of the JCM
   1-2. JCM Partner Countries
   1-3. JCM Subsidy Program
   1-4. JCM Subsidy Program by MOEJ

2. Introduction of Survey Project in Mandalay
   2-1. Background - Collaboration between Kitakyushu & Mandalay
   2-2. Overview of the Survey Project
   2-3. Organization at Implementation Phase
   2-4. Experience and Adopted Technology
   2-5. Points of Attention for Application of JCM Subsidy
   2-6. Schedule from Application to Project Implementation

1-1. Basic Concept of the JCM (Joint Crediting Mechanism)

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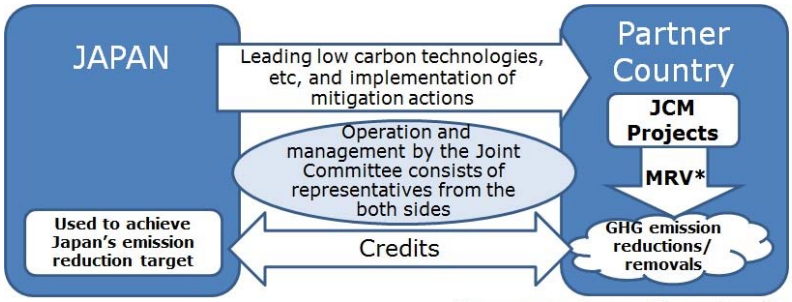
- Facilitating diffusion of leading low carbon technologies, products, systems, services and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries;
- Appropriately evaluating contributions from Japan to GHG)emission reductions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



*measurement, reporting and verification

1-2. JCM Partner Countries

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- Japan has held consultations for the JCM with developing countries since 2011 and has established the JCM with Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Lao PDR, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar, Thailand and the Philippines.

Mongolia
Jan. 8, 2013
(Ulaanbaatar)

Bangladesh
Mar. 19, 2013
(Dhaka)

Ethiopia
May 27, 2013
(Addis Ababa)

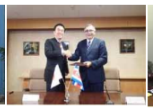
Kenya
Jun. 12,2013
(Nairobi)

Maldives
Jun. 29, 2013
(Okinawa)

Viet Nam
Jul. 2, 2013
(Hanoi)

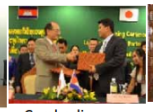
Lao PDR
Aug. 7, 2013
(Vientiane)

Indonesia
Aug. 26, 2013
(Jakarta)



Costa Rica
Dec. 9, 2013
(Tokyo)

Palau
Jan. 13, 2014
(Ngerulmud)

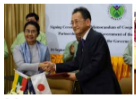


Cambodia
Apr. 11, 2014
(Phnom Penh)

Mexico
Jul. 25, 2014
(Mexico City)

Saudi Arabia
May 13, 2015

Chile
May 26, 2015
(Santiago)



Myanmar
Sep. 16, 2015
(Nay Pyi Taw)

Thailand
Nov. 19, 2015
(Tokyo)

the Philippines
Jan. 12, 2017
(Manila)

1-3. JCM Subsidy Program

The budget for projects starting from FY 2018 is 6.9 billion JPY (60 mm USD) in total by FY2020.

(1 USD = 100 JPY)

※Includes collaboration with projects supported by JICA and other governmental-affiliated financial institute.

Government of Japan

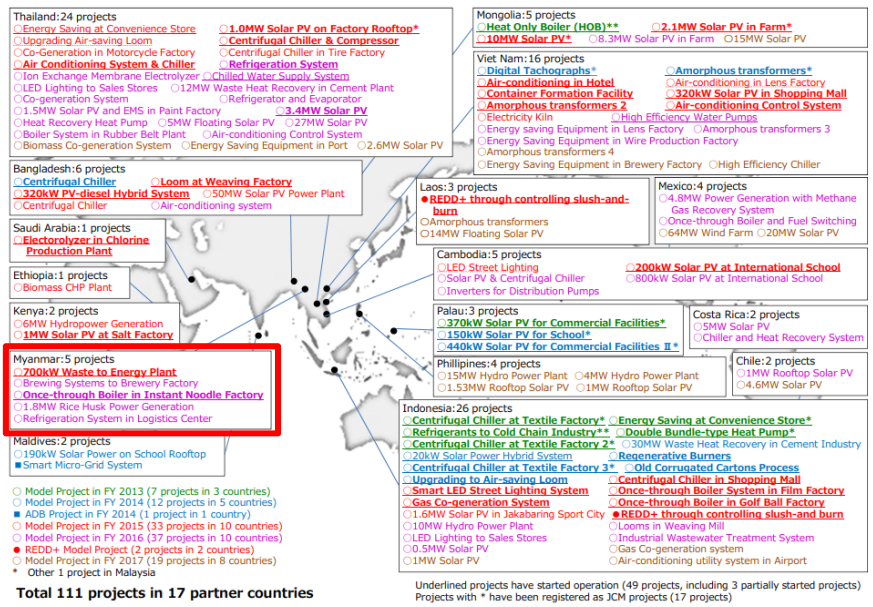
Finance part of an investment cost (**less than half**)

Conduct MRV and expected to deliver at least half of JCM credits issued

International consortiums (which include Japanese entities)

- Scope of the financing: facilities, equipment, vehicles, etc. which reduce CO2 from fossil fuel combustion as well as construction cost for installing those facilities, etc.
- Eligible Projects : starting installation after the adoption of the financing and finishing installation within three years.

1-4. JCM Subsidy Program by MOEJ (FY2013-2017)



Total 111 projects in 17 partner countries

Underlined projects have started operation (49 projects, including 3 partially started projects)
Projects with * have been registered as JCM projects (17 projects)

Source：JCM Home Page

2. Introduction of Survey Project in Mandalay

2-1. Background
- Collaboration between Kitakyushu & Mandalay

NTT DATA

City of Kitakyushu ⇔ **Further promotion of City-to-City Collaboration** ⇔ **Mandalay City**

Providing technology and experience of City of Kitakyushu, and supporting for human resource development

- **Achievements of International cooperation projects**
  （Environment and Water supply sector）
- **Collaboration with IGES－UNEP projects**
  Participate strategy-planning as specialist

Aug-2014, Mayor of Mandalay city visited Kitakyushu by JICA Partnership Program.

