FY2017 Project for Ministry of the Environment Japan

FY2017

FY2017 City to City Collaboration Program for the Realization of Low-Carbon Society

(Project for the Development of Low Carbonization in Mandalay Region, through Introduction of Saving Energy Technologies and Renewable Energies
〔Kitakyushu City- Mandalay City Collaboration Project〕)

Report

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Kitakyushu Asia Center for Low Caron Society

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Contents

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

1) Feasibility study of JCM subsidized projects

Conduct the feasibility study of JCM subsidized projects in 2 fields (1)introducing saving energy and PV (Photovoltaic) technology into large buildings, commercial buildings, hospitals, etc (PV building energy saving project group); (2) introducing power generation systems using biomass such as rice husk, cattle stools, etc (biomass project group) as below. Specific survey contents are presented in items a)～d).

<Introducing energy saving and renewable energy technologies in facilities>

- Promote large-scale buildings to switch to low carbon operation mechanism
- Promote the application of renewable energy-based energy distribution systems

＜Introducing biomass system＞

- Promote the switch to low carbon operation mechanism by utilizing agricultural residues such as rice hulls, etc.
- Promote the introduction of animal waste and excrement based energy distribution systems

a) Consideration of applied techniques

Consider technical content to be applied, efficiency of CO2 reduction, cost-effectiveness of JCM support, economic viability of the project, MRV methodology.For projects that require approval of the government such as power projects, investigate and consider procedures of applying for licenses.

b) 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 collective, consider the project implementation collective and the form of contracting.

c) Consideration of capital mobilization methods

Consider capital mobilization methods to implement the project such as self-financing, external loans, leasing equipment, etc

d) Consideration of project implementation schedule

Coordinate with the representative investor, the joint investor and the partner enterprise to determine the JCM project implementation schedule.

2) Select other priority fields related to the shift to low carbon, environmental protection mechanism.

Survey local demands in non-energy fields, select necessary priority fields to shift to the low carbon, environmental protection mechanism in Mandalay city.

3) 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.

4) 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.

5) Previous discussion in workshops held at places surveyed by the province, city government of Japan

To hold a field workshop, we will discuss in advance with related parties in Japan (Kitakyushu city as expected) for twice/year. In advance discussions, the parties will discuss about dates of workshops, workshop themes, agenda, attendees, proposals submitted to the government of Mandalay city, preparation work before each workshop, etc

6) 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

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

We participate in city-to-city linkage workshops held in Japan to further study through linkage projects between cities organized by other entities or presentations related to JCM and we will also talk about the implementation progress of this project (implemented in Kawasaki and Tokyo)

(3) Implementation time

From 24 April 2017 to 28 February 2018

(4) Survey organizations

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

Table 1.1.1 Implementation organizations

Name of organization	Role
Kitakyushu city	- Adjust talks with Mandalay City Development Committee (MCDC) - Name of workshop
Nikken Sekkei Civil	- Survey for the development of a JCM subsidized project (biomass project group) ＋Promote the shift to low carbon operation mechanism by utilizing agricultural residues such as rice hulls, etc. + Promote the introduction of animal waste and excrement based energy distribution systems - Organization of workshops - Summary of this work.
NTT DATA Institute of Management Consulting	- Survey for the development of a JCM subsidized project (PV building energy saving project group) ＋Promote large-scale buildings to shift to low carbon operation mechanism ＋Promote the application of renewable energy-based energy distribution systems

1.2 Background of work

In this part, we adjust the overview part of Mandalay city, the energy project of Mandalay city, the cooperation relationship between Kitakyushu City and Mandalay City.

1.2.1 Overview of Mandalay city

Mandalay city is the capital of Mandalay region with population of 1.28 million people (see figure 1.2.1.1), former capital of the last reign (Konbaung reign).So far, the city remains a city with 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.The table shows an overview of Mandalay city.

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.

Table 1.2.1.1 Overview of Mandalay city

Item	Content
Classification of city	Capital of Mandalay region (the 2nd largest city in Myanmar)
Population/area	Approximately 1.28 million people (2013)/approximately 314.7m^2
Overview of the city	- This was the capital of Myanmar’s last reign (Konbaung regin:1860～1885) and now Old palace is still located in the center of the city.Mandalay Hill is 236 meters above sea level in the northeastern part of the Old Palace, the whole hill was formerly a pagoda and the supreme sanctuary of Mandalay. On the way to the top of the hill, there are, in addition to buddhist towers, also many buddhist temples or towers built along the stairs. - This is an economic, commercial center in the north central of Myanmar which is closely linked to northern China.In the suburb areas, there is an international airport of Mandalay, which provides access to Bangkok, Kunming, Singapore, etcFurthermore, Mitsubishi Shoji Corporation and JALUX are involved in the operation of the airport. - In Konbaung period, this area was concentrated by many craftsmen such as weaving or carving, so the traditional craft industry is still very developed. - In the south of the city, there is Mandalay industrial zone (1,820 acres) with beverage factories, chemical plants, steel plants, etc which have the highest power consumption. - There are few Japanese enterprises who invest in this city such as Komatsu construction equipment repair plant or Yamaha bike dealer. In contrast, there are many Chinese companies investing here.

＜Mandalay region＞

Urban areas	Region
Population	Approx. 6.166million people (2014)[1]
Area	Approx.29,954km^2 (2016)[1]

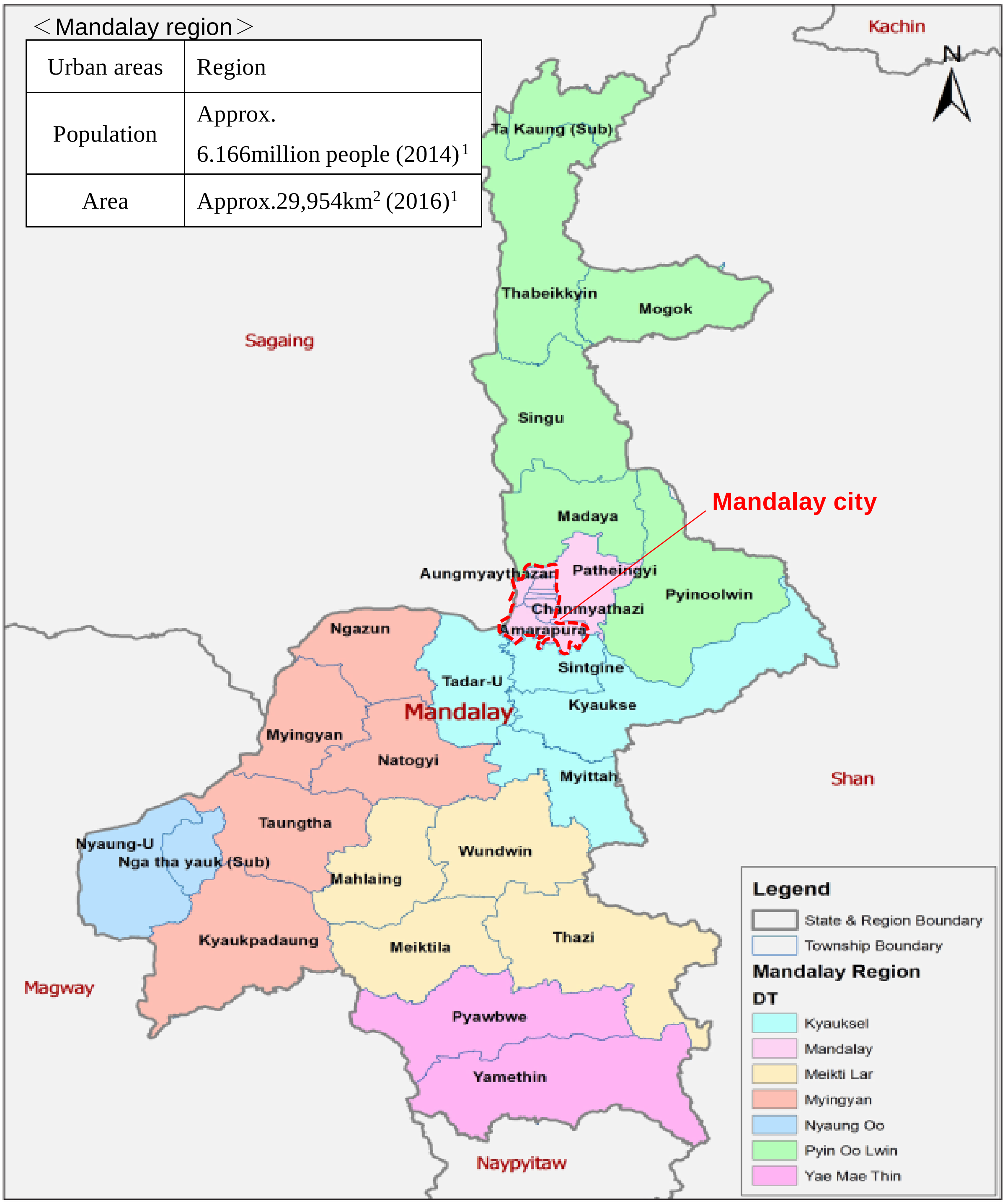

Figure 1.2.1.1 Overview map of Mandalay region, location map of Mandalay city[2]

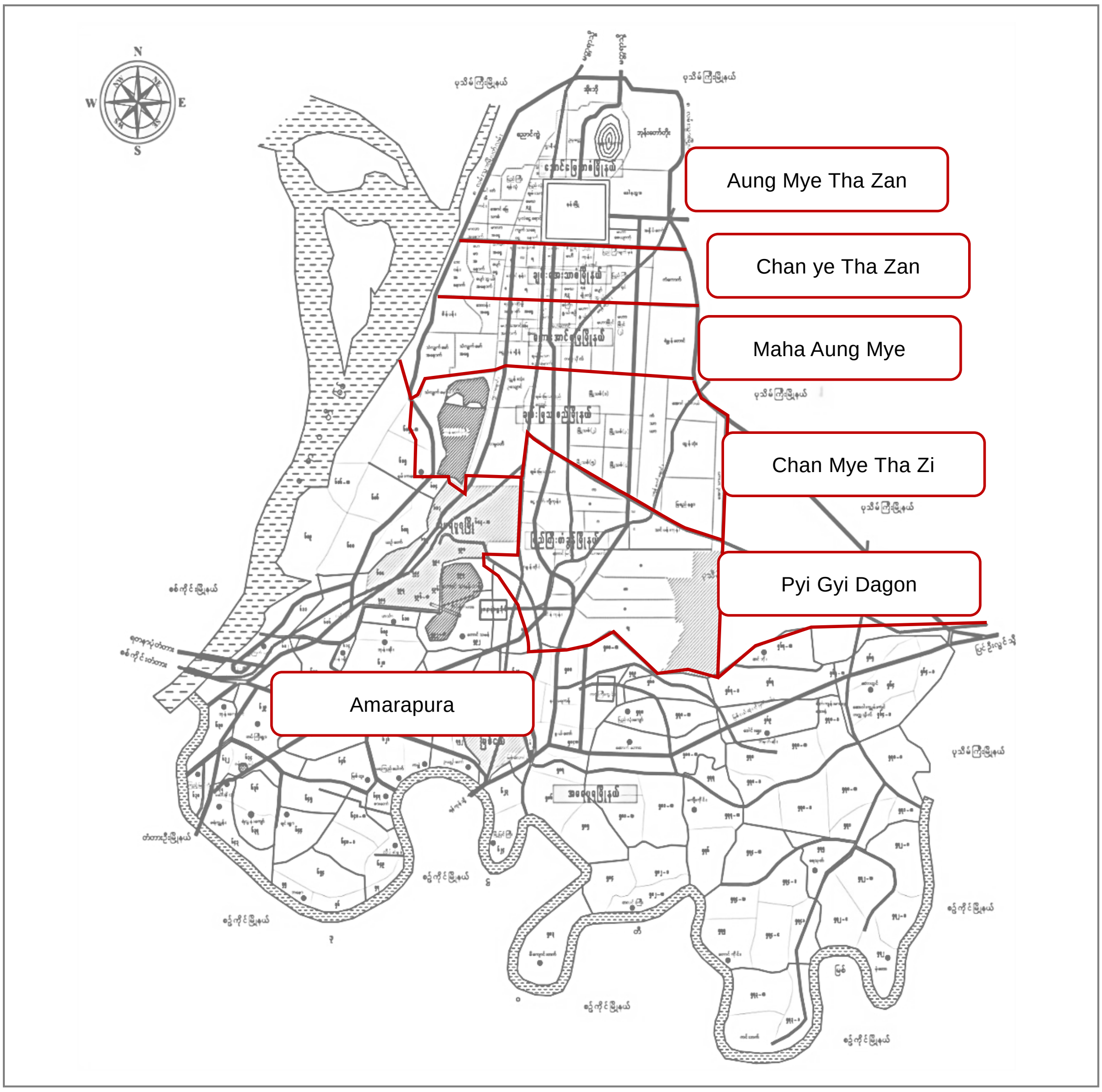

Figure.1.2.1.2 Boundary of townships in Mandalay city[3]

Table 1.2.1.2 Area and Population of each township in Mandalay city

No.	Township	Area(km^2)[4]	Population[5]
1	Aung Mye Tha Zan	28.11	254,898
2	Chan ye Tha Zan	12.14	229,847
3	Maha Aung Mye	15.07	233,557
4	Chan Mye Tha Zi	30.18	199,519
5	Pyi Gyi Dagon	28.49	157,062
6	Amarapura	204.92	207,678
	Total:	318.91	1,282,561

1.2.2 Energy situation in Mandalay city

(1) Current situation

Mandalay city primarily consumes power from hydropower plants. The below table shows hydropower plants and equipment capacity in Mandalay region in 2012. At present, 55% households are legally supplied with power, 26% households are supplied by these households legally supplied with power.17% households haven't access to power

In 2013, low water capacity in Yeywa hydropower reservoir led to low power generation capacity and the city had to stop planned power supply. However, the later situation was improved. According to a social survey conducted by ADB, over 80% the people in Mandalay city answer that "Frequently powered on"[5].Note that according to an interview with Mandalay power company, electrification in the whole Mandalay region has been slow, so the ratio of electrification has just reached 40%.Therefore, we believe that there is a special demand for renewable energy in non-electrified areas.

Table 1.2.3.1 Hydropower plants and equipment capacity in Mandalay region[5]

№	Name of hydropower plant	Equipment capacity (MW)
1	Yeywa	790
2	Kinda	56
3	Sedawgyi	25
4	Paunglang	280
Total:		1,151

(2) Plan[5]

In recent years, the World Bank, ADB and the Ministry of Electricity and Energy have intended to implement power supply projects with a view to improving the power supply situation here.

Table 1.2.3.2 Power supply project

<table>
<tr><th>Agency/organization</th><th>Project name</th><th>Content</th></tr>
<tr><td>World Bank (WB)</td><td>Myanmar's power projects</td><td>- Combined cycles power plant: USD 130 million
- Technical support and consulting services: USD 10 million</td></tr>
<tr><td rowspan="2">Asian Development Bank (ADB)</td><td>Initial surveys in the field of energy</td><td>- Restore power generation and power distribution
- Make a general hydropower development plan
- Generalize electrification</td></tr>
<tr><td>46390-003:Power distribution improvement project</td><td>Upgrade 66/11 kV and 33/11 kV lines with 33 kV and 11 kV lines, upgrade 11/0.4kV transmission lines, upgrade digital meters. Target regions: Yangon, Mandalay, Sagain, Magway</td></tr>
<tr><td rowspan="2">The Ministry of Electricity and Energy</td><td>Content presented in July, 2013</td><td>Plan 17 hydropower projects and thermal projects by 2016.
Estimated total power is 2,192MW</td></tr>
<tr><td>Speech by Mr. Myint Oo, the minister of the ministry of electricity in November 2014</td><td>Decide the 15-year development plan for increasing capacity from 4,581MW to 29,000MW in 2031, decide areas to deploy 41 new power projects from 2016 to 2030.
Make a plan for the construction of 20 hydropower plants in Mandalay, Kachin, Cain and Shan regions</td></tr>
</table>

Figure 1.2.1.3 shows the situation of upgrading the power grid including Mandalay region for reference.

Figure 1.2.1.3 The situation of upgrading the power grid including Mandalay region[6]

1.2.3 Cooperation relationship between Kitakyushu city and Mandalay city

In the context of implementing this project, Kitakyushu has, with the support of Mandalay city, deployed since 2012.The cooperation is mainly in the field of waste treatment and now field workshops are being deployed and training is provided to cadres of the sanitation department of MCDC.

【Overview of the cooperation between the cities: History of the cooperation process】

(1)The field of waste treatment

- In 2012:Train cadres of the sanitation department of MCDC (CLAIR (Council of Local Authorities for International Relations))
- In 2013:Carry out field investigation, survey, interview in Mandalay city (CLAIR)
- In 2014:Hold a workshop between Kitakyushu city and Mandalay city (IGES)
- In 2015:Visit, inspect environment related facilities as organized by cadres of the sanitation department of MCDC (IGES)

  Develop teaching materials on environment of Mandalay city and hold exchanges between the two cities (IGES)
- In 2016:Hold a workshop to develop a waste management strategy (IGES・UNEP)
- In 2017: Invite the head of the sanitation department of MCDC belonging to the Ministry of Environment's cooperation project between the cities.

(2)Water supply and drainage

- 2014 to present: The visit by the mayor of Mandalay city has been done, cadres of the sanitation department of MCDC in the "project for improving the operation management capacity of the water filter plant in Mandalay city, Myanmar" belonging to JICA's technical cooperation project have been trained.

Referenced documents

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[1] The Government of the Republic of the Union of Myanmar Ministry of Planning and Finance, Myanmar Statistical Year Book 2016

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

[3] Correction of the map provided by MCDC

[4] Population Statistics for Countries, Administrative Areas, Cities and Agglomerations – Interactive Maps and Charts、https://www.citypopulation.de/php/myanmar-admin.php?adm1id=0901

[5] JICA Survey for the preparation of a plan for upgrading water supply system of Mandalay city, Myanmar, april 2015

http://open_jicareport.jica.go.jp/618/618/618_104_12231114.html

[6] Myanmar Energy Sector Initial Assessment, October 2012, ADB

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

2.1　Purpose and Implementing System of Project Feasibility Study

2.1.1 Project Overview（Purpose & Scope）

The goal of this project is to realize projects that will lead to energy-related CO_2 emission reduction as measures against climate change and solve energy related issues / needs of Mandalay City and surrounding areas. Furthermore, as a co-benefit effect, this project will contribute to the sustainable development of Myanmar where rapid urbanization is progressing.

In this chapter, JCM case study on the following two fields are summarized.

(1) Activity-1：Low-carbonization of large scale facilities by saving energy & renewable energy

In Myanmar the electricity rate system was revised in 2014. As shown in Table.2-1, the electricity charges for general households are relatively high price setting. In addition, due to the vulnerable power supply regime, blackouts occur frequently so private operators own private power generators and respond to the power demand at the time of power failure. For this reason, there is an increasing need for reducing electric power costs, particularly in industrial contracts, by saving energy and introducing renewable energy. Based on the above situation, investigate the possibility of introduction of energy conservation and renewable power

Table.2-1.Erectricity rate system in Myanmar

Usage	Selling Price (Unit : Kyat/kWh)	
For General Household Use	1kWh ～ 100kWh/month	35
	101kWh ～ 1,000kWh/month	40
	Over 201kWh /month	50
For Industrial Use	1kWh ～ 500kWh/month	75
	501kWh ～ 10,000kWh/month	100
	10,001kWh ～ 50,000kWh/month	125
	50,001kWh ～ 200,000kWh/month	150
	200,001kWh ～ 300,000kWh/month	125
	Over 300,001kWh/month	100

(2)Activity-2：Promotion of introduction of distributed energy system using renewable energy.

The Myanmar governments is promoting electrification aiming for domestic electrification rate of 100% by 2030, but the electrification rate is 34% as of 2015. The electrification rate in Yangon City, which is an urban area is 78%, while in Mandalay city it is 40%, but the rural electrification is less than 20%. In addition, even in regions with high electrification rates, power outages occur frequently as described above, so the use of in-house generators is essential, and many use diesel generators.

As a climate characteristic, Myanmar is blessed with solar radiation conditions, and is suitable for solar power generation and solar thermal utilization. Also, in Myanmar where rice cultivation is thriving, the irrigation canals are relatively well-organized, and there is the possibility of mini hydropower or micro hydro power generation that can generate electricity even at small head drops.

Based on these circumstances, the possibility of installation of solar power generation for the vacant space of water supply and sewer facilities, the suitable space such as the roof of the airport, the vacant space of the recycling factory operated by public institutions, etc., and the possibility of installing mini/micro hydropower is investigated.

2.1.2 Implementing System

Based on City-to-City collaboration between City of Kitakyushu and Mandalay City, this project is conducted by the Nikken Sekkei Civil Co., Ltd. and NTT Data Institute of Management Consulting, Inc. The implementation system is shown in Figure 2-1.

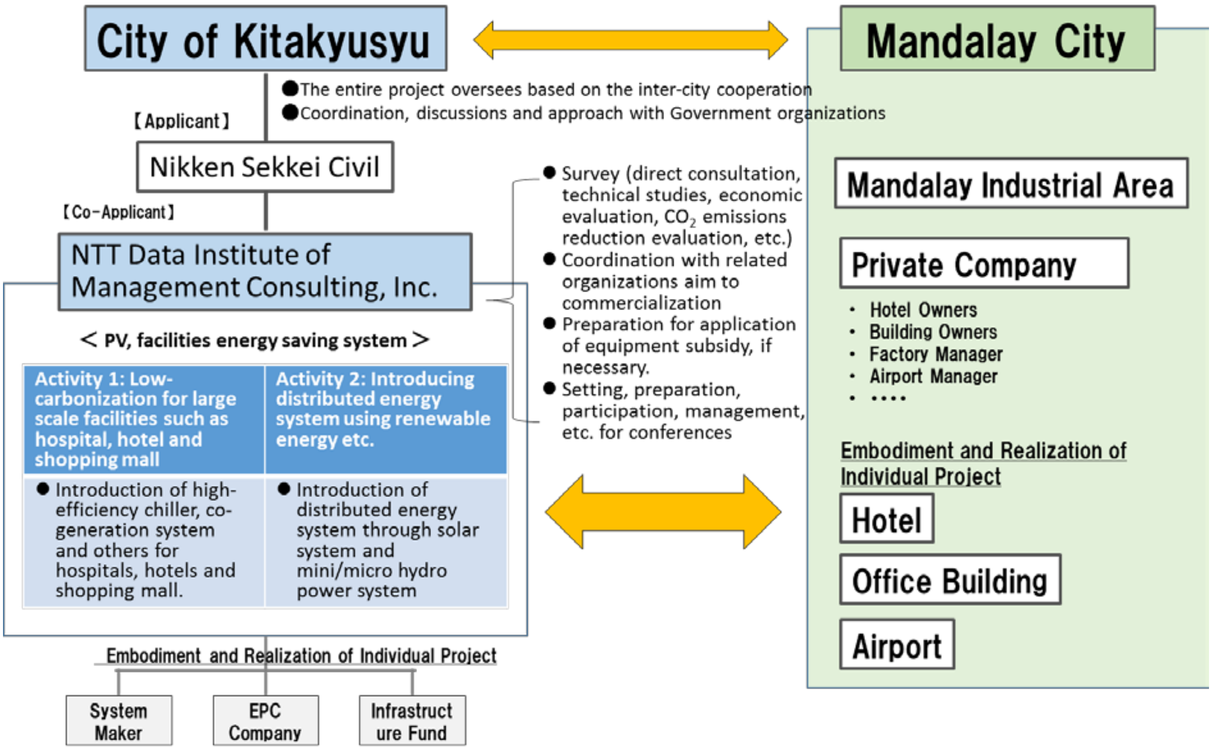


Figure.2-1.Survery Implementation Structure

2.1.3 Investigation Method and Schedule.

＜Investigation Method＞

For activities 1 & 2, investigation is conducted according to the following method.

How to proceed investigation	Method and means of investigation
List up large-scale hotels, supermarkets, etc. from public information such as the web, and promote direct consultation. For other high potential facilities which is unspecified, get information from Mandalay City Development Committee.	● Consultation with relevant departments of Mandalay City and listing of survey target facilities (unspecified facilities only) ● Direct consultation with the listed facilities / explanation of JCM etc. ● Re-negotiate on candidate facilities which has high interest in JCM, and conduct detailed examination. (Technical evaluation, economic evaluation etc.) ● Evaluation of CO_2 emission reduction based on examination results ● Decision making based on the above evaluation results (preparation for preparation of equipment auxiliary project)

＜Investigation Schedule＞

The planned schedule of this survey project is shown in Figure.2-2.

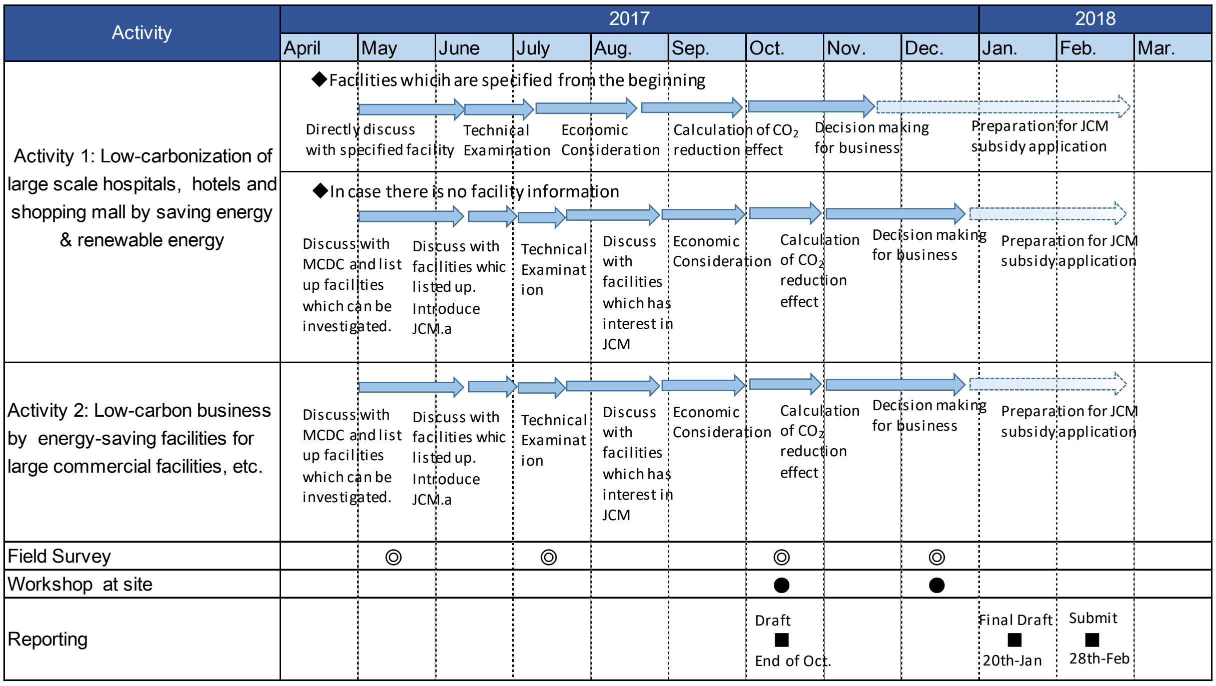


Figure.2-2. Planned Schedule

2.2 Result of Project Feasibility Study.

In this chapter, the filed survey is summarized and describe the introduction technology, project implementation system, fund procurement method, project implementation schedule on individual projects that are likely to lead to JCM subsidy projects.

2.2.1 Summary of Field Survey

(1) Travel History

Totally 5 local trips were conducted and survey team held consultations with municipal officials, discuss individual projects likely to lead to JCM equipment subsidies, and held on-site workshops. The period and purpose of each travel are shown below. Detailed travel records are summarized in the reference material.

	Period	Purpose
1	29^{th}-May to 2^{nd}-June.	【1st Survey】 ・ Consultation with the mayor ・ Consultation with related department of Mandalay City ・ Consultation with candidate facilities (JCM explanation, hearing about current situation)
2	8^{th}-Oct. to 13^{th} –Oct.	【2nd survey】 ・ Collect local information at Yangon ・ Consultation with candidate facilities (JCM explanation, current hearing) ・ Discussion of individual projects (survey of candidates for EPC company of airport projects)
3	24^{th}-Oct.-2017	・ Discussion of individual projects (survey of candidates for EPC company of airport projects)
4	8^{th}-Nov.-2017	・Hold workshop
5	16^{th}-Jan. to 19^{th}-Jan.-2018	【3rd survey】 ・ Consultation with candidate facilities (JCM explanation, current hearing) ・ Discussion of individual projects (survey of candidates for EPC company of airport projects)

(2) Result of Interview

The summary of the interview results is classified into hotels, large-scale facilities (shopping malls, airports), manufacturing industry, other enterprises, and they are listed below. The progress of the survey on mini / micro hydro power generation is also described.

<Hotel>

As for the hotel, there is no department in charge at MCDC, so investigation started based on web information of each hotels. The meeting with the Mandalay Hotel Association is conducted during the 3rd traveling, and chairman of association confirmed that there is a high need for introducing energy conservation and renewable energy facilities utilizing JCM subsidy project.

Hotel	Working Status
Mandalay Hotel Association	· Approx. 200 hotels and 200 guest houses registered to The Mandalay Hotel Association. In addition, there are about 100 newly registered applications for the next fiscal year, and there are expansion trends. · Generally, electricity charges at local hotels in Mandalay account for 40 to 50% of the total cost. It is confirmed that interest in energy conservation is high in Mandalay. Since almost all hotels use private generators to prepare for a power outage, there is a high needs for installing of power supply system including renewable energy. · They were positive to utilize JCM subsidy projects and agreed to widely announce the JCM scheme to members of the association. The possibility of business utilizing the association network, including energy saving business by multiple hotels, was also discussed. · They hope Japanese side to present a case study on concrete economic effects in order to build hotel owners understanding. They confirmed that they can cooperate if there is a continued survey for the next fiscal year. · In addition, the chairman of the Mandalay Hotel Association also concurrently serves as a member of the Myanmar country hotel association. According to him, as the rapidly growing resort area is away from the national grid, hotels in that area rely on private generators for 100% of the electricity, which is one of the big problem of hotel industry in Myanmar.
Hotel A	Hotel A is a five star hotel in the city. Although it is confirmed that they have a positive intention for JCM subsidy project, they just had updated chiller facilities in the previous fiscal year so it is difficult to develop JCM project. As they are constructing a new hotel in Mandalay and Bagan area, they said that they will contact if there is possibility of utilize JCM subsidy project
Hotel B	Hotel B is a five star hotel in the city. Telephone interview was conducted and confirmed that they are interested in energy saving of facilities. However, large-scale renovation work was on-going this fiscal year so negotiation could not be carried out.
Hotel C	Hotel C is operated by a committee member of the Hotel Association, which started operation in 2015. The owner had a very high interest in the JCM subsidy project.

＜Shopping mall, Airport＞

Interview on the large facilities such as shopping mall, airport were conducted and the possibility of project formulation was discussed.

Large Facilities	Working Status
Mandalay International Airport	・ Japanese company A has signed and operates a business right contract for airport operation, collection and maintenance business for 30 years from 2015 with Myanmar Airlines Bureau. ・ The chiller introduced about 2 years ago is out of order, so the individual air conditioning system are utilized now. Individual air conditioning takes time and labor for maintenance, so they were considering introducing a chiller system next fiscal year. ・ They are positive to utilize JCM subsidy project and asked us to explain JCM to their parent company. ・ Their Parent Company also show positive attitude as they said that this project is not only contributing to the enhancement of the corporate value of the airport, but also being involved in environmental conscious efforts by utilizing the arrangements between the two countries. It also has important implications from the viewpoint of CSR. ・ The construction of existing chiller is before the start of Company A's business, so Company A does not possess detailed facility information. Because there is little information on existing chillers, it takes time to select estimators. Survey team made estimate requests to multiple construction companies and are now adjusting with Company A necessary information for estimation. ・ In addition to the above, since it has extensive land, it is confirmed that they are positive to establish other projects such as installing solar power generation facilities.
Shopping Mall B	・ This company is one of the largest supermarket chain in Myanmar. They own a warehouse in 7 areas. (Yangon, Mandalay, Taunggyi, Nepidoo, Pattin, Monywa, Mawlamyaing) ・ In Yangon, they are planning to install solar power generation facilities in warehouse and construct a food factory. They have a positive intention for the JCM subsidy project, and will consider in the company. ・ They own a large-scale facility in Yangon city, but there is only a small scale in Mandalay city. Therefore, facilities in Mandalay is lower priority even if applying JCM equipment subsidy.

<Manufacturing Industry>

Regarding manufacturers, interview with large scale factories which introduced by MCDC were conducted and possibility of JCM project were discussed.

Manufacturing Industry	Working Status
Tea Factory C	▪ The tea factory is manufacturing Myanmar's own "eating tea" and bagging of oolong tea leaves. They are interested in installing solar power generation facilities utilizing JCM subsidy project due to the concern against high power consumption of facilities necessary for the manufacturing process. ▪ In the past they considered introducing solar panels of Chinese companies. Although they considered introducing it in combination with a battery, abandoned it due to poor return on investment. This is because they can't sell power.
Textile Factory D	▪ The company that processes and dyes cotton-like chemical raw materials imported from Taiwan, Korea and Thailand, and produces and ship chemical fibers. ▪ Many equipment is used in the manufacturing process, so energy consumption is large. Since coal boilers are always burning at the time of factory operation for the dyeing process, there is a room for reducing CO_2 emissions. However, they said that they don't feel the problem as to the energy cost and there is no expansion plan for the facility. ▪ Because the owner was absent, it is confirmed that they will share information later in there office and contact survey team if they are interested in JCM subsidy project.
Construction equipment recycling plant F	▪ It is a Myanmar branch of Japanese construction machine maker. Their business is to rebuild the components of the construction machine and the assembly of the generator. ▪ Since the current occupancy rate is low and large equipment is not introduced, the energy cost is small. There is low possibility to lead to JCM subsidy projects.
Milk powder Factor G	▪ The company produces powdered milk, condensed milk, cream from domestic raised cattle and milk collected from surrounding farmers and sells domestically. The largest factory in Myanmar. ▪ There are few facilities that consume large amounts of energy so it is difficult to formulate projects in the field of energy saving. ▪ A power outage always occurs every week on Saturdays, and power outages occur all day on Sundays. Therefore, they operate a factory by diesel in-house generators all day on Sunday.

＜Others＞

In addition, interview with developers of industrial estates and company that originated in City of Kitakyushu were also conducted.

