FY2015 Feasibility Studies on Joint Crediting Mechanism
Projects towards Environmentally Sustainable Cities in Asia

Final Report

Study for building a sustainable low carbon city around the industrial zone in Pathein City, Ayeyarwady Division, Myanmar

March 2016

Mitsubishi Research Institute, Inc.

Fujita Corporation

Executive Summary

- Ayeyarwardy Region: an attractive new development area

Myanmar has recently been experiencing rapid economic growth, and is one of the most attention-attracting countries in Asia. Ayeyarwady is an administrative region located west of Yangon in the delta area of the Ayeyarwady River. Ayeyarwady is the foremost granary area producing 30% of the total rice output of Myanmar. It has rich human resource, with high population density (Region average: 177 people/km2, country average: 74 people/km2, Japanese average: 339 peoplpe/km2). Recently, infrastructure such as roads and railways has been developed, and the area is attracting attention due to its potential for future economic development.

Pathein, the project site of this research, is the capital of the Ayeyarwady Region with a population of around 300,000. Located on the banks of the Ayeyarwady River, it is the second largest port city after Yangon. In the future, construction of a deep water sea port accessible to large ships is planned, and the area is expected to become a new center for development.

- A new industrial zone in Pathein (capital of the Ayeyarwady Region)

To promote industrial development in the Ayeyarwady Region, a development plan for Pathein Industrial City is being promoted under the Chief Minister of the region. Under the plan for Pathein Industrial City, development of the whole area around the industrial zone, including construction of housing, large commercial facilities, hotels and leisure facilities, and water treatment facilities is planned. Through this development, the area is expected to become a trade center of Myanmar. By developing Pathein Industrial City, industrial and economic development is expected in the area. Constructing Pathein Industrial City and creating new employment will decrease poverty and contribute to the neighboring area. Therefore, there are high expectations for the development of Pathein Industrial City.

To construct Pathein Industrial City as an industrial zone that can contribute to local economic development, the latest international technologies for infrastructure such as power, waste treatment, and water treatment are being procured. Pathein Industrial City has completed most of its land acquisition and is in the process of preparing management facilities and roads, as well as site preparation. Creating and executing a comprehensive grand design for the region, preparing infrastructure such as stable power supply and waste management, and installing advanced technologies for environmental measures, are key factors to attract more factories in the future. Using experiences and knowledge of Japanese municipalities and businesses, Pathein Industrial City and its surrounding area will be able to develop in a unique way. Such an attractive development will promote industrial accumulation and further economic development.

Background and Overview of Inter-City Cooperation

- Background to inter-city cooperation between Pathein and Fukushima City

Myanmar has high expectations for Japanese experiences and technologies because Japan has already undergone a period of rapid economic development. In April 2015, the Chief

Minister of Ayeyarwady Region visited Japan and learned about various activities related to energy efficiency and renewable energy in Fukushima City. The event later turned into an opportunity for the Chief Minister to send an official letter of intent to Fukushima City, asking for support and cooperation in the development of Pathein Industrial City (letter of intent for inter-city cooperation with the city of Fukushima for holding a sustainable low carbon city).
Upon receiving the letter of intent, Fukushima City, Fukushima Chamber of Commerce and Industry Companies, Mitsubishi Research Institute, and Fujita Corporation collaborated to consider future possibilities for specific development activities under inter-city cooperation. The team investigated possible projects in the renewable energy and waste treatment sector, and explored the possibilities for applying Japanese experiences and technologies.

- Activities under inter-city cooperation

As a platform for inter-city cooperation, the “Partnership for a Low-Carbon Initiative in Ayeyarwady” was established, and a bilateral dialogue was promoted. At field surveys and workshops conducted in Pathein, the current situation and needs of the Ayeyarwady Region and activities in Fukushima City, as well as related technologies, were shared. The potential of JCM project development and collaboration in waste treatment and renewable energy sectors were discussed.

- First local workshop (September 2015, Pathein)
- Workshop in Fukushima City (October 2015, Fukushima City)
- Discussion in Japan with visitors from Myanmar, site visits (January 2016, Tokyo)
- Second local workshop (February 2016, Pathein)

In addition, when government officials of Fukushima City visited Pathein in February 2016, the letter of intent from the mayor of Fukushima City was handed to Minister of Ayeyarwady Region. Cooperation in various areas using the experiences of Fukushima, not only in renewable energy and waste management but also in the formulation of a master plan, was announced to achieve a sustainable, resilient, and low-carbon society in Pathein.

Discussion with the mayor of Fukushima City

Workshop in Pathein

Sightseeing of waste collection in Fukushima City

New industrial zone in Pathein (under construction)

Overview on the Result of Consideration (JCM Project Proposal)

Through discussions at workshops and field surveys under inter-city cooperation, the following common understanding was reached.

(Waste treatment sector)~Achieving an environmental city~

- All waste in Pathein is landfilled, but the landfill site is already occupied. It is time to consider a new means of treating waste. There is a lot of interest in Japanese waste separation/collection schemes, using waste to generate energy, and recycling waste; a new approach to waste treatment will be considered under Japanese cooperation (e.g. Promotion of 3R: reduce, reuse, and recycle)
- It is time to consider strengthening environmental measures in Pathein. New measures for appropriately treating waste will be considered with the aim of achieving an advanced city with a limited environmental impact. For example, management of rice husk waste from rice mills is a serious issue in the area; a project to develop a power plant using biomass such as rice husks from rice mills, will be implemented promptly.

(Renewable energy sector)

- For regional economic development, a stable power supply is an issue of the utmost importance. Pathein Industrial City plans to provide an electricity supply from the national grid. However, as national electricity demand is increasing, it would be difficult to provide the whole electricity demand in industrial zone from the national grid. Therefore, some needs to be supplied elsewhere from generation resource that does not rely on the national grid; there is strong interest in renewable energy as a locally distributed energy resource.
- To attract factories, it is essential to prepare a power supply system, and an independent power supply system within the industrial zone is needed. Partially building a power plant, prior to attracting factories, is needed and specific measures must be considered promptly.

- Solar power is a renewable energy source with great potential in a country rich radiation; the possibility of installation will be considered under inter-city cooperation.

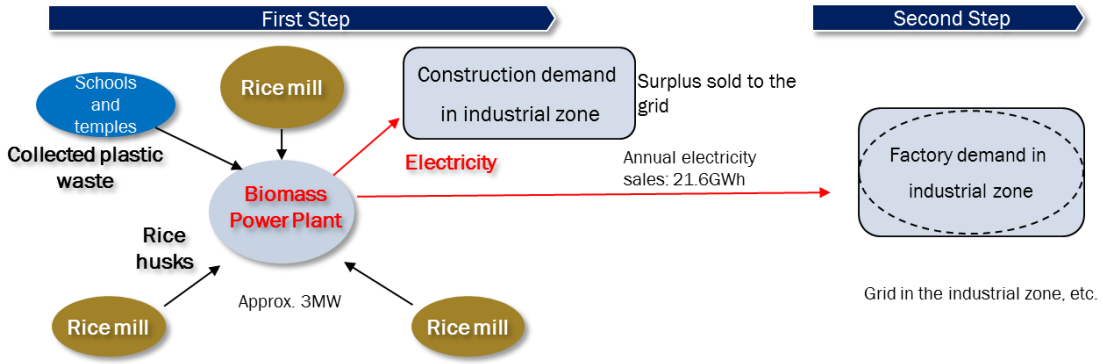
I. Proposal for Project Development Using JCM Scheme (Inter-Corporate Approach)
To implement specific plans in the waste treatment and renewable energy sectors, JCM is an extremely effective approach for improving project economics (equipment construction support), promoting cooperation between Japanese and local industries, and using Japanese technologies and knowledge. In September 2015, a bilateral document on a Joint Crediting Mechanism was signed, and JCM was officially launched to further promote activities for low-carbon development between Japan and Myanmar.
This study identified that a "power plant project using biomass such as rice husks (est. 3 MW)" and a "mega solar project installed at a wastewater treatment facility (est. 1 MW)" were promising projects for JCM in Pathein Industrial City. In 2016, JCM project formation will be considered in detail by cooperating with local stakeholders; a prompt start to the project is targeted using equipment subsidies for JCM.

- Possible JCM projects in the waste treatment sector

"Power plant project using biomass such as rice husks (estimate output of 3 MW, planned to start operating in 2019)"
As a power plant facility to be prepared in advance in Pathein Industrial City, a biomass power plant project will be developed using rice husks as fuel.
Local needs for effectively using rice husks generated from numerous rice mills in Pathein were expressed at the workshop. Apower plant project using biomass fuels such as rice husks, meets local needs well from the aspect of appropriately treating and using rice husks and from the aspect of providing stable power supplies in the industrial zone. In addition, with the development of municipal waste measures (e.g. promoting 3R) in mind, plastic waste (e.g. PET bottles) will be collected at sites such as schools, as a model for municipal waste separation and collection. The collected plastic waste will be co-fired in the biomass power plant (impact from environmental education on waste separation is expected as well).