Jan-2017, Head of Cleansing Dep. of Mandalay city participated Workshop on Waste Management through City-to-City Collaboration by MOEJ at Kitakyushu and discussed about **「Promote City-to-City Collaboration projects」**

Promote City-to-City Collaboration on required 4 Sector .

Water & Sewerage	Environmental Protection
Energy	Waste Management

FY2018：Activities for JCM Project formulation in Energy & Waste MNG Sector.

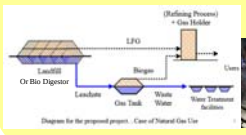
＜ Energy Sector ＞ 【NTT Data Institute of Management Consulting】

Realize project which reduce amounts of CO2 emission by introducing energy conservation equipment and solar power generation system into large facilities, and Primary industries. Moreover, conduct activity which promote economic growth so that it can contribute to solve regional poverty as a co-benefit effect.



＜ Waste Management ＞ 【EX Research Institute 】

To realize GHG emission reduction through project implementation, in which collecting biogas by high efficient bio digestor & utilizing as alternative fuel for NGV and etc.





2-2. Overview of the Survey Project

NTT DATA

Survey will be conducted about below 2 activities in energy sector, utilizing collaboration between City of Kitakyushu and Mandalay.

Activity	A) Low carbonization for relatively large facilities	B) Low Carbonization for Primary Industries
Outline	• Introduction of high-efficiency chillers, solar power generation system. • Survey on projects for smartization by utilizing distributed power supply × energy management for hotel counties in the city / off grid areas	• Introduction of high efficiency equipment into farm aquaculture business that needs temperature control and water treatment and pastoral livestock business that needs heat treatment. • Realize low carbonization and safe food supply in the primary industrial field by introducing distributed power supply x fishery / agricultural production equipment x energy saving equipment as a set
Technology	• Renewable energy (solar power generation, solar thermal utilization system) • High efficiency boiler, chiller, • Co-generation system	• Renewable energy (solar power generation, solar thermal utilization system, mini hydropower) • High efficiency pomp, generator. • Hydroponic culture

Exhaust heat recovery system

High Efficiency Chiller Unit

PV system

Hydroponic culture

2-3. Organization at Implementation Phase

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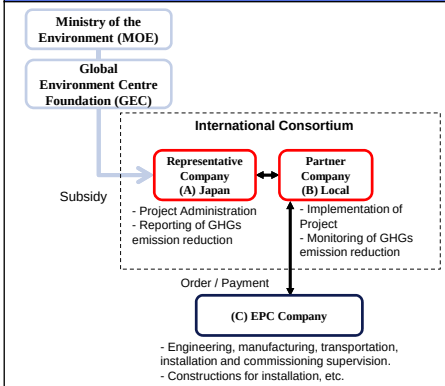
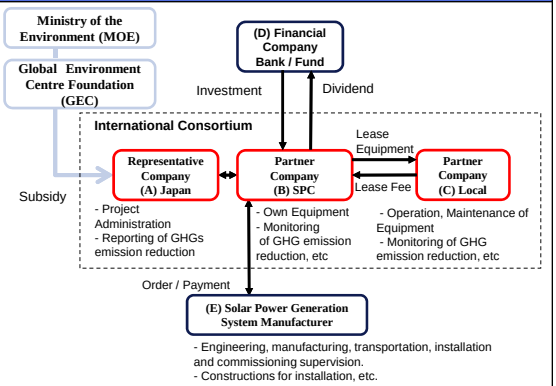
The following shows organization when the proposed activities (tentative plan) are implemented as JCM project.

(A) General Scheme



A) NTT Data Institute of Management Consulting, Inc
B) Hotel in Mandalay, Mandalay International Airport, etc.
C) Japanese chiller manufacturers (DAIKIN, HITACHI, etc.), Japanese gas engine manufacturer (KHI, Fuji electric, etc.)

(B) SPC Scheme



A) NTT Data Institute of Management Consulting, Inc
B) Establish SPC(Special Purpose Company) for each Project
C) Hotel in Mandalay, Mandalay International Airport, etc.
D) Japanese Investor
E) Japanese solar panel manufacturer (Panasonic, KYOCERA, next energy etc.), Japanese mini-micro hydro manufacture (Kawabata steel, shiebel international, etc.)

2-4. Experience and Adopted Technology (1/3)

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The following table shows adopted JCM subsidy business of NTT Data Institute of Management Consulting, Inc. (2016)

※
- (Upper) Without JCM Subsidy
- (Lower) Financed by JCM Subsidy

Partner Country	Contents / Installed System	Target technical field	Initial Investment	Expected CO2 Emission Reductions	ROI ※ (year)	IRR ※(%)
Vietnam	4.75MW Power Generation System by Waste Heat Recovery for Cement Plant	Energy production	11.1 M USD	17,592 (tCO2/y)	・6.5 ・3.9	・18 ・39
Costa Rica	5MW Solar Power Project in Belen	Energy production	10.9 M USD	2,401 (tCO2/y)	・13.5 ・8.1	・2.6 ・9.9
Costa Rica	High Efficiency Chiller and the Exhaust Heat Recovery System in Hotel	Energy conservation	1.2 M USD	401 (tCO2/y)	・6.1 ・3.0	・10.2 ・30.6
Mexico	4.8MW Power Generation with Methane Gas Recovery System	Waste	15.3 M USD	17,180 (tCO2/y)	・9.7 ・5.8	・8.6 ・18.2
Thailand	12MW Power Generation System by Waste Heat Recovery for Cement Plant	Energy production	6.7 M USD	31,180 (tCO2/y)	・4.6 ・3.0	・20 ・33