Others	Working Status
Developer H	▪ The company have developed MYOTA industrial park from 2012 in cooperation with Mandalay Provincial Government administration. Environmental impact assessment has been completed in 2016 and it is in the infrastructure development stages such as substation equipment and water supply piping network. There are six enterprises entering in this area. ▪ Although they are interested in JCM subsidy projects, applicability is low from the current state of industrial park. ▪ The master plan of the industrial estate has already been prepared and it aims at a circulation type industrial cluster. The company has interested in eco-industrial town in City of Kitakyushu so there is a possibility of collaborating with City of Kitakyushu regarding constructing eco-industrial town scheme. ▪ The company try not only industrial parks planning but also town planning in Myota industrial park , therefore there is a possibility of cooperation even in smart city planning.
Company from City of Kitakyushu	▪ The company is a local branch office of the company in Kitakyushu city. In Japan, they conduct a wide range of projects including taxi business as well as real estate business and nursing care welfare business. In Myanmar, they also develop not only taxi business but also event business and fishery processing business. ▪ They are planning an eeling business which is an advanced initiative in Myanmar country. There is possibility of energy saving in temperature control, large amount of water treatment, water management process. There is a high possibility that they launch this eeling business and have intention to apply for JCM subsidy project. ▪ They are also planning the construction and operation of a nursing care worker training school in Tanlin which is the middle point between Yangon and Tirawa district. It is confirmed that they intend to apply to JCM subsidy projects if possible, regarding energy saving of air conditioning equipment etc. to be introduced at the facility.

＜Mini / micro hydraulic power generation＞

1) Investigation of permission

Survey team contacted the hydraulic power staff of the Myanmar Ministry of Energy (MOEE) and heard about information on permission for power generation project and hydropower potential map. Feasibility Study (FS) on domestic medium-scale to large-scale hydropower potential has been implemented, but it is non - public data. As for the scale below the small hydropower generation, FS has not been implemented as a country.

Table 2-2 shows the rule of permits and approvals for implementing power generation projects. The capacity of mini / micro / small hydroelectric power generation targeted in this survey is less than 30 MW, and system is not connected to national grid as a distributed power supply, so consultation with local governments is necessary. According to the person in charge, if FS study is submitted, government will give permission.

Although environmental impact assessment is necessary regardless of the scale, it is unnecessary for power generation equipment for private consumption.

Table.2-2.Authorization of power generation project in Myanmar

Capacity / Grid connection	Connect to Grid	Not connect to Grid
Over 30MW	Ministry's permission required	Ministry's permission required
Less than 30MW	Ministry's permission required	Consultation with local governments is necessary

2) Find Local Survey Partner

Because it is important to collaborate with a stakeholder familiar with the local circumstances, the information of small-scale hydropower generation potential sites, and consultation with the local residents, survey team contacted the Japanese hydroelectric generator makers which expands their business to Myanmar. The company has established a joint venture with a local company that conducts hydropower generation and other renewable energy consulting business. Survey team explained JCM to the company and established a cooperative relationship in the field survey of mini / micro hydro power generation.

As written above, survey team were able to find the investigation partner. However, first priority of this year's survey is the early realization of the JCM project, so the survey of the mini / micro hydro power generation projects were not proceeded because it takes time to conduct on-site survey etc. in this fiscal year.

（３） Potential project that could lead to JCM subsidy project

Through field survey, it is confirmed that the following two cases are likely to lead to JCM subsidy project.

- Introduction of high efficiency chiller into Mandalay International airport.
- Introduction of high efficiency equipment into eeling business in Yangon.

COMPANY A, the airport operator, plan to install high efficiency chiller into Mandalay International Airport, has high intention to utilize JCM subsidy project. In addition to introduction of high efficiency chillers, COMPANY A also considers the possibility of multiple projects such as solar power generation facilities utilizing a vast airport site and energy saving of diesel private power generators used at power outages. For this time, the introduction of highly efficient chillers and solar power system was examined. Details of various studies are described in 2.2.2 - 2.2.5. This section describes the outline of Mandalay

International Airport and the efforts and significance of energy conservation at the airport.

<Outline of Mandalay International Airport>

Mandalay International Airport and the outline of COMPANY A is described in Table.2-3. Mandalay International Airport is located approximately 40 km south of Mandalay City, opened in 1999. It is the hub airport which has a route connecting Mandalay City with 11 domestic cities and 4 overseas cities. The numbers of passenger have increased by 20% on average for domestic flights and 60% on international flights since 2010. The number of passengers in 2013 is about 750,000 (international 190,000 / domestic 560,000), but the facility has capacity capable of handling up to 3 million.

COMPANY A is an airport operating company established by a joint venture of three companies (Japanese company B 45.5%, Japanese Company C 45.5%, Myanmar Local Company D 9%) Their business is repair improvement and maintenance of airport related facilities such as terminal buildings and runways, operation of the airport (excluding some operations such as air traffic control). They signed a 30-year business license agreement with the Department of Civil Aviation (DCA), and it is also possible to extend the 20-year project period as an option. This is the first privatization of airport business which Japanese companies tackle with 100% private capital overseas.

Table.2-3.Overview of Mandalay International Airport

Overview	Operation, Refurbishment, and maintenance of Mandalay International Airport. Project period : 30 years (Optionally extended for 20 years)
Schedule	Nov.-2014･･･ Business agreement concluded Apr.-2015 ･･･ Operation start
Operating Company Info	･Establishment :2014-Apr.-1 ･Nos employees: Approx. 550 (as of June-2017)
Business Scope	･Repair and remodeling of existing facilities including runways, guidance and parking lots ･Operation of the entire airport(Except control & lubrication) ･Construction of cargo terminal ･Procurement of ground support equipment
Route	･11cities in Myanmar. ･4 cities abroad(Bangkok、Singapore,Hong Kong、Kunming)
Passenger Number	･Fiscal Year 2013 ･･･ 0.75MM. (International Flight 0.19MM/Domestic Flight 0.56MM) ･Fiscal Year 2013 ･･･ 0.94MM

Figure.2-3. Picture of Mandalay International Airport

＜Efforts for low-carbonization of Mandalay International Airport＞

The parent company of COMPANY A, carries out multiple airport projects at the Transportation Infrastructure Division, and they are proceeding several overseas airport construction project. In order to contribute to the eco airport initiative promoted by the Ministry of Land, Infrastructure and Transport of Japan (MLIT), the company carries out low carbonization of the airport. Solar power generation system has been installed at their airport in Singapore. Even at Mandalay International Airport, since COMPANY A began airport management on April 1, 2015, they have been considering the possibility of introducing low carbon facilities. Table 2-4 shows the study on the low carbonization of the airport.

As shown in the same table, GPU and energy saving lighting have already been introduced. Regarding solar power generation, they had examined in the past, but it was a time of Myanmar political change, they abandoned it considering project implementation risk. However, due to the frequent power outages, they are positive for doing solar power generation at the airport. The site of the airport is borrowed from the government and it is 3000 acres. Because of this extensive area, it is easy to secure the place to install the solar panel.

MLIT has established cooperative relations with the Myanmar Ministry of Transportation and the Ministry of Railways and Transport to implement comprehensive environmental measures in the transportation field. In technical cooperation in the aeronautics field, DCA is impressed with the Eco Airport concept. Therefore, this project contributes to the cooperative relationship between the two countries, and at the same time it improve the image of the airport which is the gateway to Myanmar's leading tourism area, Mandalay.

Table.2-4. Status of consideration of low carbon equipment at Mandalay International Airport

Elements	Possible measures	Anticipated introduction place	Specific measures	Review situation
Sox,Nox,CO2 Generation Suppression	GPU(Groud power supply)	Basic facility	Mobile CPU vehicle	Already Installed
	Low pollution vehicle	Basic facility	Hybrid lamp bus, electric type belt loader	Not yet considered
Adoption of energy saving syste,	Heat pump system	Terminal building, control tower building etc.	Geothermal heat, river heat utilization	Chiller system is under consideration
	Inverter control	Terminal building, control tower building etc.	Inverter type air conditioner fan, cold / hot water pump	
	Energy saving lighting	Various buildings, parking lots, surrounding roads	LED lighting, solar lighting, air volume power generation lighting	Partially installed
	Local and limited use of lighting, heating and cooling	Terminal building, control tower building etc.	Lighting sensor, automatic air conditioning management system	Not yet considered
	Reduction of building heat load	Terminal building, control tower building etc.	Heat insulating paint / sheet, heat insulating glass	Under consideration
Renewable energy generation system	Solar power generation system	Terminal building, Surrounding Idle place	Installation of PV system	Under consideration
	Wind power generation system	Parking lots, Surrounding Idle place	Installation small wind power system	Difficult wind situation

2.2.2 Examination of Introduction Technology

(1) Outline of Introduction Technology

【Review-1: Introduction of high efficiency chiller system】

For the international airport which is a large facility in Mandalay city, installation of high efficiency chiller is considered and it will contribute to low carbonization of this facility. The facility has introduced an air-cooled chiller system about two years ago, but now it is out of order and they are using package air conditioner as temporary measure. The newly introduced chiller system is assumed to be a water-cooled type. The reason is that compared with the air-cooled type, exhaust heat is not generated by water-cooled-type chiller so that it is possible to prevent the temperature rise inside the room, making it more clean environment. Moreover, because there is no cooling fan of the condenser so noise is low, and it has a high exchange rate. However, since the existing chiller system (under failure) is air-cooled type, several points are required to check when installing water-cooled-type chiller system such as securing the installation location of the cooling tower and securing the supply environment of circulating water throughout the year. Figure 2-4 shows a schematic diagram of the assumed air conditioning system.

The capacity of the chiller system covered by this project is 300 USRT × 5. The existing chiller is product of McQuay Hong Kong Company.

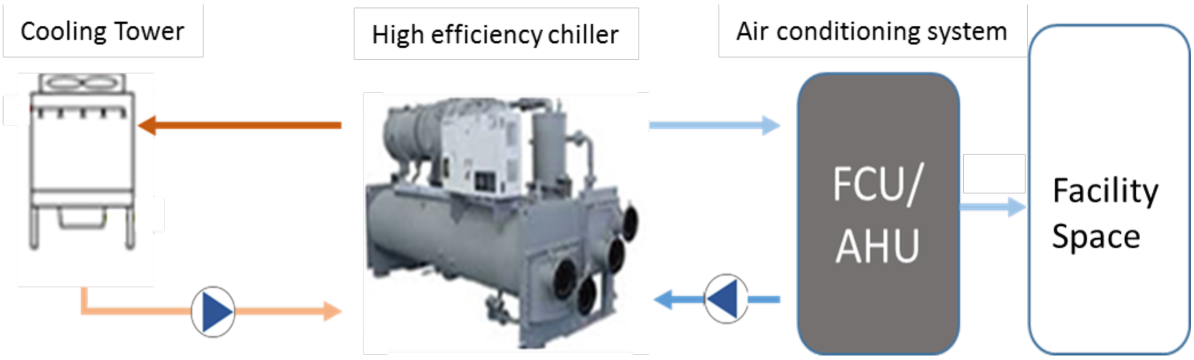


Figure.2-4. Image of air conditioning system utilizing high efficiency chiller

【Review-2: Introduction of solar power generation system】

As mentioned above, there is a large vacant land at Mandalay International Airport, so it is easy to secure the place to install solar panels. Therefore, we are investigating the possibility of installing solar panel on the ground instead of roof type.

(2) CO_2 Reduction Effect

【Review-1: Introduction of high efficiency chiller system】

In this project, by adopting highly efficient energy-saving type chillers compared with general-purpose chillers, it will reduce power consumption and reduce CO_2 emissions. Although survey team have not yet reached the stage of consultation on the products to be introduced, the effect of reducing CO_2 emissions by introducing high-efficiency chillers are calculate for reference.

＜Assumed equipment to be installed ＞

The Hitachi GFG model (300USRT × 5 units) is assumed as an installed facility. The model is a high-efficiency chiller, which has a higher COP than other products. For reference, Figure 2-5 shows the COP of each company's chiller in the Cambodian market. The COP of the assumed GHG model manufactured by Hitachi ranges from 6.24 to 6.60. On the other hand, considering the COP of another company's product as a reference COP, it is around 5.36 to 5.81. Therefore, it can be said that this product has higher energy saving effect than other products. For the calculation of the amount of CO_2 emission reduction, the COP value in the Cambodian market shown in the figure is used. This is because the economic development level of Cambodia and Myanmar is similar (the nominal GDP per capita in 2016 is 1,277.7 USD and 1,231.8 USD respectively), so it is assumed that there is no big difference between products on the market.

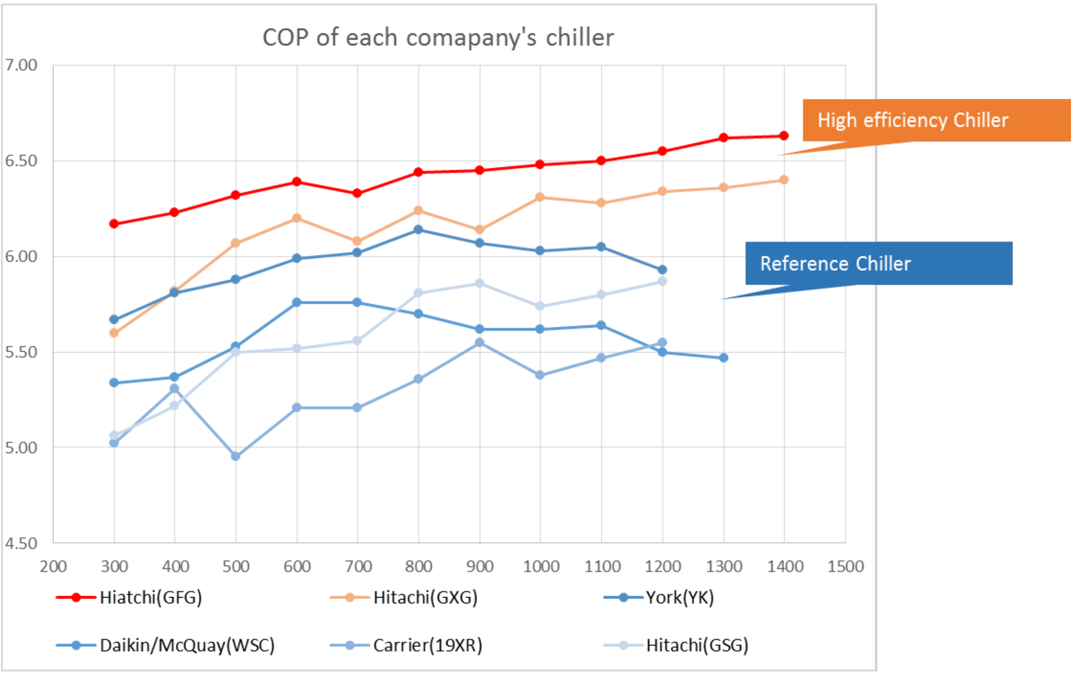


Figure.2-5.　COP of each company's chiller in Cambodia market

＜Grid Emission Factor used for calculation＞

Calculation of Amount of CO2 emission reduction was performed by utilizing the worksheet of calculating the annual CO_2 emission reduction effect of high efficiency chiller published by the Public Interest Foundation Global Environment Center Foundation (GEC). For calculation, the CO_2 emission factor (ton - CO_2 / MWh) of the grid electric power is used. The following two kinds of numerical values are used as the grid emission coefficient of Myanmar this time. One is the numerical value (emission factor ①) published by the Asian Development Bank (ADB), and the other is the numerical value that the GEC is using for JCM subsidy project review (emission factor ②). In this country, about 70% of the power supply is hydropower generation, so it has a relatively low emission factor.

- Grid emission factor ① ＝ 0.332 (ton- CO_2/MWh)
- Grid emission factor ② ＝ 0.1 (ton- CO_2/MWh)

＜Calculation Result＞

The calculation result of the Amount of CO2 emission reduction is shown in Table 2-5, and the worksheet used for the calculation is shown in Figure 2-6. The number of facilities planned to be introduced is five, but in the existing chiller system three of the five are running and the two have been introduced as the standby state. On condition that the same operation is carried out, the amount of CO_2 emissions reduction by three units is calculated. As shown in the below table, the emission reduction effect when using the grid emission coefficient publicly listed by ADB is 135 ton - CO_2 / year, on the other hands, the result of using GEC emission index is 42 ton - CO_2 /year.

Table.2-5.　Calculation result of CO_2 emission reduction

	Grid Emission Factor (ton-CO2/MWh)	Annual Emission reductrion amout per unit (ton-CO2)	number	Annual Emission reductrion amout by 3 unit (ton-CO2)
Result ①	0.332	45	3	135
Result ②	0.1	14	3	42

Calculation of CO2 emission reduction amount for refrigerator introduction (in the case of 300 RT)

Fill in　　Automatic Calculation

Project Name : Introduction of high-efficiency chillers to airport facilities (Myanmar)

Q CO2 emission reductino amount ton-CO2/year　45

Q=Ry-Py

Ry Reference CO2 emission　ton-CO2/year

Py Project CO2 emission　ton-CO2/year

•Calculation of required refrigeration capacity (air conditioning load etc.)

RQ y Annual required refrigeration capacity　MWh/year　5390.028 MWh/year

RQ y = Required capacitu per hour (kWh) ×annual uptime(h/year)/100((MW/year)　Required capacitu per hour(kWh) 1054.80

Annual uptime(h/year) 5110

RQ y = 300URT×3.516 (k W· URT) ×14 (h/day)×365/1000r

•Calculation of Reference CO2 Emission

R y = RQe y ×gef　ton-CO2/year　335

RQey=Rqy/Rcop　1,009

RQey Annual power consumption for Reference　MWh/year

Rcop COP of Reference Chiller　COP of Reference Chiller 5.34

g e f Grid Emission Factor　ton-CO2/Mw h e　0.3320

•Calculation of Project CO2 Emission

P y = RQe y ×gef　ton-CO2/year　290

PQey=Rqy/Pcop　874

PQey Annual power consumption for Project　MWh/year

Pcop COP of Project Chiller　COP of Project Chiller 6.17

g e f Grid Emission Factor　ton-CO2/MW h　0.3320

Figure.2-6.　Annual CO_2 emission reduction calculation sheet per high efficiency chiller[1]

【Review-2: Introduction of solar power generation system】

By introducing a solar power generation system, CO_2 emissions will be reduced by reducing purchases from national grid power by consuming electricity generated by renewable energy power sources at the airport.

＜Assumed equipment and location to be installed＞

For approximate calculation of the amount of CO_2 emission reduction by the solar power generation system, VBHN 240 SJ 25 of Panasonic Corporation is assumed. According to the value in catalog of the product, the area per module is 1.26 m^2, and the maximum output per module is 240 W.

Assumed installation location is the space beside the airport parking lot shown in Figure 2-7. It is possible to secure an installation space of 15,000 m^2 (100 m × 150 m) in the area surrounded by the yellow solid line

[1] Based on application form of Public Interest Foundation Corporation Global Environment Center Centre Foundation　JCM Equipment Subsidized Project Created

shown in the figure. Although there is a vast vacant land that can be used next to the runway, this time we assume the scale of facilities which can supply electricity equivalent to the power consumption of the chiller system to be introduced. In this sense, the space next to airport parking lot is enough.

Figure.2-7. Assumed installation location of solar panel for estimation.

＜Calculation Result＞

Regarding the method of calculating the forecasted power generation per year, the solar power generation guidebook issued by NEDO (New Energy and Industrial Technology Development Organization) was referred.

As a result of the calculation, the system capacity of the panel is 2,850 kW, and the amount of annual power generation Ep is about 3,797,000 kWh. Since the annual power requirement of the high efficiency chiller mentioned above is 5,390 MWh, the power generated by the solar panel installed in the area can be used for the power consumption of the chiller.

（Annual forecasted power generation calculation formula）

Annual forecasted power generation Ep (kWh)

＝ Output per unit area P × installed area A × Yearly average solar radiation H × Loss Factor K

$P = 0.19\ kW/m^2$ ・・・ according to catalog of Panasonic VBHN240SJ25

$A = 100 \times 150 = 15{,}000 m^2$

$H = 1{,}8251\ kWh/m^2/year$[2]

$K = 0.732$[3]

2 Off Grid Power Forum - Inter Solar Europe 2014

3 the solar power generation guidebook issued by NEDO (New Energy and Industrial Technology Development Organization)

The calculated value of the Amount of CO_2 emission reduction is 1211.2 ton-CO_2 / year. The emission factor is set at 0.319 which is used by the GEC for the examination of JCM subsidy projects.

(Annual Amount of CO_2 emission reduction calculation formula)
Annual CO_2 emission reduction
= Annual forecasted power generation Ep 3,796,913 kWh × Grid emission factor 0.319
= 1211.2 ton- CO_2

(3) Review of MRV methodology

【Review-1: Introduction of high efficiency chiller system】

The methodology of high efficiency chiller is considered to be able to refer to a methodology approved in other countries (ID_AM 002 "Energy Saving by Introduction of High Efficiency Centrifugal Chiller" etc.). The methodology is described below.

- **Calculation of reference emissions**

$$\mathbf{RE_p = \sum_i \{EC_{PJ,i,p} \times (COP_{PJ,tc,i} \div COP_{RE,i}) \times EF_{elec}\}}$$

RE_p : Reference emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller *i* during the period *p* [MWh/p]
$COP_{PJ,tc,i}$: COP of project chiller *i* calculated under the standardizing temperature conditions [-]
$COP_{RE,i}$: COP of reference chiller *i* under the standardizing temperature conditions [-]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

- **Calculation of project emissions**

$$\mathbf{PE_p = \sum_i (EC_{PJ,i,p} \times EF_{elec})}$$

PE_p : Project emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project chiller *i* during the period *p* [MWh/p]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

- **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
$COP_{RE,i}$	The COP of the reference chiller *i* is selected from the default COP value in the following table in line with cooling capacity of the project chiller *i*. **$COP_{RE,i}$** <table><tr><th>Cooling capacity /unit (USRt)</th><th>x<300</th><th>300≦ x<450</th><th>450≦ x<500</th><th>500≦ x<700</th><th>700≦ x<1,250</th></tr><tr><td>$COP_{RE,i}$</td><td>4.92</td><td>5.33</td><td>5.59</td><td>5.85</td><td>5.94</td></tr></table>	The default COP value is derived from the result of survey on COP of chillers from manufacturers that has high market share. The survey should prove the use of clear methodology. The $COP_{RE,i}$ should be revised if necessary from survey result which is conducted by JC or project participants every three years.

【Review-2: Introduction of solar power generation system】

The methodology of introducing the solar power generation system can also 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.

(4) Cost effectiveness of project profitability and JCM subsidy

【Review-1: Introduction of high efficiency chiller system】

Generally when a construction company of a developed country such as Japan, Europe and the United States complete projects, they submit all the relevant documents such as drawings, calculation notes, equipment list etc. to the client as per contract. However, according to Japanese EPC Company, because there are no customs such as submitting projects document to client in Myanmar, information of past construction often does not remain as a record. In case of Mandalay International Airport, the installation work of the existing faulty chiller system was done before COMPANY A got the business right, therefore the COMPANY A did not own the information of the existing air conditioning system. Under these circumstances, it takes time to acquire information which is necessary to start estimate work. Because of this, the estimation of the project cost of this project has not been completed and economic consideration can’t be carried out.

As a reference value, the amount of JCM equipment subsidy is calculated from the calculated annual Amount of CO_2 emission reduction by the expected cost-effectiveness of JCM equipment subsidies of 4,000 yen / ton-CO_2. The results is as follows. In determining the project period, the statutory useful life of the airport is assumed to be 25 years, referring to the revised model by the Ministry of Internal Affairs and Communications. In addition, trial calculations are made based on two types of grid emission factors (① = 0.332 (ton - CO_2 / MWh), ② = 0.1 (ton - CO_2 / MWh)).

Amount of CO_2 emission reduction during project period (ton-CO_2)　（Assumed project period is 25 years ）

- Result.① ＝ 3,375 ton- CO_2
- Result.② ＝ 1,050 ton- CO_2

Amounts of JCM subsidy calculated from cost-effectiveness (4,000 yen/ton-CO_2).

- Result.① ＝ 13,500,000 円
- Result.② ＝ 4,200,000 円

【Review-2: Introduction of solar power generation system】

The initial investment of the solar power generation system varies depending on the construction company. For this estimation, it assumed that it is 2 USD/W. The amount of JCM subsidy is calculated from the annual CO^2 emission reduction by the expected cost-effectiveness of JCM equipment subsidies of 4,000 yen / ton-CO^2. The result is shown as follows. In addition, it is assumed that special purpose entities (SPVs) that conduct lease-type projects, which will be described later, own solar power generation systems and sell power to the airport. Therefore, the statutory useful life is set to 17 years.

Initial Investment

＝ System Output 2.85 MW × Initial Cost Unit 2 USD/W

＝ 627,000,000 yen （Assumed that USD = 110 yen）

Amounts of JCM subsidy calculated from cost-effectiveness (4,000 yen/ton-CO_2).

＝ (1211.2 ton-CO_2/year × 17 project year) × 4,000 yen/ton-CO_2

＝ 823,616,000 yen （13.1% of initial investment）

2.2.3 Examination of project implementation system

Figure 2-8 shows the image of the project implementation system when promoting JCM subsidy project. Since COMPANY A intended to not join the international consortium, survey team examined the structure which set COMPANY A outside the international consortium. As local joint venture companies, a Special Purpose Vehicle (SPV) to be established, assuming a lease-type scheme in which the established SPV owns facilities and lends equipment to COMPANY A.

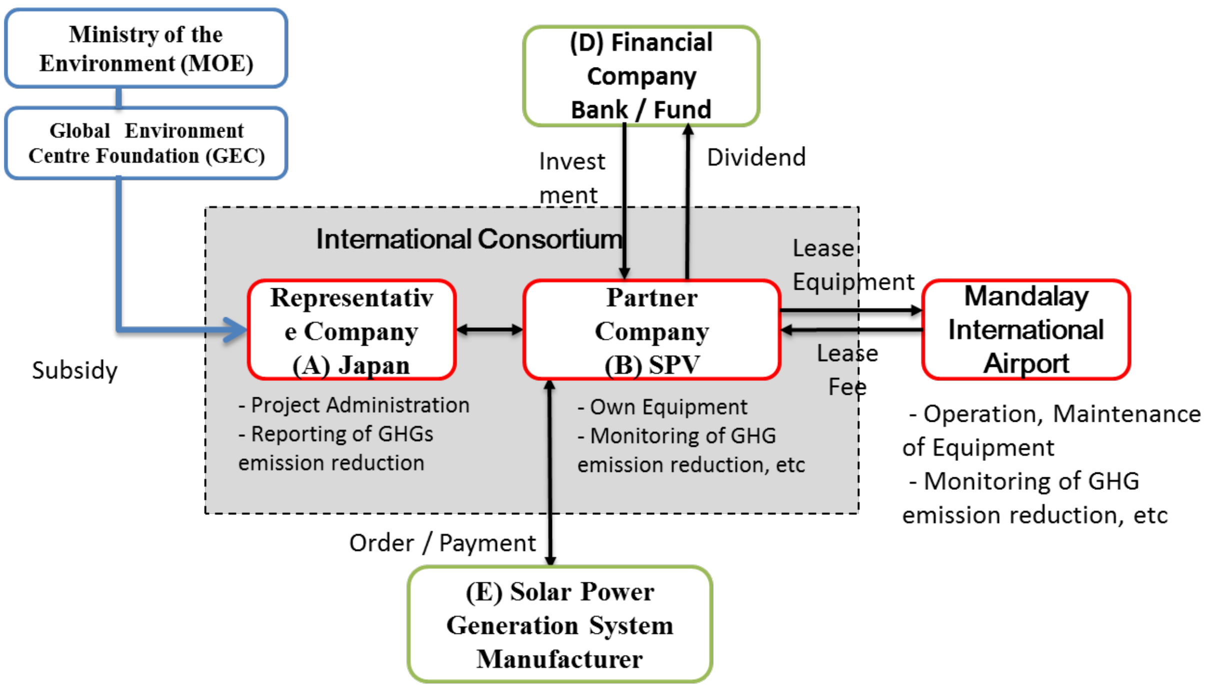


Figure.2-8. Assumed Implementation System

2.2.4 Examination of fund procurement method

As mentioned above, the SPV, which was launched as a joint venture, purchases equipment and doing a lease-type business that lends it to COMPANY A (Operating company of Mandalay International Airport). Therefore, COMPANY A does not require 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 moved to COMPANY A.

Regarding fund procurement, utilization of local banks and funds for financing of SPV is considered. In particular, it is supposed to procure funds through collaboration with infrastructure funds that invest only in projects that contribute to reducing CO_2 emissions.

2.2.5 Examination of the project implementation schedule

As mentioned above, this project is in the process of estimation and duration of construction is unexamined. Since COMPANY A intends to implement the introduction of the chiller system next fiscal year, survey team aim to apply for JCM subsidy project of fiscal year 2018. As for the solar power generation system, since introduction of the chiller system is prioritized, it has not reached the specific examination stage, but parallel consultation is assumed.

Chapter 3 JCM project investigation <Biomass project>

3.1 Overview of investigation

We conducted the feasibility study of JCM subsidized projects in fields regarding introducing power generation systems using biomass such as rice husk, livestock excreta, etc (biomass project) .

Organizations which we visited and suggested to in the investigation is shown Table 3.1.1.

Table 3.1.1 Organizations visited and content of proposal (May, 2017～January,2018)

No.	Organizations visited	Quantity	Content of proposal
1	Rice processing plants (Sagaing region)	1	Biomass power generation
2	Powdered milk, condensed milk factories (Mandalay region)	1	
3	Livestock production facilities (Mandalay region: 2 facilities, Bago region: 1 facility)	3	Biomass power generation
4	Mandalay University	1	
5	Confectionery factories (Mandalay industrial zone)	1	
6	Distilleries (Mandalay industrial zone: 2 distilleries, in the suburb of Yangon: 2 distilleries, within the city of Yangon: 1 distillery)	5	Biogas system (biogas specialized boilers), water treatment facility.
7	Restaurants (Chinese restaurants built in Yangon, Mandalay)	1	BDF production equipment

According to the survey result, there are 4 projects deemed to be capable of installing this system, we have considered techniques of installation, efficiency of CO2 reduction, cost-effectiveness of JCM equipment subsidy, profitability (Business profitability) of the project, MRV methodology.

The review results are described in table 3.1.2, the project has big scale of emission in order of 1) the biogas system and the wastewater treatment system in distilleries, 3) Rice husk based power generation facilities of rice processing plants.

The high cost-effectiveness of JCM equipment subsidy is 1) biogas system / wastewater treatment system of the distillery factory. In addition, the project profitability becomes very high when the project 1) is implemented for companies whose operations are stopped by the administration because the factory wastewater exceeds the environmental standard value.

4) Install BDF production equipment for restaurants although the emission reduction is small but the scale of the project in Yangon area is large, so the cost-effectiveness of JCM equipment subsidy or the business profitability is high.

1) Introduction of Bio Gas systems and Wastewater treatment systems to distilleries
2) Introduction of Biogas Generation Systems in Livestock Production Facilities
3) Introduction of Power Generation Facilities Utilizing Rice Husk to Rice Processing Plants
4) Introduction of BDF Production Equipment to Restaurants

Table 3.1.2 Total project cost, reduced emissions, cost-effectiveness of each project

Project	Total project cost (initial cost) (million JPY)	Reduced emissions By year (tCO2e/year)	Reduced emissions Project time (tCO2e)	Cost-effectiveness of JCM equipment subsidy (JPY/tCO2e)	Business profitability (initial cost payback period) (years)
1) Biogas systems and wastewater treatment systems in distilleries	・682 ・473*	・28,417 ・6,541*	・284,170 ・65,410* (10 years)	・1,199 ・3,608* source)	Business profitability is high when introducing it to factories under suspended operation. 25.5*
2) Biogas power generation systems in livestock production facilities.	360	398	2,786 (7 years)	64,600	12.4
3) Rice husk power generation systems in rice processing plants.	660	3.315	33,150 (10 years)	7.964	3.6
4) BDF production equipment in restaurant chains.	Yangon 5.3	84	670(8 years)	3.955	4.4
	Mandalay 3.75	16	128 (years)	14.650	16.0

*When reducing energy-derived CO2

(1) Install rice husk power generation systems in rice processing plants

According to an interview with the rice association in Mandalay region, rice husk hasn't been sold anymore for the last 2 years, resulting in redundancy of rice husk. The reason is that many sugar factories which buy to resell rice husk has lost the market, gone bankrupt due to failure to compete with China's products with cheap price and higher quality. Furthermore, similar to distilleries which buy then resell rice husk must stop operation due to wastewater issues. Even so, there are many rice processing plants in electrified areas. Due to the cheap power prices, the demand for power from rice husk is also low.

On the other hand, in Mandalay region the rice processing plants have milling capacity of less than 20t/day and there are difficulties in concentrating rice husk, so we have investigated Sagaing region, the second largest rice granary in Myanmar right next to Mandalay region. The result is that there is in Sagaing region concentration of rice processing plants which have desired to generate power from rice husk, so we have considered the possibility of installing rice husk based power generation systems (2MW) for rice processing plants in this industrial zone. The review results are shown in table 3.2.3.


Photo 3.1.1　Rice milled rice made in Japan used in rice mills (Sagaing region)

(2) Install rice husk based power generation systems in powdered milk, condensed milk factories

In the powdered milk, condensed milk factories in the south of Mandalay region, there is usually a power cut at week-ends, so they must operate home generators (diesel generators).

These factories shall incur fuel of operating diesel generators, so they are very interested in installing rice husk power generation with capacity of 2MW. The result of considering the installation of rice husk power generation systems with capacity as presented in 3.2.3.


Photo 3.1.2　Appearance of milk powder factory · Milk dewatering machine made in China (Mandalay region)

(3) Install biogas power generation facilities in livestock production facilities.

According to an interview with MCDC or JICA Myanmar office, almost livestock production facilities in Myanmar are households with breeding as their auxiliary agricultural job while there are few large-scale livestock production facilities. There are 4 relative large-scale livestock production facilities in Mandalay region and chicken farms with scale of 40,000 chickens, pig farms with scale of 100 pigs, cow farm with scale of 200 cows (milk cows) (in which there are 2 cow farms) in the adjacent region. However, a company with pig farms plan to build chicken farms with scale of 14~30 ten thousand chickens.

In addition, this company is interested in biogas power generation facilities, so we have considered the construction and installation of biogas generation facilities here. The consideration results are shown in table 3.2.2

Photo 3.1.3 Milk cow livestock production facility with scale of 200 cows (Bago region)

(4) Install biogas power generation facilities in Mandalay University

The faculty of chemical engineering belonging to Mandalay University is studying the biogas power generation which utilizes redundant agricultural products, livestock excreta or the organic fertilizer production method which utilizes redundant waste after generating biogas.

According to requests of Mandalay University, we have presented information as well as cost related to biogas power generation facilities as described in item (3). However, the construction cost of biogas power generation facilities, estimated cost of the university can’t be met, we haven’t considered more specifically.

Finally, we have talked, exchanged Kyoto University which is jointly cooperating in the global environment study with Asian universities to consider whether it’s possible to coordinate with Mandalay university to jointly study organic biogas such as biological waste or not.