Project site	Adjacent to the power plant area in the industrial zone
Scale	Medium (2-3 MW: the size will be confirmed after considering amount of rice husks)
Fuel	Rice husks and plastic waste (collected at schools and temples) *Know-how of Fukushima City will be used for collecting plastic waste at the site
Installed technology	Boiler turbine (biomass power plant)
Power supply	<For a certain period> Power will be supplied to meet electricity demand for construction in the industrial zone. The surplus will be sold to the grid. <In the future> Power will be supplied in the industrial zone, off-grid.

Project scheme	SPC (e.g. Japanese company and local partner) is planned. Use of equipment subsidy under JCM is planned.

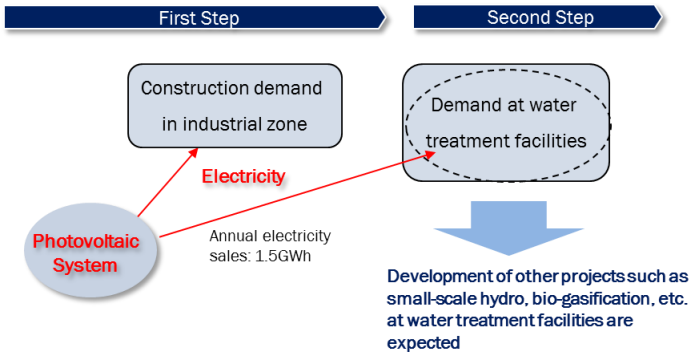


- Possible JCM projects in the renewable energy sector

"Mega solar project installed at a water treatment facility (estimated output of 1 MW, planned to start operating in 2019-2020"

Pathein Industrial City plans to supply industrial water and prepare an industrial wastewater treatment facility. As an independent distributed energy resource, a mega solar power plant will be installed at waste treatment facilities. A service water treatment plant and a wastewater treatment plant have not been installed in Pathein. In the future, along with economic development, demand for water treatment facilities will rise, not only in industrial zone area. This mega solar system installed at the wastewater treatment facility is expected to become a regional model for a low-carbon water treatment facility (to surrounding and other areas)

Project site	Within water treatment facilities in the industrial zone
Scale	Around 1 MW (the size will be confirmed after electricity demand at the water treatment facility is considered)
Installed technology	Mega solar
Power	<For a certain period> Power will be supplied to meet electricity demand for construction in the industrial zone. The surplus will be sold to the grid. <In the future> Power will be supplied to the water treatment facility.
Project scheme	SPC (e.g. Japanese company and local partner) is planned. Use of an equipment subsidy under JCM is planned.



II. Importance of Framework Covering Individual Projects (Through Policy Dialogues)

To develop individual projects using JCM in the long term, public-private cooperation is important. In Japan, a comprehensive regional development plan (so-called basic plan and masterplan) at national and municipal levels is developed; individual projects are planned according to the fundamental strategy. By developing individual projects under such a framework (a grand design for regional development), activities with a long-term aspect are promoted, and advanced activities are accelerated (combination of development by business owners and development through policies).
Such organizational planning is not conducted in regional development in Myanmar, but there is a trend for a new approach to regional development under the new regime. In other words, there is increased interest in considering a regional masterplan.
It is necessary to consider a masterplan for Pathein Industrial City and its surrounding area. As the first step, a development vision for the region must be clarified, and development measures with local characteristics (a grand design of regional development) are important. A deep understanding of these key issues and development approaches was obtained, and cooperation for its implementation was requested from the Ayeyarady regional government officials to Fukushima City. Development vision needs to be clarified and details of regional development grand design need to be planned under inter-city cooperation to create specific measures under such an approach. In addition, for industries in Fukushima, new business opportunities in a developing environment would provide an attractive market. Therefore, initially, inter-city cooperation is expected to be used to set up a system to shape future business seeds.

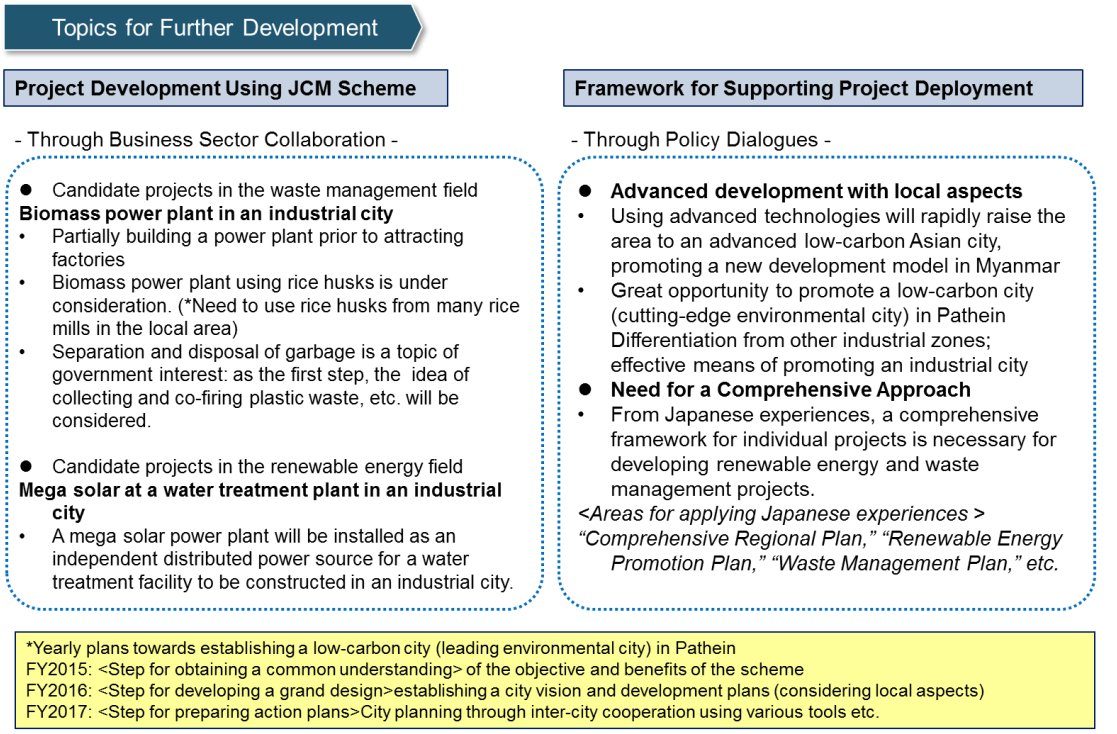
<Aspects for development vision consideration>

- Innovative measures that consider local characteristics
- It is important to aim for a low-carbon city model using advanced low-carbon technologies, placing the new industrial zone at the center (the area can be considered a new regional development model in Myanmar).
- Future vision and promotion plan for a Pathein version of a “low-carbon city (cutting-edge environmental city)” using Japanese technologies and knowledge must be considered (the area can be differentiated from other industrial zones, which will be important for attracting factories).

<Using know-how of the Japanese business sector>
Japanese companies, including those in Fukushima City, have developed businesses in the environment and renewable energy sectors, and also in the urban development sector. With such a background, they possess unique products, management know-how, and human resources. Using those resources for urban development in Myanmar is expected to lead to the formation of a win-win relationship between Japanese and local industries. In addition, business development in the low-carbon sector is expected as well.

- Importance of comprehensive (interdisciplinary) approach
- From Japanese experiences, a comprehensive framework that covers all individual projects must be constructed to formulate projects in the renewable energy and waste treatment sectors, instead of considering individual projects.

<Using know-how of Japanese municipalities>
In Fukushima City, for instance, the Fukushima City Comprehensive Plan has been established on top of the various plans in the city. The plan shows principles of urban development based on the characteristics and issues of the city; it is composed of basic concept, basic plan, and action plan. The basic concept shows the ideal vision of the city and the direction of policies, and defines the structure of specific measures in the basic plan. Such a process, from the comprehensive strategy of regional development to its action plans, will be useful for achieving regional development in Pathein (Pathein version of cutting-edge environmental city, leading green city (tentative)).



Future Development of Partnership for Low Carbon Initiative in Ayeyarwady

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List of Abbreviations

This report uses the following standardized units and abbreviations.

Unit

t	ton
kg	kilogram
MJ	megajoule
MW	megawatt
kVA	kilovolt-ampere
MVA	megavolt-ampere
kW	kilowatt
kWh	kilowatt hour
GWh	gigawatt hour
TWh	terawatt hour
Mpa	megapascal
ha	hectare
m2	square meter
m3	cubic meter
t-CO2	carbon dioxide emissions (t)
kg-CO2	carbon dioxide emissions (kg)
MMK	Myanmar kyat
USD	U.S. dollar

Abbreviations

ADB	Asian Development Bank
ASEAN	Association of South−East Asian Nations
BTG	Boiler, Turbine, Generator
CDM	Clean Development Mechanism
DICA	Directorate of Investment and Company Administration
EIA	Environmental Impact Assessment
EPC	engineering, procurement, construction
ERIA	Economic Research Institute for ASEAN and East Asia
ESE	Electricity Supply Enterprise
FAO	Food and Agriculture Organization
FIL	Foreign Investment Law
GHG	greenhouse gas
HPGE	Hydropower Generation Enterprise
IEA	International Energy Agency

IEE	Initial Environment Examination
IFC EHS	International Finance Corporation Environmental Health and Safety
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
JOGMEC	Japan Oil, Gas and Metals National Corporation
KSGM	KDDI Summit Global Myanmar Co., Ltd.
MEPE	Myanmar Electric Power Enterprise
MIC	Myanmar Investment Commission
MOAI	Ministry of Agriculture and Irrigation
MOE	Ministry of Energy
MOECAF	Ministry of Environmental Conservation and Forestry
MOEP	Ministry of Electric Power
MOU	Memorandum of Understanding
MRMA	Myanmar Rice Millers' Association
MRV	Measurement, Reporting and Verification
O&M	operation and maintenance
PV	Photovoltaics
SPC	Special Purpose Company
UNFCCC	United Nations Framework Convention on Climate Change
YESB	Yangon City Electric Enterprise

1 Purpose and Implementation Arrangement

1.1 Purpose

Japan establishes and implements Joint Crediting Mechanism (JCM) in order both to appropriately evaluate contributions from Japan to greenhouse gas (GHG) emission reductions or removals in a quantitative manner achieved through the diffusion of low carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions in developing countries, and to use them to achieve Japan's emission reduction target.