2-4. Experience and Adopted Technology (2/3)

NTT DATA

Ex-1. Solar Power

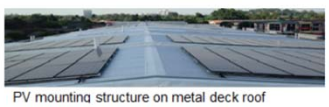
MODEL PV power generation system for the office building

PP from Japan : NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc / PP from host Country: KEN TTDI SDN BHD

Outline of GHG Mitigation Activity

The PV panels installed on the top of building roof in Kuala Lumpur, Malaysia will generate electricity power and contribute to CO2 reduction.
The solar cell is made of a thin monocrystalline silicon wafer surrounded by ultra-thin amorphous silicon layers. This product offers the industry's leading performance and value; 19.4% conversion ratio. The electricity amount generated on solar panel will be monitored and managed in the data management server.

an example of Installation work of PV



PV mounting structure on metal deck roof

Expected GHG Emission Reductions

179 tCO_2/year

- (RE_p – PE_p) = (The generated electricity of solar power × Emission factor(EF)) - 0 RE_p : Reference CO_2 emissions period $_p$ ($tCO_2/_p$) PE_p : Project CO_2 emissions period $_p$ ($tCO_2/_p$) EF : CO emission factor for Malaysia region = 0.000741(tCO_2/kWh)

Sites of JCM Model Project

Source：JCM HP

2-4. Experience and Adopted Technology (3/3)

NTT DATA

Ex-2. High Efficiency Air-conditioning (Vietnam, 2015)

MODEL Introduction of High Efficiency Air-conditioning in Hotel

PP(Japan): NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc.
PP(Vietnam): Peace Real Estate Investment Company Limited

Outline of GHG Mitigation Activity

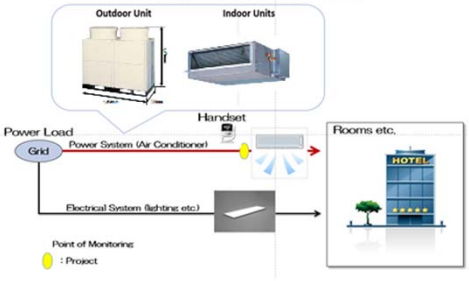
While non-inverter air conditioner with poor energy efficiency is popular in hotels in Vietnam, this project is intended to achieve the energy saving as a whole with the introduction of high efficiency air-conditioning system, which is introduced to the new Novotel Suites in Hanoi (total floor area of about 29,000㎡, 17 floors above ground, two floors underground, 200 rooms), and achieves GHG emission reductions from reducing power consumption with introduction of high efficiency air-conditioning.
(Equipment performance : COP 4.53, 73.0kW x 1set, COP4.09, 90kW x 12set, COP4.05, 95.0kW x 2set, COP3.29, 109kW x 1set, COP3.27. 125kW x 1set)

Expected GHG Emission Reductions

826 tCO_2/ year

Calculated based on the electricity consumptions of non-inverter air conditioner and project air-conditioner as well as grid emission factor in Vietnam (3,412tCO_2/year - 2,586tCO_2/year = 826tCO_2/year).

<Introducing of Inverter Air Conditioner>



Source：JCM HP

2-5. Points of Attention for Application of JCM Subsidy

NTT DATA

1. Upper Limit of Subsidy Rate

- **Subsidy rate changes depending on the contents of the project and country.**

Adoption number of similar technology in the country to implement the project	0 (first case)	From 1 to 3	Over 4
Subsidy late	**Maximum 50 %**	**Maximum 40%**	**Maximum 30%**

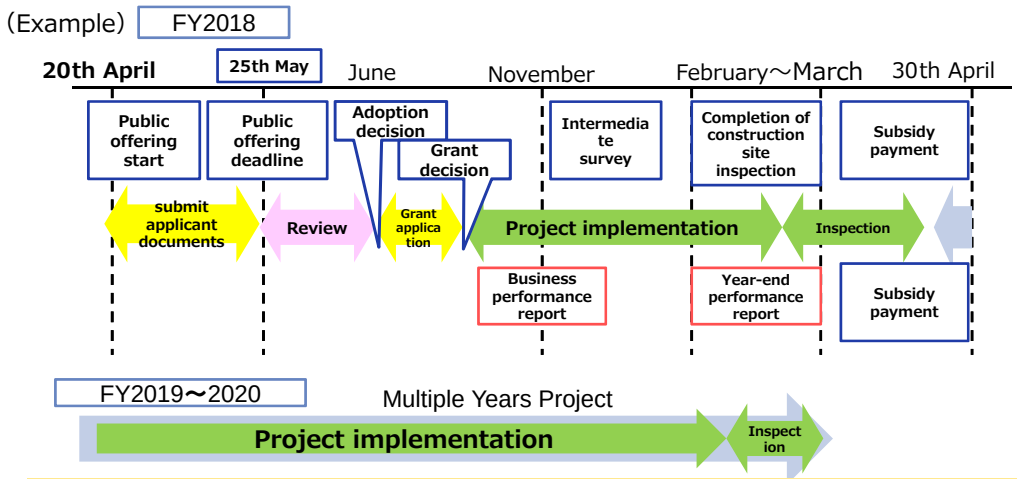
2. Cost-Effectiveness and Payback Period

2 points to be checked to get subsidy.