Photo 3.1.4 Biogas test in Mandalay university

(5) Install biogas power generation equipment in confectionery factories

We cooperate with Mandalay Industrial Zone Management Committee to survey the feasibility of building biogas power generation facilities which utilize organic waste discharged from food production factories in this industrial zone.

We had an interview with a confectionery factory, which is the largest food factory in the industrial zone. However, the factory isn’t large enough to build a biogas power generation facility, so we haven’t conducted any further consideration.

Photo 3.1.5　Appearance of the confectionery factory and organic waste
(Mandalay industrial zone)

(6) Install biogas systems and wastewater treatment systems in the distilleries

Within the city of Mandalay, there is a distillery but it currently doesn’t operate as the distillery’s wastewater fails to meet environmental standards. In addition, we find that this distillery can’t effectively utilize biogas generated during the wastewater treatment process.　Therefore, we have considered the installation of new biogas system by effectively reclaiming biogas for use as a fuel for boilers and a wastewater treatment system with large capacity. The consideration results are shown in table 3.2.1

Like the above distillery, there are, in Yangon or Mandalay, many factories which are forced to close down due to their wastewater issues. So I think the demand for biogas systems and good wastewater treatment systems developed by Japanese enterprises will be quite high. (Refer to the article below)

＜The article deals with the state's administrative regulations on wastewater＞

HEARTBEAT OF THE NATION

MYANMAR TIMES

Yangon factories told to treat water or else

October 23, 2017

The government warned factories to treat their wastewater properly before disposing it into rivers or face penalties, including closure of their facilities.

There are total of 72 distilleries around the country and out of 16 distilleries located in Yangon Region, 14 have been closed temporarily for not have wastewater treatment facility, according to PCCD’s statistics.

(7) Install BDF production equipment in restaurants.

The Chinese restaurant chain including 2 restaurants within the city of Mandalay currently discharges untreated waste cooking oil (sunflower oil) to the environment. Therefore, we have considered the production of BDF (Bio Diesel Fuel) from these waste edible oil to use them as fuels for trucks or fuels for home generators. In addition, this restaurant also has six shops in Yangon city and is expected to scale up horizontally. The consideration results are shown in table 3.2.4

3.2 Examination of Introduction Technology

We considered technical contents to be applied, efficiency of CO2 reduction, cost-effectiveness of JCM equipment subsidy, economic viability of the project, MRV methodology regarding the following 4 projects.

1) Introduction of Bio Gas systems and Wastewater treatment systems to distilleries
2) Introduction of Biogas Generation Systems in Livestock Production Facilities
3) Introduction of Power Generation Facilities Utilizing Rice Husk to Rice Processing Plants
4) Introduction of BDF Production Equipment to Restaurants

3.2.1 Introduction of Bio Gas systems and Wastewater treatment systems to distilleries

We have considered the installation of equipment in Whisky plant in Mandalay city. The current wastewater treatment system follows the flowchart described in figure 3.2.1.1. However, it's impossible to recover biogas generated in the anaerobic treatment process (Methane fermentation tank). As the treated wastewater exceeds permissible environmental standards, the wastewater treatment plant has been stopped by the government.

Therefore, we have considered introducing new wastewater treatment systems and Biogas systems to recover Biogas efficiently and to use it as fuel for boilers.

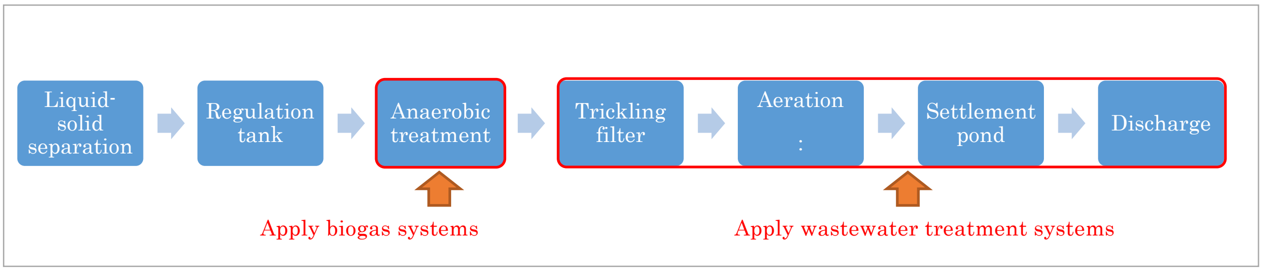


Figure 3.2.1.1. Wastewater treatment flowchart at Whisky plant

(1)Overview of techniques

In this consideration, we apply an anaerobic membrane methane fermentation system as a biogas system and MBR system as a wastewater treatment system (see Figure 3.2.1.2).

The anaerobic membrane methane fermentation system is a system which operates in the principle that wastewater from the Whisky plant (Whisky cake) is pretreated at a screening tank, a dissolving tank , biogas (Methane : 60%, CO2:40%) generated in the methane fermentation tank will be recovered and used as a fuel for gas generators or boilers.

In this system, an anaerobic membrane tank is equipped to separate methane fermentation inhibitors, and methane bacterium groups and to remove the inhibitors to outside the system. Therefore, it is possible to well maintain development conditions of methane bacterium groups, to maintain concentration of high methane bacterium groups and to increase methane recovery efficiency.

Because the MBR system filters activated sludge with a membrane which has pore size of 0.2 μm, it's possible to collect water with better quality compared with the standard activated sludge method combined with sand filters and sterilization equipment. Furthermore, MBR may save installation area with the installation area occupying 30 ~ 50 % that of the standard activated sludge method (See figure 3.2.1.3).

Therefore, this is a useful device for distillery companies - production facilities which desire to expand production but can’t meet the workshop area.

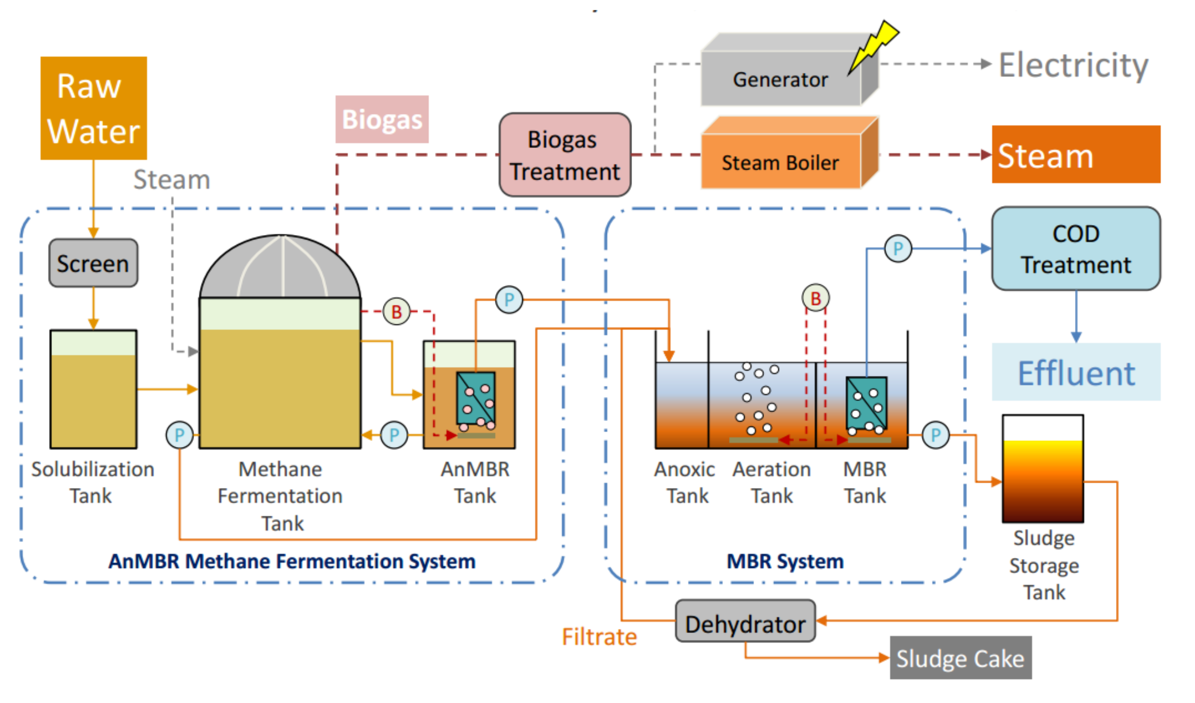
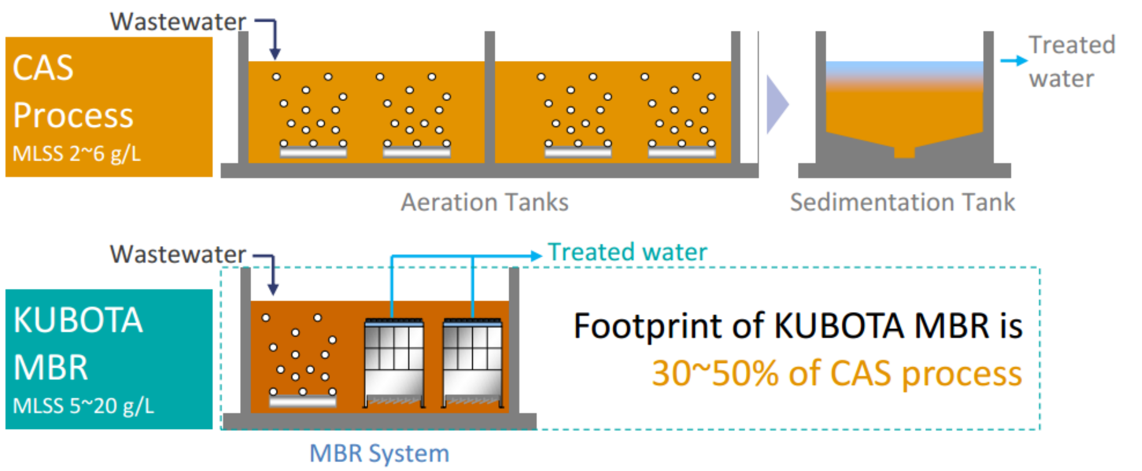


Figure 3.2.1.2. An MBR Methane Fermentation System + A MBR System[1]



In the MBR system, a sedimentation tank is not required and it’s possible to minimize the aeration tank.

Figure 3.2.1.3. Save the installation area of a wastewater treatment system due to the use of MBR

(2)CO2 reduction effect

It's possible to use methane collected from the above system to ferment the anaerobic membrane instead of coal which is currently used as a fuel for boilers, reducing discharged CO2 (Reduce emissions from the use of energy).

With the application of a MBR system, it's possible to reduce methane discharged to the atmosphere in wastewater treatment processes in plants.

In this part, we refer to JCM methodology in previous studies "Methane recovery from organic effluent through controlled anaerobic digestion and its use for energy in Myanmar[2]" to calculate emission to be reduced.

1) Reference emission amount

・Reference emissions are calculated by CH4 generated from organic wastewater treated by sedimentation tanks in an open system and CO2 generated from the use of fossil fuels.

・COD of raw water from the Whisky plant - the project plant is 60,000 mg/L and COD of treated water from the current device is 6,000 mg/K, which doesn't meet environmental standards (COD: 250 mg/L). In the future, if the device is improved, the volume of treated water may meet environmental standards. The treatment process is installed after referring to the treatment equipment in Yangon treatment plant of Whisky company – the owner of the project plant (Refer to the table below).

・In terms of power consumption in the treatment process, we expect to use power equal to or greater than the power amount consumed for the project activities, we fail to meet the target of reducing CO2 generated in power consumption.

Table 3.2.1.1. Water quality before and after treatment according to treatment methods (reference scenarios)

Treatment method	Water quality	Before treatment (mg/L)	After treatment (mg/L)	Note
Liquid-solid separation (Settlement tank)	CODcr	60,000	40,000	
Anaerobic treatment	CODcr	40,000	6,000	Not recover methane
Aerobic treatment	CODcr	6,000	700	
Settlement pond	CODcr	700	250	

a) Reference emission amount

$\underline{RE_y = RE_{treatment,y} + RE_{discharge,y} + RE_{power}}$

$=21{,}876+14+6{,}545$

$=28{,}435\ tCO2e$

In which,

RE_y : Reference emissions in year y (tCO2e)

$RE_{treatment,y}$: CH4 emissions from reference wastewater in year y (tCO2e) (R1)
$RE_{discharge,y}$: CH4 emissions from effluent discharged into sea, river or lake in year y (tCO2e) (R2)
RE_{power} : CO2 emissions from consumption of electricity and/or fossil fuel in year y (tCO2e) (R3)

b) CH4 emissions from the wastewater treatment system

$$\underline{RE_{treatment,y} = \Sigma_i\{ Q_y * (COD_{inflow,i,RS} - COD_{outflow,i,RS}) /1,000,000 * MCF_{treatment,RS,i} \} * B_{o,ww} * UF_{RS} * GWP_{CH4}}$$

$$= 120,000\times((60,000 - 40,000)/1,000,000\times0.5 + (40,000 - 6,000)/1,000,000\times0.8 + (6,000 - 700)/1,000,000\times0.3 + (700 - 250)/1,000,000\times0.5)\times0.25\times0.89\times21$$

$$= 21,876 \ tCO2e$$

In which

i : Wastewater treatment system code in the reference scenario

Q_y : Volume of wastewater treated in year y (m^3) 400m^3/day×300day＝120,000m^3

$COD_{inflow,i,RS}$: Concentration of COD in the wastewater flows in to the system i in the reference scenario (mg/L)

$COD_{outflow,i,RS}$: Concentration of COD in the wastewater flows out from the system i in the reference scenario (mg/L)

$MCF_{treatment,RS,i}$: CH4 correction factor for reference wastewater treatment systems i

Determine according to the table below.

Table 3.2.1.2. Default values of Methane correction factor (MCF) (IPCC)[3]

Type of treatment system	MCF
Discharged into the sea, river and lake	0.1
Treated in a well-managed aerobic situation	0.0
Treated in a unwell-managed aerobic situation	0.3
Anaerobic reactor, which does not collect methane	0.8
Anaerobic shallow lagoon (Depth less than 2 metres)	0.2
Anaerobic deep lagoon (Depth more than 2 metres)	0.8
Latrine tank	0.5

$B_{o,ww}$: CH4 producing capacity of the wastewater (t-CH 4/t–COD)

Apply 0.25t-CH4/t-COD as stipulated by IPCC[3].

UF_{RS} : Model correction factor to account for model uncertainties Apply 0.89

GWP_{CH4} : Global Warming Potential for CH4 Apply 21

c) CH4 emissions from decomposable organic matters in treated water discharged to rivers, lakes, oceans.

$$\underline{RE_{discharge,y} = Q_y * GWP_{CH4} * B_{o,ww} * UF_{RS} * COD_{discharge,RS} / 1,000,000 * MCF_{discharge,RS}}$$

$$= 120,000\times21\times0.25\times0.89\times250/1,000,000\times0.1$$

$$= 14 \ tCO2e$$

In which

Q_y ：Volume of wastewater treated in year y (m^3) $400m^3/day \times 300day ＝ 120{,}000m^3$

GWP_{CH4} ：Global Warming Potential for CH4 Apply 21。

$B_{o,ww}$ ：CH_4 producing capacity of the wastewater (t-CH4/t–COD)

Apply 0.25t-CH4/t-COD as stipulated by IPCC[3].

UF_{RS} ：Model correction factor to account for model Apply 0.89

$COD_{discharge,RS}$ ：Concentration of COD discharged into sea, river or lake in the reference scenario

$MCF_{discharge,RS}$: CH4 correction factor for discharged effluent in the reference scenario

Determine according to table 3.2.1.2.

d) CO2 emissions from the consumption of fossil fuels

$\underline{RE_{power,y} = RE_{thermal,y}}$

$= 72{,}240 \times 0.0906 = 6{,}545\ tCO2e$

In which

$RE_{thermal,y}$ ：CO 2 emissions from consumption of fossil fuel (tCO2e)

$RE_{thermal,y} = EG_{net,thermal,PJ,y} * EF_{FF,RS}$

$EG_{net,thermal,PJ,y}$ ：Thermal energy of fossil fuel in year y（GJ）

＝Design value after implementing the project ※

※ Biogas volume recovered when implementing the project：

$11{,}200Nm^3/day \times 300day \times$ quantity of biogas of biogas $21.5MJ/Nm^3 ＝ 72{,}240GJ$

$EF_{FF,RS}$ ：CO2 emissions factor of fossil fuel (tCO2/TJ)※

※CO2 emission factor of coal [4]＝0.0247tC/GJ×44/12=0.0906tCO2e/GJ

2) Project emission amount

a) Project emission amount

$\underline{PE_y = PE_{treatment,y} + PE_{discharge,y} + PE_{power,y}}$

$= 0 + 18 + 0$

$= 18\ tCO2e$

In which

PE_y ：Project emissions during in year y (tCO2e)

$PE_{treatment,y}$ ：Project CH4 emissions from effluent treatment system without biogas plant, affected by the project activity (tCO2e) (P-1)

$PE_{discharge,y}$: Project CH4 emissions from effluent discharged into sea, river or lake (tCO2e) (P-2)

$PE_{power,y}$: CO2 emissions from electricity and/or fossil fuel used by the project activity (tCO2e) (P-3); *Energy consumed in activities of the project such as expected power amount will be very small compared with that of the reference scenario. It will be close to 0 similar to the reference scenario.*

b) CH4 emissions from the waste treatment system

$$PE_{treatment,y} = \Sigma_i \{ Q_y * \Delta COD_{i,y} / 1,000,000 * MCF_{treatment,PJ,i} \} * B_{o,ww} * UF_{PJ} * GWP_{CH4}$$

$$= 120,000 \times (60,000 - 250) / 1,000,000 \times 0.0 \times 0.25 \times 1.12 \times 21$$

$$= 0$$

In which

i : Wastewater treatment system code of the project

Q_y : Volume of wastewater treated in year y (m^3) 400m^3/day×300day＝120,000m^3

$\Delta COD_{i,y}$: The amount of COD removed in the wastewater in the system i in year y (mg/L)

$MCF_{treatment,PJ,i}$: CH4 correction factor for project wastewater treatment

Treated in a well-managed aerobic situation; 0 (table 3.2.1.2)

$B_{o,ww}$: CH4 producing capacity of the wastewater (t-CH4/t-COD)

Apply 0.25t-CH4/t-COD as stipulated by IPCC.

UF_{PJ} : Model correction factor Apply 1.12

GWP_{CH4} : Global Warming Potential of methane Apply 21

c) CH4 emissions from decomposable organic matters in treated water discharged to rivers, lakes, oceans.

$$PE_{discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{discharge,PJ,y} / 1,000,000 * MCF_{discharge,PJ}$$

$$= 120,000 \times 21 \times 0.25 \times 1.12 \times 250 / 1,000,000 \times 0.1$$

$$= 18 \text{ tCO2e}$$

In which

$Q_{ww,y}$: Amount of effluent treated in the system in year y (m^3)

GWP_{CH4} :Global Warming Potential of methane Apply 21

$B_{o,ww}$: CH4 producing capacity of the wastewater (t-CH4/t-COD)

Apply 0.25t-CH4/t-COD as stipulated by IPCC.

UF_{PJ} :Model correction factor Apply 1.12

$COD_{discharge,PJ,y}$: Concentration of COD in the treated wastewater discharged into sea, river or lake in year y (mg/L)

$MCF_{discharge,PJ}$: CH4 correction factor based on discharge pathway Apply 0.1

3) Emission reduction amount

Reduced emissions are the reference emissions minus the emissions of the project.

$\underline{ER_y = RE_y - PE_y}$

$= 28,435 - 18 = 28,417 tCO2e$

Reduced emissions generated in the fuel consumption will be equivalent to CO2 generated in the fossil fuel consumption of the reference scenario.

$\underline{ER_{Eng\text{-}Org,y} = RE_{thermal,y}}$

$= 6,545\ tCO2e$

Reduced emissions in the implementation phase of the project ER_p

$\underline{ER_p = ER_y \times P}$

$= 28,417 \times 10$

$= 284,170\ tCO2e$

In which

P: The project implementation time; The legal use time of devices used in the beverage industry = 10 years.

Reduced emissions generated from the use of energy in the project implementation time $ER_{Eng\text{-}Org,p}$

$\underline{ER_{Eng\text{-}Org,p} = ER_{Eng\text{-}Org,y} \times P}$

$= 6,545 \times 10$

$= 65,450\ tCO2e$

(3)Cost-effectiveness

1) Equipment cost (Initial cost)

Summary of equipment is described in table 3.2.1.3. Equipment cost is approximately USD 6.2 million (including civil works construction cost).

Equipment to reduce emissions from the use of energy is the methane fermentation system, biogas specialized boilers. Cost of this equipment is approximately USD 4.3 million (including civil works construction cost).

Table 3.2.1.3. Summary of installed equipment

Equipment	Summary
Anaerobic membrane methane fermentation system	･Anaerobic membrane tank: approximately 200m^3 ･Dissolving tank and methane fermentation tank : Approximately 800m^2× 12m depth.
Biogas specialized boilers	・ Including biological sulfur remover, booster ・ Meet approximately 11,200 Nm3/day biogas (CH4 60%) ・ Once-through steam boiler ・ 2,000 kg/h（each base）×2 bases ・ Steam pressure: 1.96 MPaG
MBR system	･Anaerobic tank, Aeration tank , MBR tank: approximately 3,000m^3

2) Cost-effectiveness

Cost-effectiveness is calculated by dividing JCM equipment subsidy for the initial cost by emission reduction amount during the project period.

Cost-effectiveness = Approximately USD 6.2million ×50%／284,170 tCO_2e
= Approximately 10.9USD/ tCO_2e = Approximately 1,199JPY / tCO_2e (1USD＝110 JPY)

In term of cost-effectiveness related to reduced emissions generated from the use of energy, if the desire is similar, we can obtain the result as follows.

The cost-effectiveness related to reduced emissions generated from the use of energy
= Approximately 4.3million USD×50%／65,450 tCO_2e
＝Approximately 32.8USD/ tCO_2e＝Approximately3,608 JPY/ tCO_2e (1USD＝110JPY)

(4)Business profitability

If this project is implemented in the factory which is suspended due to factory wastewater exceeding environmental standards, the business profitability will be very high because cost-benefit ratio (B／ C) will be the main business profit ／ total project cost of the factory.

The collection period of the initial cost burden can be obtained from the following formula, which is about 25.5 years. However, in reality, not only reduction of coal but also maintenance cost can be expected to be reduced (effects of maintenance and management cost reduction due to reduction of sludge generation by installing anaerobic membrane fermentation system, etc).

【Payback period of initial cost】
= 【Initial cost】／【Fossil fuel cost of existing boilers (coal) which can be reduced by introducing anaerobic membrane methane fermentation system and biogas exclusive boiler】

1) Annual coal reduction cost

-The volume of coal is equivalent to the amount of biogas heat collected from activities of the project = approximately 2,811t/year
-Cost of coal reduction = approximately 2,811t/year×approximately 30 USD /t
= approximately 84,330 USD /year

2) Payback period of initial cost

Initial investment cost payback period ＝Equipment cost ×50%／Cost of coal reduction
＝Approximately USD 4.3million×50%／Approximately USD84,330/year
＝Approximately 25.5years

(5)MRV methodology

The amount of reduced emissions is calculated based on JCM methodology - used in previous studies "Recover, use methane generated from organic wastewater in the anaerobic decomposition treatment in Myanmar". Factors and parameters in this methodology are displayed in the table below. Monitoring parameters, design values are established based on documents announced by international organizations and local governmental organizations as announced by IPCC.

Table 3.2.1.4. Method of establishing parameters, factors to calculate reduced emissions.

Factors/parameters	Interpretation of data	Establishment method
Q	Emissions from a distillery plant in the reference scenario (m3/year)	Actual measured value in the project.
$COD_{inflow,i,RS}$	COD in wastewater is put into a wastewater system i in the reference scenario (mg/L)	Actual measured value or design values before the project.
$COD_{outflow,i,RS}$	COD in wastewater from a system I in the reference scenario (mg/L).	Actual measured value or design values before the project.
$MCF_{treatment,RS,i}$	Methane correction factor of a system I	IPCC2006 manual, etc.
$B_{o,ww}$	Methane generation capacity of wastewater (t-CH 4/t–COD)	IPCC2006 manual, etc.
UF_{RS}	Model correction factor	As in SBSTA(Subsidiary Body for Scientific and Technological Advice) ,etc.
GWP_{CH4}	Global warming potential of methane	Documents of IPCC, etc.
Q_{RS}	Emissions from a distillery in the reference scenario	Actual measured value or design values.
$COD_{discharge,RS}$	COD in treated water discharged to rivers, lakes, oceans in the reference scenario (mg/L)	Actual measured value or design values.
$MCF_{discharge,RS}$	Methane correction factor of wastewater discharged in the reference scenario	Documents of IPCC, etc.
$EG_{net,thermal,PJ,y}$	Thermal energy of fossil fuel (=【Biogas volume recovered when implementing the project】×【Heat quantity of biogas】)	Actual measured value in the project.
$EF_{FF,RS}$	CO2 emission factor when changing fossil fuels (tCO2/TJ)	Values announced by the government of Myanmar (In the ordinance) ,etc.
$\Delta COD_{i,}$	The amount of COD removed in the wastewater in the system i in year y (mg/L)	Actual measured value in the project.
$MCF_{treatment,RS,i}$	Methane correction factor of a system i(project)	Documents of IPCC, etc.
UF_{PJ}	Model correction factor (project)	SBSTA(Subsidiary Body for Scientific and Technological Advice) ,etc.
$Q_{ww,y}$	Amount of effluent treated in the system (m^3)	Actual measured value in the project.
$COD_{discharge,PJ}$	Concentration of COD in the treated wastewater discharged into sea, river or lake (mg/L)	Actual measured value in the project.
$MCF_{discharge,PJ}$	CH4 correction factor based on discharge pathway	IPCC2006 manual, etc.

3.2.2 Introduction of Biogas Generation Systems in Livestock Production Facilities

The company in Mandalay city operating in the business of big livestock production facilities and aquaculture farms is planning to build a chicken farm (140,000 egg-laying hens). We surveyed the egg-laying hen farm in order to consider the installing a methane fermentation system using poultry manure, pig excrement and fish viscera and using methane gas as a generation fuel. This system is able to reduce power consumption and CO2 emission.

(1)Overview of techniques

The biogas generation system shown in figure 3.2.2.1 is constituted by solubilization tank, fermentation tank, gas holder and gas generator, etc.

Calculating from the amount of organic waste such as poultry manure (including poultry manure, fish viscera), the capacity of generation system will be 150 kW. The capacity of the expected biogas generation system and expected amount of organic waste are described in table 3.2.2.1. In this study, we apply a scalable container system which reduce construction cost to help the enterprise to meet expansion plans in future.

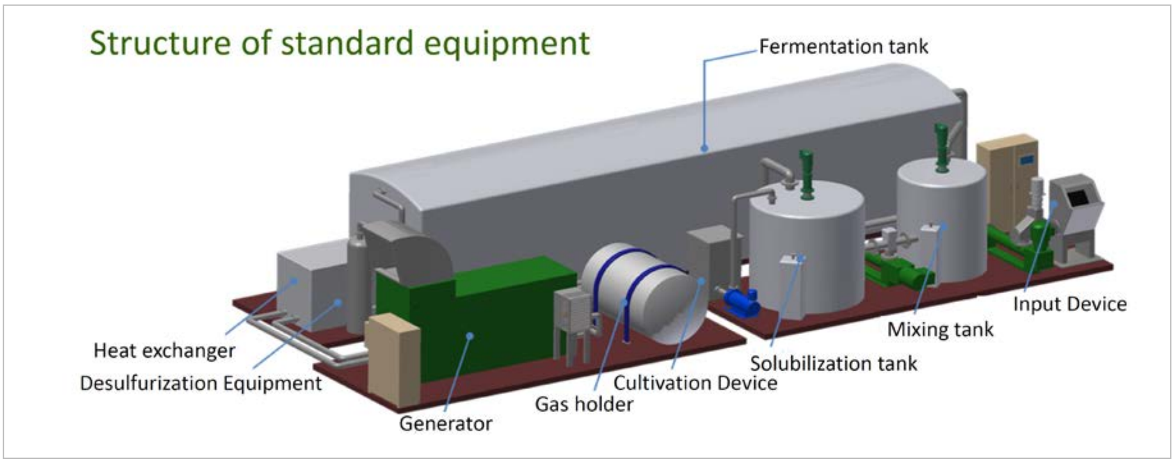


Figure 3.2.2.1 Biogas Power Generation System

Table 3.2.2.1 Scale of Biogas generator and Organic waste volume

Item	Content
Scale of system (Container system)	・Mixing tank： 40ft container×1 unit ・Dissolving tank： 40ft container×5 units ・Methane fermentation tank： 40ft container×8 units ・Generator 150kW：40ft container ×2 units → Total：40ft container ×16 units (Installation floor area：640 m^2)
Organic waste volume	・Input amount：Approximately 20t/day ＜Details＞ - Egg-laying hens : 140,000 hens → Poultry manure 19.0 t-wet/day - Pigs : 100 pigs → Pig stools 0.840 t-wet/day - Fish viscera → 100-120 kg/day

(2)CO2 reduction effect

In term of reduced emissions, we calculate based on referring approved CDM methodology “EN-R-007 Ver.1.0: Replace fossil fuels or power grid with biogas (methane generated from the anaerobic fermentation)”.

1) Reference emissions

- In the reference scenario, all power used in chicken farms is covered from power grid.
- With poultry manure discharged from chicken farms, the reference scenario is similar to that in Mandalay region when poultry manure is used as a fertilizer.

a) Reference emissions

$$\underline{RE_y = RE_{y,M} + RE_{y,S}}$$

$$= 414 + 0$$

$$= 414\ tCO2e$$

In which

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

$RE_{y,M}$: *Main emissions in the reference scenario in y years.* In this study, it means emissions generated in the consumption of power from a power grid system.

$RE_{y,S}$: *Accompanied emissions in the reference scenario in y years. To indicate emissions when treating livestock excreta, in this study, emissions are assumed to be fertilized to agricultural land, so we consider the emissions to be 0.*

b) Reference main emissions

$$\underline{RE_{y,M} = EG_{PJ,y} \times EF_{elec}}$$

$$= 1,299 \times 0.319$$

$$= 414\ tCO2e$$

In which

RE_y : Reference emissions in y years (tCO2e)

$EG_{PJ,y}$: Amount of power generated in 1 year through activities of the project in y years (MWh) : 1,299MWh (1 year with 6,794hours of operation)

EF_{elec} : CO2 emission factor of grid power in a similar area in Myanmar: 0.319(tCO2e/MWh)[5]

2) Emissions of the project

a) Emissions of the project

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

$$= 16 + 0$$

$$= 16\ tCO2e$$

In which

PE_y : Emissions of the project in y years (tCO_2e)

$PE_{y,M}$: *Main emissions of the project in y years.* In this study, it means emissions generated from the use of installed equipment.

$PE_{y,S}$: *Accompanied emissions of the project in y years* (tCO_2e). It means emissions generated from the treatment of livestock excreta. However, in this study the emissions are generated from filtering sediment after the fermentation process of livestock excreta used as a liquid fertilizer, we may consider the emissions to be 0.

b) Reference main emissions of the project

$$\underline{PE_{y,M} = EL_{PJ,process,y} \times EF_{elec}}$$
$$=50\times 0.319$$
$$=16\ tCO_2e$$

In which

$PE_{y,M}$: Main emissions of the project in y years (tCO_2e)

$EL_{PJ,process,y}$: The amount of power consumption in activities of the project in y years (MWh): 50MWh

EF_{elec} : CO_2 emission factor in case of using grid power in corresponding areas of Myanmar ; 0.319(tCO_2e/MWh)[6]

3) Reduced emissions

Reduced emissions are the reference emissions minus the emissions of the project.

$$\underline{ER_y = RE_y - PE_y}$$
$$=414-16=398tCO_2e$$

Reduced emissions during the implementation of a project ER_p

$$\underline{ER_p = ER_y \times P}$$
$$=398\times 7$$
$$=2,786\ tCO_2e$$

In which

The project implementation time; The legal use time of devices used in the agricultural equipment = 7 years

(3)Cost-effectiveness

Cost-effectiveness is calculated by dividing JCM equipment subsidy for the initial cost by reduced emissions in the project implementation time. Take JCM equipment support ratio as 50%.

・Equipment cost = approximately 360,000,000 JPY

・Cost-effectiveness = Approximately JPY 360,000,000 x ×50%／2,786 tCO_2e

= approximately 64,600 JPY/ tCO_2e

(4)Business profitability

When introducing a biogas generation system, it's possible to reduce power consumption from grid power. In term of Business profitability, we may calculate the payback period of initial cost by dividing the initial cost excluding the JCM equipment subsidy by the annual profit obtained from the system (saved electricity bill - maintenance cost) and evaluate.

The result is that the equipment cost payback period is approximately 12.4 years. For enterprises in Myanmar which tend to do short-term business, this period is relatively long. However, in future when the power price increases, this is a field of business that may develop in a long term.

1) Reduced power cost in 1 year

Amount of power generated by a biogas generation system in 1 year is 1,299MWh×12.4JPY/kWh = 16,100,000 JPY (Power price: 150kyat/kWh＝12.4JPY/kWh)

2) Annual maintenance cost

Total power loss cost for a biogas generation system, desulphurization agent cost, equipment maintenance management cost = 1,600,000 JPY

3) Payback period of Initial investment cost

Initial investment cost payback period = Initial investment cost incurred by the enterprise / (Cost of reduced power cost in 1 year - Maintenance management cost in 1 year)

= Approximately 360,000,000 JPY ×50%／(16,100,000 JPY – 1,600,000 JPY)

= Approximately 12.4 years.

(5)MRV methodology

Reduced emissions are calculated based on approved CDM methodology "EN-R-007 Ver.1.0: Replace fossil fuels or grid power with biogas (Methane generated from anaerobic fermentation). Parameters displayed in this methodology are listed in the table below. The parameters are established based on monitoring, design values, documents announced by IPCC, local government.

In this study, we assume the biogas system is installed for a chicken farm, so the emissions from activities of the project in the reference scenario is 0. However, if trucks are used to transport poultry manure, it's required to calculate the amount of fuel consumed by the trucks and it's also required to calculate spent residue after its fermentation if the spent residue isn't used as a fertilizer.

Table 3.2.2.2 Method of establishing parameters, factors to calculate reduced emissions

Factor/parameter	Interpretation of data	Establishment method
$EG_{pj,y}$	Amount of power generated in 1 year after implementing the project (kWh)	Actual measured value
$EL_{pj,process,y}$	Amount of power consumption of bio gasification after implementing the project (kWh)	Actual measured value
EF_{elec}	CO2 emission factor of Grid power in localities of Myanmar	Establish based on documents announced by the government of Myanmar

3.2.3 Introduction of Power Generation Facilities Utilizing Rice Husk to Rice Processing Plants

In this survey we found that there was, in Shwebo in Sagaing region adjacent to Mandalay, an industrial zone concentrated with rice processing plants. Power grids in this industrial zone are usually subject to power outages and unstable voltage, so rice processing plants frequently must operate diesel generators utilizing rice husk in the office area. Rice husk is usually burned in fields or piled up in fields and aren't used effectively.