Japan's Intended Nationally Determined Contributions (INDC) draft states that amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan's reduction. Accumulated emission reductions or removals by FY 2030 through governmental JCM programs to be undertaken within the government's annual budget are estimated to be ranging from 50 to 100 million t-CO2.

In order to accomplish items stated above, effort towards formulating JCM projects under the active support of Japanese government is necessary.

This project is a feasibility study for building a sustainable low carbon city in Asia and acquiring JCM credits, through inter-city cooperation between partner country's municipality and Japanese municipality that possesses knowledge and experiences in forming a low carbon society. It is expected that inter-city cooperation brings reduction of energy-derived GHG emission in various sectors in the city or region, and the establishment of a low carbon society in the city as a whole. In order to form packaged JCM projects effectively and efficiently for the entire city or region, advanced low carbon technologies and policies considering local aspects, and operation or maintenance arrangement, are coordinated by Japanese organizations including research institutes, private companies, and universities.

1.2 Survey items and survey arrangement

The following items were surveyed in this research.

1. Research in renewable energy sector
   - Overview and local needs
   - Japanese experiences and technologies for application
   - Possible JCM projects
   - GHG emission reduction
   - Project and policy proposal
2. Research in waste treatment sector
   - Overview and local needs
   - Japanese experiences and technologies for application
   - Possible JCM projects
   - GHG emission reduction
   - Project and policy proposal

Research structure is described in Figure 1-1.

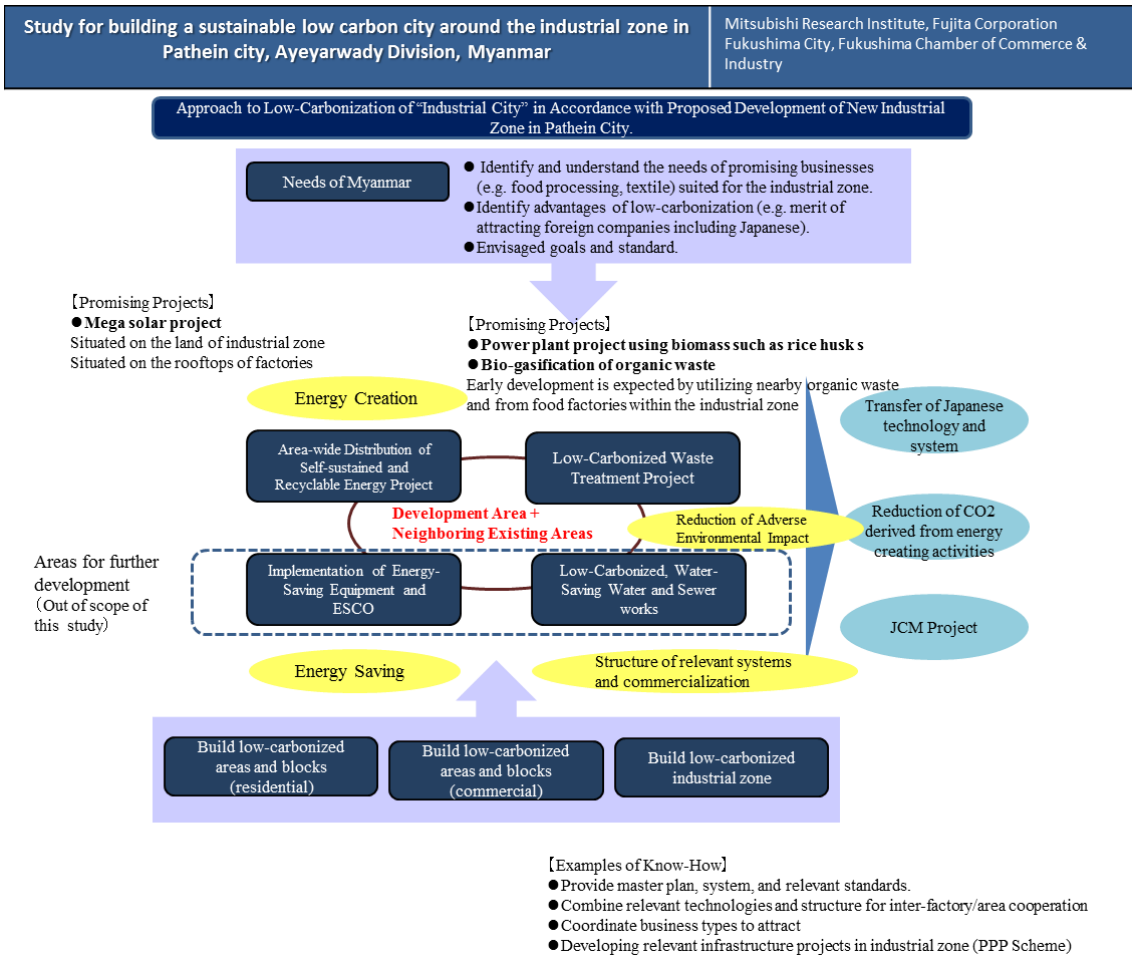


Figure 1-1 Research Structure

The research was conducted by Mitsubishi Research Institute (MRI), as the representative, cooperating with Fujita, its research partner, Fukushima City and Fukushima Chamber of Commerce and Industry Companies. The research was conducted in coordination with the local partner, Ayeyar Hinthar (a local company developing businesses in various sectors including rice industry, urban development industry, and financial industry). Organizational structure of the research is shown below (Figure 1-2).

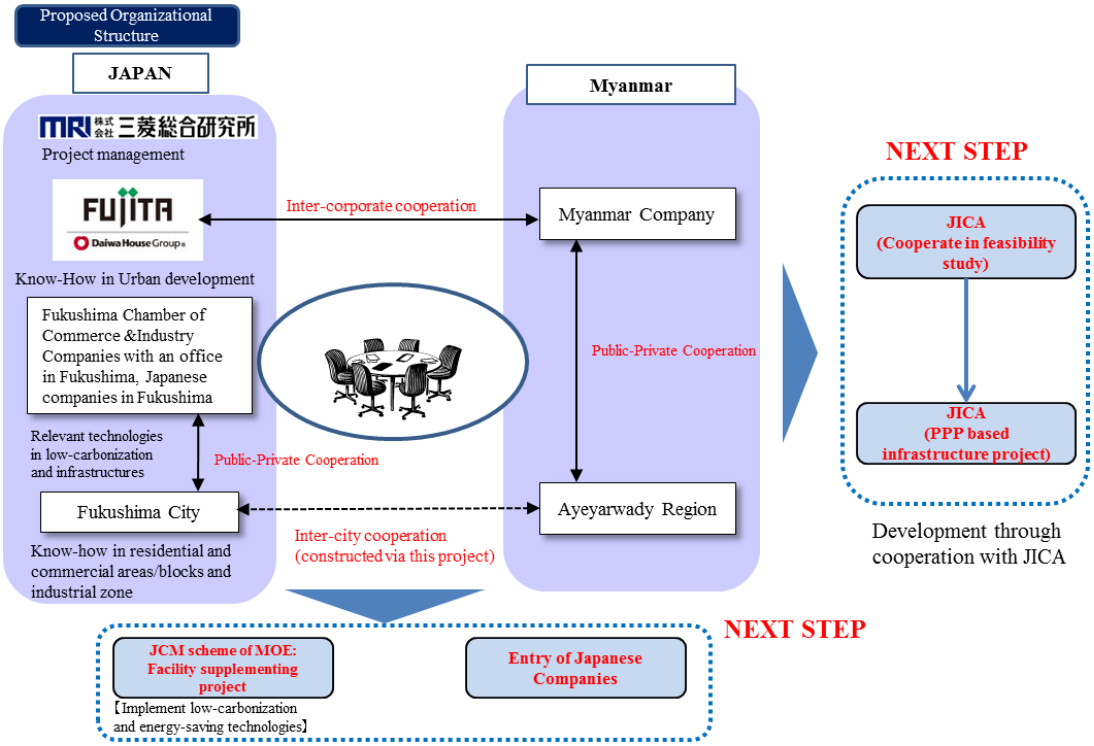


Figure 1-2 Organizational Structure

Mitsubishi Research Institute, with its rich experiences in policy implementation, planning, and JCM research for the Japanese national and municipal government, collected relevant information, managed workshops, considered formulation of JCM projects, and supported policy dialogue between Fukushima City and the local government, in addition to its role of the overall project management.