1. Cost-effectiveness should be less than 4000JPY/t-CO2 (approx. 40USD/t-CO2) (subsidy vs amount of reduced CO2)

2. Payback period
- **Payback period should be longer than three years.**

2-6. Schedule from Application to Project Implementation



- **Grant application is needed from the adoption unofficial within 3 months.**
- **pay estimate to the end of each FY year, the settlement payment in the final year**

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Global IT Innovator

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NTT DATA

1. Introduction of our company
2. Introduction of JCM
3. Case Study
4. Outline of project this year (Potential project)
5. Supplementary information of JCM

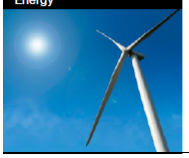
1. Introduction of our company

NTT DATA

Corporate outline

Name	NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc.
Date of Establishment	April 12, 1991
Shareholder	NTT DATA Corporation 100%
Capital	¥450 million
Head Office	10th floor, JA Kyosai Building, 7-9, Hirakawa-cho 2-chome, Chiyoda-ku, Tokyo 102-0093, Japan Tel +81-3-3221-7011 (main number) Fax +81-3-3221-7022
Office Toyosu	25th floor, Toyosu Center Building, 3-3, Toyosu 3-chome, Koto-ku, Tokyo 135-6025, Japan Tel +81-3-3221-7011 (main number) Fax +81-3-3534-3880
Office Singapore Branch	20 Pasir Panjang Road, #11-28 Mapletree Business City, Singapore 117439
URL	http://www.keieiken.co.jp/english/

Society, Environment and Energy



The environmental and energy sectors continue to be the scene of dynamic developments exemplified by the revision of energy policy, approaches to global warming, and recycling of dwindling resources. They also hold much promise for industrial activity. We promote client approaches through activities including support for smart community development, assistance with export of infrastructural elements, and creation of new business by private-sector consortiums.

- Development of environmental business and environmental management
- Social and environmental communication
- Building of recycling-oriented social systems
- Measures to mitigate global warming
- New energy and energy conservation
- Systems for assurance of safety/security and management of chemical substances
- Smart communities
- Infrastructural export

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1. Introduction of our company
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2-1. Basic Concept of the JCM (Joint Crediting Mechanism)

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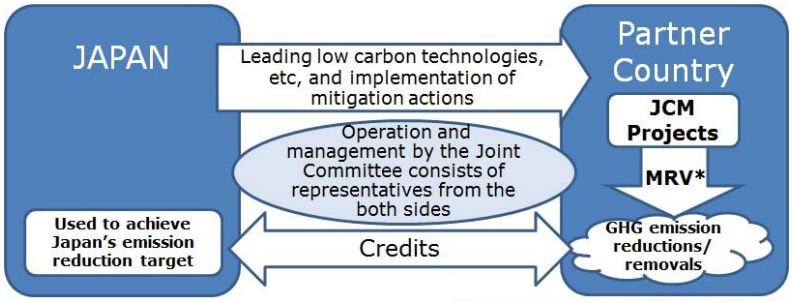
- Facilitating diffusion of leading low carbon technologies, products, systems, services and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries;
- Appropriately evaluating contributions from Japan to GHG)emission reductions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



*measurement, reporting and verification

2-2. JCM Partner Countries

NTT DATA

- Japan has held consultations for the JCM with developing countries since 2011 and has established the JCM with Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Lao PDR, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar, Thailand and the Philippines.

Mongolia
Jan. 8, 2013
(Ulaanbaatar)

Bangladesh
Mar. 19, 2013
(Dhaka)

Ethiopia
May 27, 2013
(Addis Ababa)

Kenya
Jun. 12,2013
(Nairobi)

Maldives
Jun. 29, 2013
(Okinawa)

Viet Nam
Jul. 2, 2013
(Hanoi)

Lao PDR
Aug. 7, 2013
(Vientiane)

Indonesia
Aug. 26, 2013
(Jakarta)

Costa Rica
Dec. 9, 2013
(Tokyo)

Palau
Jan. 13, 2014
(Ngerulmud)

Cambodia
Apr. 11, 2014
(Phnom Penh)

Mexico
Jul. 25, 2014
(Mexico City)

Saudi Arabia
May 13, 2015

Chile
May 26, 2015
(Santiago)

Myanmar
Sep. 16, 2015
(Nay Pyi Taw)

Thailand
Nov. 19, 2015
(Tokyo)

the Philippines
Jan. 12, 2017
(Manila)

2-3. JCM Subsidy Program

NTT DATA

The budget for projects starting from FY 2018 is 6.9 billion JPY (60 mm USD) in total by FY2020.

(1 USD = 100 JPY)

※Includes collaboration with projects supported by JICA and other governmental-affiliated financial institute.

Government of Japan

Finance part of an investment cost (**less than half**)

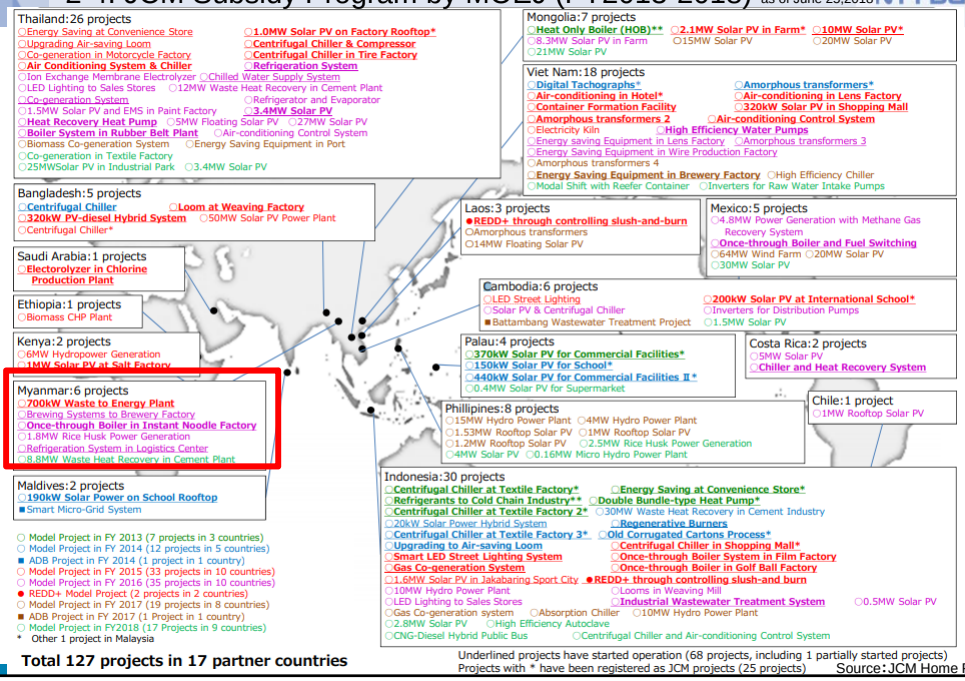
Conduct MRV and expected to deliver at least half of JCM credits issued

International consortiums (which include Japanese entities)

- Scope of the financing: facilities, equipment, vehicles, etc. which reduce CO2 from fossil fuel combustion as well as construction cost for installing those facilities, etc.
- Eligible Projects : starting installation after the adoption of the financing and finishing installation within three years.