Therefore, we have considered the use of biomass power generation equipment utilizing unused rice husk in this industrial zone to reduce fuels used for diesel generators or power consumption in offices in order to minimize CO2 emissions.

Photo 3.2.3.1 Rice husk burned in fields

Photo 3.2.3.2 Rice husk piled up in plants

(1)Overview of techniques

In power generation facilities utilizing rice husk, apply direct combustion method. This method is the method of generating power by directly burning rice husk to create steam, which causes a turbine to rotate in order to generate power.

There is also a method of gasification power generation (Gasification power generation system) by the thermal decomposition from rice husk to create steam which runs a power generation gas engine. When the power generation scale is 2MW in this method, the initial cost or the running cost and the oil treatment (tar) cost are higher than those of the direct combustion method. In addition, we also consider impacts on the surrounding environment through using tar treatment water, using the direct combustion method.

When the power generation scale is 2MW as expected by rice processing plants (power generation terminal output: 2.35MW, power transmission end output: 2MW). Necessary rice husk amount for power generation is 40t/day (operation for 16h/day), which may be fully met in the industrial zone because the industrial zone is discharging 150t/day.

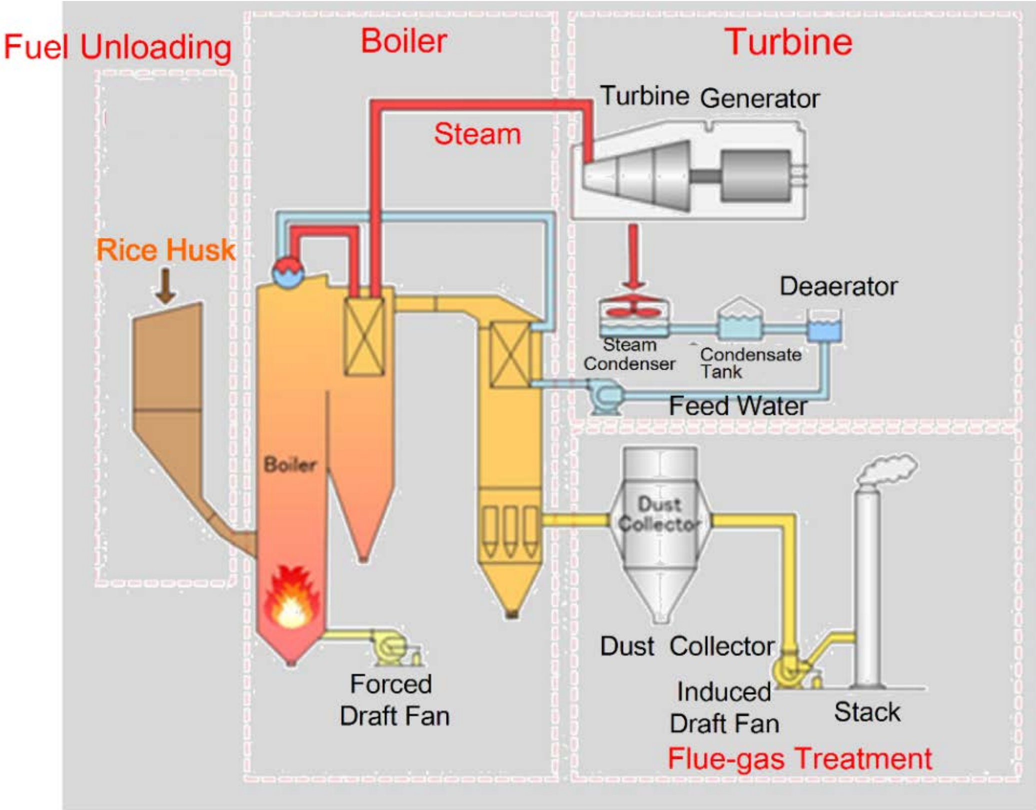


Figure 3.2.3.1 Direct combustion method

(2)CO2 reduction effect

In this part, we will consider emission reduction amounts after referring to the methodology discussed in previous survey reports[7]

1) Reference emissions

・The surveyed area is frequently subject to power outages and the rice processing plants must frequently operate diesel generators. However, the power grid system is assumed to be improved in future, then the power supply of the rice processing plants will, in the reference scenario, be grid power.

・Rice husk hasn't been effectively and have been frequently burned, therefore, methane emission will, in term of maintainability, not be considered due to piling up rice husk outdoors.

$$RE_y = EG_{PJ,y} \times EF_{elec,y}$$
$$=10{,}912 \times 0.319$$
$$=3{,}481\ tCO2e/year$$

In which,

RE_y : Reference emissions in y year (tCO2e/year)

$EG_{PJ,y}$: Annual power generation amount under the project activity (Quantity of net electricity generated by the renewable energy unit installed under the project activity in a year) (MWh) ;

2.0MW×16h/day×341days/year＝10,912MWh/year

$EF_{elec,y}$: Grid power emission factor in Myanmar (Grid power CO2 emission factor) ; 0.319(tCO2e/MWh)

2) Emissions of the project

Emissions of the project are emissions from light oils consumed in newly constructed power generation facilities and calculated according to the formula below. The emissions related to the transport and collection of rice husk is inconsiderable because the collection is done from adjacent rice processing plants. In addition, CO2 emissions are, in the reference scenario, assumed to be less than CO2 emissions of the transport of rice husk to burning sites and are not included in the formula.

$$PE_y = \sum_i FC_{i,y} \times EF_{i,y}$$

＝51,8×3.2

＝166 tCO2e/year

In which,

PE_y : Project emissions due to fossil fuel in a year (tCO2e/year)

$FC_{i,y}$: Fossil fuel i consumed in a year (t/year)

＝Fuel consumption amount at

startup (90L/hour×2hours)×Operation days in a year (341days/year)×Fuel specific

gravity (0.8439kg/L※)/1000=51.8t/year ※International Energy Agency et al,2004

$EF_{i,y}$: Emission factor of fossil fuel i (tCO2e/t)

＝3.2(tCO2e/t)※ ※CDM methodology AMS-I.B

3) Emission reduction amounts

The emissions amount reduction was calculated as the difference between the reference emission amount and the project emission amount according to the formula below. In addition, the emission reduction amounts for the project period (Statutory useful life) is determined by multiplying the annual emission reduction amounts by the project period (number of years). The statutory useful life is set at 10 years as the biomass power generation equipment utilizing rice husk can be considered to be equivalent to the rice husking equipment in the “Ministry directive on service life for depreciating amortization assets”.

Annual emission reduction amounts

$$ER_y = RE_y - PE_y$$

＝3,481 －166

＝3,315(tCO2e/year)

In which,

ER_y : Emission reductions in a year (tCO2e/year)

RE_y : Reference emissions in a year (tCO2e/year)

PE_y : Project emissions due to fossil fuel in a year (tCO2e/year)

Emission reduction amounts during project period ER_p

$$ER_p = ER_y \times P$$

$$=3,315(tCO2e/year)\times 10years$$

$$=33,150(tCO2e)$$

In which,

ER_p : Emission reductions during the period P (tCO2)

P : Project Period (year)

(3)Cost effectiveness

Cost-effectiveness is calculated by dividing JCM equipment subsidy over the equipment cost (initial cost) by emission reduction amount in the project period.

The cost of power generation equipment utilizing rice husk (2MW) is expected to be approximately USD 6.0million (including civil works construction cost). In addition, JCM equipment subsidy is estimated to be 40% the initial cost through similar work done with JCM equipment subsidy.

Cost effectiveness＝approximately USD 6.0million ×40%／33,150 tCO2e

＝Approximately 72.4USD/tCO2e= Approximately 7,964 円/tCO2e(USD1=110 円)

(4)Business profitability

It is possible to reduce power cost by using power generation facilities utilizing rice husk. In contrast, as the maintenance management cost for power generation facilities utilizing rice husk is costed, annual profit will deduct this the maintenance management cost from the power cost reduction. Evaluate by dividing the initial cost of the enterprise by the above calculated profit in consideration of the initial cost payback period.

The result is that the initial cost payback period of the enterprise is approximately 3 years and is evaluated to be highly profitable.

1) Power cost reduction

Annual power generation amount under the project activity＝10,912MWh/year

Power cost reduction＝10,912MWh/year×0.113USD/kWh

＝1.23millionUSD/year

(Power cost：150kyat/kWh＝0.113USD/kWh)

2) Maintenance management cost

Fossil fuel i consumed in a year x Unit price of fossil fuel

＝(90L/hour×2hours×341days/year)×0.49USD/L

＝0.03million USD/year

3) Initial cost payback period

Initial cost payback period

＝Equipment cost ×60%／(power cost reduction－Maintenance management cost)

＝Approximately USD 6.0million×60%／(USD 1.23million/year－USD 0.03million/year)

＝Approximately 3.0 years

(5)MRV methodology

Factors or parameters used to calculate emission reductions in this consideration are shown in the table below, set based on documents announced by international organizations or native local governments on monitoring or design values or announced by IPCC.

Table 3.2.3.1 Parameter, factor setting methods for emission reduction calculations

Factor, parameter	Data explanation	Setting method
$EG_{PJ,y}$	Annual power generation amount under the project activity (MWh)	The measurement and summary of power generation amount of power generation facilities installed in this project will be measured by a Wattmeter
$EF_{elec,y}$	CO2 emission factor of grid electricity in corresponding areas of Myanmar (tCO2e/MWh)	Set based on documents officially announced by the government of Myanmar.
$FC_{i,y}$	Fossil fuel i consumed in a year	The measurement and summary of fossil fuel consumed by power generation facilities installed in the project will be measured
$EF_{i,y}$	Emission factor of fossil fuel i (tCO2e/t)	Set based on documents officially announced by the government of Myanmar.

3.2.4 Introduction of BDF Production Equipment to Restaurants

(1) Overview of techniques

1) Overview of facilities to be installed and used

The Chinese restaurants including 2 shops in Mandalay city are very popular restaurants. These restaurants currently discharge approximately 5 gallons/day (equivalent to 22.7L/day) waste edible oil (sunflower oil). In addition, this Chinese restaurant also deploys 6 shops in Yangon city. The situation of discharging waste edible oil (sunflower oil) as shown in table 3.2.4.1 is approximately 83.5 L/day, more than 4 times that of Mandalay.

Here, we consider to produce BDF (Bio Diesel Fuel) from these waste edible oil to use as fuel for trucks or fuels for home generators.

Note that the restaurant in Mandalay doesn't treat waste oil in both shops and directly discharges to sewers, polluting water resources. Therefore, BDF treatment of waste edible oil also contributes to improving water pollution.

Table 3.2.4.1 Emission of Waste edible oil in the above restaurant in the city and consumption of diesel

Item	Mandalay	Yangon
1. Number of shops	2 shops	6 shops
2. Emission of edible oil	Approximately 22.7L/day (5gal/day)	Approximately 83.5L/day
3. Number of trucks	1ton×2 vehicles	2ton×8 vehicles, 1ton×4 vehicles
4. Amount of fuel consumed by trucks (Diesel)	380L/month (approximately 12.7L/day)	3,200L/month (approximately 107L/day)
5. Home generators	400KVA×1 unit 400KVA×2 units	400KVA×7 units Only 1 shop has 2 units and other shops have 1 unit
6. Amount of fuel consumed by home generators (Diesel)	320～360L/month(Months 3-9) 640～720L/month(Months 10-2)※ ※Power loss in dry season.	In recent times, there hasn't been no power loss, not use home generators.
7. Recycle waste edible oil	Not recycle untreated waste edible oil which is directly discharged to sewers.	Part of waste edible oil is used in soap plants.

(Source: Based on the survey, interview results of the shops)

Photo 3.2.4.1 Chinese restaurant in Mandalay city

Photo 3.2.4.2 Drainage channel of this restaurant

2) Overview of used techniques

BDF is a clean fuel which replaces diesel. BDF uses vegetable based waste edible oil such as rapeseed oil or sunflower oil to produce fatty acid methyl esters by esterification and ester metabolism. Plants like rapeseed absorb CO_2 in the atmosphere during their growth and development. During the entire life cycle of a plant, CO_2 in the atmosphere absorbed by the plant does not change, so burning fuels with this plant will reach "CO_2 count zero" or carbon neutralization (carbon neutral).

Photo 3.2.4.3 is an external photo of a BDF system, Photo 3.2.4.4 is an example of the BDF refining process. In addition, Photo 3.2.4.1 shows the BDF production flow, table 3.2.4.1 shows the results after comparing components of BDF and light oil (Diesel).

Photo 3.2.4.3 BDF production system (batch type)

Photo 3.2.4.4 BDF refining process

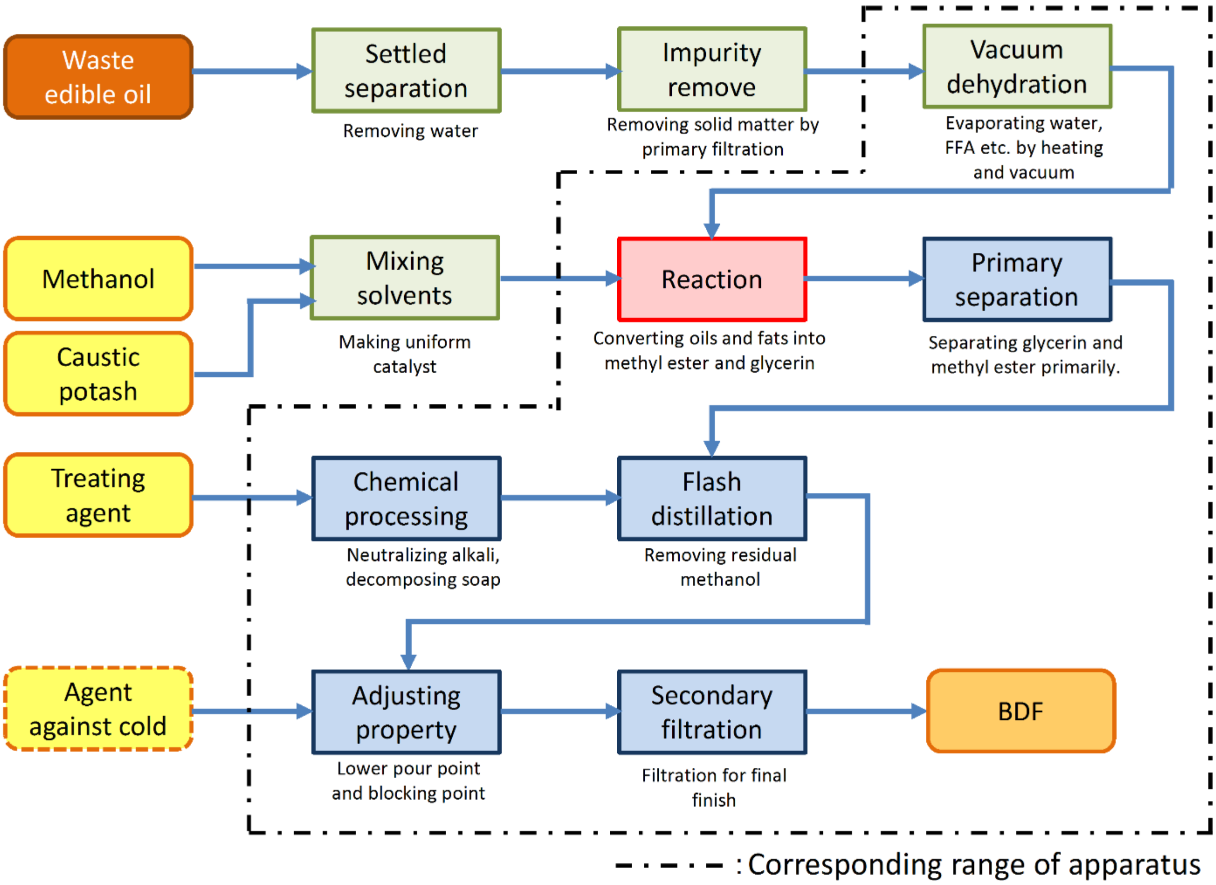


Figure 3.2.4.1 BDF production flow

Table 3.2.4.1 Comparing components of BDF and diesel

Item	BDF	Diesel
Density (g/cm3)	0.86-0.90	≦ 0.86
Melting point (°C)	≧ 120	≧ 50
Sulfur content (ppm)	≦ 10	≦ 10
Carbon residue (% mass)	≦ 0.3	≦ 0.1
Cetane value	≧ 51	≧ 50
Kinematic viscosity (mm^2/s)	3.5-5.0	≧ 2.7

The following is a simple demonstration of the characteristics of BDF.

■Characteristics of BDF

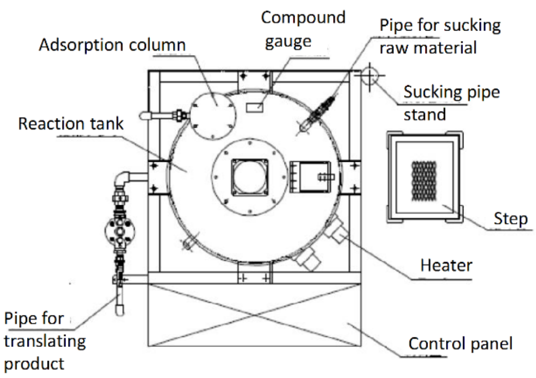
- Improve environmental pollution due to waste edible oil
- CO2 emission is zero count
- Black smoke emission is more less 1/3 than diesel fuel
- Sulfur oxide is rarely included
- Available for commercial diesel cars
- Show mileage and run characteristics that are equal to diesel fuel

3) Overview of the system

Table 3.2.4.2 shows in detail technical parameters of the used system, figure 3.2.4.2 shows the system overview diagram.

Table 3.2.4.2 Technical parameters of the used system

Type	D.・OIL 50H	D.・OIL 100H
Size	970L×750W×1,450H	970L×800W×1,770H
Weight	Approximately 150kg	
Capacity	50 L/batch	100 L/Batch
Operation method	Semi-automatic	Semi-automatic
Treatment time	7 hours /batch	7 hours /batch
Rated output	4 kW	6 kW
Power consumption	8.9 kWh/batch	13.3 kWh/batch
Machine price	2,500,000 JPY	3,500,000 JPY
Accessories	Fuel tank, catalyst tank, glycerin tank	



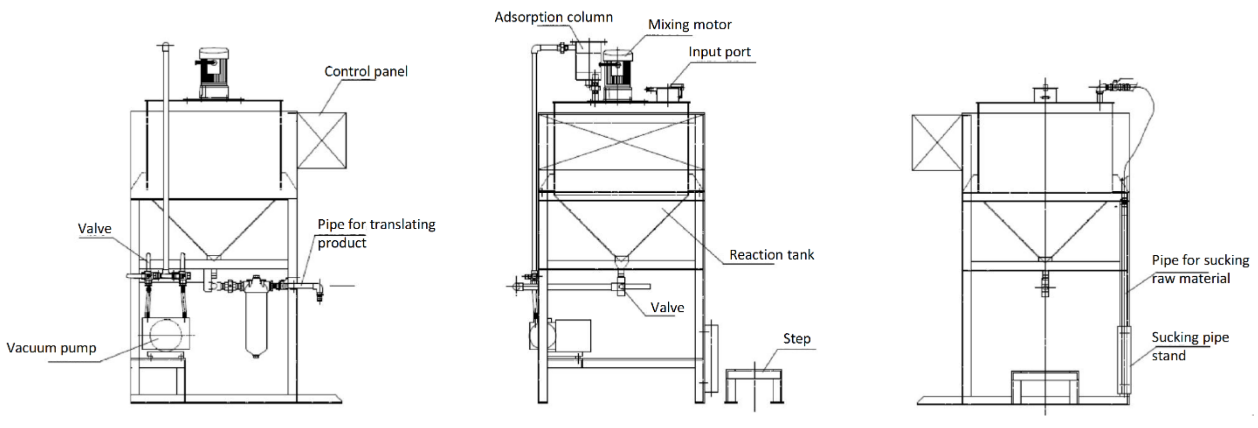


Figure 3.2.4.2 Overview diagram of BDF production equipment

4) Scale of applied system

Based on the scale of arising waste edible oil, the restaurant in Mandalay region, one of the 2 restaurants which will install this system will apply 50L/batch type as described in table 3.2.4.2. In addition, at restaurants in the Yangon area, out of the six restaurants will install 100L / batch system in a place with the shortest waste edible oil collection distance. The number of operation days in both regions are estimated at 330 days.

Table 3.2.4.3 Output, input results of the system applied in the Chinese restaurant in Mandalay

Input			Output		
- Waste edible oil	22.7	L/day	- BDF	19.7	L/day
- Methanol	4.07	L/day	- Waste glycerin	5.88	L/day
- Caustic potash	0.347	Kg/day	- Collected frozen solution	0.55	L/day
- Treating agent	0.016	L/day			
- Power consumption	3.51	kWh/day			

Table 3.2.4.4 Output, input results of the system applied in the Chinese restaurant in Yangon

Input			Output		
- Waste edible oil	83.5	L/day	・BDF	72.6	L/day
- Methanol	14.96	L/day	・Waste glycerin	21.64	L/day
- Caustic potash	1.278	Kg/day	・Collected frozen solution	2.03	L/day
- Treating agent	0.058	L/day			
- Power consumption	9.66	kWh/day			

Note that the use of BDF in the restaurants in Mandalay and Yangon shall meet conditions described in table 3.2.4.5 based on the current volume of arisen waste edible oil, used diesel and purposes of use.

Table 3.2.4.5 BDF use plan in restaurants

Item		Mandalay	Yangon
Truck fuel	Amount of supply	19.7 L/day	72.6 L/day
	Amount of demand	12.7 L/day (All supply is BDF)	106.7 L/day (In which, 72.6L/day is replaced with BDF)
Home generators	Amount of supply	7.0 L/day	—
	Amount of demand	8.0 L/day (In which, 7.0L/day is replaced with BDF)	—

(2)CO2 reduction effect

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.

The efficiency of reducing CO2 is separately calculated for Mandalay area and Yangon area.

＜Yangon＞

1) Reference emission amount

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

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

$=1,354.1\times0.0187\times44/12$

$=92.85\ tCO2e/year$

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)

$Q_{R,heat,input}=106.7\times330\times\frac{1}{1,000}\times38.2=1,354.1$ (GJ/year)

2) Project emission amount

a) Project emission amount

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

$=0.00+9.16$

$=9.16\ tCO2e/year$

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

$$PE_{y,M} = 0.0tCO2/\text{years}$$

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,

$$PE_{y,s,trans} = 106.7 \times 330 \times 0.03 \times \frac{1}{1{,}000} \times 38.2 \times 0.0187 \times \frac{44}{12}$$

$$= 2.77 \text{ (tCO2e/year)}$$

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,

$$PE_{y,s,process} = 9.66 \times 330 \times \frac{1}{1{,}000} \times 0.319$$

$$\fallingdotseq 1.02 \text{ (tCO2e/year)}$$

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)

$$(\fallingdotseq 14.96 \times 330 \times \frac{1}{1{,}000} \times 0.7918 = 3.909 \text{ (t/year)})$$

Methanol density: 0.7918 (t/m^3)

$$PE_{y,s.MeOH} = 3.909 \times \frac{12}{32} \times \frac{44}{12}$$

$= 5.37$ (tCO2e/year)

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

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

= 2.77+1.02+5.37

= 9.16 (tCO2e/year)

3) Emission reduction amount

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

$\underline{ER_y = RE_y - PE_y}$

$= 92.85 - 9.16 = 83.69$ *tCO2e/year*

Reduced emissions in the project implementation time ER_p

$\underline{ER_p = ER_y \times P}$

$= 83.69 \times 8$

$\fallingdotseq 670$ *tCO2e*

In which,

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

＜Mandalay＞

1) Reference emission amount

In the reference scenario, calculate carbon dioxide emissions in case cars and home generators use fuels.

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

$= 260.9 \times 0.0187 \times 44/12$

$= 17.89$ *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 by equipment 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) （GJ/ｋL）

$$Q_{R,heat,input} = (12.7+8.0) \times 330 \times \frac{1}{1{,}000} \times 38.2 = 260.9 \text{ (GJ/year)}$$

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 BDF 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

$$PE_{y,M} = 0.0tCO2 \text{ / year}$$

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 1% 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,

$$PE_{y,s,trans} = 12.7 \times 330 \times 0.01 \times \frac{1}{1{,}000} \times 38.2 \times 0.0187 \times \frac{44}{12}$$

$$= 0.11 \text{ (tCO2e/year)}$$

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,

$$PE_{y,s,process} = 3.51 \times 330 \times \frac{1}{1{,}000} \times 0.319$$

$$\fallingdotseq 0.37 \text{ (tCO2e/year)}$$

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)

$$(\fallingdotseq 4.07 \times 330 \times \frac{1}{1{,}000} \times 0.7918 = 1.063 \text{ (t/year)})$$

Methanol density: 0.7918 (t/m^3)

$$PE_{y,s.MeOH} = 1.063 \times \frac{12}{32} \times \frac{44}{12}$$

$$= 1.46 \text{ (tCO2e/year)}$$

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

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

= 0.11+0.37+1.46

= 1.94 (tCO2e/year)

3) Emission reduction amount

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

$\underline{ER_y = RE_y - PE_y}$

=17.89 −1.94 =15.95 tCO2e/year

Reduced emissions in the project implementation time ER_p

$\underline{ER_p = ER_y \times P}$

$= 15.95 \times 8$

$\fallingdotseq 128\ tCO2e$

In which,

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

(3)Cost-effectiveness

Cost-effectiveness is calculated by dividing JCM equipment support cost over the equipment cost by reduced emissions in the project time.　However, JCM equipment support cost rate is assumed to be 50%.

＜Yangon＞

・Equipment cost＝Approximately 5,300 thousand JPY(Consider installation cost, taxes, estimate 1.5 times the fixed price)

・Cost-effectiveness＝approximately 5,300 thousand JPY×50%／670 tCO2e

＝approximately 3,955 JPY/ tCO2e

＜Mandalay＞

・Equipment cost＝Approximately 3,750 thousand JPY(Consider installation cost, taxes, estimate 1.5 times the fixed price)

・Cost-effectiveness＝approximately 3,750 thousand JPY×50%／128 tCO2e

＝approximately 14,650 JPY/ tCO2e

(4)Business profitability

Using BDF equipment may help to reduce fuels used for car engines or home generators. Profitability is assessed by dividing the initial cost spent by the manager after deducting the JCM equipment support cost by the annual profit (Fuel reduction cost - maintenance management cost) obtained due the application of this system, in which the initial cost payback period is required.

The result is that the cost equipment payback period is approximately 4.4 years in Yangon area and approximately 16 years in Mandalay area, the profitability in Mandalay area is extremely difficult. In contrast, the volume of waste edible oil in Yangon is also much, so the payback period is approximately 4.4 years and the profitability is high when implementing the project.

＜Yangon＞

1) Yearly fuel reduction

Production capacity of BDF 72.6L/day×330day× 68 JPY/L (≒840Kyat/L× 0.0818 JPY/Kyat)

=1,629 thousand JPY/year

2) Annual maintenance management cost

Total maintenance management cost such as cost of power, chemicals used for BDF system
= 1,025 thousand JPY

3) Initial cost payback period

Initial cost payback period = initial cost / (yearly fuel reduction cost - yearly maintenance management cosst)
＝Approximately 5,300 thousand JPY×50%／(1,629 thousand JPY－1,025 thousand JPY)
= Approximately 4.4 years.

＜Mandalay＞

1) Yearly fuel reduction

Production capacity of BDF 19.7L/day×330day×68 JPY/L
= 442 thousand JPY/year

2) Annual maintenance management cost

Total maintenance management cost such as cost of power, chemicals used for BDF system
＝325thousand JPY

3) Initial cost payback period

Initial cost payback period = initial cost / (yearly fuel reduction cost - yearly maintenance management cost)
＝Approximately 3,750 thousand JPY×50%／(442 thousand JPY－325 thousand JPY)
= Approximately 16.0 years.

(5) MRV methodology

Amount of required reduced emissions is based on approved J Credit methodology “EN-R-004 Ver.1.0: Replace fossil fuels or grid power with liquid biofuel (BDF, bioethanol, bio oil)”. Parameters displayed in this methodology is as described in table 3.2.4.6, established based on documents announced by international organizations such as IPCC or native local governments such as monitoring or design values.

Table 3.2.4.6 Method of establishing parameters and factors to calculate reduced emissions

Factors, parameters	Interpretation of data	Establishment method
$F_{PJ,BF}$	Volume of BDF used by the equipment after implementing the project (KL/year)	Actual measured value
$F_{PJ,trans}$	Volume of fuel used for the collection and transportation of waste edible oil after implementing the project (KL/year)	Actual measured value
$CEF_{PJ,trans}$	CO2 emission factor over each unit of heat arisen when using fuels for the collection and transportation of waste edible oil after the project	Establish based on documents announced by Myanmar
$EL_{PJ,process}$	Power consumption for the production of BDF after implementing the project (kWh/year)	Actual measured value
$CEF_{electricity,t}$	CO2 emission factor of grid power in corresponding areas of Myanmar	Establish based on documents announced by Myanmar
$MC_{PJ,MeOH}$	Amount of methanol used for the production of BDF after implementing the project (t/year)	Actual measured value

3.3 Examination of Project Implementation System

For all the above four projects, we intend to establish an International Consortium of representative enterprises (Japanese enterprises) and Myanmar enterprises to implement the project.

Regarding facility design, equipment procurement, works related to installation (EPC) and maintenance of facility, we will consign them to an engineering company outside the international consortium.

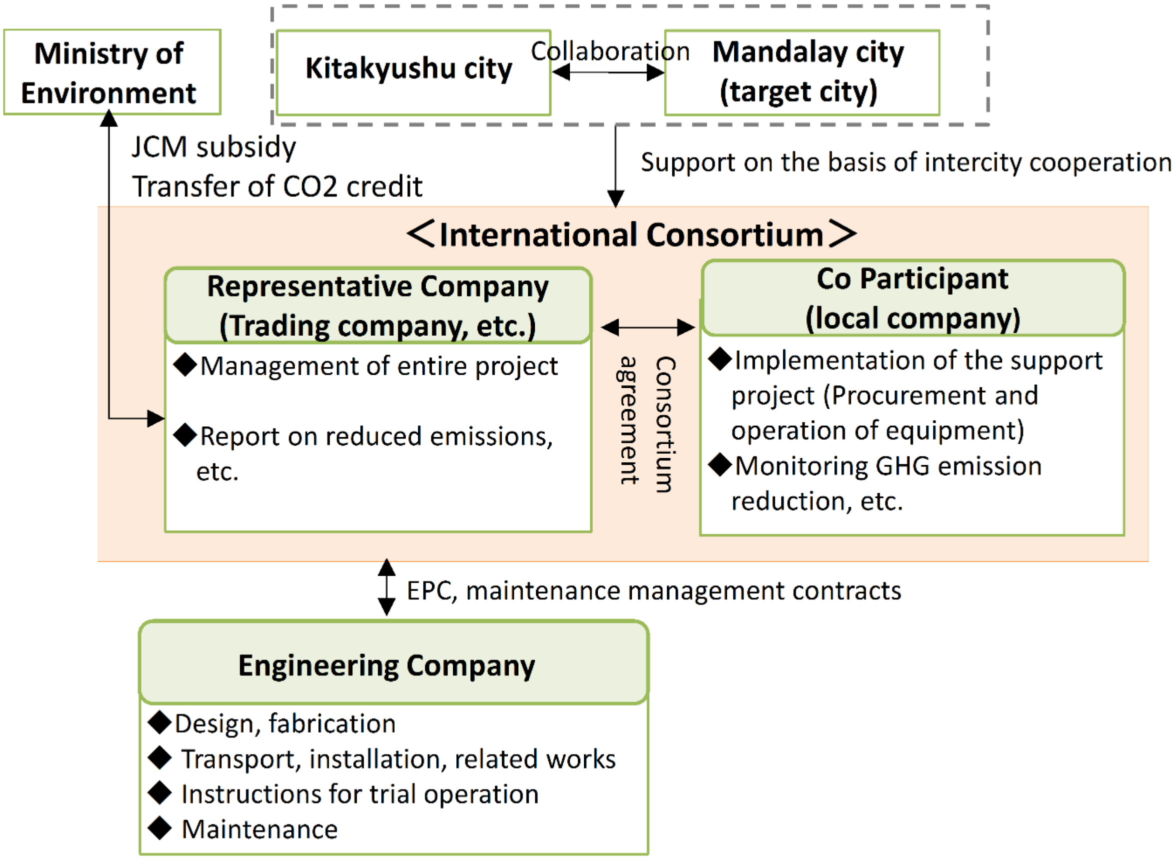


Figure 3.3.1 The project implementation system

3.4 Examination of Fund Procurement Methods

Basically, the remaining business funds (initial cost) excluding JCM equipment subsidies are self-financed by local companies.

According to interviews with local companies, in Myanmar, loans from banks are not realistic because the interest rate is very high at 13.0% per year.

We conducted interviews with Japanese leasing companies on the possibility of reducing the burden of initial expenses of local companies by conducting leasing business. But leasing to Myanmar companies is very risky and the lease term is one year. Therefore, when conducting a leasing project, it is necessary to establish a leasing company by a representative company and other investors.

3.5 Examination Project Implementation Schedule

After there is an adjustment between a representative/consortium enterprise and a cooperation enterprise, the JCM equipment subsidy project implementation schedule will be determined. At present, after selecting a JCM equipment subsidy project, we plan a schedule as follows:

1) Install biogas systems and wastewater treatment systems in distilleries

- Design: Approximately 6 months
- Equipment procurement, construction, trial operation: Approximately 1 year.

2) Install biogas power generation systems in livestock production facilities

- Design: Approximately 6 months
- Equipment procurement, construction, trial operation: Approximately 1 year.

3) Install rice husk power generation systems in rice processing plants

- Design: Approximately 3 months
- Equipment procurement, construction, trial operation: Approximately 3 months

4) Install BDF production equipment in restaurants

- Design: Approximately 2 months
- Equipment procurement, construction, trial operation: Approximately 4 years.

3.6 Summary of Project Feasibility Study

Based on the results of this survey, tasks for realizing projects utilizing biomass are as follows.