Fujita Corporation, with its knowledge and experiences in industrial, urban, and regional development, further considered the possibility of specific candidate projects.

Fukushima City had policy dialogue with the officials of the local government to discuss policy-side approach for low carbonization of the industrial zone. It also introduced policy-side aspects of “industrial city” including its whole surrounding area, by sharing Japanese experiences. It utilized its experiences and knowledge in creating renewable energy promotion plan, waste treatment plan (with a focus on approaches to waste treatment policies and low carbonization, regarding possible project development for recycling and waste power plant), and in building industrial zones.

Fukushima Chamber of Commerce and Industry Companies cooperated with its member companies to introduce their technologies and know-how in businesses, and to investigate possibilities in transferring technologies of companies related to Fukushima City.

1.3 Overview of inter-city cooperation

In this way, for Pathein Industrial City and its surrounding area to accomplish comprehensive development in the future, there are various challenges, such as electricity issues and waste treatment issues, to be solved. By utilizing the experiences and technologies of Japanese municipalities and industries, Pathein Industrial City area will be able to develop in a distinguishable way. Such attractive development will promote industrial accumulation and further economic development.
Myanmar has high expectations for Japanese experiences and technologies because Japan has already undergone a period of rapid economic development as well. In April 2015, the Chief Minister of Ayeyarwady Region visited Japan and learned about various activities in energy efficiency and renewable energy in Fukushima City. The event later turned into an opportunity for the Chief Minister to send an official letter of intent to Fukushima City, asking for support and cooperation in Pathein Industrial City development (letter of intent for inter-city cooperation with Fukushima City for establishing a sustainable low carbon city).
On receiving the letter of intent, Fukushima City, Fukushima Chamber of Commerce and Industry Companies, Mitsubishi Research Institute, and Fujita Corporation collaborated to consider future possibilities for specific development under inter-city cooperation. The team investigated possible projects in the renewable energy and waste treatment sector, and explored possibilities of applying Japanese experiences and technologies.
As inter-city cooperation, the following activities were conducted.

- Overview of local survey and Fukushima City workshop

From October 20th to 22nd in 2015, Ayeyarwady regional government officials visited Fukushima City. Workshop and site visit to several places related to renewable energy and waste treatment, including waste treatment facility and recycling facility and renewable energy facility (Tsuchiyu Hot Spring) binary cycle power plant, were conducted.
In addition, courtesy call on Mayor of Fukushima City was made, and a seminar was held with members of the Fukushima Chamber of Commerce & Industry, to exchange opinions on future possibilities of cooperation.

<Discussions with Fukushima City Mayor>
Mr, Myo Lwin, director of the Directorate of Industrial Supervision & Inspection, the Ministry of Industry mentioned the citizen-engaged environmental activities in Fukushima City, and expressed his high expectations for inter-city cooperation, to implement similar activities in Pathein City as well. Fukushima City, to achieve a society that does not rely on nuclear power, is promoting the installment of renewable energy such as solar power, small-scale hydro, and binary; opinions were exchanged for possibility of cooperation in this area. For Myanmar, a country that is beginning to face economic development, experiences of Japan and Fukushima City, which have also undergone economic development in the past as well, would be insightful; opinions on waste and water treatment were exchanged as well from this aspect. Cooperation in the agricultural area was mentioned as a possibility as well.

Present from Myanmar to the Mayor of Fukushima City

Discussion in Workshop

- Overview of local survey and Pathein City workshop

On September 29th, 2015, the first workshop was held in Pathein City, with participants from the Ayeyarwady regional government and Japan (Mitsubishi Research Institute, Fujita Corporation, and Fukushima Chamber of Commerce and Industry). Those from Myanmar expressed their high expectations for inter-city cooperation with Fukushima City, and explained the current situation in Ayeyarwady Region and Pathein City. The Japanese team introduced activities in Fukushima City and relevant Japanese technologies, and the two parties had a discussion afterwards.

On February 9th, 2016, the second workshop was held, with participants from the Ayeyarwady regional government and Japan (Mitsubishi Research Institute, Fujita Corporation, and Fukushima Chamber of Commerce and Industry). A courtesy call was made upon the Minister of the Ayeyarwady Region, and the response letter from them Mayor of Fukushima City was given. In the letter of response, cooperation in various areas, including areas outside of renewable energy and waste treatment secor, such as creating a masterplan, with the rich experiences in Fukushima City, to achieve a sustainable low-carbon city in Pathein City.

The First Workshop (September)

Discussions with the Minister of Ayeyarwady Region

- Overview of local survey and Pathein City workshop

In January, 2016, Ayeyarwady regional government officials visited Japan for “Inter-City Cooperation Workshop for JCM” (held by MOE, Global Environment Centre Foundation). Waste treatment and recycling, and mega solar project in Japan were introduced, and discussions for further cooperation were held as well.

- Presentation and discussion in Fukushima City

On establishing the Partnership for Low-Carbon Initiative in Ayeyarwady, discussions were held among those in Fukushima City and Fukushima Chamber of Commerce and Industry. In addition, when Ayeyarwady regional officials came to visit Japan in September 2015, a seminar was held for interaction with members from Fukushima Chamber of Commerce and Industry; in February 2016, results of local survey and workshop in Pathein and the outcomes of the project were presented, along with discussion among the stakeholders in Fukushima City.

2 Project Area Overview

2.1 Overview of Myanmar and Ayeyarwady

Myanmar has recently been in a rapid economic growth, and is one of the most attention-attracting countries in Asia. Myanmar is composed of seven divisions and seven states. The Ayeyarwady Region is an administrative region located in the west of Yangon, and in the delta area of the Ayeyarwady River. Ayeyarwady is the foremost granary area producing 30% of the total rice output of Myanmar. Overview and maps of Myanmar and the Ayeyarwady Region are shown in Table 2-1, Figure 2-1, and Figure 2-2.

Table 2-1 Overview of Myanmar and Ayeyarwady

	Myanmar	Ayeyarwady Region
Area	680,000km2	35,000km2
Climate	Most of the land belongs to tropical or sub-tropical zone with great difference of temperature and precipitation depending on the location. A year can be divided into three seasons: wet season (mid-May to October), dry season (October to February), and hot season (March to May)	Delta area located in the south of Myanmar
Population	50.2 million	6 million
Population Density	74 people/km2	177 people/km2
Household	10.9 million households	1.5 million households
Local Administration System	Composed of seven Divisions and seven States. Divisions are mainly inhabited by Burmese, while States are mostly populated by other minority people.	Capital: Pathein City
Economic Trend	Since Thein Sein administration started at the end of March 2011, democratization and economic revolution have been progressing. In November 2015, national election for the first time in five years was held, and National League for Democracy, led by Aung San Suu Kyi had a victory over the current government. Further democratization is expected.	Main location for rice production

Source: Ministry of Foreign Affairs Myanmar
http://www.mofa.go.jp/mofaj/area/myanmar/index.html
JETRO http://www.jetro.go.jp/world/asia/mm/#
Population: Population and Housing Census of Myanmar, July 2015

Figure 2-1 Map of Myanmar

Source: UN Myanmar Map

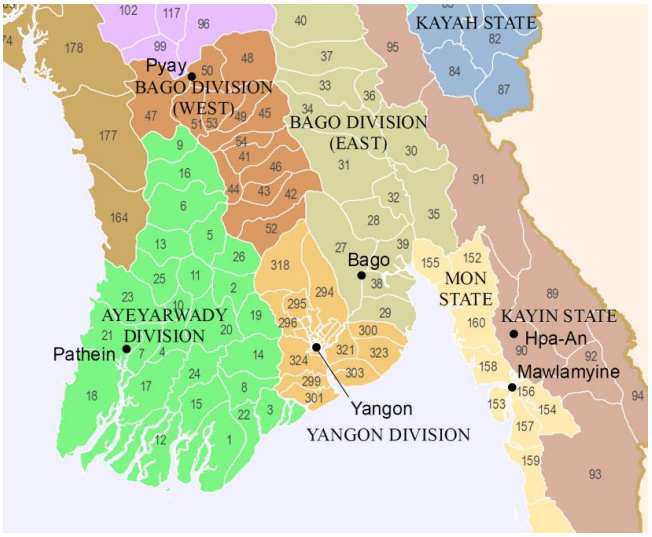


Figure 2-2 Map of Ayeyarwady Region and Location of Pathein District

Source: Myanmar Information Management Unit

2.2 Overview of Pathein City and Pathein Industrial City

Pathein City is the capital of the Ayeyarwady Region, with population of approximately 300,000. It is the second largest port city after Yangon, located at the bank of the Ayeyarwady River. In the future, construction of a deep sea port with accessibility for large ships is planned, and transportation infrastructure connecting the site from Yangon, such as highways and railways, is planned. In this way, the area is expected to become the new center of development.