2-4. JCM Subsidy Program by MOEJ (FY2013-2018) as of June 25,2018

NTT DATA



Total 127 projects in 17 partner countries

Underlined projects have started operation (68 projects, including 1 partially started projects)
Projects with * have been registered as JCM projects (25 projects) Source:JCM Home Page

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3-1.Experience of JCM related Projects(1/2)

◆Industrial Sector

NO	Outline of Activity	Purpose	Phase
1	Installation of Co-generation System into the Factory and Industrial Estate (Indonesia, Vietnam)	Reduce CO2 Emission & Energy Cost	Study
2	Installation of Economizer for the Existing Boiler in Factory (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
3	Installation of Exhaust Heat Recovery & Electricity Generation System into the Existing Cement Factory (Vietnam and Thailand)	Reduce CO2 Emission & Energy Cost	Study, Implementation
4	Replacement or Installation of Saving Energy Type of Electrical Furnace into Casting Companies (Vietnam)	Reduce CO2 Emission & Energy Cost	Implementation
5	Installation of Electricity Generation System using Rice Husk (Indonesia)	Reduce CO2 Emission & Energy Cost	Study
6	Installation of Solar Electricity Generation System on the Roof of the Existing Cold Storage Warehouse (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
7	Replacement of Existing Lighting System into LED Lighting System (Indonesia)	Reduce CO2 Emission & Energy Cost	Implementation
8	Changing Fuel Type from Oil to Natural Gas in a Factory (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
9	Installation of Mini-hydro Electricity Generation System in Isolated Area (Kenya and Ethiopia)	Reduce CO2 Emission & Energy Cost	Implementation
10	Installation of Mega Solar Electricity Generation System (Costa Rica)	Reduce CO2 Emission & Energy Security Increase	Implementation
11	Installation of Landfill Gas Recovery & Electricity Generation System (Mexico)	Reduce CO2 Emission & Energy Cost	Implementation

3-1. Experience of JCM related Projects(2/2)

NTT DATA

◆Commercial Sector

No	Outline of Activity	Purpose	Phase
1	Replacement or Installation of Saving Energy Type of Chiller or Air-conditioning System into Hotel, Commercial Building and Shopping Mall (Indonesia, Vietnam, Cambodia, Costa Rica)	Reduce CO2 Emission & Energy Cost	Implementation
2	Installation of Mini Co-generation System into Hotel (Indonesia)	Reduce CO2 Emission & Energy Cost	Study
3	Replacement of Refrigerated Show Case into Saving Energy Type (Vietnam)	Reduce CO2 Emission & Energy Cost	Study
4	Replacement of Air-conditioning System, Lighting System and Refrigerated Show Case of Convenience Store into Saving Energy Type (Vietnam, Thailand)	Reduce CO2 Emission & Energy Cost	Implementation
5	Installation of Solar Electricity Generation System on the Roof of the New Building (Malaysia, Thailand), Hospital (Cambodia) , Shopping Mall (Vietnam) and university (Chile)	Reduce CO2 Emission & Energy Cost	Implementation, Study
6	Introduction of EV Bus & Solar Electricity Generation System with Funding Mechanism in an Isolated Island (Vietnam)	Keep Environment and Reduce CO2 Emission	Study
7	Installation of Solar System & Saving Energy Equipments into the Existing School, Building and Hotel, using Environmental Fund & ESCO + Leasing System (Costa Rica)	Reduce CO2 Emission & Energy Cost	Study

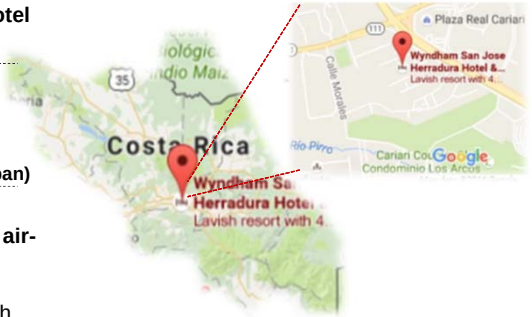
3-2. Case Study
① Costa Rica ~Project Overview~

NTT DATA

Introduction of the High Efficiency Chiller and the Exhaust Heat Recovery System

Place	**Wyndham San Jose Herradura Hotel (San Jose, Costa Rica)**
Adapted Technology	**1.High Efficiency Chiller (Daikin, Japan)** **2. Exhaust Heat Recovery system Templifier (water heater)(Daikin, Japan)**
Outline of Project	This project aims to improve the energy efficiency of a luxury hotel's **air-conditioning system & hot water supply system** by replacing the existing centrifugal chiller with a high efficiency chiller and existing heavy oil boilers with a water heater utilizing the waste heat from the chiller.