1) Organic wastewater treatment biogas systems, wastewater treatment systems

- In Myanmar, regulations for industrial wastewater are very strict. Many distilleries have been stopped due to their failure to treat wastewater, so there will be a high demand for biogas systems which ferment organic wastewater thoroughly and recover biogas effective and high capacity wastewater treatment systems in many distilleries and sugar cane sugar factories which need to treat organic wastewater.
- As seen in many industrial parks in Myanmar, even in the Mandalay Industrial Park, many factories discharge to sewer pipes managed by MCDC without proper treatment by simple treatment with sedimentation tank. It is considered that the number of factories that will be shut down will increase and the needs for this system will increase in the future.
- In contrast, according to our interviews with local companies, the cost of installing equipment of Chinese or Indian manufacturers is 1/2～1/3 that of Japanese manufacturers and the maintenance after installation or the quality of Chinese, Indian equipment still meet requirements of local companies.
- However, the space saving of the wastewater treatment facility by the MBR system suggested in this study is a great advantage for distilleries who plan to expand production scale and distilleries

where it is difficult to secure land for urban areas. Therefore our proposal drew strongly the interest of local companies. In addition to this unique technology, it is important for Japanese manufacturers to appeal their strengths related to introducing facilities such as ease of maintenance and treatment quality level, durability and so on.

2) Utilizing biomass such as agricultural waste, livestock excreta (biomass power generation, biogas power generation)

- In Myanmar, agricultural productions and livestock industries are not of a large scale, so the standard for JCM subsidized project with total cost of 100 million JPY or more has been just applicable to large-scale chicken farms or areas with concentration of rice processing plants in recent years.
- In this consideration, we find that rice husk power generation (direct burning) with short initial cost payback period, high profitability. The reason is that the collection of rice husk is costless. In Myanmar, power prices are low, so it is especially important to reduce the cost of rice husk.
- In addition, in order to secure biomass, equipment that can handle multiple types of biomass is required (e.g. mixed power generation of rice husk and wood chips etc.).
- For biogas power generation which utilizes livestock excreta, the cost-effectiveness of JCM equipment support or the profitability (initial cost payback period) is low. Therefore we needs to consider both the use of heat in addition to power generation and the further reduction in the cost of biogas power generation.

3) BDF from waste edible oil

- The cost-effectiveness of JCM subsidized project or the profitability (initial cost payback period) for a BDF facility which utilizes waste edible oil will be determined depending on the volume of recoverable waste edible oil, so the important thing is whether to collect an appropriate volume of waste edible oil or not. In this consideration, we find that if the volume of waste edible oil is at 80L/day, the cost-effectiveness of support is approximately 4,000 JPY/tCO2e, the initial cost payback period is approximately 4 years and the profitability may be guaranteed.
- If it is difficult for one company to secure waste edible oil, it is necessary to construct a mechanism for waste edible oil recovery in areas including surrounding shops and households.
- As seen in restaurants in this survey, in Myanmar, waste edible oil are, in many cases, directly discharged to the environment without treatment. Therefore, the installation of BDF equipment may contribute to preventing water pollution. In our opinion, the demand for installing these systems will be high. In fact, MCDC also has great expectations for preventing water pollution by installing BDF equipment.
- The major obstacle to a JCM project to be chosen is the standard project scale (project cost: 100 million JPY) or emission reduction limit.

Referenced documents

[1] Kubota Corporation : Consider the installation of wastewater treatment/biogas treatment devices
[2] Nikken Sekkei Civil Engineering: Use methane to ferment from palm oil mill effluent (POME) and improve environment.
[3] IPCC2006 manual
[4] Document of the Ministry of Environment https://www.env.go.jp/council/16pol-ear/y164-04/mat04.pdf
[5] Global Environment Centre Foundation, JCM equipment support project in 2017 (2nd announcement) List of CO2 emission factors for the use of power (tCO2/MWh)
[6] Global Environment Centre Foundation, JCM equipment support project in 2017 (2nd announcement) List of CO2 emission factors for the use of power (tCO2/MWh)
[7] FY2014 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia -Feasibility Study (Rice Husk Power Generation System for Low-carbon Communities in Ayeyarwady Region, Myanmar (Mitsubishi Research Institute, Inc.))

Chapter 4 Selection of other priority areas related to Low Carbonization and Environmental Protection

4.1 Demand in Mandalay city

<Waste field>

・Mandalay city has a great demand for solid waste treatment of approximately 900tons / day. (This is the highest priority project in Mandalay city)

<Reference>

・With the support of UNEP-IGES, a waste management strategy and action plan of Mandalay city have been developed. Based on this plan, activities that encourage people to classify, collect, implement 3R (Reduce, Reuse, Recycle), to use organic waste (Composting, etc.) at model areas being considered and investigated.

・Kitakyushu city started to send specialists to participate, support this plan.

・During November trip, we also discussed the management of waste in Mandalay city, one of the site suitable based on the assumption that JCM will be implemented to link the cities since the next year and the project will support JCM devices.

<Waterworks field >

・A water supply project is highly needed for Phi Gyi Dagon Township, where the access of clean water is only 30%.

・The people are not equipped with tap-water systems and mostly water from private shallow wells, which are becoming more and more polluted. So, the rate of water-related disease incidence here is very high compared to other townships.

<Sewerage field>

・The Cleansing Department of MCDC, Ministry of Natural Resources and Environmental Protection strengthen the monitoring of wastewater discharged from industrial zones. More and more plants are closed down, dissolved due to failure to meet environmental requirements.

・The demand for industrial wastewater treatment is increasing.

<Report on Circular on Industrial Wastewater Treatment issued by the government>

HEARTBEAT OF THE NATION

MYANMAR TIMES

Yangon factories told to treat water or else

October 23, 2017

The government warned factories to treat their wastewater properly before disposing it into rivers or face penalties, including closure of their facilities.

There are total of 72 distilleries around the country and out of 16 distilleries located in Yangon Region, 14 have been closed temporarily for not have wastewater treatment facility, according to PCCD's statistics.

It can be seen that the Government of Myanmar is facing industrial wastewater issue with a strict attitude to protect the environment of rivers and lakes. The Myanmar Times · The Times warns that the government of Myanmar has issued a circular to promote the wastewater treatment in local plants, and if the plants fail to comply, the government will consider to impose severe sanctions and even force closedown. The government of Myanmar has shown specific actions such as closing down distilleries with large volume of waste. According to PCCD, there are now 72 distilleries in Myanmar, 16 of which are located in Yangon. In which, 14 distilleries are requested for stop by the government due to lack of wastewater treatment equipment.

4.2 Select priority fields

<Waste field>

・In the field of waste, the project for "Enhancement on Appropriate Waste Management in Mandalay city (Temporary name)" is expected to be deployed to link JCM cities in 2018 in order to promote the management and recycling of waste appropriately.

<Waterworks field>

・Implement "The project for improving the operation management capacity of the water filter plant in Yangon, Myanmar" as a technical cooperation project (Important part in the regional economic reconstruction) in 3 years from January, 2014 to December, 2016. In addition, "The survey and preparation of the plan for building a clean water supply system in Mandalay city" - ODA project of MOFA ended in April, 2015. Phi Gyi Dagon Township clean water supply project plan stated in table 4.2.1 has been built.

Table 4.2.1. The content of Phi Gyi Dagon Township clean water supply project plan

Item	Summary of clean water supply plan
Target year	2020 (However, the target year of application in designing the clean water supply network is 2025)
Planned clean water supply areas	5 wards of Phi Gyi Dagon Township ※
Planned population supplied with clean water	51,919 people (The population in 2013 of the project area expected to be supplied with clean water is: 46,780 people)
Maximum volume of water to be supplied in 1 day according to the plant	9,074m^3/day
Flow of the water supply system	Wells => Water pipe => Distribution ponds => Chlorine disinfection => Distribution pipe => Distribution <Water supply>

※ A ward is an administrative unit of Mandalay city. Phi Gyi Dagon Township has 16 wards.

Source: Myanmar Mandalay City Water Supply Improvement Plan Preparatory Survey Final Report (Preliminary release version) 2015. JICA.

Before the demands for “waste” and “waterworks” as above stated, Kitakyushu city has also promoted its leading role. Response actions for each demand have been given. Therefore, for the wastewater treatment in industrial zones - a priority issue in the field of “wastewater treatment”, we have considered response measures to link JCM projects such as utilizing methane generated from the anaerobic treatment.

Specifically,

+ We are aiming to install Biogas systems and Waste treatment systems at beverage plants, wishing to pilot the installation of combined wastewater treatment systems in order to save space, to be economical and to recycle waste (1 set). In particular, we will consider and present a business model that can comprehensively combine economy and environmental, including operation, without involving owners in simple price competition with China etc.

Chapter 5 Hold local workshops

5.1 Summary of Local Workshops

Summarize the result of discussion of the workshop and debrief session held in Mandalay city as stated in table 5.1.1. Through these meetings, MCDC and local private companies were able to recognize issues related to energy and the environment in Mandalay City and low carbonization and environmental technology as countermeasures.

The documents used in these meetings are posted on the page after nex.

Table 5.1.1. Summary of workshop and debrief session

Times/Time/Place	Summary
Workshop November 8th, 2017 13:30 ~ 15:50 Place: Mandalay Industrial Zone Management Committee	・Present to enterprises leasing land in Mandalay Industrial Zone on issues related to 1) Summary of JCM; 2) Kitakyushu city model in Mandalay; 3) Installation of energy-saving equipment, renewable energy operated equipment in plants, hotels, big trade centers. ・Present assistance programs to help enterprises to reduce initial investment costs such as ESCO Project. ・Present participants' questions related to equipment investment, installation cost.
Debrief Session January 18th, 2018 Place: MCDC Government office Building	・Present to Deputy mayor, members of the Committee on results of this project and later efforts. ・MCDC also states that it will continue to support activities of the Japanese side subsequently.

Contents

Photo 5.1.1 Workshop

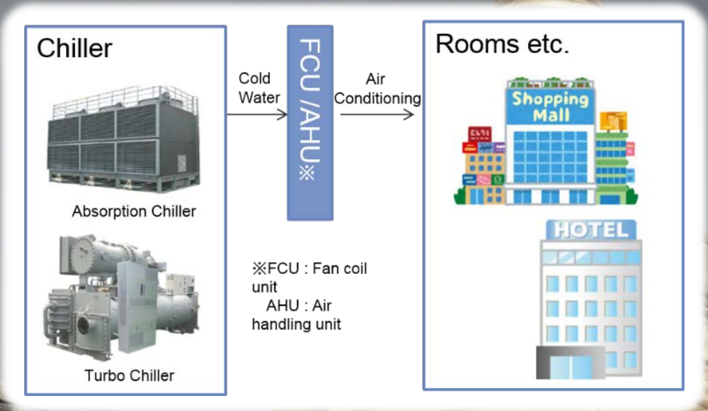
Photo 5.1.2 Debrief Session

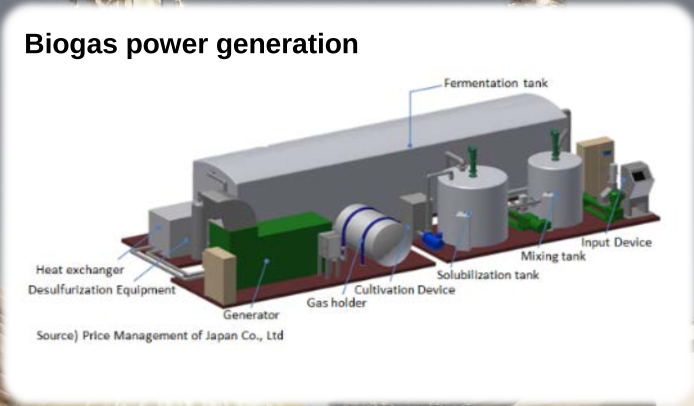
Announcement on the 1st Workshop Regarding JCM Projects Held on November 8, 2017

(Supported by Ministry of Environment, Japan)

Objective

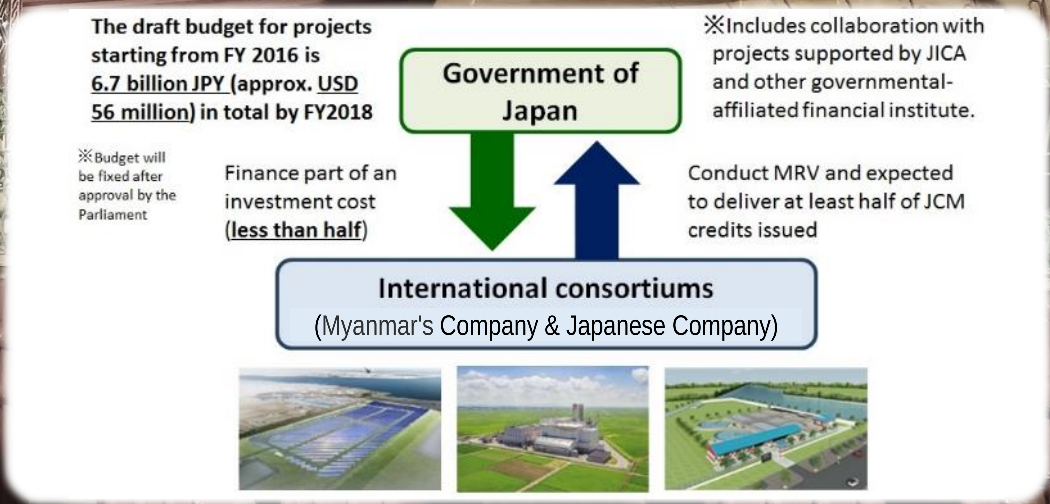
- ◆ Under the cooperative relationship between Mandalay City and City of Kitakyushu, we are conducting feasibility studies for 1) introduction of energy saving (ES) and renewable energy (RET) technologies such as PV, etc. in factories, large scale hotels, commercial facilities, etc. and 2) introduction of biomass power generation using agricultural waste, livestock excreta, etc. in order to reduce GHG, and will aim for commercialization (JCM model Project) from the next fiscal year.
- ◆ The objective of this workshop is to let you know that installing ES & RE technologies by using JCM scheme has many advantages such as reduction of electricity expense, fuel costs and environmental improvement. We hope that this workshop will become a trigger for you to consider introducing technology.





Outline of JCM model project

- ◆ This scheme was launched in 2013. The scope of the financing includes facilities, equipment, and vehicles which reduce CO_2 from fossil fuel combustion as well as construction cost for installing those facilities.
- ◆ Through the programme, Ministry of Environment, Japan financially supports part of the initial cost (up to half), on the premise of seeking to deliver at least half of the issued JCM credits to the government of Japan. The budget for projects starting from FY 2016 is 6.7 billion JPY (approx. USD 56 million) in total by FY2018.



<u>Agenda (tentative)</u>

1 Date: November 8, 2017　13:30－15:30

2 Venue: Not yet decided

3 Agenda

Opening Session		
13:30-13:40 (10min)	Opening Remarks Outline of JCM	Nikken Sekkei Civil
13:40-13:55 (15min)	Introduction of Kitakyushu city Introduction of Kitakyushu city's activities in Mandalay city Kitakyushu city's Support for JCM model projects	Kitakyushu city
Pilot Project Session		
13:55-14:25 (30min)	Introduction of energy saving and renewable energy technologies in factories, large scale hotels, commercial facilities etc. 1)Outline, effect, precedents of technologies 2)Progress of feasibility study in Mandalay region	NTT DATA
14:25-14:35 (10min)	Questions and answers session.	NTT DATA
14:35-14:45 (10min)	Coffee Break	
14:45-15:15 (30min)	Introduction of biomass power generation using agricultural waste, livestock excreta 1)Outline, effect, precedents of technologies 2)Progress of feasibility study in Mandalay region	Nikken Sekkei Civil
15:15-15:25 (10min)	Questions and answers session.	Nikken Sekkei Civil
Closing		
15:25-15:30 (10min)	Closing Remarks	Nikken Sekkei Civil

4 Participants

－**Mandalay Side**－

✓Mandalay Region Chamber of Commerce and Industry

✓Mandalay Industrial Zone Management Committee

✓Company interested in JCM project.

－**Kitakyushu Side**－

✓ Kitakyushu City

✓Nikken Sekkei Civil Engineering LTD

✓NTT DATA Institute of Management Consulting, Inc.

Recent Development of The Joint Crediting Mechanism (JCM)

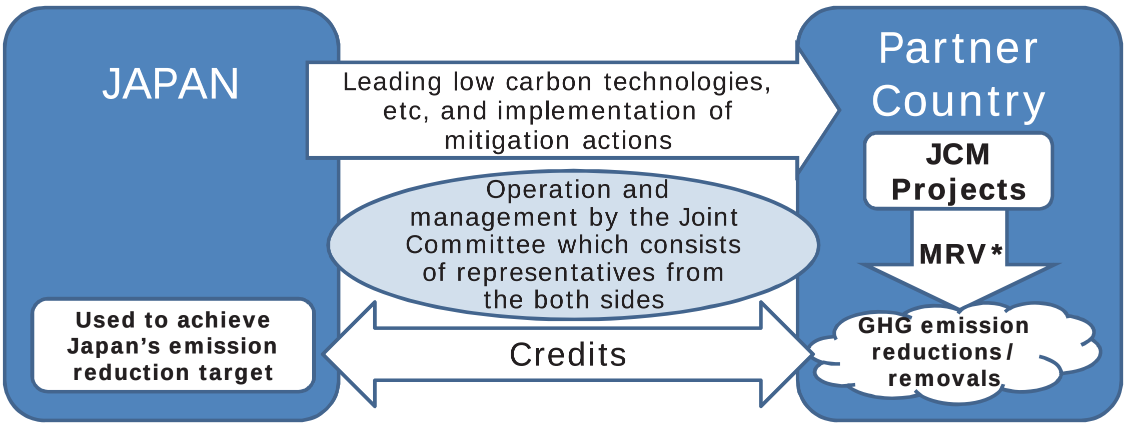
January 2017

Government of Japan

All ideas are subject to further consideration and discussion with partner countries

Basic Concept of the JCM

- 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

JCM Partner Countries

➢ 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）

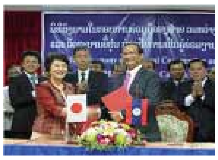
Bangladesh
Mar. 19, 2013
(Dhaka)

Ethiopia
May 27, 2013
(Addis Ababa)

Kenya
Jun. 12,2013
(Nairobi)

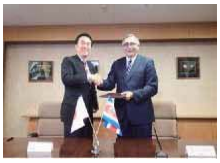
Maldives
Jun. 29, 2013
(Okinawa)

Viet Nam
Jul. 2, 2013
(Hanoi)



Lao PDR
Aug. 7, 2013
(Vientiane)

Indonesia
Aug. 26, 2013
(Jakarta)



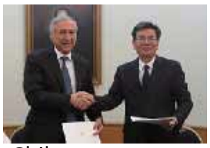
Costa Rica
Dec. 9, 2013
(Tokyo)

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)

7

Statement by Prime Minister Shinzo Abe at the COP21 (Excerpt)

PARIS2015
CONFÉRENCE DES NATIONS UNIES
SUR LES CHANGEMENTS CLIMATIQUES
COP21·CMP11

The second component of Japan's new set of contribution is innovation. The key to acting against climate change without sacrificing economic growth is the development of innovative technologies. To illustrate, there are technologies to produce, store and transport hydrogen towards realizing CO2–free societies, and a next-generation battery to enable an electric car to run 5 times longer than the current level. By next spring Japan will formulate the "Energy and Environment Innovation Strategy." Prospective focused areas will be identified and research and development on them will be strengthened. (snip)

In addition, many of the advanced low-carbon technologies do not generally promise investment-return to developing countries. Japan will, while lowering burdens of those countries, promote diffusion of advanced low carbon technologies particularly through implementation of the JCM.

8

JCM Model Projects by MOE

The draft budget for projects starting from FY 2017 is 6.0 billion JPY (approx. USD 60million) in total by FY2019

(1 USD = 100 JPY)

※Budget will be fixed after approval by the Parliament

Government of Japan

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

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

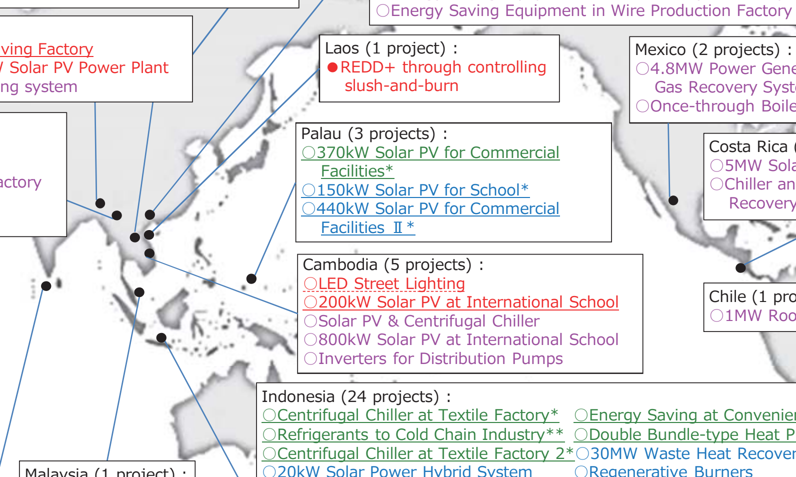
Conduct MRV and expected to deliver at least half of JCM credits issued

International consortiums
(which include Japanese entities)



- Scope of the financing: facilities, equipment, vehicles, etc. which reduce CO_2 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.

JCM Financing programme by MOEJ (FY2013～2016) as of January 13, 2017



Thailand (21 projects) :
○Energy Saving at Convenience Store ○1.0MW Solar PV on Factory Rooftop
○Upgrading Air-saving Loom ○Centrifugal Chiller & Compressor
○Co-Generation in Motorcycle Factory ○Centrifugal Chiller in Tire Factory
○Air Conditioning System & Chiller ○Refrigeration System
○Ion Exchange Membrane Electrolyzer ○Chilled Water Supply System
○LED Lighting to Sales Stores ○12MW Waste Heat Recovery in Cement Plant
○Co-generation System ○Refrigerator and Evaporator
○1.5MW Solar PV and EMS in Paint Factory ○3.4MW Solar PV
○Heat Recovery Heat Pump ○5MW Floating Solar PV ○27MW Solar PV
○Boiler System in Rubber Belt Plant ○Air-conditioning Control System

Bangladesh (6 projects) :
○Centrifugal Chiller ○Loom at Weaving Factory
○320kW PV-diesel Hybrid System ○50MW Solar PV Power Plant
○Centrifugal Chiller ○Air-conditioning system

Myanmar (5 projects) :
○700kW Waste to Energy Plant
○Brewing Systems to Beer Factory
○Once-through Boiler in Instant Noodle Factory
○1.8MW Rice Husk Power Generation
○Refrigeration System in Logistics Center

Saudi Arabia (1 project) :
○Electrolyzer in Chlorine Production Plant

Ethiopia (1 project) :
○Biomass CHP Plant

Kenya (2 projects) :
○6MW Hydropower Generation
○1MW Solar PV at Salt Factory

Maldives (2 projects) :
○190kW Solar Power on School Rooftop
■Smart Micro-Grid System

Malaysia (1 project) :
○140kW Solar PV

Mongolia (4 projects) :
○Heat Only Boiler (HOB)** ○2.1MW Solar PV in Farm
○10MW Solar PV ○8.3MW Solar PV in Farm

Viet Nam (13 projects) :
○Digital Tachographs* ○Amorphous transformers*
○Air-conditioning in Hotel ○Air-conditioning in Lens Factory
○Container Formation Facility ○320kW Solar PV in Shopping Mall
○Amorphous transformers 2 ○Air-conditioning Control System
○Electricity Kiln ○High Efficiency Water Pumps
○Energy saving Equipment in Lens Factory ○Amorphous transformers 3
○Energy Saving Equipment in Wire Production Factory

Laos (1 project) :
●REDD+ through controlling slush-and-burn

Mexico (2 projects) :
○4.8MW Power Generation with Methane Gas Recovery System
○Once-through Boiler and Fuel Switching

Palau (3 projects) :
○370kW Solar PV for Commercial Facilities*
○150kW Solar PV for School*
○440kW Solar PV for Commercial Facilities Ⅱ*

Costa Rica (2 projects) :
○5MW Solar PV
○Chiller and Exhaust Heat Recovery System

Cambodia (5 projects) :
○LED Street Lighting
○200kW Solar PV at International School
○Solar PV & Centrifugal Chiller
○800kW Solar PV at International School
○Inverters for Distribution Pumps

Chile (1 project) :
○1MW Rooftop Solar PV

Indonesia (24 projects) :
○Centrifugal Chiller at Textile Factory* ○Energy Saving at Convenience Store*
○Refrigerants to Cold Chain Industry** ○Double Bundle-type Heat Pump
○Centrifugal Chiller at Textile Factory 2* ○30MW Waste Heat Recovery in Cement Industry
○20kW Solar Power Hybrid System ○Regenerative Burners
○Centrifugal Chiller at Textile Factory 3* ○Old Corrugated Cartons Process
○Upgrading to Air-saving Loom ○Centrifugal Chiller in Shopping Mall
○Smart LED Street Lighting System ○Once-through Boiler System in Film Factory
○Gas Co-generation System ○Once-through Boiler in Golf Ball Factory
○1.6MW Solar PV in Jakabaring Sport City ●REDD+ through controlling slush-and burn
○10MW Hydro Power Plant ○Looms in Weaving Mill
○LED Lighting to Sales Stores ○Industrial Wastewater Treatment System
○Air-conditioning Utility System in Airport ○0.5MW Solar PV

○ Model Project in FY 2013 (7 projects in 3 countries)
○ Model Project in FY 2014 (13 projects in 6 countries)
■ ADB Project in FY 2014 (1 project in 1 country)
○ Model Project in FY 2015 (33 projects in 10 countries)
○ Model Project in FY 2016 (38 projects in 10 countries)
● REDD+ Model Project (2 projects in 2 countries)

Total 93 projects in 16 partner countries

Underlined projects have started operation (34 projects, including 7 partially started projects)
Projects with * have been registered as JCM projects (13 projects)

Future City Kitakyushu

©teitan,City of Kitakyushu

Kitakyushu City's Activities for Low-carbonization in Asia

City of Kitakyushu

City located near to other Asian nations, rich in nature, and developed as a manufacturing area

Population: 957,000 (2016)

Area: 491.95 Km^2

GDP: 3,366 billion yen (2013)

Rich nature and branded food materials

Karst Plateau Hiradai

Wakamatsuhoku Beach

Ouma Bamboo Shoots

Kanmon Straits Octopuses

Kokura Beef

Buzen-Sea Oysters

Wakamatsu Special Tomatoes

Major companies in Kitakyushu area

Nippon Steel Corporation

Yasukawa Electric Corporation

TOTO Ltd.

Mitsubishi Chemical Corporation

Toyota Motor Corporation · Nissan Motor Co., Ltd.

Mitsubishi Materials Corporation

Overcoming Severe Pollution: Kitakyushu's Experience

1960s

Today

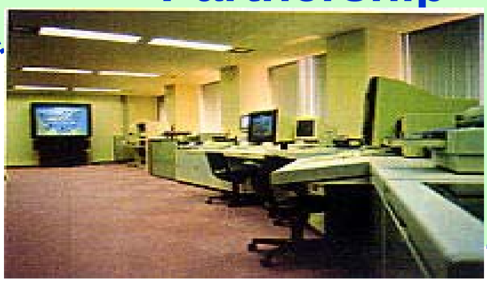
Key Factors: Partnerships among Multi-Stakeholders

Residents

Residents observing a private company

Study session on air pollution measures with university professors

Partnership



Environmental supervision & environmental infrastructure

Local Government

Cleaner Production & pollution control equipment

Private Enterprises

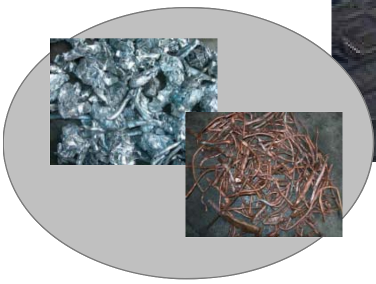
Taking on the Challenge of a Resource Recycling Society Kitakyushu Eco-Town Project

Automobile recycling

Japan's Largest Eco-Town

Approved 1997, Started operations 1998
No. business facilities: 29
No. research facilities: 16

R&D on recycling technologies for solar power systems



Collection/treatment of rare metals

- Investment ~66 billion yen
- Employees ~1,300
- Visitors ~1,500,000 (1998-October 2016)

Fluorescent lighting recycling

Development of international cooperation on environmental issues

Partnership with other Asian nations for mutual prosperity

Accepted trainees: 8,207 persons from 156 nations; Dispatched specialists: 192 persons to 25 nations
Promotion of cooperation networking between Asian cities and environmental improvement projects

UN ESCAP Ministerial Conference on Environment and Development (2000)

Contribution to environmental improvements in Dalian, China
(Dalian City received the Global 500 Award in 2001.)

Exchanged memorandum for cooperation on eco-town with Tianjin City
(At the Prime Minister's official residence)

Water supply project at Phnom Penh

Air pollution survey in Mongolia

Driving forward the waste composting project with Surabaya City, Indonesia
(Adopted by over 20,000 families)

OECD Green Cities Programme

Paris, France

Chicago, U.S.A.

Stockholm, Sweden

Kitakyushu, Japan

"Green Growth in Kitakyushu, Japan "
issued by OECD in 2013

Once a polluted industrial zone, Kitakyushu is now a modern industrial city pursuing green growth.

OECD Green Cities Programme Commemorative Meeting on the Publication of Kitakyushu Report, 18 October, 2013

Mayor Kitahashi received the report from Director of Public Governance and Territorial Development, OECD.

7

Kitakyushu Asian Center for Low Carbon Society

Center established as engine for green growth activities

Concept : **Developing interactions that place value on the relationship between cities and that will help Japan gain respect from international society in order to contribute to the creation of green cities in Asia**

Compile the experiences and know-how of the city from the process of overcoming pollution and becoming an environmental city in order to
Create the "Kitakyushu Model"

141 projects in cooperation with 106 Japanese companies and universities in 57 Asian cities

8

Development Scheme for Exporting Green Cities

Inter-governmental (G to G)

Logistical support through dialogue and consensus

Inter-city (City to City)

Recognized and supported as a national project

National government ⟷ X city ⟷ Kitakyushu City ⟷ National government of Japan

Project conference

Business development through public-private partnership

Local firms ⟷ **Inter-firm** ⟷ Japanese firms

Green City Master Planning

(Development of a comprehensive environmentally-friendly urban master plan)

Application of Kitakyushu Model

Water — Energy — Recycling — Environmental conservation — ·····

Consensus-building between the public, industry, government, and other stakeholders

Social Platform Formation

Capacity building to enhance the foundations to develop the capacities of the government, citizens, and technology

Private financial institutions

Financial assistance

Project identification

Project development
(feasibility studies & demonstrations)

Commercialization
(including fundraising)

Public financial institutions/ Public-private fund

Public financial assistance

Public-private fund assistance

Cross-border Infrastructure development

9

Recycling waste in Surabaya, Indonesia

Nishihara Corporation

Expansion of intermediate treatment of waste to developing countries through ODA/OECF (MoFA, 2012)

Public-Private Partnerships (JICA, Nov 2013-)

Waste generated in Surabaya is open dumped at final landfill sites (1,200 t/day).

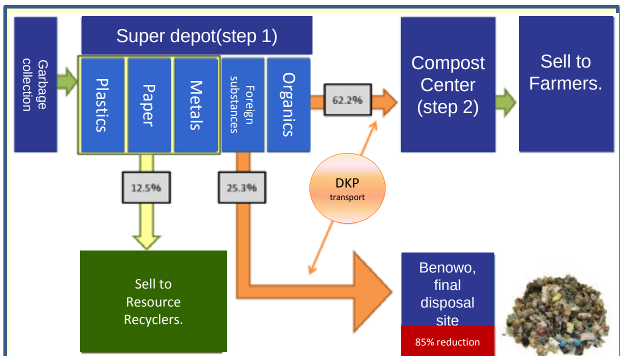
With the introduction of an intermediate treatment facility for recycling of waste, Surabaya is promoting the recycling of valuables and the composting of organic waste in order to reduce the amount of waste sent to final landfill (potential to reduce waste by 75%).

These activities are carried out in cooperation with waste pickers who make a living collecting valuables, such as plastic and metals, from waste under often difficult labor conditions.

Pilot stage
15 t/day

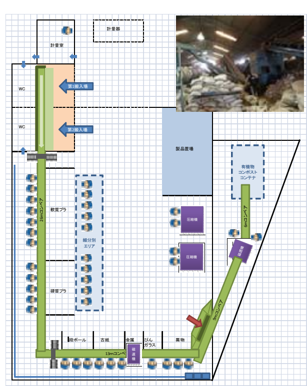
1st stage of commercialization
150 t/day

2nd stage of commercialization
Citywide



The project also examines the production of alternative fuels from the 25% of residue and plastics that cannot be recycled, to be used as a replacement for coal in cement plants, for example.

SUPERDEPO (Step 1)



Compost Center (Step 2)

Selling Compost to fertilizer factory

10

Green Sister City : Surabaya, Indonesia

International cooperation for composting household waste started in 2004

- ✓ 30% reduction of waste
- ✓ Streets decorated with flowers
- ✓ Improvement of public environmental awareness

Building a relationship of trust

"Green Sister City" agreement was signed in November 2012 between Surabaya and Kitakyushu

Kitakyushu's Involvement in Large-Scale JCM Project Development

Promotion of low-carbon development of entire cities using intercity cooperation

Surabaya, Indonesia: 2nd largest city in Indonesia with a population of 3 million

＜FY 2013- 2015＞ Low Carbon City Planning Project in Surabaya, Indonesia

Target areas: Energy, waste management, transportation, water resources

Participating Japanese companies: 13

Green Sister City agreement signed (Nov 2012)

Haiphong, Viet Nam: Major port city in Viet Nam with a population of 1.9 million

＜FY 2014-2016＞Green Growth Promotion Plan of the City of Hai Phong

Target areas: Low-carbon city planning, energy, waste management, conservation of Cat Ba island

Participating Japanese companies: 10

Sister city agreement signed (Apr 2014)

Iskandar, Malaysia: 2nd largest economic zone in Malaysia

＜FY 2014-2016＞ GHG Emissions Reduction Project in Iskandar

Target areas: Waste-to-energy, energy savings and industrial waste recycling in an industrial estate

Participating Japanese companies: 4

Consultation with Mayor of Pasir Gudang City (Feb 2015)

Rayong Province, Thailand: Major heavy chemical industrial zone in Thailand with 2 large industrial parks

＜FY 2015-2016＞GHG Emissions Reduction Project in Rayong Province

Target areas: Waste-to-energy project, energy savings, total recycling of industrial waste in an industrial zone

Participating Japanese companies: 4

MOU signed with Department of Industrial Works (Dec 2014)

Phnom Penh, Cambodia: Capital City of Cambodia with a population of 1.7 million

＜FY 2016＞Action Plan for the climate change strategy in Phnom Penh Capital City

Target areas: Low-carbon city planning, energy

Participating Japanese companies: 4

Sister city agreement signed (Mar 2016)

Development of Environmental Education Programme in Mandalay City

Background

➢2012
Staff officer from Cleansing Department of Mandalay City Development Committee (MCDC) joined Solid Waste Management training at JICA Kyushu.