In order to promote industrial development in the Ayeyarwady Region, development plan of Pathein Industrial City is being promoted under the Chief Minister of the region. In the past, other industrial zones such as Pathein Industrial Park (different from Pathein Industrial City, the project site of this research; approximately 250 acres), Hinthada Industrial Zone (approximately 86 acres), and Myaungmya Industrial Zone (approximately 58 acres) have been constructed. In addition to these industrial zones, a new plan of constructing an industrial zone, Pathein Industrial City, is being promoted.

Pathein Industrial City would be accessible from Yangon City by car in approximately three hours with the construction of the new highway, and five minutes away from Pathein City by car. Its project area is approximately 1,093 ha, and Ayeyarwady Development is in charge of its development.

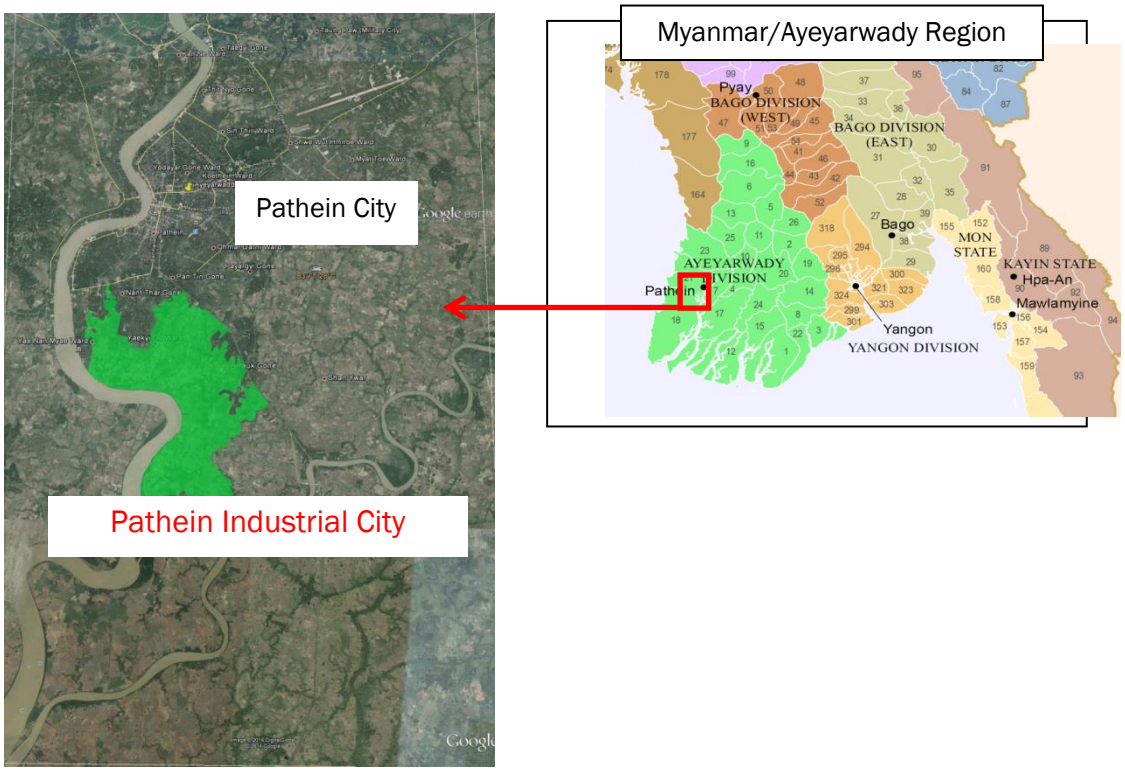


Figure 2-3 Location of Pathein Industrial City

Figure 2-4 Final Image of Pathein Industrial City (under construction)

Source: JCM City to City Collaboration Workshop (Yokohama) "Partnership for Low Carbon Initiative in Ayeyarwady under Collaboration of Fukushima City and Pathein City"

Table 2-2 Overview of Pathein Industrial City

Project Name	Pathein Industrial City
Opening year	Site Office & Showroom - within March, Total - 2018 (approx.)
Developer	AYEYARWADDY DEVELOPMENT Co., Ltd
Address	Pathein-Ngaputaw Road, Kangyidaung & Pathein Township, Pathein District, Ayeyarwaddy Region
Location	Yangon : 188km
Site area	Total area:1,093ha(2,700acre)
	Industrial Zone: 526ha (1,300acre), Residential & Commercial zone : 567ha (1,400acre)
Power supply	11/0.4 KV, 315 KVA (For current operation only)
Industrial water	Water intake : reservoir
	Supply after water treatment
Industrial wastewater	Sewage treatment

Under Pathein Industrial City development plan, development of the whole area around the industrial zone, including the preparation of housings, large commercial facilities, hotels and leisure facilities, water treatment facilities, is planned. Through this development, the place is expected to become the new trade center of Myanmar. By developing Pathein Industrial City, accumulation of industries and economic development are expected in the whole area. Constructing Pathein Industrial City and creating new employment will contribute to the region by decreasing poverty. Therefore, there are high expectations for the development of Pathein Industrial City.

In order to establish Pathein Industrial City as an industrial zone that can contribute to local economic development, members of Ayeyar Hinthar in charge of development are procuring the latest international technologies for infrastructure such as power, waste treatment, and water treatment. They are planning to construct an industrial zone that meets international standards in order to attract foreign investment.
Currently, Pathein Industrial City development plan has finished 80% of its planned land acquisition, out of the whole 1,093ha (2,700 acres) project area. The construction of a model facility for promotion has been completed (Figure 2-5, Figure 2-6). In the future, development will proceed in three phases, each area likely to be around 400 ha.

Figure 2-5 Current Situation (Whole Project Area)

Figure 2-6 Current Situation (Model Facility)

There are plans for investment and electricity demand in each phase, but the actual economic development has been larger than the prediction made at the beginning of the plan formation. Furthermore, the new government regime will take place in February 2016, with the appointment of the new president and government officials. As for the Ayeyarwady Region, while its operation under the new government regime will start from March 31st, there will be a national festival in mid-April during when various government processes are expected to slow down. Therefore, various processes of the plan are expected to take place from May.
Pathein Industrial City development plan has been promoted with the rich support of the Ayeyarwady Region government, and support under the new government is essential as well. Therefore, various proceedings of the plan are likely to take place after the new government starts is operation. There may be some changes in development plan due to economic development and its future prospects, and new economic policies under the new government, but detailed planning is likely to take place within 2016, and land purchase agreement is likely to be made in 2017.

(Reference)

Overview of the Existing Industrial Zone in Pathein City

Currently in Pathein City, an industrial zone called Pathein Industrial Park (different from the project site of this research, Pathein Industrial City) has already been constructed. Pathein Industrial Park is an industrial zone with an area of around 252.8 acres. There were several companies from China and Taiwan during the research team's visit in September 2015 (Figure 2-7), but there were only few factories that had already completed their construction.

Figure 2-7 Taiwanese Textile Factory in Operation

Since there are multiple landowners in this industrial zone, there is no integrated development plan, and there are some buildings utilized for purposes other than those that were intended.
The industrial zone will provide 800kVA of electricity capacity for its construction area of 24,000m2, but infrastructure in the industrial zone is inadequate, with 5~10 minutes of blackouts every day; they are complemented by diesel generators (Figure 2-8).

Figure 2-8 Generator for Blackouts

2.3 Overview of the power sector

(1) Power supply in Myanmar and National Electrification Plan

Electricity demand in Myanmar is rapidly increasing along with economic development. In 2013, total electricity consumption in Myanmar increased up to approximately three times the amount in 2000 (3.5TWh) to 10.1TWh. The amount of electricity consumption in residential sector has increased from 2653.5GWh in 2010 to 3763.8GWh in 2013 as well[1]. However, while electricity demand has been increasing, power sector in Myanmar still holds various issues. One of the serious issues is the low electrification rate. Electrification rate in Myanmar was 33% in 2014; the rate was even lower in the rural area, as low as 16%. Electricity can be supplied from the national grid in urban areas such as Yangon, but in most rural remote areas, electricity cannot be supplied from the grid. Therefore, even though electricity demand in Myanmar has been increasing, electricity consumption per capita is low. In 2013, electricity consumption per capita was 160kWh/year, which is as low as 6.4% of that in Thailand, and 3.6% of that in Malaysia[2] (Figure 2-9).