Initial Investment	WithOut Subsidy	**1.137mm USD**	With Subsidy	**0.568 mm USD**
Pay Back		**6.08 year**		**3.04 year**
IRR		**10.2%**		**30.6%**



Nos. Room : 229
Floor : 4

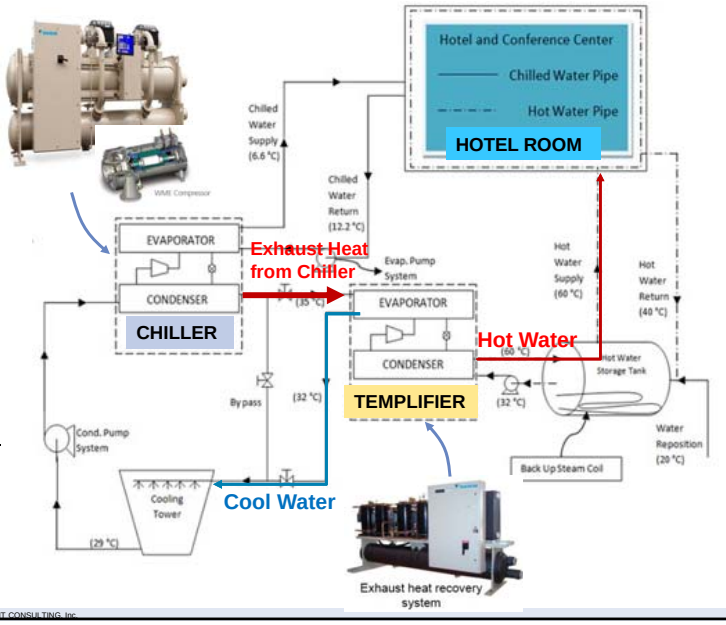
3-2. Case Study
① Costa Rica ~System Overview~

NTT DATA

System image to be introduced

The high efficiency chiller (Daikin WMC400DC)
- Low operating noise (76dBA),
- Easy Maintenance (optimized control through digital)
- Improve the energy efficiency of up to 40% compared to a standard centrifugal chiller
- Restart in as little as 43 seconds after a power restoration.

The high efficiency exhaust heat recovery water heater (Daikin Templifier TGZ060B) can supply hot water and heating, and also be utilized for cooling the cooling tower by combining with the chiller.



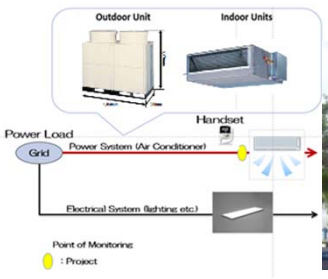
3-2. Case Study
②Vietnam ~Project Overview~

NTT DATA

Introduction of the High Efficiency Inverter Air Conditioner

Place	**Novotel Suites Hanoi (Hanoi, Vietnam)**
Adapted Technology	**Inverter Air Conditioner (Daikin, Japan)** • **78.3 kW ✕ 1 set** • **95.9 kW ✕ 16 set** • **114 kW ✕ 1 set**
Outline of Project	This project aims to achieve the energy saving by introducing high efficiency air-conditioning system. In hotels in Vietnam, non-inverter air conditioner with poor efficiency is popular.

Initial Investment	WithOut Subsidy	**0.946mm USD**	With Subsidy	**0.473 mm USD**
Pay Back		**12.6 year**		**6.3 year**
IRR		**0.42%**		**12.35%**



Nos. Room : 200
Floor : 17

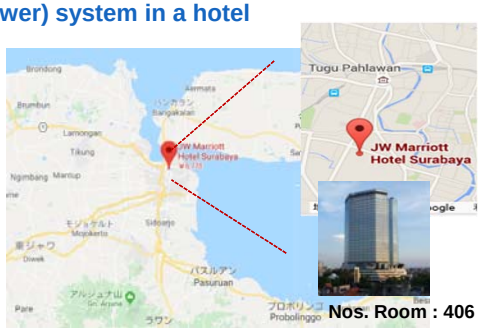
3-2. Case Study
③ Indonesia ~Project Overview~

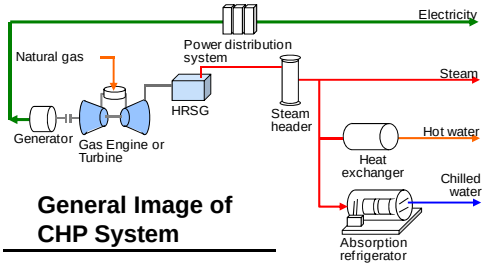
NTT DATA

Installation of CHP (Combined Heat and Power) system in a hotel

Place	**JW Marriot Hotel Surabaya (Surabaya, Indonesia)**
Adapted Technology	**Co-generation system (1,200kWh, Gas Engine) (2G Energy, German)**
Outline of Project	This project aims to confirm the cost and CO2 emission reduction, and to secure an independent power source by installing a CHP system consisting of boiler at a hotel.

	WithOut Subsidy	With Subsidy
Initial Investment	**2.73 mm USD**	**1.36 mm USD**
Pay Back	**8 year**	**4 year**
IRR		**24.2%**



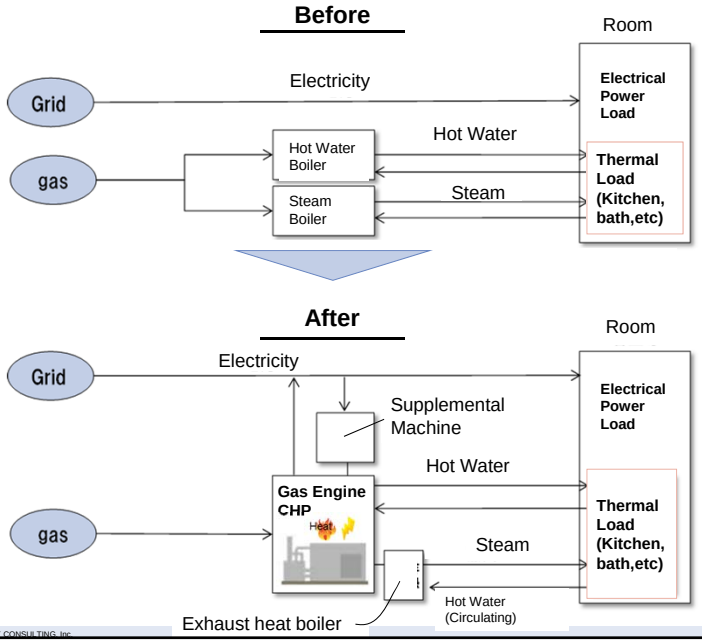


General Image of CHP System

3-2. Case Study
③ Indonesia ~System Overview~

NTT DATA

By introducing a cogeneration system, to generate power and steam at the same time, and the amount of electric power is reduced as well as the natural gas that was been consumed in the hot water and steam boilers.