➢2013-2014
City officials from Environment Bureau of City of Kitakyushu visited Mandalay City twice through CLAIR project. There was a request from MCDC to Kitakyushu about support for capacity building regarding SWM and Environmental Education.

➢2014
Mayor of Mandalay visited Water Bureau of City of Kitakyushu for JICA partnership cooperation. Committee member of MCDC visited Kitakyushu for JICA training.

➢ November 2014
Joint Workshop on SWM for citizens and MCDC was held in cooperation with MCDC, Kitakyushu and IGES.
-Moving towards building a 3R Society in Mandalay-

Collaboration activity with Kitakyushu and IGES

2015

1. Developed Ecology Note

Developed an Ecology Note based on Kitakyushu City's experience

Organized a training workshop for teachers in 3 model schools

2. Skype meeting with ASEAN Eco Model school in Mandalay and UNESCO school in Kitakyushu

Through Skype both side of students exchanged opinions and shared their value about ecological friendly activities.

2016

1. Teachers training workshop for 18 model schools

Demonstration class for Grade 5
Introduction with Earth ball
Watch DVD `Globe now.'
Ecology Bingo game
Eco message presentation
Eco puzzle

2. Workshop for citizens and city officials in a model community

Sharing Benefits as Part of Asia

Kitakyushu: Economic benefits
- Activate the local economy
- Create new industries by learning from Asia

Asian Cities: Social benefits
- Improved lifestyles
- Solutions for environmental issues
- Improved energy efficiency

A relationship of mutual learning and support!

Thank you for your attention!

For further information, please contact

Kitakyushu Asian Center for Low Carbon Society

Environment Bureau, City of Kitakyushu, Japan

http://www.asiangreencamp.net/

1st workshop regarding JCM ～Introduction of energy saving and renewable energy technologies into factories, large scale hotels, commercial facilities etc ～

November 8th, 2017
NTT Data Institute of Management Consulting, Inc.,
Socio & Eco Strategic Consulting Unit
Partner, Motoshi Muraoka

Index

1. **Introduction of our company**

2. **Outline of this year Project**

1. Introduction of our company

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

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

◆Industrial Sector

Outline of Activity	Purpose	Phase
Installation of Co-generation System into the Factory and Industrial Estate (Indonesia, Vietnam)	Reduce CO2 Emission & Energy Cost	Study
Installation of Economizer for the Existing Boiler in Factory (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
Installation of Exhaust Heat Recovery & Electricity Generation System into the Existing Cement Factory (Vietnam and Thailand)	Reduce CO2 Emission & Energy Cost	Study, Implementation
Replacement or Installation of Saving Energy Type of Electrical Furnace into Casting Companies (Vietnam)	Reduce CO2 Emission & Energy Cost	Implementation
Installation of Electricity Generation System using Rice Husk (Indonesia)	Reduce CO2 Emission & Energy Cost	Study
Installation of Solar Electricity Generation System on the Roof of the Existing Cold Storage Warehouse (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
Replacement of Existing Lighting System into LED Lighting System (Indonesia)	Reduce CO2 Emission & Energy Cost	Implementation
Changing Fuel Type from Oil to Natural Gas in a Factory (Malaysia)	Reduce CO2 Emission & Energy Cost	Study
Installation of Mini-hydro Electricity Generation System in Isolated Area (Kenya and Ethiopia)	Reduce CO2 Emission & Energy Cost	Implementation
Installation of Mega Solar Electricity Generation System (Costa Rica)	Reduce CO2 Emission & Energy Security Increase	Implementation
Installation of Landfill Gas Recovery & Electricity Generation System (Mexico)	Reduce CO2 Emission & Energy Cost	Implementation

2．Experience of JCM related Projects(2/2)

NTT DATA

◆Commercial Sector

Outline of Activity	Purpose	Phase
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
Installation of Mini Co-generation System into Hotel (Indonesia)	Reduce CO2 Emission & Energy Cost	Study
Replacement of Refrigerated Show Case into Saving Energy Type (Vietnam)	Reduce CO2 Emission & Energy Cost	Study
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
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
Introduction of EV Bus & Solar Electricity Generation System with Funding Mechanism in an Isolated Island (Vietnam)	Keep Environment and Reduce CO2 Emission	Study
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．Example of our Projects

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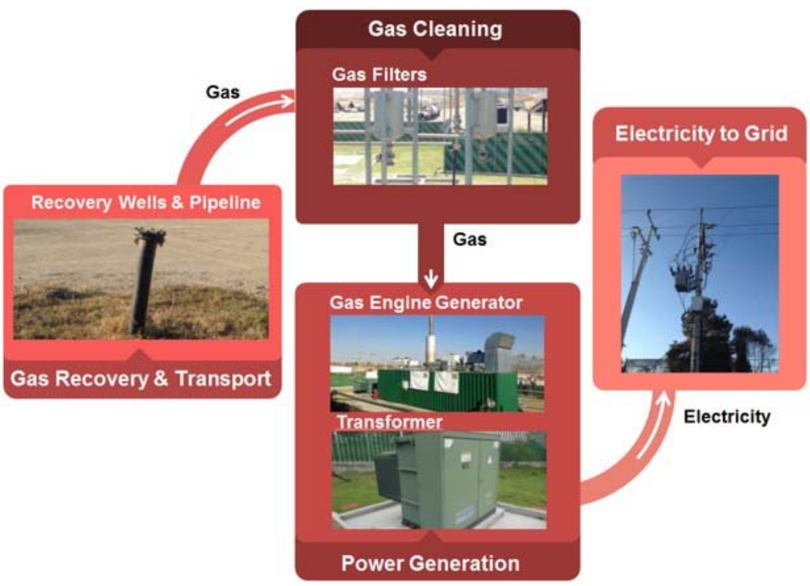
Introduction of 4.8MW Power Generation with Methane Gas Recovery System (Mexico) ①

Outline of GHG Mitigation Activity

This project is power generation by gas engine using collected methane gas from landfill at three landfill sites in Mexico.
The methane gas recovery system consists of recovery wells, pipelines, gas filters, gas engine generator and transformer. Captured methane gas is transported to the gas engine power generation facilities through pipelines and filters.
Electricity generated from the gas engine generator will be sold under long-term PPAs with local municipality.
GHG emission reductions are achieved by replacement of grid electricity and avoidance of methane emission from landfill sites.



3. Example of our Projects

NTT DATA

Introduction of 4.8MW Power Generation with Methane Gas Recovery System (Mexico) ②

Expected GHG Emission Reductions

244,629 [tCO2/year]
= Emission reductions by electricity generation
+ Emission reductions by methane recovery
Emission reductions by electricity generation
=17,180[tCO2/year] ≒ electricity generation 37,843 [MWh/year]
× grid emission factor 0.454 [tCO2/MWh]
Emission reductions by methane recovery
= 227,449 [tCO2e/year]

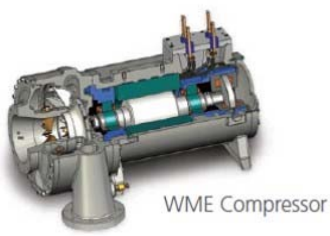
3. Example of our Projects

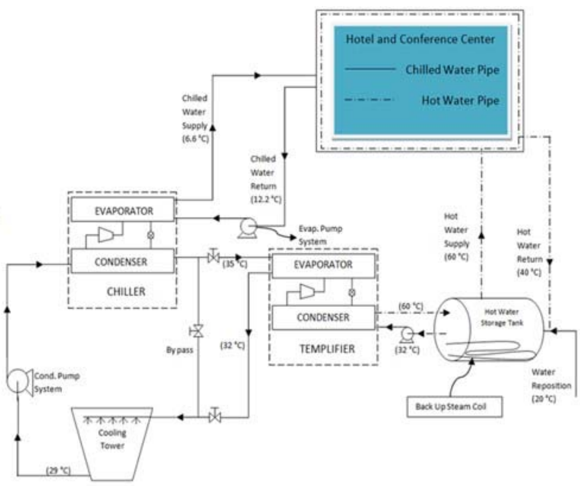
NTT DATA

Introduction of the High Efficiency Chiller and the Exhaust Heat Recovery System (Costa Rica) ①

Outline of GHG Mitigation Activity

This project aims to improve the energy efficiency of a luxury hotel's air-conditioning 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.
The high efficiency chiller (Daikin WMC400DC) delivers; low operating noise (76dBA), optimized control through digital, easy to maintenance. It enables to improve the energy efficiency of up to 40% compared to a standard centrifugal chiller and 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.





【System image to be introduced】

3. Example of our Projects

NTTDATA

Introduction of the High Efficiency Chiller and the Exhaust Heat Recovery System (Costa Rica) ②

Expected GHG Emission Reductions

<u>402.1tCO2/year</u>

CO_2 Emission reductions
= Reference CO_2 emissions (RE) – Project CO_2 emissions (PE)

High efficiency chiller: 71.45 tCO_2/year
ØRE: 140.44 tCO_2e/year
ØPE: 68.99 tCO_2e/year

Exhaust heat recovery water heater: 330.67 tCO_2/year
ØRE: 388.88 tCO_2e/year
ØPE: 58.21 tCO_2e/year

Grid CO_2 emission factor (0.2732 $kgCO_2$/kWh)

4. Project Implementation Structure

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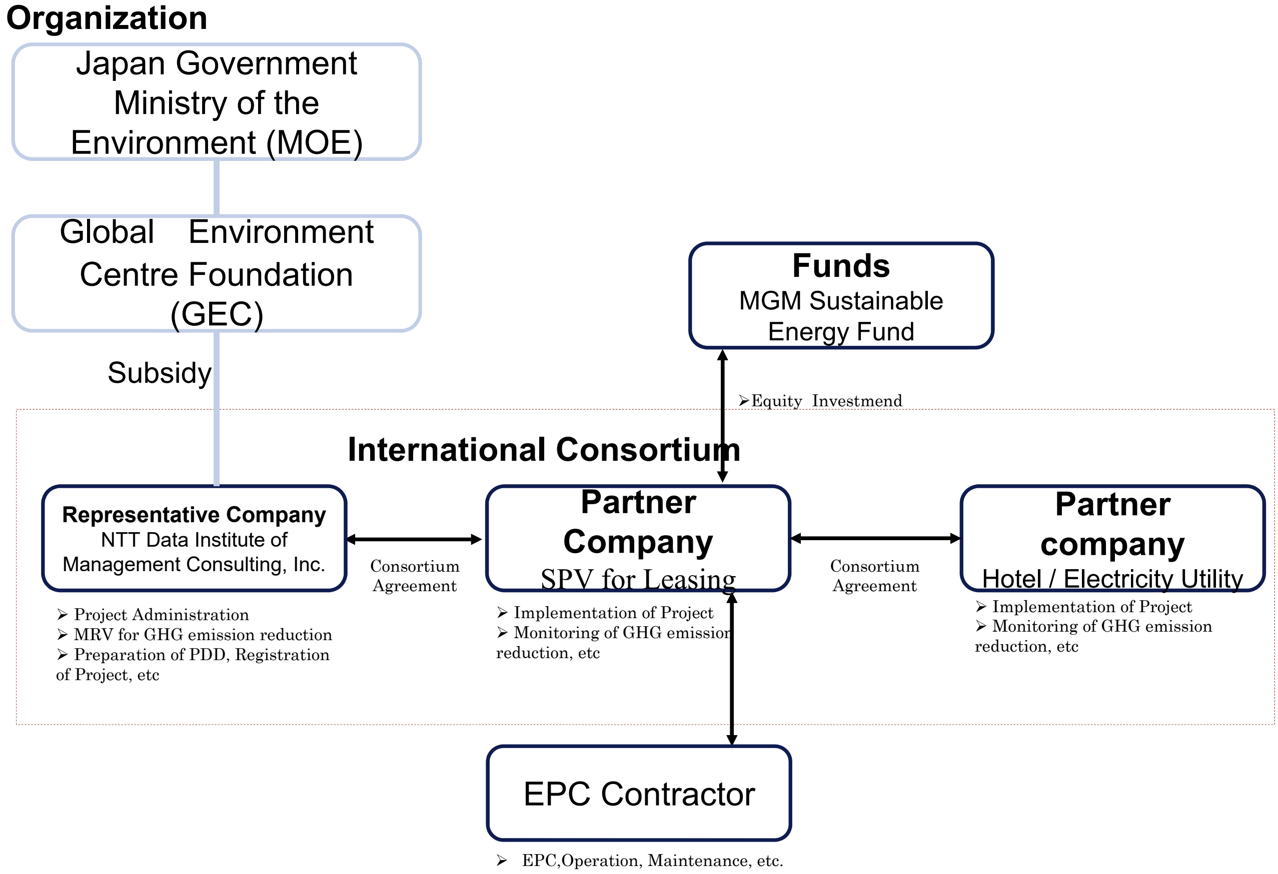
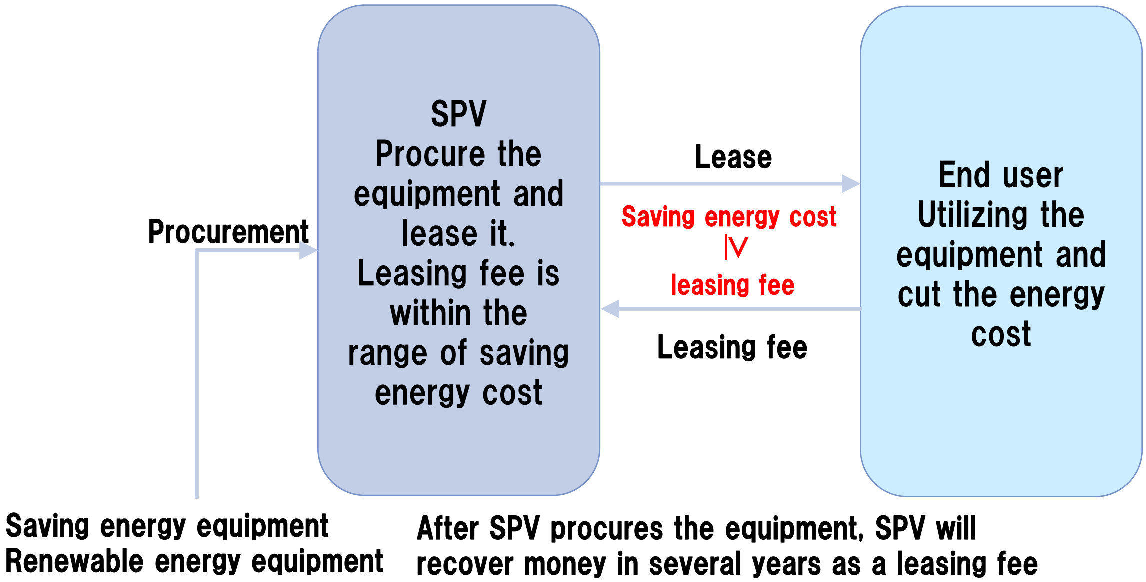


5. Characteristics of Project

End user will not have to bear initial investment.



After SPV procures the equipment, SPV will recover money in several years as a leasing fee from end user, which is smaller than the saving energy cost of users. When SPV completes the recovery, the ownership of the equipment will be transferred to END User.

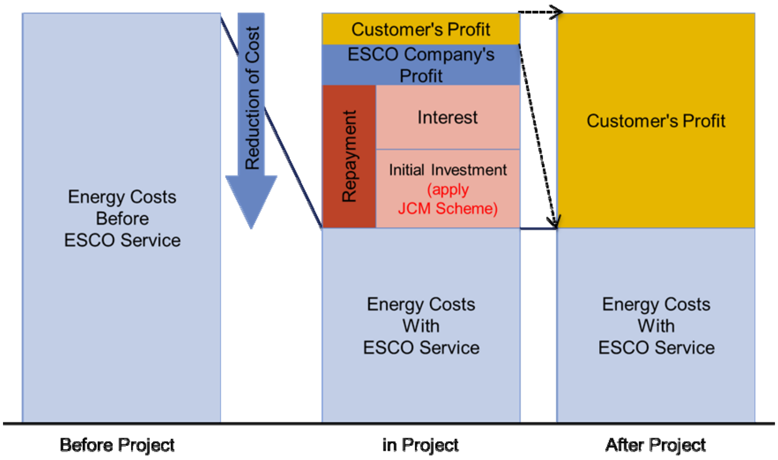
(Reference) ESCO business model

What Is the ESCO Business? ***ESCO stands for Energy Service Company**

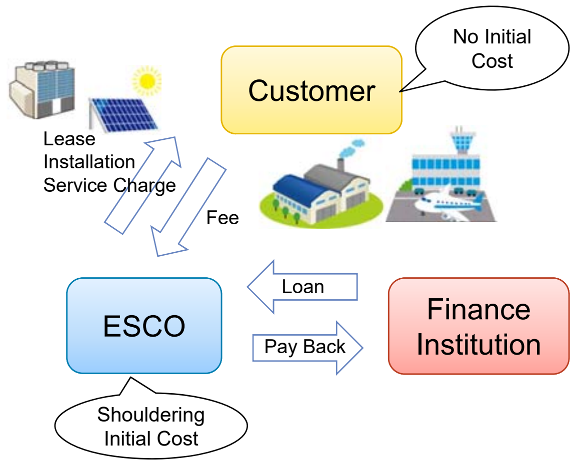
- A business that offers comprehensive services on energy conservation to clients, who in return will offer a part of their energy saving gains (saving on utility bill, etc.)
- The business has two forms:
  - "Guaranteed savings agreement" … customers cover business costs.
  - "Shared savings agreement"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

  These options enable service provision according to customer needs.

Source: The Energy Conservation Center, Japan



Overview of the ESCO business



Shared saving agreement

1. Outline of Project this year

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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 implementatio n structure	•Applied for JCM subsidy program •Starting Project

2. Present Status of Project this year

NTT DATA

	Selection of Candidate Site	Discussion	Diagnosis
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

So far, we had the discussion with Hotels, Airport and Developer of the industrial estate.
We would like to find out more potential site & company.

3. Assumed Project (Potential Project) ①

Activity	A) Low-carbonization of large scale hospitals, hotels and shopping mall by saving energy	B) Introducing distributed energy system using renewable energy.
Outline	Study on the possibility of introducing energy conservation and reengineering for relatively large hospitals, hotels, shopping malls, airports, etc.	Study on the possibility of introducing renewable energy system into the vacant space of water supply and sewer facilities, suitable land such as airport roof, vacant space of recycling factory operated by public institution etc.
Technology	High efficiency boiler, chiller, co-generation system	Renewable energy (solar power generation, solar thermal utilization system, mini hydropower)
Scheme	See Next Sheet	
Amounts of Subsidy, ROI	To be discussed based on survey result	

Exhaust heat recovery system

High Efficiency Chiller Unit

Mini Hydro Power

PV system

3. Assumed Project (Potential Project) ②

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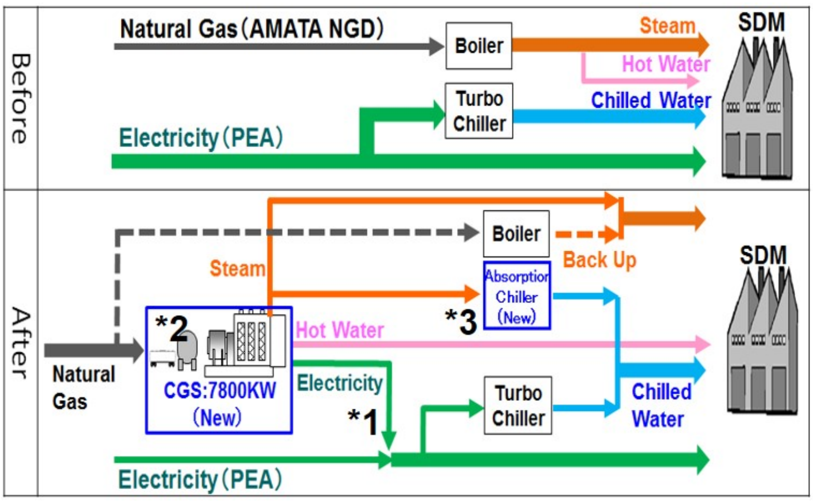
lq#wkh#idfwru|#ru#krwhov



Ip djh#ri#lqghshqghqw#srz hu#
Vxssd|#wr#idfwruhv

Small Hydro Power

Rice Milling Plant
Lumber mill
Cement Plant, etc..
[off grid area]

1. Upper Limit of Subsidy Rate

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

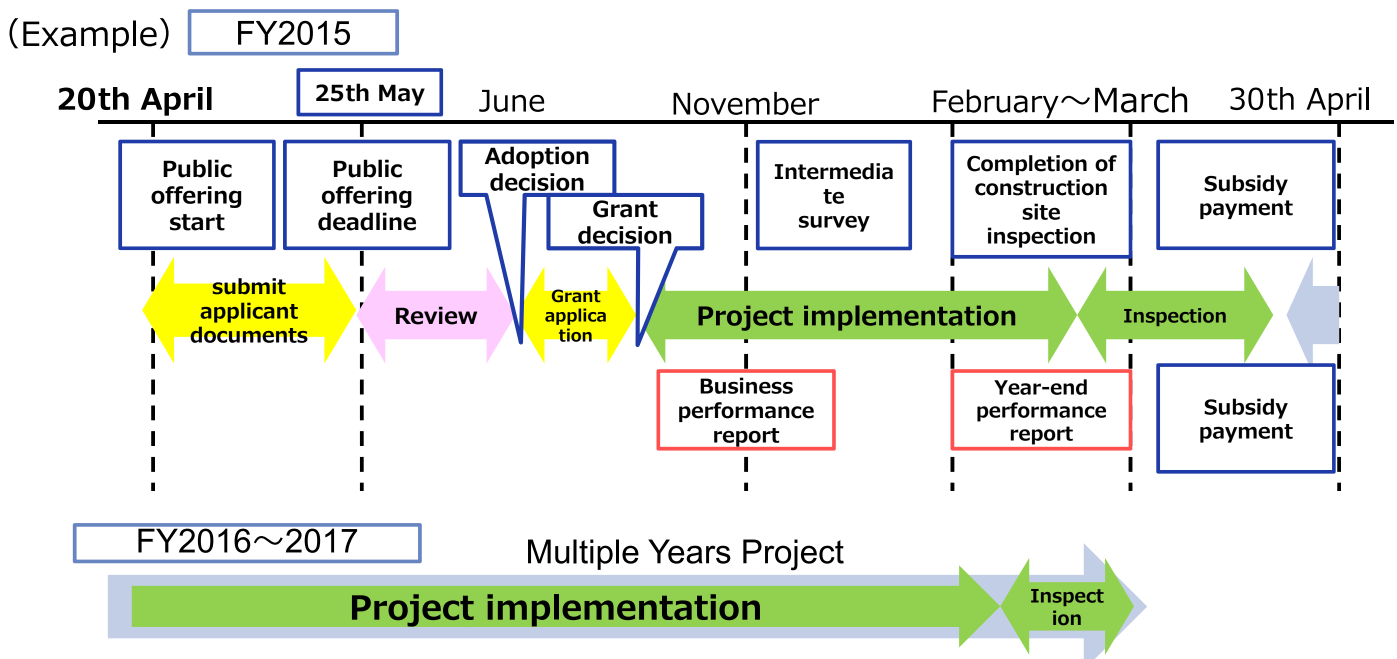
Adoption number of similar technology in the country to implement the project	0 (first case)	From 1 to 3	Over 4
Subsidy late	**Maximum 50 %**	**Maximum 40%**	**Maximum 30%**

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.**



- **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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変える力を、ともに生み出す。

Project to realize low carbonization in Mandalay region, through introduction of saving energy technologies and renewable energies
(City of Kitakyushu- Mandalay City Cooperation Project)

Promotion of utilization of biomass

November, 2017

Kitakyushu Asian Center for Low Carbon Society

NIKKEN SEKKEI CIVIL ENGINEERING LTD

Electricity Price

The Irrawaddy SEARCH...

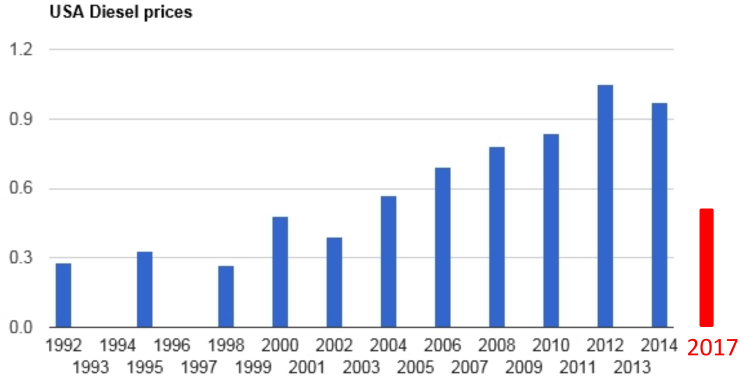
Burma

Ministry Announces Electricity Price Hike

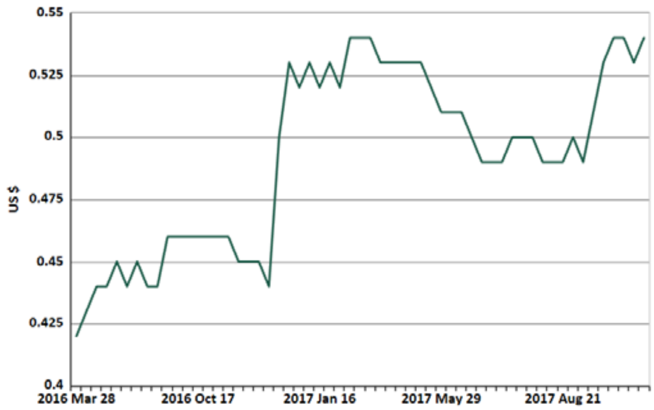
By Pe Thet Htet Khin 11 May 2017

NAYPYIDAW — Burma's Ministry of Electricity and Energy has announced plans to increase electricity prices, though it has not yet decided the new rates.

Fuel Price

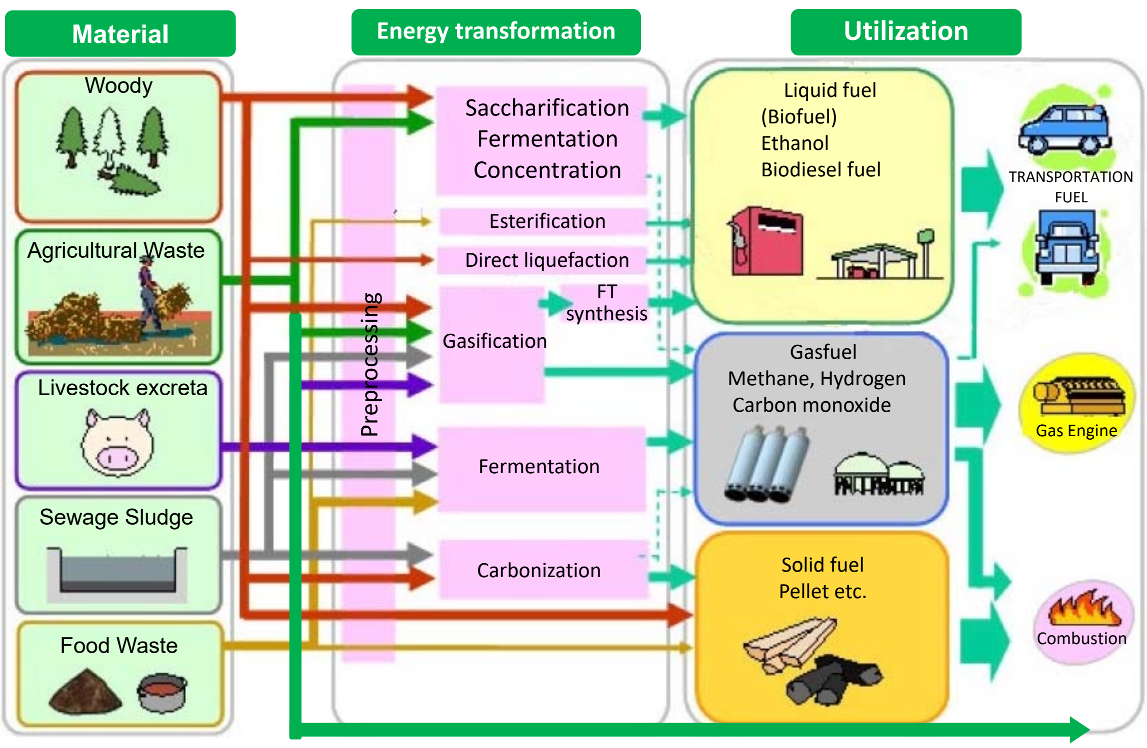


http://www.theglobaleconomy.com/USA/diesel_prices/



https://knoema.com/atlas/Myanmar/Diesel-price

Biomass Conversion Technology

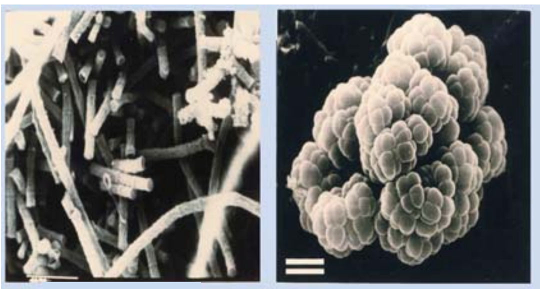


http://www.nedo.go.jp/activities/FF_00072.html

Gasification Power Generation / Heat Utilization (Methane Fermentation)

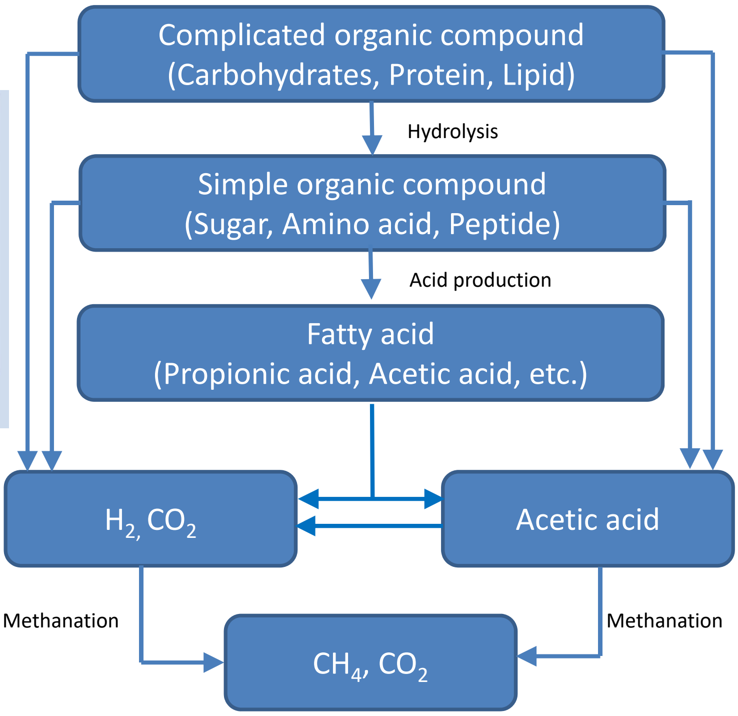
Outline of Methane Fermentation

The methane fermentation is a technique to product biogas (consists of approx. 60% of CH_4 and approx. 40% of CO_2) from organic waste by the function of methane bacteria (anaerobic microbe).



Filamentous Methanosaeta *Spherical Methanosarcina*

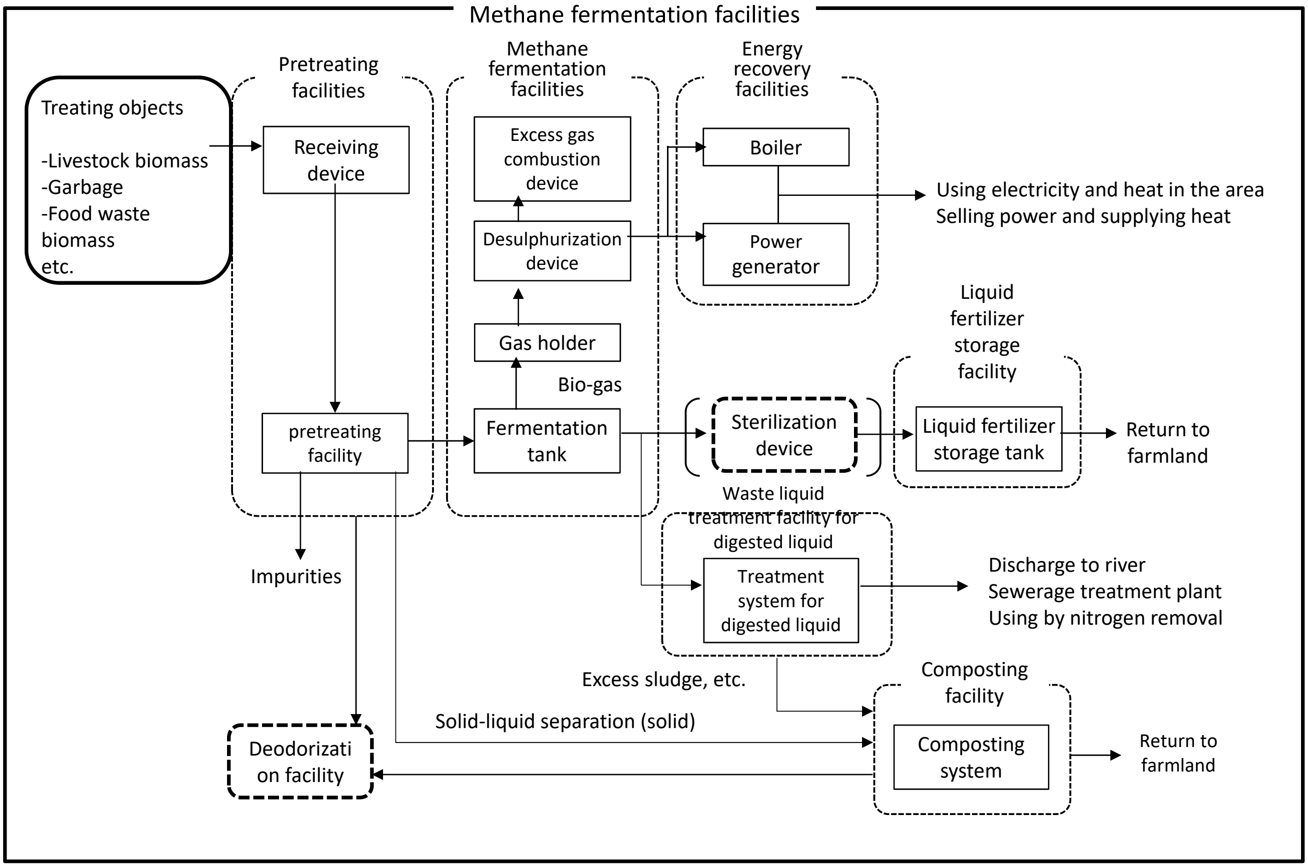
http://www.repa-npo.com/Kaiin_PDF/TERAKOYA_02.pdf



Outline of methanation process

6

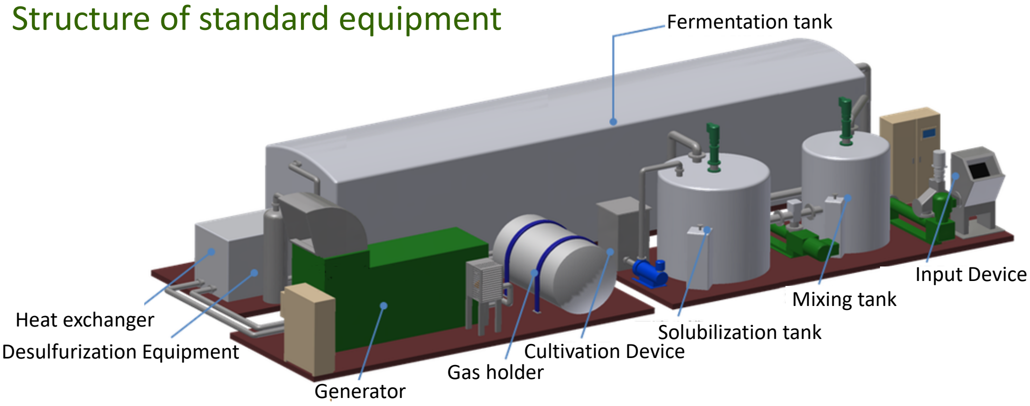
Outline of Methane Fermentation



http://www.repa-npo.com/Kaiin_PDF/TERAKOYA_02.pdf

Chicken Farm/Structure of Equipment of Biogas Power Generation

Structure of standard equipment



Installation space (150kW)

- Mixing tank ×1 container(40ft)
- Solubilization tank ×5 container(40ft)
- Methane fermenter tank ×8 container(40ft)
- Gas engine generator ×2 container(40ft)

→ 16 container = 640 m^2

Input (Approx.20t/day)

- Chicken: 140 thousands → 19.0 t-wet/day
- Pig: 100 → 0.840 t-wet/day
- Built in aquaculture fish → 100-120 kg/day

Chicken Farm/Profitability

Initial Cost

approx. 3 million USD

→ approx. 1.5 million USD (JCM Subsidized project ※)

※ If this project is admitted by Ministry of Environment, Japan, a maximum 50% of the initial equipment installation costs are assisted by Japanese government.