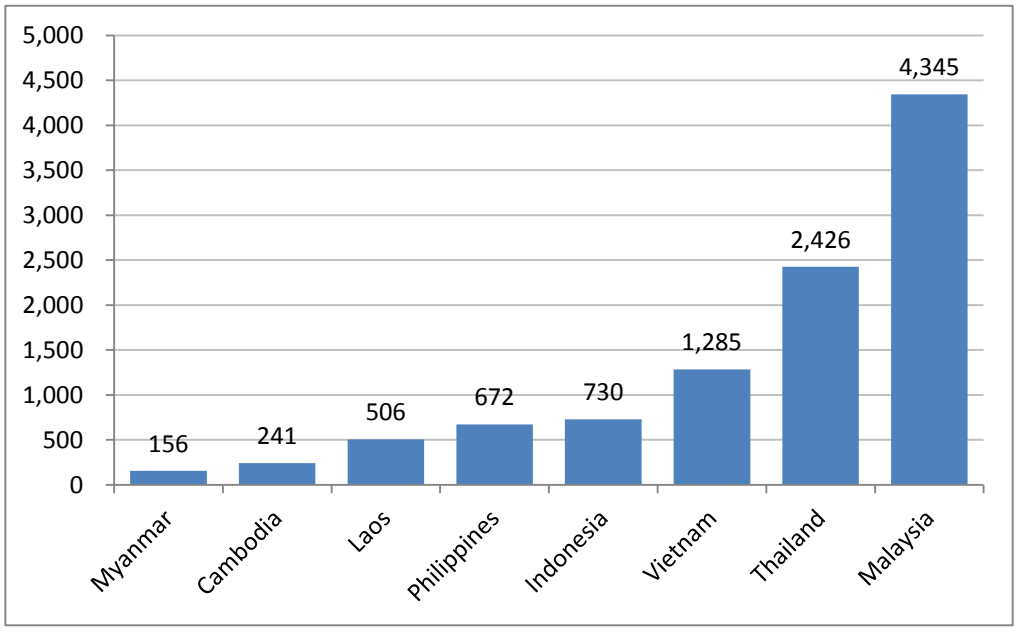


Figure 2-9 Electricity Consumption (kWh) per Capita in ASEAN Countries (2013)

Source: ADB Economics Working Paper Series "Power Sector Development in Myanmar" (October 2015)

Therefore, Myanmar created the National Electrification Plan in 2015, under the support of World Bank. The goal of the plan is to accomplish universal electrification within the country by 2030 (Figure 2-10). In order to accomplish this goal, Myanmar must accomplish twice as many new grid connections each year. The plan is comprised of two different electrification methods, in urban area and rural area, respectively.

[1] World Bank "Myanmar: Towards Universal Access to Electricity by 2030" (2014.10.1)

[2] ADB Economics Working Paper Series "Power Sector Development in Myanmar" (October 2015)

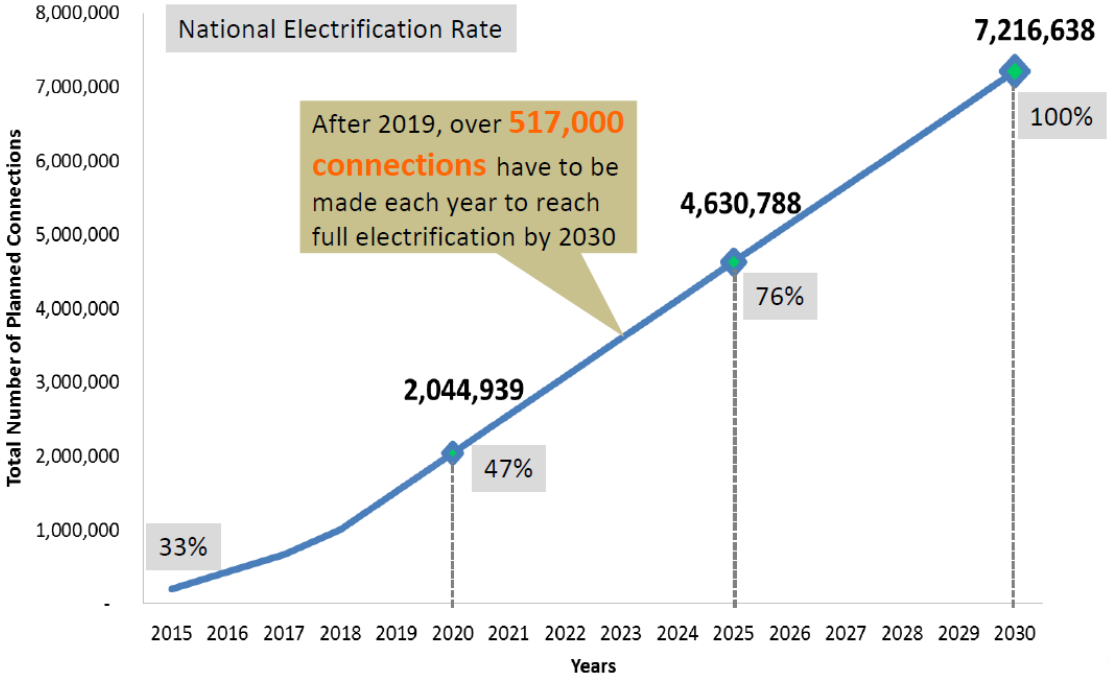


Figure 2-10 Roadmap for Universal Electrification in 2030

Source: World Bank "Myanmar: Towards Universal Access to Electricity by 2030" (2014.10.1)

National Electrification Plan is comprised of three main parts. The largest part in terms of budget is grid rollout. In this part, grid connection is made from regions requiring least cost for connection, by building and rehabilitating facilities such as substations. However, some rural areas that are remote and have high cost of grid rollout may not be able to receive electricity supply from the grid for another 10 years or more. The second part of National Electrification Plan, the off-grid part, provides small solar systems and micro hydropower for villages in these areas. The scale of these systems is for households, to provide electricity for small electronic appliances including lighting and refrigerator. The third part of the plan is capacity building for related authorities and institutions, to be able to coordinate and cooperate together to accomplish universal electrification in 2030. The structure of the National Electrification Plan is shown in Figure 2-11.

<table>
<tr><th colspan="3">National Electrification Plan
Goal: 100% Electrification Rate by 2030</th></tr>
<tr><td>Part 1. Grid Rollout (Urban Areas)</td><td colspan="2">Part 2. Off-Grid Pre-electrification
(Rural Areas)</td></tr>
<tr><td rowspan="2">Investment support for grid rollout
Goal: Six million connections by 2021 (Five phases)
● Rehabilitation and construction of medium voltage substations
● Rehabilitation and construction of medium/low voltage power lines and transformers
● Connecting housings with distribution lines and meters</td><td colspan="2">Investment support for off-grid electrification (targeting areas where power will not be supplied from the grid in ten years)</td></tr>
<tr><td>50 households or more: Minigrid</td><td>Less than 50 households: Household energy systems such as solar power, mini hydro, diesel, hybrid system, etc.</td></tr>
<tr><td colspan="3">Part 3. Capacity Building and Technical Assistance
● Capacity building and advisory support for electricity related authorities
● Technical design, economic and financial analysis, environmental and social impact management, procurement and financial management</td></tr>
</table>

Figure 2-11 Components of National Electrification Plan

Source: World Bank "Myanmar: Towards Universal Access to Electricity by 2030" (2015/1.28)

(2) Power supply in the Ayeyarwady Region and electrification plan

The Ayeyarwady Region has one of the lowest electrification rate in the country. Electrification rate in 2013 was 11%, which was the third lowest rate in Myanmar (Table 2-3).

Table 2-3 Electrification Rate by Region

State/Region	Electrification	Power Consumption	
		GWh	%
Yangon	78%	5,031.5	49.8
Kayah	46%	36.0	0.4
Mandalay	40%	1,740.8	17.2
Naypyitaw	39%	558.7	5.5
Mon	35%	209.5	2.1
Shan(South)	28%	276.0	2.7
Kachin	28%	49.9	0.5
Bago (East)	28%	280.4	2.8
Sagaing	25%	448.0	4.4
Shan(North)	23%	183.6	1.8
Bago (West)	23%	199.6	2.0
Magway	18%	493.9	4.9
Chin	17%	4.7	0.0

State/Region	Electrification	Power Consumption	
		GWh	%
Shan(East)	16%	67.8	0.7
Rakhine	16%	20.3	0.2
Ayeyarwady	**11%**	**324.3**	**3.2**
Tanintharyi	9%	29.1	0.3
Kayin	6%	157.8	1.6

Source: ADB Economics Working Paper Series "Power Sector Development in Myanmar" (October 2015)

Grid rollout is the main electrification method in the Ayeyarwady Region (Table 2-4), but off-grid pre-electrification is planned in some villages as well (Table 2-5).

Table 2-4 Priority Areas for Grid Rollout

State/Region	# Townships	# Villages	# Households
Ayeyarwady	**26**	**704**	**77,901**
Bago(East)	14	558	76,523
Bago(West)	14	784	73,382
Chin	4	13	1,141
Kachin	10	180	29,112
Kayah	3	39	1,762
Kayin	3	87	9,114
Magway	12	227	32,503
Mandalay	20	680	99,531
Mon	7	96	15,915
Naypyitaw	8	170	34,704
Rakhine	-	-	-
Sagaing	30	733	99,818
Shan(East)	2	4	210
Shan(North)	1	3	154
Shan(South)	18	290	28,113
Tanintharyi	7	24	5,700
Total	179	4,592	585,583

Source: World Bank "Myanmar: Towards Universal Access to Electricity by 2030" (2015.1.28)

Table 2-5 Priority Areas for Off-Grid Pre-Electrification and Installed Systems

State/Region	# Townships	Solar Home Systems		Mini-Hydro	
		# Villages	# Households	# Villages	# Households
Ayeyarwady	**3**	**12**	**2,668**	**-**	**-**
Bago(East)					
Bago(West)					
Chin	9	115	5,344	10	793
Kachin	3	28	4,000	-	-

State/Region	# Townships	Solar Home Systems		Mini-Hydro	
		# Villages	# Households	# Villages	# Households
Kayah	3	15	750		
Kayin	2	62	3,333	-	-
Magway					
Mandalay					
Mon					
Naypyitaw					
Rakhine					
Sagaing					
Shan(East)	9	108	5,298	3	821
Shan(North)	8	66	4,000	1	600
Shan(South)	5	41	4,000	2	600
Tanintharyi					
Total	42	447	29,393	16	2,814

Source: World Bank "Myanmar: Towards Universal Access to Electricity by 2030" (2015.1.28)

In addition to its low electrification rate, since the Ayeyarwady Region includes many areas which are located towards the ends of national grids, they suffer from chronic power shortage and voltage sag. Even in the case of partial usage of grid power, voltage sag is a persistent challenge for them.