3-3. Project Implementation Structure

NTT DATA

Organization

Japan Government Ministry of the Environment (MOE)

Global Environment Centre Foundation (GEC)

Subsidy

Funds
MGM Sustainable Energy Fund

➢Equity Investmend

International Consortium

Representative Company
NTT Data Institute of Management Consulting, Inc.

➢ Project Administration
➢ MRV for GHG emission reduction
➢ Preparation of PDD, Registration of Project, etc

Consortium Agreement

Partner Company
SPV for Leasing

➢ Implementation of Project
➢ Monitoring of GHG emission reduction, etc

Consortium Agreement

Partner company
Hotel / Electricity Utility

➢ Implementation of Project
➢ Monitoring of GHG emission reduction, etc

EPC Contractor

➢ EPC,Operation, Maintenance, etc.

3-4. (Reference) ESCO business model

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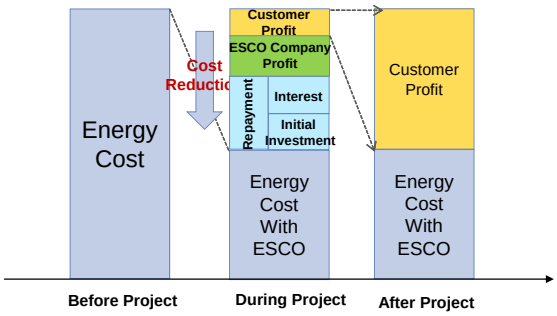
What Is the ESCO Business?

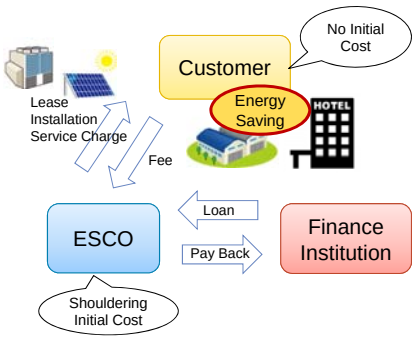
- A business that offers comprehensive services on energy conservation to clients, who in return will offer a part of their energy saving gains (saving on utility bill, etc.)
- The business has two forms:
  - "Guaranteed savings agreement" … customers cover business costs.
  - "Shared savings agreement" … ESCO business covers business costs.

  These options enable service provision according to customer needs.

Overview of the ESCO business



Shared Saving Agreement



Source: The Energy Conservation Center, Japan

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4-1. Background - Collaboration between Kitakyushu & Mandalay

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City of Kitakyushu ⇔ **Further promotion of City-to-City Collaboration** ⇔ **Mandalay City**

Providing technology and experience of City of Kitakyushu, and supporting for human resource development

- **Achievements of International cooperation projects** (Environment and Water supply sector)
- **Collaboration with IGES－UNEP projects**

Participate strategy-planning as specialist

Aug-2014, Mayor of Mandalay city visited Kitakyushu by JICA Partnership Program.

Jan-2017, Head of Cleansing Dep. of Mandalay city participated Workshop on Waste Management through City-to-City Collaboration by MOEJ at Kitakyushu and discussed about **「Promote City-to-City Collaboration projects」**

Promote City-to-City Collaboration on required 4 Sector .

Water & Sewerage	Environmental Protection
Energy	Waste Management

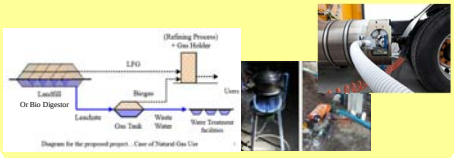
FY2018 : Activities for JCM Project formulation in Energy & Waste MNG Sector.

< Energy Sector > 【NTT Data Institute of Management Consulting】

Realize project which reduce amounts of CO2 emission by introducing energy conservation equipment and solar power generation system into large facilities, and Primary industries. Moreover, conduct activity which promote economic growth so that it can contribute to solve regional poverty as a co-benefit effect.

< Waste Management > 【EX Research Institute 】

To realize GHG emission reduction through project implementation, in which collecting biogas by high efficient bio digester & utilizing as alternative fuel for NGV and etc.



4-2. Outline of Project this year

NTT DATA

We would like to find out a potential project fit for JCM.
Our activity is as below.

	Selection of Candidate Site	Discussion	Diagnosis	Proposal & Discussion	JCM Project
Activity	• Based on Kitakyushu-Mandalay Collaboration, we would like to find out the potential site & company	• Explanation of JCM Scheme and proposed the research for energy saving	• Energy Diagnosis (Cellection of the existing Energy data) • Based on the Energy Diagnosis result, proposed saving energy action using JCM Scheme	• Contacted with manufacturer based on diagnosis result • Manufacturer prepared proposal • Proposal was submitted to Owner • Prepared implementation structure	• Applied for JCM subsidy program • Starting Project

4-3. Overview of the Survey Project

NTT DATA

Survey will be conducted about below 2 activities in energy sector, utilizing collaboration between City of Kitakyushu and Mandalay.