Running Cost (Operation Time : 20.6 hour × 330day/year)

approx. 14,500 USD/ year

Profit(Operation Time : 20.6 hour × 330day/year)

approx. 143,700 USD/year

+ Reduction of electrical charges : approx. 143,700 USD (Electric rate unit price :150 kyat/KWh)
+ Reduction of fuel oil for heat utilization: approx.20,600 USD (coal oil (kerosene) :560 kyat/ L (=2536 Kyat/gallon) ×approx.49,500L)

Payback Period

=Initial Cost/(Profit-Running Cost)

=1.5 million USD /(143,700 USD - 14,500 USD)= 11.6years

Whiskey factory / Methane Fermentation, Heat Utilization, Generation + Improvement of Wastewater Treatment Processes

Appearance of target factory

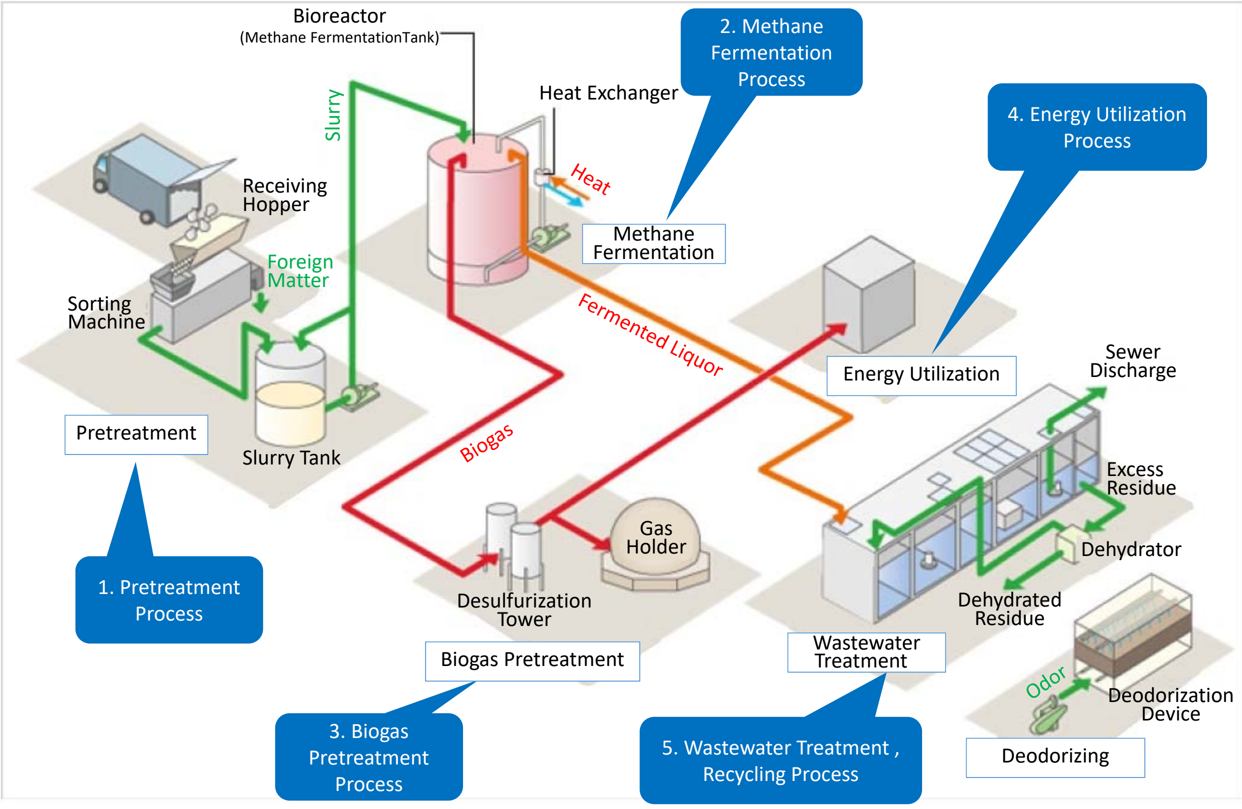
Chimney

Methane fermentation ponds

・Methane gas is not used for any heating purpose (boiler, etc.).

・There are some issues in wastewater treatment.

Whiskey factory / Methane Fermentation, Heat Utilization, Generation + Improvement of Wastewater Treatment Processes



https://www.kajima.co.jp/tech/g_warming/metakles/index.html#pagetop

Whiskey factory / Methane Fermentation, Heat Utilization, Generation + Improvement of Wastewater Treatment Processes

Advantages

◆**Reduction of residue generation**

・By methane fermentation, 70% decomposition / reduction of the solid matter (fiber, leather etc.) of lees.

◆**Bio gas significantly reduces fossil fuels**

・It is possible to collect 18,000 Nm^3 / day of biogas by decomposing a maximum lees amount of 400 t / day. (18,000Nm^3 / day of biogas is roughly equivalent to 9,700 L / day of Diesel (Approx.5,200USD/day →1.56millionUSD/year(300days)))

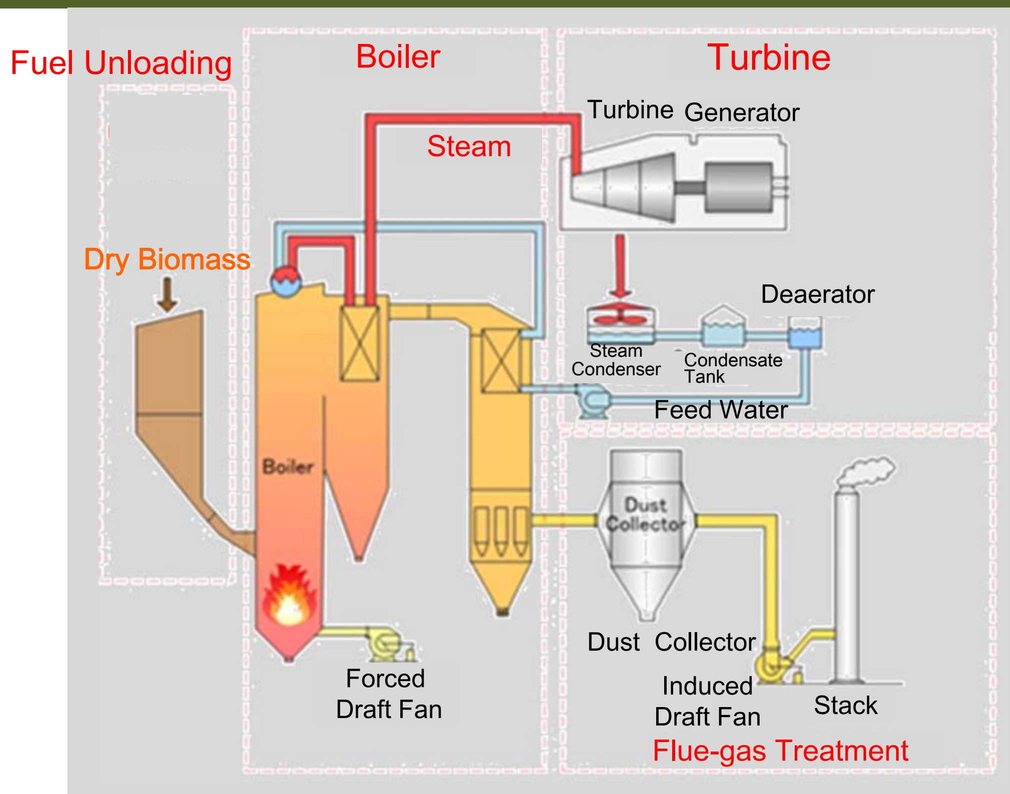
・By utilizing the collected biogas as an energy source, it is possible to dramatically reduce the amount of fossil fuel used at the factory.

◆**Reduction of greenhouse gas emissions**

・When the biogas generation amount is 18,000 Nm^3 / day, it is possible to reduce emissions of about 25 t-CO_2 per day.

https://www.kajima.co.jp/tech/g_warming/metakles/index.html#pagetop

Outline of Direct Combustion Power Generation



- Direct combustion is a system in which rice husks are burned directly to make the steam which will rotate the turbine to generate

Direct Combustion Power Generation／Fuel (agricultural residues, waste materials)

Rice husk

Lumber remaining material
https://newswitch.jp/p/1137

Thinned wood http://www.nerc.co.jp/wp/

Agricultural residue

Rice husk power generation／Business profitability

■Electric-generating capacity, Operating hours

Electric-generating capacity	kW	2,353	
Loss factor of plant-home use	%	15	
Sending-end output	kW	2,000	
Operation hours per day	hour/day	16	
The annual operation days	day/year	341	
The annual operation hours	hour/year	5,456	
The annual electric-generating capacity	kWh/year	10,912,273	Per month：2,000×16×30 ＝960,000kWh

■Rice husk consumption

Rice husk consumption	ton/day	40	2.5ton/hour× Operation hours per day
Rice husk consumption	ton/year	13,640	2.5ton/hour× The annual operation hours

■Running costs

Maintenance cost	USD/year	218,245	0.02USD/kW/hr
Rice husk purchase cost	USD/year	95,480	Rice husk consumption×7USD/ton
Fuel cost	USD/year	28,644	20Gallon/hour×2hours/times×341times (1time/day) ×3,000Kyat/gallon(about2.1USD/gallon)
Total of running costs	USD/year	342,369	

Rice husk power generation／Business profitability

Case1(Power selling price：0.07USD/kWh；Equivalent to the electricity unit price of grid electricity)

■Power sale income

Power selling amount	kWh/year	10,912,273	Grid electricity
Power selling price	USD/kWh	0.0700	The electricity unit price of grid electricity 100kyat/kwh(more than 300,001kwh/month) 100kyat=0.0733USD
Power sale income	USD/year	763,859	

■Initial cost recovery year

Project cost	USD	6,000,000	
Project cost (After 40% equipment assistance)	USD	3,600,000	
Annual profit after equipment introduction	USD／year	421,490	＝763,859－342,369
Initial cost recovery year	year	8.5	

Case2(Power selling price：0.10USD/kWh；Price slightly cheaper than current energy unit price)

■ Power sale income

Power selling amount	kWh/year	10,912,273	Grid electricity
Power selling price	USD/kWh	0.1000	The electricity unit price of grid electricity 100kyat/kwh(more than 300,001kwh/month) 100kyat=0.0733USD
Power sale income	USD/year	1,091,227	

■Initial cost recovery year

Project cost	USD	6,000,000	
Project cost (After 40% equipment assistance)	USD	3,600,000	
Annual profit after equipment introduction	USD／year	748,858	＝1,091,227－342,369
Initial cost recovery year	year	4.8	

Rice Mill／ Rice Husk Power Generation

Results of Field Survey Regarding BDF to Restaurant

- Popular Chinese restaurant that has 2 shops in Mandalay (there are 6 restaurants in Yangon).
- Waste edible oil (sunflower oil) of 5 gallons per day is discharged from the restaurant we visited to.
- It will be proposed that BDF is produced from waste edible oil and it is fuel for electric generator, boiler and so on.
- It will be studied to collect waste edible oil from other restaurants. And it will be studied the possibility as the fuel (B100) for packer cars of the cleaning station.

Drainage pipe of the restaurant

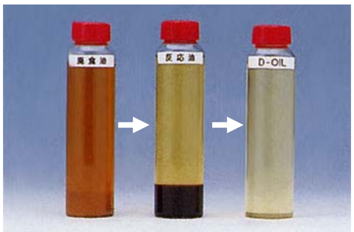
Appearance of objective restaurant

Meeting situation in the restaurant

About BDF(Bio Diesel Fuel)

◇BDF is the clean diesel as alternative fuel that it is produced from waste edible oil including rapeseed oil and the sunflower oil as raw materials plant.
◇The plants such as the rape absorb atmospheric CO_2 in the growth process. Thus the atmospheric CO_2 does not change in the whole life cycle of the plant even if the fuel which is produced from these raw materials is burned.
◇Therefore it is with "CO_2 count zero" namely carbon neutral.

・BDF production device (batch type)



Waste edible oil　Reacted oil　BDF

・Purified process of BDF

・Ingredient comparison between BDF and diesel fuel

Items	BDF	Diesel
Density(g/cm3)	0.86-0.90	≦ 0.86
Flush point (℃)	≧ 120	≧ 50
Sulfur content (ppm)	≦ 10	≦ 10
Carbon residue (mass%)	≦0.3	≦0.1
Cetane value	≧ 51	≧ 50
Kinematic viscosity (mm^2/s)	3.5-5.0	≧ 2.7

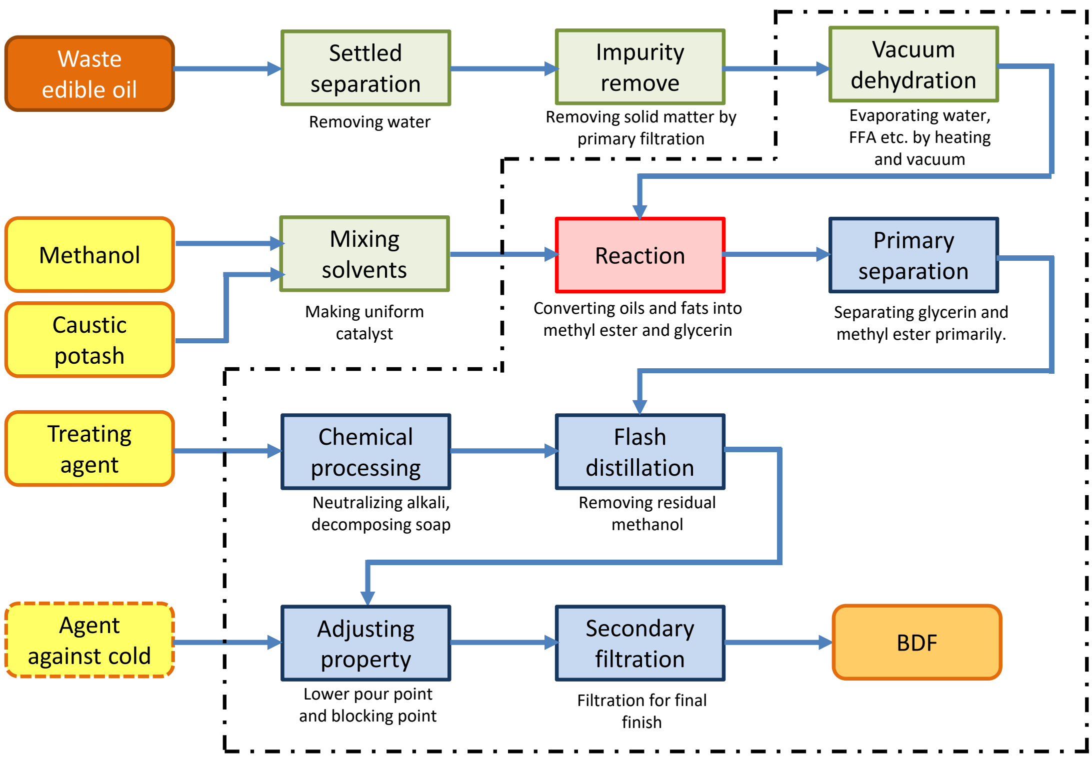
Notice: applied diesel oil which is No.1 for summer (according to JIS K2204)

■Characteristics of BDF

・Improve environmental pollution due to waste edible oil
・CO_2 emission is zero count
・Black smoke emission is more less than 1/3 than diesel fuel
・Sulfur oxide is rarely included
・ Available for commercial diesel cars
・Show mileage and run characteristics that are equal to diesel fuel

Production Flow Chart of BDF

◇Production flow chart



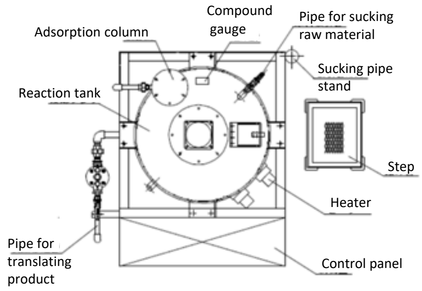
- ・- ・- : Corresponding range of apparatus

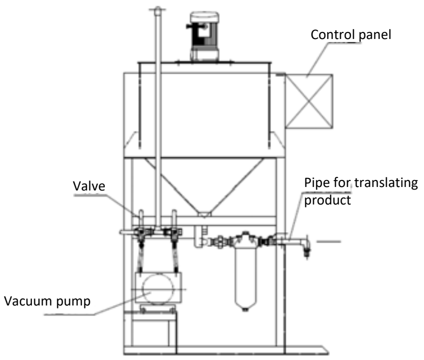
Primary Specification of Facility

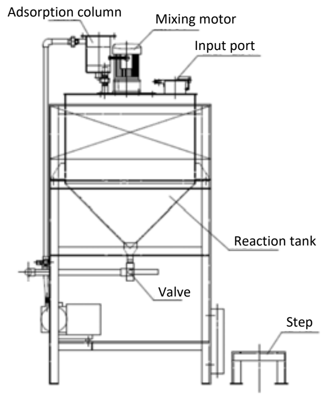
Primary specification of facility

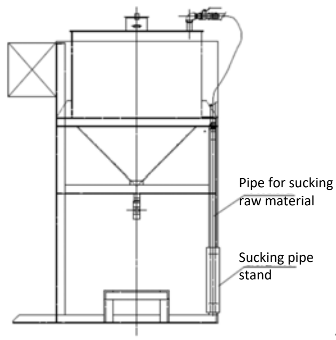
Type	D・OiL 50H	D・OiL 100H
Size	970L × 750W × 1,450H	970L × 800W × 1,770H
Weight	Approx. 150 kg	Approx. 250 kg
Capability	50 L/batch	100 L/batch
Operation system	Semi-automatic	Semi-automatic
Processing time	7 hours/batch	7 hours/batch
Rated output	4 kW	6 kW
Electricity consumption	8.9 kWh/batch	13.3 kWh/batch
Base Price	21,750 USD	30,450 USD
Ancillary facilities	Raw materials container, catalytic dissolution container, glycerin container	

As for this model, wastewater treatment facility is not necessary.









Mass Balance and Production Cost of BDF

◇Mass balance（Case of BDF production of 50L）

Input		Output	
Waste edible oil	57.5 L	BDF	50 L
Methanol	10.3 L	Waste glycerin	14.9 L
Caustic potash	0.88 Kg	Collected condensate	1.4 L
Treating agent	0.04 L		

＊Palm oil etc. which have bad fluidity at the time of low temperature are not suitable

◇Production cost of BDF (under investigation)

Category	Items	Price	Unit	Remark
Price of device	Base price	21,750	USD	BDF producing ability 50 L/day 50L/day × 330days＝16,500L/year
Income(1)	Unit sales price	0.52	USD/L	
Expenditure (2)	Sub total	0.44	USD/L	
	Labor cost	0.07	USD/L	Labor cost : 5,000Kyat/day
	Utility cost	0.007	USD/L	Electricity bill 57Kyat/kWh
	Chemical cost	0.33	USD/L	Methanol, Caustic potash, Treating agent
	Disposal cost of waste edible oil	0	USD/L	
	Maintenance cost	0.026	USD/L	2% of apparatus costs
	Disposal cost of waste glycerin	0	USD/L	Using it as fuel for boilers
	General administrative expenses	0.007	USD/L	assume 10% of labor cost
(1) - (2)		0.08	USD/L	

Operation and Maintenance

◇Operation

・Preparation process: Investing waste edible oil into raw materials container, investing methanol and caustic potash into catalytic dissolution container, investing treating agent into its container
・Operation process: Pushing switch of operation panel every process and carry out production
・Final process: Extracting BDF from tank

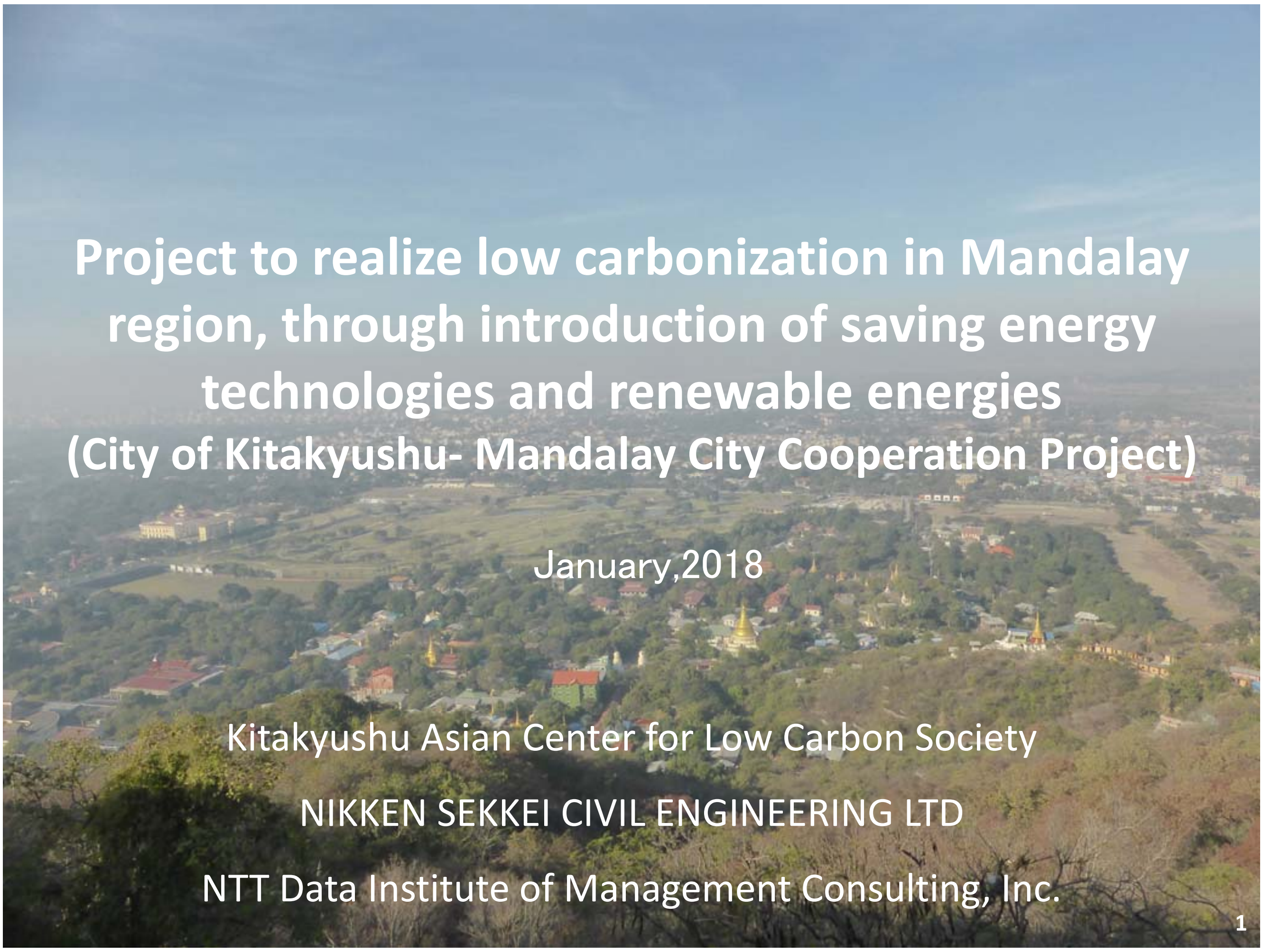
These processes mentioned above are able to be carried out by only one worker

◇Maintenance and check of device

・Exchanging oil of vacuum pump : 1 time per 5 batch (depend on raw material)
・Exchanging filter: 1 time per 3 – 5batch or case that filter is clogged up

◇Safety management

・Checking oil leak , methanol leak or water leak before and after operation
・Confirming that there is no origin of fire at the methanol retention place
・Cutting off main power supply after operation
・Locking when leaving
・Conducting safety management according to other dangerous materials


Project to realize low carbonization in Mandalay region, through introduction of saving energy technologies and renewable energies
(City of Kitakyushu- Mandalay City Cooperation Project)
January,2018
Kitakyushu Asian Center for Low Carbon Society
NIKKEN SEKKEI CIVIL ENGINEERING LTD
NTT Data Institute of Management Consulting, Inc.
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Contents

Progress Summary of Field Survey

◆Field Survey(8th-13th, 24th Oct-2017,)

Field Survey was carried out in Yangon and Mandalay.
Mandalay International Airport agreed to consider making a JCM. Regarding mini-micro hydro power generation project, local company agreed to cooperate in conducting survey.

Major Destinations and discussion result

No	Destination	Objective	Progress	Priority
1	Kawabata Sumino Ltd	Build relationship with company who has information of potential place of mini-micro hydropower generation and connection of	**Confirmed the possibility of collaboration in hydroelectrric power survey.**	○ (Long-Term)
2	City Mart Holding Company Ltd.	Survey on possibility of project formulation with the largest supermarket chain in Myanmar.	High interest in JCM. However, in Mandalay, the size of the store is small so it is difficult to make projects. They are planning solar power project in Yangon and will discuss adaptability of JCM.	△
3	MMID Public Co., Ltd	Survey on possibility of project formulation with the Myotha Industrial park which is in the early stage of development.	It is difficult to adapt JCM because there is a few company in operation.	×
4	Mandalay Hill Resort Hotel	Survey on possibility of project formulation with the large hotel in Mandalay.	Chiller system was already renovated. There is no demand for upgrading existing facilities. Management is interested in JCM, so they will consider adapatability to other facilities.	×
5	Aung Sein Texitile mill	Survey on possibility of project formulation with the chamical fiber factory in Manadalay.	Energy consumpotion is large in this factory. However they don't feel a problem with electricity usage situation and electricity charge.	△
6	KOMATSU Manufacturing Myanmar Ltd.	Survey on possibility of project formulation with Japanease company entering Mandaly.	It is difficult to formulate JCM scheme because there is no large size equipment currently.	×
7	Mandalay International Airport	Explanation of business shceme for project formulation. Obtaining drawing information etc. for	**They show an ambitious response to the renewal of the chiller facilitiy utilizieng JCM. Get agreement to proceed estimation.**	◎

4

Filed Survey Report

【Mandalay City: Chemical fiber manufacturing plant】

- Manufacturing chemical fibers from cotton-like chemical raw materials imported from Taiwan, South Korea, Thailand, and shipping them to the domestic market.
- Since coal boiler is constantly burning for the dyeing process, CO2 emission reduction is expected.
- Currently there are no plans for expansion of facilities. For JCM business, they will consider with the president.

Company Overview

Company	Aung Sein Textile mill
Establishment	2002
Business	Production and shipment of chemical fiber
Number of employees	Approx. 1100
Site area	3acre
Main Facilities	· 5 diesel generators (US, UK) · Coal boiler (steam amount 4 ton) · Manufacturing equipment in each process
Sales	Approx. 5.4 MM yen / month
Electrical Charge	Approx. 7.0 MM yen / month

Manufacturing Process

Material Procurement ➡ Crushing, Shredding ➡ Molding ➡ Linear Processing ➡ Staining ➡ Drum Impression ➡ Packing, Shipping


Packing Process


Molding Process


Coal boiler

Project Progress (Low-carbonization for large scale facilities)

【Introduction of new chiller facilities to Mandalay International Airport】

■Project Overview

- The chiller system introduced two years ago is out of order, so individual air-conditioning is used in a sudden way. They are planning to introduce new chiller system and consider using JCM.
- This project would contribute to "The Eco-Airport" plan which Myanmar government interested and raise the reputation of this airport.
- The existing equipment
  Air-cooled chiller 300 ton × 5stes

Outline of MJAS's airport management business

Company	MC-Jalux Airport Services Co.,Ltd. (MJAS)
Establishment	Apr-14
Overview	Operation, Refurbishment, and maintenance of Mandalay International Airport. Project period : 30 years
Schedule	Nov.-2014… Business agreement concluded Apr.-2015 … Operation start
Projectg Scope	· Repair and remodeling of existing facilities including runways, guidance and parking lots · Operation of the entire airport(Except control & lubrication) · Construction of cargo terminal · Procurement of ground support equipment
Passenger number	Fiscal Year 2014 … 0.94MM. (22,000 flights) Fiscal Year 2014 … 1.01MM. (24,600 flights)

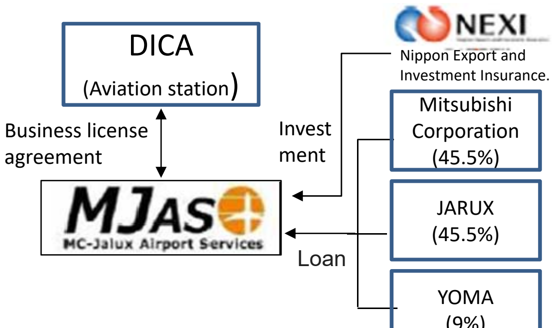
■Progress

(Consensus Building)

- Held a meeting with MJAS and explained a business scheme (10E). MJAS showed a positive response and introduce shareholder Mitsubishi Corporation (MC).
- MC has also and showed favorable response because the project contribute to eco-airport and it would raise evaluation of MJAS.

(Economic-Technical Consideration)

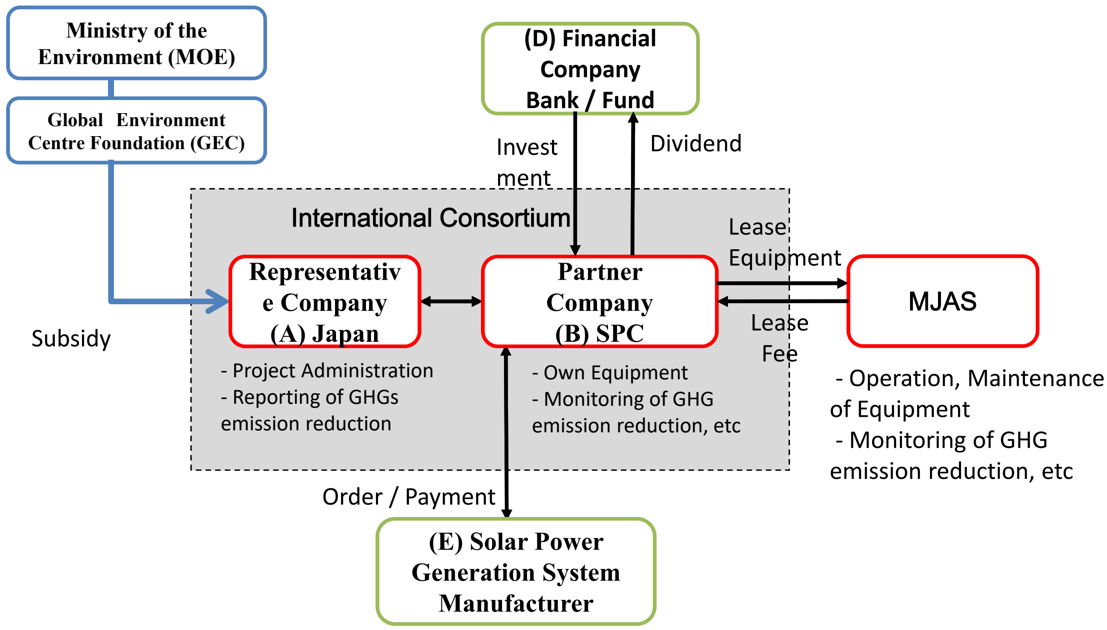
- On-going. (12M)



Source： Mitsubishi Corporation HP

Organization at Implementation Phase

・ Considering ESCO type business structure



Future Plans

【①Introduction of new chiller facilities to Mandalay International Airport】

- Examining Technology, Economic, Reduction of CO_2 Emission, and Project Implementation Scheme.
  - Proceed coordination with EPC company and conduct estimation. (1st Priority)
  - Specify installed equipment, technologies, amounts of CO_2 emission
  - Based on the above consideration, plan financing and lease model by cooperating with the funds.

- Preparation for application to JCM subsidy project
  - Deciding implementation schedule with project stakeholders.
  - Considering MRV methodologies to be applied.

【②Other Activities】

- Continue to investigate large facilities (hotel etc.) within Mandalay Province.
- We will have a meeting with Company from Kitakyushu city entering Yangon for a project formulation.