Figure 2-12 Myanmar's Power Distribution Chart

Source: ADB "Myanmar Energy Sector Initial Assessment"

Table 2-6 Transmission Loss

Year	Net Transmitted Energy (GWh)	Net Received Energy Distribution Side (GWh)	Energy Losses (GWh)	Losses (%)
2013	11,386	10,853	533	4.68
2012	10,567	9,820	747	7.07
2011	9,812	9,041	771	7.86
2010	7,614	7,042	573	7.52
2009	6,665	6,167	499	7.48
2008	6,281	5,921	361	5.74
2007	6,007	5,588	419	6.93

Source: ADB Economics Working Paper Series "Power Sector Development in Myanmar" (October 2015)

Table 2-7 Distribution Loss

Year	Losses (%)
2013	12.5
2012	16.7
2011	19.2
2010	19.6
2009	19.4
2008	22.3
2007	21.6

Source: ADB Economics Working Paper Series "Power Sector Development in Myanmar" (October 2015)

As stated above, electrification in the Ayeyarwady Region will proceed with its main focus on grid rollout. However, it will take some more time and investment to realize stable and sufficient power supply in the area, considering remaining issues such as transmission and distribution loss and voltage sag. Therefore, in order to support continuous economic development in the Ayeyarwady Region, alternative measures, such as installment of local distributed energy system, are necessary to increase power supply for the grid, or power supply off-grid for large consumers such as Pathein Industrial City, and to improve power supply situation.

(3) Power supply in Pathein Industrial City

As already stated, power supply in the Ayeyarwady Region is insufficient. Its low electrification rate, as well as chronic voltage sag due to its location at the end of the national grid, are serious issues in the area.
There are measures for electrification and reducing transmission and distribution loss, but they are limited. Pathein Industrial City is located five to six kilometers in the south of central Pathein City, but there are no large villages; it is currently located towards the end of the national grid.
Although electricity demand at industrial zones differ according to the tenant factories, a rough estimate of electricity demand at Pathein Industrial City was calculated based on the electricity capacity of other industrial zones in Myanmar. The average capacity of the industrial zones was 0.07MW/ha (not including Mingaladon Industrial Zone, which has an exceptionally large capacity per area compared with other industrial zones). Based on this

estimate, it was calculated that approximately 28MW electricity capacity would be necessary in the first phase of Pathein Industrial City. Even though the final amount of electricity consumption during the phase may differ from this estimate, electricity demand of at least 15~20MW (0.04~0.05MW/ha) is expected.

Even if economic development in Myanmar exceeds our expectations, it is highly likely that the national grid cannot sufficiently provide the electricity demand for a while. Thus, off-grid power generation is essential as part of the development plan. The current development plan includes construction of a port along Pathein River with a power plant in the neighboring area. From this aspect, locally produced and consumed renewable energy plant would be a meaningful part of the development vision, in terms of investment and industrial accumulation.

2.4 Measures for climate change in Myanmar and JCM needs

Myanmar submitted the first national report on climate change in December 2012, and was provided with the emission inventory and measures for GHG emission reduction. Compared to the result of 1990, energy-derived CO2 emission has been in the increasing trend. With the prospects of proliferation of the demand for power, and the consumption of fossil fuel, measures for GHG emission would become an important policy issue.

Table 2-8 GHG Emission Volume

	1990	2000	2010	2000NC
CO2 from fossil fuel combustion	4.1	9.4	8.0	7.7
CO2 from non-energy Sources	743.0	455.5	243.6	33.7
Methane	84.0	66.9	78.2	26.2
N2O	44.2	31.2	26.3	4.0
F-gases	-	-	-	-
Total	875.3	563.1	357.0	71.6

Source: IEA and Myanmar Country Report (2000NC column)

At the workshop held in Pathein in September, strong expectations towards JCM were shown from Myanmar. Electricity and waste treatment were recognized as important issues, and strong needs and expectations were expressed for application of Japanese technologies through JCM

3 Possible Projects in the Renewable Energy Sector

3.1 Overview and local needs

3.1.1 Renewable energy in Myanmar

Currently, Myanmar's generation mix is highly dependent on hydropower. Especially for grid generation mix, hydropower accounts for nearly 70% (3,011MW) of the overall installed power. Dependence on hydropower has been increasing between 1990 and 2010, but according to Economic Research Institute for ASEAN and East Asia (ERIA), the dependence is expected to alleviate by 2035, with the increase of fuels such as natural gas and renewable energy.

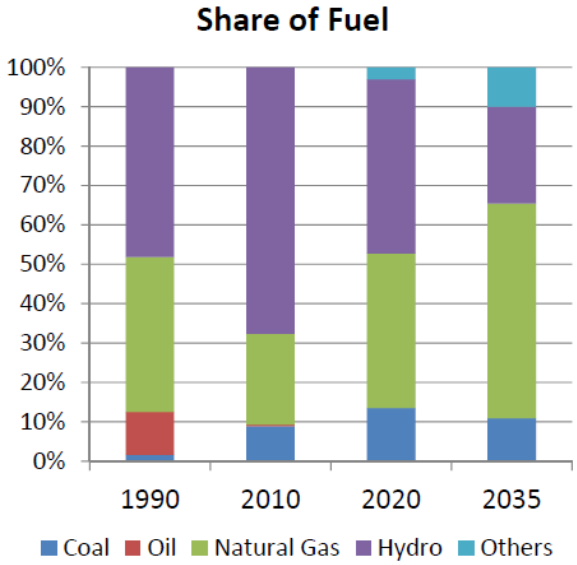


Figure 3-1 Future Share of Fuel in Generation Mix

Source: ERIA (2013.12) "Myanmar Energy Outlook: A Country Report from EAS Energy Saving Potential Project 2013"

(1) Government authorities related to the energy sector in Myanmar[3]

Currently, government authorities dealing with energy related issues are the Ministry of Energy (MOE) and the Ministry of Electric Power (MOEP). The role of MOE is to create energy policies on oil and gas, and to coordinate international support. MOEP is in charge of power generation, transmission, and distribution. The main generation enterprises are Hydropower Generation Enterprise (HPGE) and Myanmar Electric Power Enterprise (MEPE). Power distribution is mainly managed by Yangon City Electricity Supply Board (YESB) in Yangon area, and in other areas by Electricity Supply Enterprise (ESE). Besides MOE and MOEP, Ministry of Environmental Conservation and Forestry (MOECAF) is responsible for regulations of wood use for biomass energy generation. Ministry of Science and Technology is responsible for promoting renewable energy and off-grid rural electrification. In this way,

[3] ADB "Renewable energy developments in the Greater Mekong Region"

various government authorities are related with renewable energy related projects (Table 3-1).

Table 3-1 Energy Institutional Framework in Myanmar

Related Areas	Government Authorities
Oil and gas	Ministry of Energy
Hydropower, thermal power, mini-hydro, power transmission and distribution	Ministry of Electric Power *Power generation and distribution: Hydropower Generation Enterprise(HPGE), Myanmar Electric Power Enterprise (MEPE), Yangon Electricity Supply Board (YESB), Electricity Supply Enterprise (ESE)
Coal	Ministry of Mines
Biomass/wood	Ministry of Agriculture and Irrigation Ministry of Environmental Conservation and Forestry
Energy efficiency	Ministry of Industry
Renewable energy development and promotion	Ministry of Science and Technology

Source: ADB "Renewable energy developments in the Greater Mekong Region"

(2) Renewable energy in energy policies

Energy policy in Myanmar is composed of four main principles: (1)energy independence, (2)promotion of new energy such as renewable energy, (3)energy efficiency, and (4)promotion of alternative fuels such as biomass in households. Renewable energy, as stated above, is one of the four important principles in Myanmar energy policy. However, renewable energy related authorities and institutions are fragmented; therefore, there is no unified policy for promoting the development and use of renewable energy in Myanmar. There are no incentives in Myanmar that directly promotes the implementation of renewable energy. In some cases, tax exemptions under Foreign Investment Law may apply for renewable energy projects.

(3) Renewable energy potential in Myanmar

Myanmar possesses high renewable energy potential, such as solar power, other than hydropower that is currently heavily installed.
Since 60% of the land in Myanmar has high radiation, a large amount of electricity generation can be expected from solar power. However, on the other hand, there are geographical constraints due to mountainous regions. In addition, the transmission and distribution system are vulnerable with small capacity. Grid-connected project would be the realistic solution for mega solar projects, but since there are no clearly-stated preferential measures for renewable energy electricity sales (Feed-in-Tariff scheme, premium tariffs, etc.), considering the standard electricity tariff posed by the Ministry of Electricity, its feasibility is low.