Activity	A) Low carbonization for relatively large facilities	B) Low Carbonization for Primary Industries
Outline	• Introduction of high-efficiency chillers, solar power generation system. • Survey on projects for smartization by utilizing distributed power supply × energy management for hotel counties in the city / off grid areas	• Introduction of high efficiency equipment into farm aquaculture business that needs temperature control and water treatment and pastoral livestock business that needs heat treatment. • Realize low carbonization and safe food supply in the primary industrial field by introducing distributed power supply x fishery / agricultural production equipment x energy saving equipment as a set
Technology	• Renewable energy (solar power generation, solar thermal utilization system) • High efficiency boiler, chiller, • Co-generation system	• Renewable energy (solar power generation, solar thermal utilization system, mini hydropower) • High efficiency pomp, generator. • Hydroponic culture


Exhaust heat recovery system


High Efficiency Chiller Unit


PV system


Hydroponic culture

4-4. Assumed Project (1/2)

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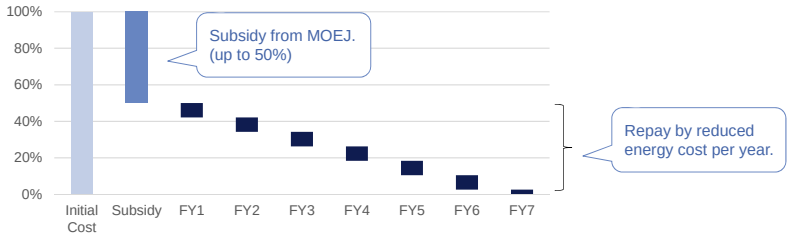
Points ：**Project Scale is required.**

✓ To apply JCM subsidy, project scale is required over 1.0 mm USD.(indication)

✓ Initial Investment is repay by the reduced energy cost.



✓ Hotels in Mandalay is medium-small size. However, if several hotels corporate, project scale can be increase.

4-4. Assumed Project (2/2)

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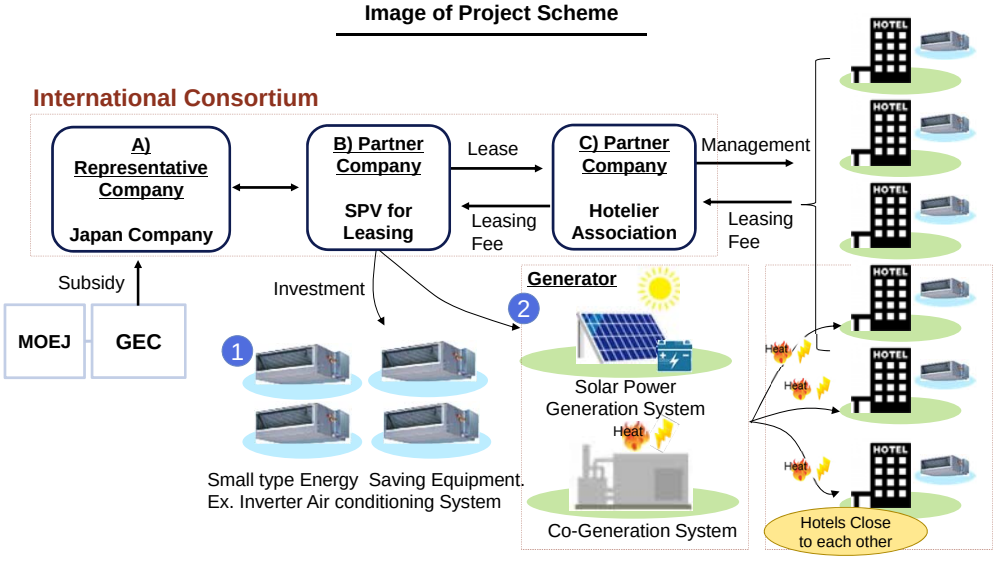
Image of Project Scheme



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2-5. Points of Attention for Application of JCM Subsidy

1. Upper Limit of Subsidy Rate

- **Subsidy rate changes depending on the contents of the project and country.**

Adoption number of similar technology in the country to implement the project	0 (first case)	From 1 to 3	Over 4
Subsidy late	**Maximum 50 %**	**Maximum 40%**	**Maximum 30%**

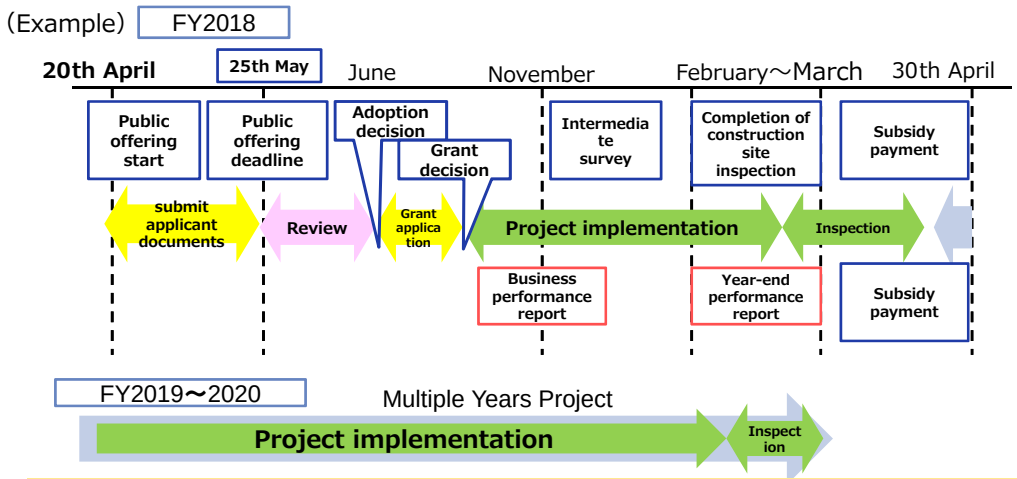
2. Cost-Effectiveness and Payback Period

2 points to be checked to get subsidy.

1. Cost-effectiveness should be less than 4000JPY/t-CO2 (approx. 40USD/t-CO2) (subsidy vs amount of reduced CO2)

2. Payback period
- **Payback period should be longer than three years.**

2-6. Schedule from Application to Project Implementation



- **Grant application is needed from the adoption unofficial within 3 months.**
- **pay estimate to the end of each FY year, the settlement payment in the final year**

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