Subject of Investigation

■Field Survey(May - November,2017)

No.	Company・University	Proposal	Priority
1	Shwe Thi Ha (Rice mill)	Biomass power generation	
2	Mandalay Livestock Development	Biogas power generation	
3	San Pya Livestock Co., Ltd	Ditto	
4	December Farm(Livestock industry)	Ditto	
5	Super Win(Confectionery company)	Ditto	
6	Myanmar Distillery Company	Biogas system (Steam boiler) & Wastewater treatment	○
7	Asia Beverage Company	Biogas system (Steam boiler)	○
8	Golden Duck (Restaurant)	Biodiesel fuel	○
9	DUWON (oil-manufacturing company)	Ditto	
10	Mandalay University Department of Chemistry	Biogas power generation	

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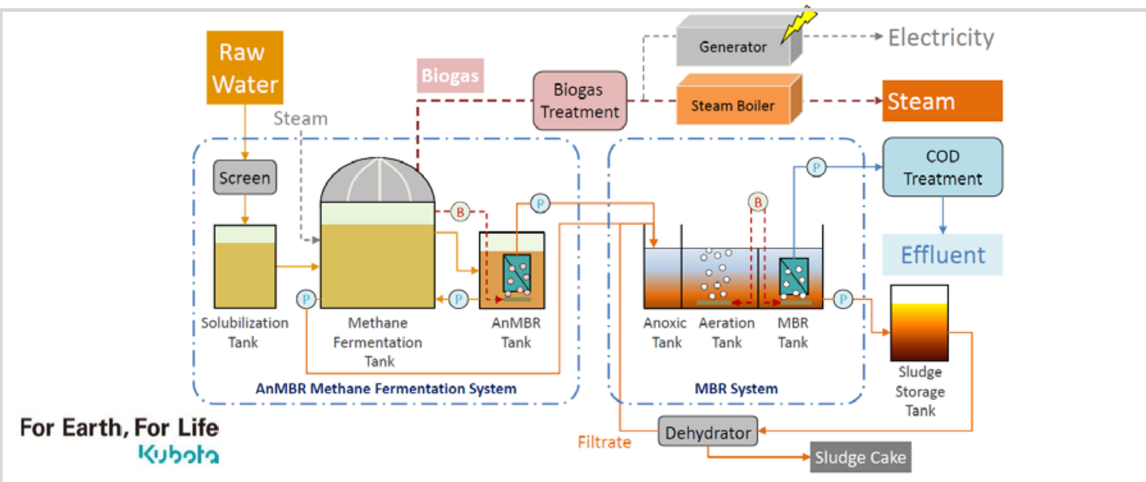
Brewing maker / Biogas System & Wastewater Treatment System

■Present Issues

- Biogas generated during the treatment process of lees has not been utilized for heating or power generation.
- Operation of factory has been stopped by the administration because the treated water does not meet environmental standers.（Many companies is shutdown due to wastewater problems In Yangon, Mandalay).

■Proposal

Biogas Plant: AnMBR Methane Fermentation
Wastewater Treatment Plant: MBR System (MBR: Membrane Bio-Reactor)



Brewing maker / Biogas System & Wastewater Treatment System

■Advantages

(1)AnMBR Methane Fermentation System

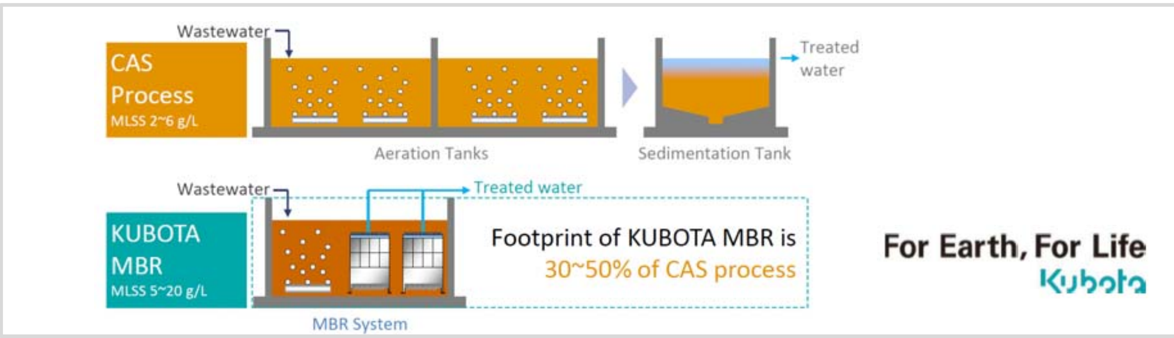
- It is possible to reduce the present fuel cost and electricity by using biogas for producing steam or generating electricity.
- The strength of this system is that the amount of biogas (methane: 60%, CO_2: 40%) collected is large and the amount of sludge generated is small because lees can be completely fermented.
- It can also contribute to water quality improvement of treated water.

(2)MBR System (MBR: Membrane Bio-Reactor)

◆**Small footprint**

- Smaller aeration tank volume than CAS process (CAS: Conventional Activated Sludge)
- No need of sedimentation tanks due to membrane separation

★ In the case of facilities of a brewery company in Myanmar, the facility area can be reduced by 98%.



◆**Excellent quality of treated water**

-Equivalent to or better than CAS + sand filtration + disinfection, due to the liquid-solid separation by 0.2 µm-pore-size membrane

◆**Easy to operation and maintenance / Energy saving / Long service life**

Results of Field Survey Regarding BDF to Restaurant

・Popular Chinese restaurant that has 2 shops in Mandalay (there are 6 restaurants in Yangon).
・Waste edible oil (sunflower oil) of 5 gallons per day is discharged from the restaurant we visited to.
・It will be proposed that BDF is produced from waste edible oil and it is fuel for electric generator, boiler and so on.
・It will be studied to collect waste edible oil from other restaurants. And it will be studied the possibility as the fuel (B100) for packer cars of the cleaning station.

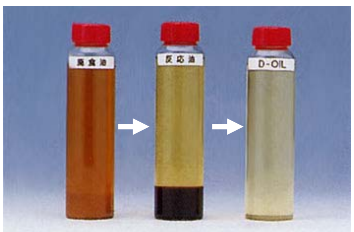
Appearance of objective restaurant


Meeting situation in the restaurant

About BDF(Bio Diesel Fuel)

◇BDF is the clean diesel as alternative fuel that it is produced from waste edible oil including rapeseed oil and the sunflower oil as raw materials plant.
◇The plants such as the rape absorb atmospheric CO_2 in the growth process. Thus the atmospheric CO_2 does not change in the whole life cycle of the plant even if the fuel which is produced from these raw materials is burned.
◇Therefore it is with "CO_2 count zero" namely carbon neutral.


・BDF production device (batch type)



・Purified process of BDF

・Ingredient comparison between BDF and diesel fuel

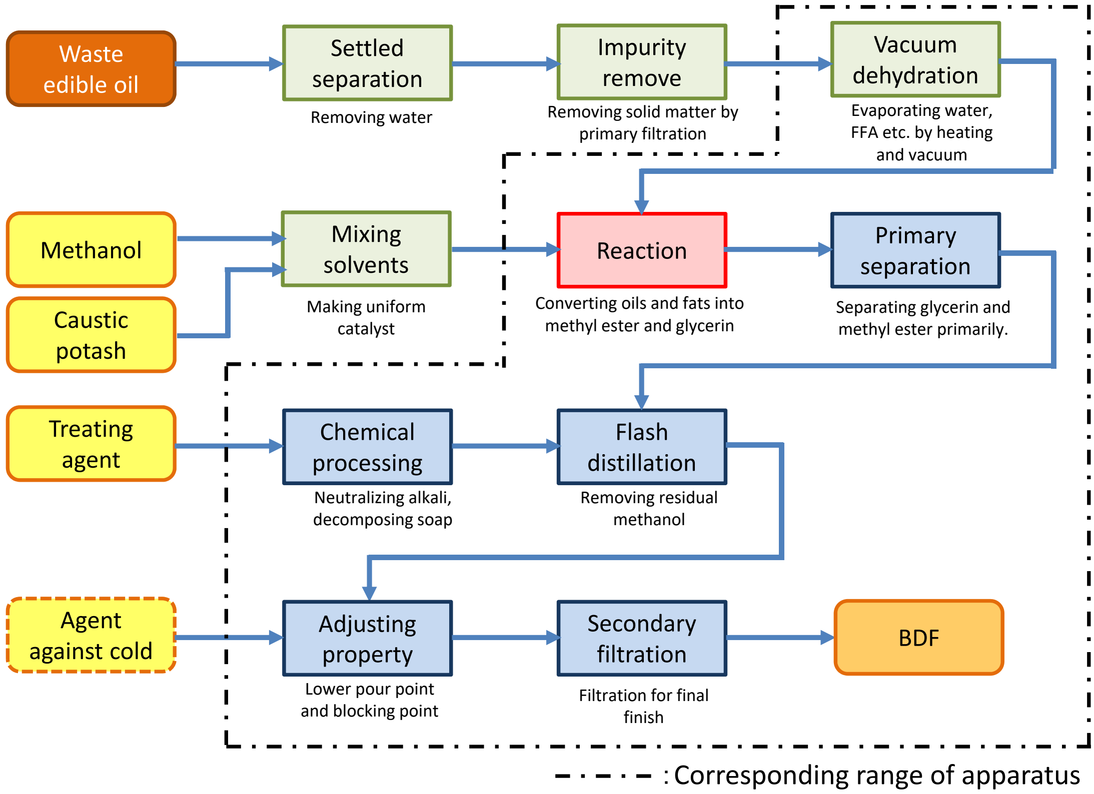
Items	BDF	Diesel
Density(g/cm3)	0.86-0.90	≦ 0.86
Flush point (℃)	≧ 120	≧ 50
Sulfur content (ppm)	≦ 10	≦ 10
Carbon residue (mass%)	≦0.3	≦0.1
Cetane value	≧ 51	≧ 50
Kinematic viscosity (mm^2/s)	3.5-5.0	≧ 2.7

Notice: applied diesel oil which is No.1 for summer (according to JIS K2204)

■Characteristics of BDF
・Improve environmental pollution due to waste edible oil
・CO_2 emission is zero count
・Black smoke emission is more less than 1/3 than diesel fuel
・Sulfur oxide is rarely included
・ Available for commercial diesel cars
・Show mileage and run characteristics that are equal to diesel fuel

Production Flow Chart of BDF

◇Production flow chart

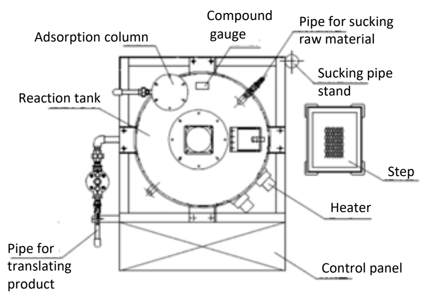


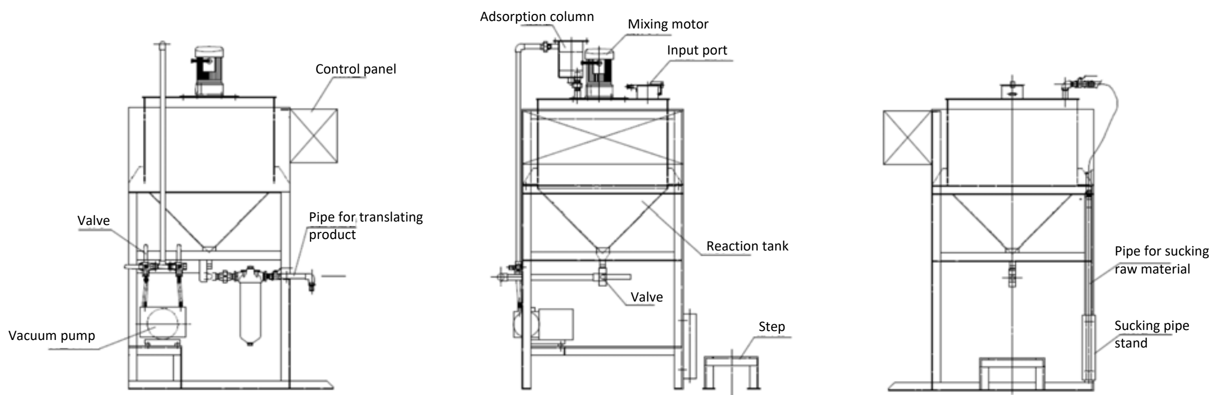
Primary Specification of Facility

Primary specification of facility

Type	D・OiL 50H	D・OiL 100H
Size	970L×750W×1,450H	970L×800W×1,770H
Weight	Approx. 150 kg	Approx. 250 kg
Capability	50 L/batch	100 L/batch
Operation system	Semi-automatic	Semi-automatic
Processing time	7 hours/batch	7 hours/batch
Rated output	4 kW	6 kW
Electricity consumption	8.9 kWh/batch	13.3 kWh/batch
Base Price	21,750 USD	30,450 USD
Ancillary facilities	Raw materials container, catalytic dissolution container, glycerin container	

As for this model, wastewater treatment facility is not necessary.





Mass Balance and Production Cost of BDF

◇Mass balance（Case of BDF production of 50L）

Input		Output	
Waste edible oil	57.5 L	BDF	50 L
Methanol	10.3 L	Waste glycerin	14.9 L
Caustic potash	0.88 Kg	Collected condensate	1.4 L
Treating agent	0.04 L		

* Palm oil etc. which have bad fluidity at the time of low temperature are not suitable

◇Production cost of BDF (under investigation)

Category	Items	Price	Unit	Remark
Price of device	Base price	21,750	USD	BDF producing ability 50 L/day 50L/day×330days＝16,500L/year
Income(1)	Unit sales price	0.52	USD/L	
Expenditure (2)	Sub total	0.44	USD/L	
	Labor cost	0.07	USD/L	Labor cost：5,000Kyat/day
	Utility cost	0.007	USD/L	Electricity bill 57Kyat/kWh
	Chemical cost	0.33	USD/L	Methanol, Caustic potash, Treating agent
	Disposal cost of waste edible oil	0	USD/L	
	Maintenance cost	0.026	USD/L	2% of apparatus costs
	Disposal cost of waste glycerin	0	USD/L	Using it as fuel for boilers
	General administrative expenses	0.007	USD/L	assume 10% of labor cost
(1) - (2)		0.08	USD/L	

Summary

1. Results of work in this fiscal year

· As a result of investigating airport, factories, livestock companies etc. within the Mandalay city, It turned out that there is a possibility of improving management and CO_2 reduction by introducing energy saving (ES) and renewable energy (RE) technologies.

· At the Mandalay Industrial Park, workshops were held to introduce ES & RE technologies, as well as explaining the method of reducing cost burden by JCM equipment assistance, ESCO etc, and understanding was obtained from attendees.

· Many companies stopped operating because factory wastewater exceeded the standard value, and it turned out that there is needs for wastewater treatment facilities.

2. Future activities

· For companies that are interested in the business using JCM, we will continue to approach and aim to implement the project in the future.

· We will contribute to environmental conservation in Mandalay City as a whole including not only spread of ES & RE technologies but also support for problems related to waste management and industrial wastewater.

Global IT Innovator

Introduction of JCM(Joint Crediting Mechanism)

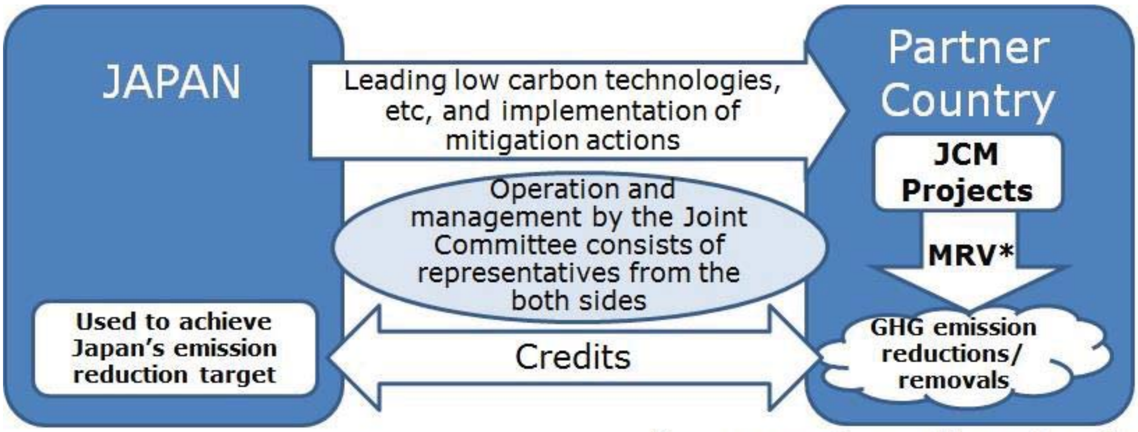
NTT Data Institute of Management Consulting, Inc.
Socio & Eco Strategic Consulting Unit

Index

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

NTT DATA

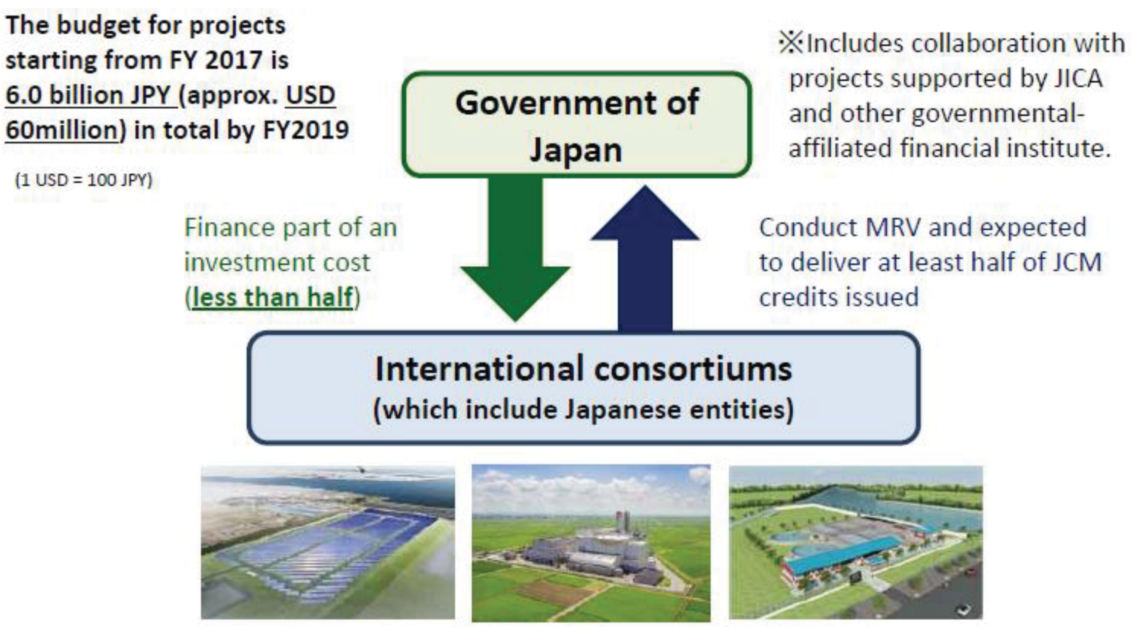
- Facilitating diffusion of leading low carbon technologies, products, systems, services and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries;
- Appropriately evaluating contributions from Japan to GHG)emission reductions 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 Subsidy Program

NTT DATA



- 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.

1-3. 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)

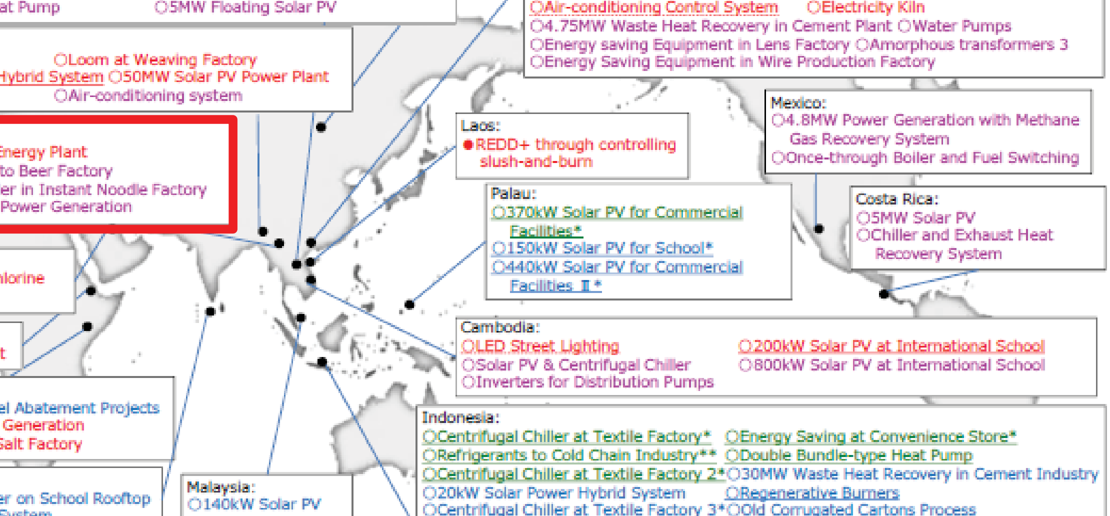

Myanmar
Sep. 16, 2015
(Nay Pyi Taw)


Thailand
Nov. 19, 2015
(Tokyo)

the Philippines
Jan. 12, 2017
(Manila)

1-4. JCM Subsidy Program by MOEJ (FY2013-2016)

NTT DATA



Thailand:
○Energy Saving at Convenience Store ○1.0MW Solar PV on Factory Rooftop
○Upgrading Air-saving Loom ○Centrifugal Chiller & Compressor
○Co-Generation in Motorcycle Factory ○Centrifugal Chiller in Tire Factory
○Air Conditioning System & Chiller ○Refrigeration System
○Ion Exchange Membrane Electrolyzer ○Chilled Water Supply System
○LED Lighting to Sales Stores ○12MW Waste Heat Recovery in Cement Plant
○Co-generation System ○Refrigerator and Evaporator
○1.5MW Solar PV and EMS in Paint Factory ○3.4MW Solar PV
○Heat Recovery Heat Pump ○5MW Floating Solar PV

Bangladesh:
○Centrifugal Chiller ○Loom at Weaving Factory
○320kW PV-diesel Hybrid System ○50MW Solar PV Power Plant
○Centrifugal Chiller ○Air-conditioning system

Myanmar:
○700kW Waste to Energy Plant
○Brewing Systems to Beer Factory
○Once-through Boiler in Instant Noodle Factory
○1.8MW Rice Husk Power Generation

Saudi Arabia:
○Electorolyzer in Chlorine Production Plant

Ethiopia:
○Biomass CHP Plant

Kenya:
○300kW Solar Diesel Abatement Projects
○6MW Hydropower Generation
○1MW Solar PV at Salt Factory

Maldives:
○190kW Solar Power on School Rooftop
■Smart Micro-Grid System

Malaysia:
○140kW Solar PV

Mongolia:
○Heat Only Boiler (HOB)** ○2.1MW Solar PV in Farm
○10MW Solar PV ○8.3MW Solar PV in Farm

Viet Nam:
○Digital Tachographs* ○Amorphous transformers*
○Air-conditioning in Hotel ○Air-conditioning in Lens Factory
○Container Formation Facility ○Electric Furnace
○320kW Solar PV in Shopping Mall ○Amorphous transformers 2
○Air-conditioning Control System ○Electricity Kiln
○4.75MW Waste Heat Recovery in Cement Plant ○Water Pumps
○Energy saving Equipment in Lens Factory ○Amorphous transformers 3
○Energy Saving Equipment in Wire Production Factory

Laos:
●REDD+ through controlling slush-and-burn

Mexico:
○4.8MW Power Generation with Methane Gas Recovery System
○Once-through Boiler and Fuel Switching

Palau:
○370kW Solar PV for Commercial Facilities*
○150kW Solar PV for School*
○440kW Solar PV for Commercial Facilities II*

Costa Rica:
○5MW Solar PV
○Chiller and Exhaust Heat Recovery System

Cambodia:
○LED Street Lighting ○200kW Solar PV at International School
○Solar PV & Centrifugal Chiller ○800kW Solar PV at International School
○Inverters for Distribution Pumps

Indonesia:
○Centrifugal Chiller at Textile Factory* ○Energy Saving at Convenience Store*
○Refrigerants to Cold Chain Industry** ○Double Bundle-type Heat Pump
○Centrifugal Chiller at Textile Factory 2* ○30MW Waste Heat Recovery in Cement Industry
○20kW Solar Power Hybrid System ○Regenerative Burners
○Centrifugal Chiller at Textile Factory 3* ○Old Corrugated Cartons Process
○Upgrading to Air-saving Loom ○Centrifugal Chiller in Shopping Mall
○Smart LED Street Lighting System ○Once-through Boiler System in Film Factory
○Gas Co-generation System ○Once-through Boiler in Golf Ball Factory
○1.6MW Solar PV in Jakabaring Sport City ●REDD+ through controlling slush-and burn
○10MW Hydro Power Plant ○Looms in Weaving Mill
○LED Lighting to Sales Stores ○Industrial Wastewater Treatment System
○Air-conditioning Utility System in Airport ○0.5MW Solar PV

○ Model Project in FY 2013 (7 projects in 3 countries)
○ Model Project in FY 2014 (14 projects in 7 countries)
■ ADB Project in FY 2014 (1 project in 1 country)
○ Model Project in FY 2015 (34 projects in 10 countries)
○ Model Project in FY 2016 (34 projects in 9 countries)
● REDD+ Model Project (2 projects in 2 countries)

Total 91 projects in 15 partner countries

Underlined projects have started operation (31 projects, including 7 partially started projects)
Projects with * have been registered as JCM projects (13 projects)

Source：JCM Home Page

2. Introduction of Survey Project in Mandalay

2-1. Background
- Collaboration between Kitakyushu & Mandalay

NTT DATA

International cooperation projects from Kitakyushu.

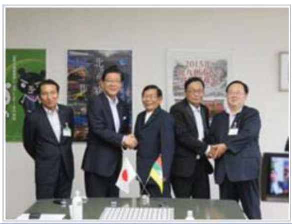
- Environmental Sector
- Water Supply Sector

Field survey, technical support, workshop, training exchange, etc.

Mayor of Mandalay city visited Kitakyushu in 2014 by JICA Partnership Program.

Head of Cleansing Dep. of Mandalay city participated Workshop on Waste Management through City-to-City Collaboration by MOEJ at Kitakyushu.in JAN of 2017.

Explain environment policy of Kitakyushu city and discussed about 「Promote City-to-City Collaboration projects」



Conducting basic survey to grasp needs for further City-to-City collaboration projects in 4 sector.

4 Sector for City-to-City collaboration project.

1. Environmental Protection Sector
2. Water Supply Sector
3. Waste Sector
4. **Energy Sector** (4 activities)

Target activities for this basic survey.

	Activity item	System to be introduced
A	Low-carbonization for large scale facilities such as hospital, hotel and shopping mall	•High-efficiency chillers, •Co-generation system
B	Introducing distributed energy system using renewable energy etc.	Distributed energy system •solar system •mini/micro hydro power system
C	Low-carbonization utilizing agricultural waste such as rice husks etc.	Biomass generation facility utilizing agricultural waste
D	Introducing distributed energy system utilizing livestock excreta	Biogas generation system utilizing livestock excreta

※Picture from IGES Home Page

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 of large scale hospitals, hotels and shopping mall by saving energy	B) Introducing distributed energy system using renewable energy.
Outline	Study on the possibility of introducing energy conservation and reengineering for relatively large hospitals, hotels, shopping malls, airports, etc.	Study on the possibility of introducing renewable energy system into the vacant space of water supply and sewer facilities, suitable land such as airport roof, vacant space of recycling factory operated by public institution etc.
Technology	High efficiency boiler, chiller, co-generation system	Renewable energy (solar power generation, solar thermal utilization system, mini hydropower)
Scheme	See Next Sheet	
Amounts of Subsidy, ROI	To be discussed based on survey result	

Exhaust heat recovery system


High Efficiency Chiller Unit


Mini Hydro Power

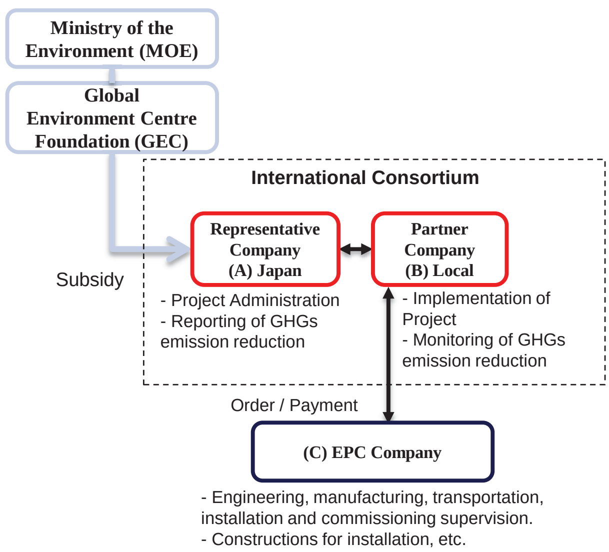

PV system

2-3. Organization at Implementation Phase

NTT DATA

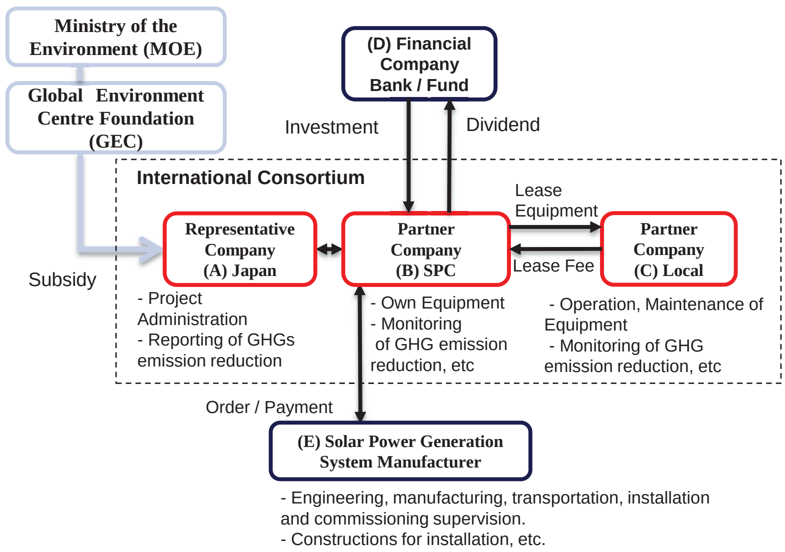
The following shows organization when the proposed activities (tentative plan) are implemented as JCM project.

(A) Low-carbonization for large scale facilities such as hospital, hotel and shopping mall



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) Introducing distributed energy system using renewable energy



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)

NTT DATA

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

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

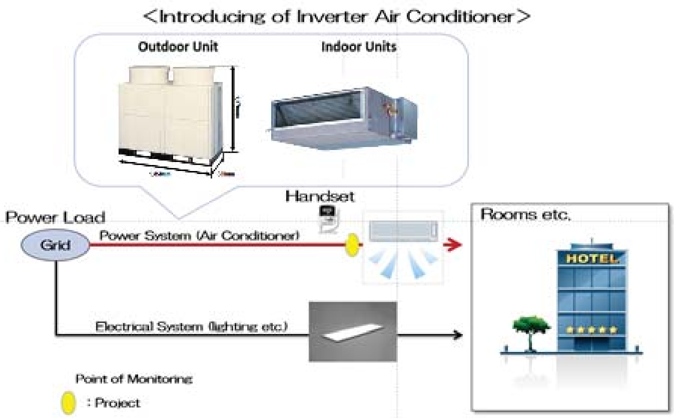
○ Expected GHG Emission Reductions

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).

○ 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)



Source：JCM HP

1. Upper Limit of Subsidy Rate

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

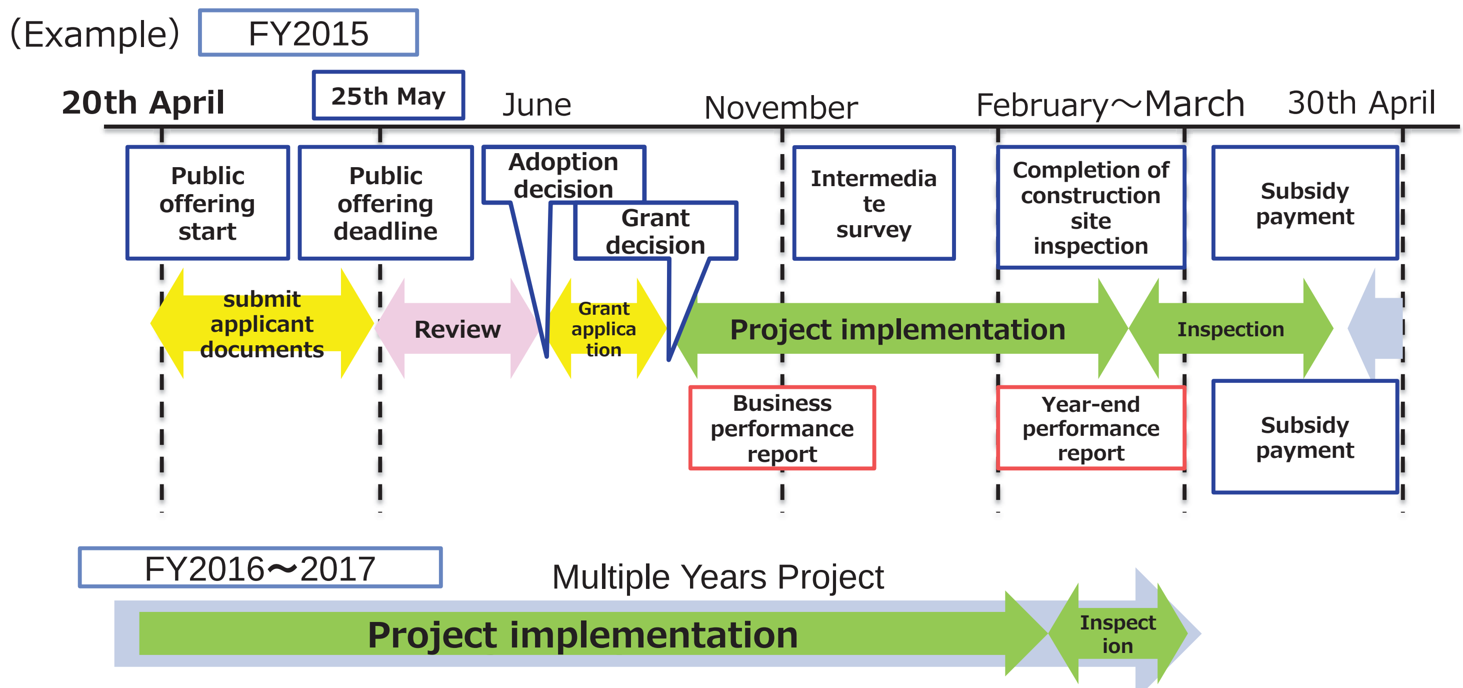
Adoption number of similar technology in the country to implement the project	0 (first case)	From 1 to 3	Over 4
Subsidy late	Maximum 50 %	Maximum 40%	Maximum 30%

2. Cost-Effectiveness and Payback Period

2 points to be checked to get subsidy.

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

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



- **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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