On the other hand, off-grid projects and small-scale solar power systems in the rural areas may possess higher economic potential than their alternatives, such as diesel generators. Solar systems are actually installed for some charging stations and lightings in some households and villages.
As for wind power, although relatively high wind speed is observed in central mountainous regions and in coastal areas, in most areas of Myanmar the average wind speed is below 4m/second; wind power potential in Myanmar is not very high. Furthermore, electricity price for national grid ($0.03/kWh~$0.08/kWh) is far below the wind power generation cost, making it difficult for grid-connected wind power projects to become economically viable. Currently, there are two MOU's for wind power projects between companies in Thailand and the Myanmar government, but these projects are still under their development stage as well.
Biomass power potential from agricultural residues is high in Myanmar, as it is an agriculture-oriented country; there are high expectations for projects in this area.

3.1.2 Renewable energy project and JCM project needs

As stated in Chapter 2, technologies that contribute to stable power supply are essential for economic development in the Ayeyarwady Region and Pathein Industrial City area. Pathein Industrial City will be facing electricity demand for construction of factories and necessary infrastructures soon. Even after the construction phase is finished, as factory tenants move in and infrastructure facilities start operating, electricity demand will continue to increase. Furthermore, development of area surrounding the industrial zone itself is planned as well, so electricity demand from related facilities, such as housings and leisure facilities, are expected to arise in the future. Therefore, Ayeyarwady Development recognizes power supply as a crucial issue in Pathein Industrial City development; it is planning to take various measures for power supply, such as constructing a power plant.
In order to improve the power supply situation in Pathein Industrial City area, providing power plants off-grid or near consumption sites is preferable, considering the issues in transmission and distribution network. Renewable energy potential in the Ayeyarwady Region is very high; radiation rate in the Ayeyarwady Region is high, and it produces abundant agricultural residues. Considering these conditions, locally produced and consumed distributed energy system using renewable energy is a desirable solution in Pathein Industrial City area.
By implementing a distributed renewable energy system in Pathein Industrial City, know-how on the operation and maintenance of the system can be transferred as well. In the Ayeyarwady Region, with high renewable energy potential and high electricity demand, there is a large market potential for renewable energy projects. Renewable energy project in Pathein Industrial City can be applied later to other parts of the region or the country.

3.2 Japanese experiences and technologies for application

(1) Fukushima City Renewable Energy Promotion Plan

In order to accomplish its vision of a "Cutting-Edge Environmental City" in Fukushima City, it has implemented a renewable energy promotion plan. The plan is placed under the Fukushima City Environment Plan, and it was implemented in 2015. It complements Fukushima City Global Warming Countermeasures Action Plan that was implemented in 2011. The renewable energy promotion plan sets various measures for installing renewable energy proposed in Global Warming Countermeasures Action Plan.
Rural landscape, woodland, natural environment and scenery filled with green, historical and cultural features are regional characteristics of Fukushima City. It is important to promote installation of renewable energy that takes such characteristics of the area into account, under the unified effort of the city, citizens, and the business owners. "Cutting-Edge Environmental City" that Fukushima City holds as its vision, is not only confined to the creation of low-carbon and recycling-based society, but also expands to the formation of a vitalized city: including reconstruction from nuclear power accident, regional revitalization, disaster-resilient urban planning, and local energy production and consumption.
The period of Fukushima City Renewable Energy Promotion Plan is from fiscal year 2015 to fiscal year 2020. During this period, goals for renewable energy installation, electricity consumption within the city, and self-sufficiency rate of energy are proposed (Table 3-2).

Table 3-2 Goals under Fukushima City Renewable Energy Promotion Plan (thousand kWh/year)

Category			FY2013 (Current)	FY2020 (Goal)	FY2030 (Mid-term)	FY2040 (Long term)
Generated electricity from renewable energy (estimate)(A)			429,506	545,000	722,000	920,000
Compositions of (A)	(1)Hydropower Plant in Tohoku Electric Power		365,532	373,000	373,000	373,000
	(2)City, citizens, and business owners		63,974	172,000	349,000	547,000
	Composition of (2)	(i) City	29,632	30,000	54,000	54,800
		(ii) Citizens	22,515	42,000	84,000	130,200
		(iii) Business owners	11,827	100,000	211,000	362,000
Electricity consumption in Fukushima City(B)			1,824,452	1,824,452	1,824,452	1,824,452
Self-sufficiency rate of energy (A)/(B)			23.5%	30.0%	40.0%	50.0%

Source: Fukushima City Renewable Energy Promotion Plan

In order to accomplish these goals under the unified cooperation of the city, citizens, and business owners, the plan defines each stakeholder's role. Fukushima City, through implementation of renewable energy, will show its citizens and business owners the direction of the plan. The citizens will hold higher interest in energy related issues, and will

proactively work towards the promotion of renewable energy. Business owners will pay attention to local production and consumption of energy, and will work towards implementation of renewable energy, while considering a scheme that brings back benefits to the local area.

(2) Example of a renewable energy project in Fukushima City: geothermal project at Tsuchiyu Hot Spring Well No.16

Background

Due to the Great East Japan Earthquake in March 2011, Tsuchiyu Hot Spring in Fukushima City had a devastating damage, including physical damages to buildings but also lowered reputation from the nuclear accident. In the face of a sharp drop in the number of tourists, the hot spring area established "Tsuchiyu Hot Spring Reconstruction Association." One of the main activities of the association was a renewable energy project that utilizes the clean water and hot spring resource. Tsuchiyu Hot Spring area decided to hold its new future vision of an "eco-town." Small-scale hydropower project and binary geothermal project are projects that contribute to these activities.

Overview of the Power Plant

The overview of the power plant is described in Table 3-3.

Table 3-3 Overview of the Power Plant

Well Head Pressure	0.25MPa
Input Temperature	120 degrees Celsius
Steam Flow Rate	3.4t/h
Hot Water Flow Rate	33.4t/h
Output at Generator Terminals	400kW
Output Available for Sales	350kW
Cooling Water Requirement	260t/h
Payback Period (Years)	Approx. 7 years

Source: Tsuchiyu Onsen Energy Brochure

3.3 Possible JCM projects

Based on the local needs and experiences of Fukushima City, several possible JCM projects in renewable energy sector were considered.

(1) Photovoltaic system in Pathein Industrial City

1) Photovoltaic system on factory rooftops

Photovoltaic system utilizing the rooftops of factories was considered as a possible JCM project. The solar panels can be installed on top of the factory rooftops. The benefit of the rooftop model is that it increases power generation (solar panel installment) with the increase of factories.
However, there are some challenges to overcome. For example, the factories expected to be constructed in the first phase are mainly light industries such as textile. They do not require cranes to be placed on ceilings, and may not have the capability to place extra weight for solar panel on the roof. Therefore, change in cost and plans may be necessary. Furthermore, bankruptcy of factories with rooftop solar is a major risk of JCM scheme operation.

2) Photovoltaic system at water treatment facility

Needless to say, water treatment facilities are an essential part of infrastructure. Since there is no water management system in Pathein, the developer of Pathein Industrial City is planning to construct a wastewater management facility for its factories. Therefore, another possible JCM model is to install solar panels at these facilities.
As water treatment facilities are essential infrastructures for the industrial city, there are several benefits in developing the model under JCM scheme.
First, default risk of factory, as explained above, is low because the facility is an essential infrastructure. In addition, as the size of water treatment facility increases with the development of industrial city, there will always be a certain amount of electricity demand at the site. Last, by installing independent electricity source at water treatment facility, it can be used as a backup power during blackouts.

3) Photovoltaic system and training facility

Photovoltaic system has not been promoted much in Myanmar, and there are limited number of engineers with knowledge in relevant technology. Thus, there are very few people who can maintain the solar systems installed in some rural areas, which is becoming a serious issue.
Even though there are plans in Pathein Industrial City to install distributed energy system such as solar power in the future to contribute to its stable power supply, it will take some time until the tenants move in and their electricity demand arise. However, a showroom of Pathein Industrial City will be constructed in advance in 2016; the facility can be utilized as a location for small photovoltaic system installment, as a training facility for photovoltaic system related technology.

Figure 3-2 Showroom to be Constructed in 2016

In rural areas of Myanmar, small scale solar systems will continue to be installed under the National Electrification Plan. From this aspect, development of JCM model can be expected, by those trained at the facility maintaining new solar systems, or operating a new community-scale PV system for the whole village.
One of the drawbacks of this JCM model is that its scale is small. As a technical assistance project, not much GHG emission reduction can be expected. Furthermore, even if this project develops into a community-scale photovoltaic project, organizations for operating and maintaining the system need to be formed, and its operation scheme needs to be considered according to the needs of each implementation site. Although this project may eventually lead to a megawatt-scale project in the future, it will take some years until the factories move in, which would be an issue as a JCM project.

(2) Photovoltaic system at base stations

KSGM, a telecommunication company in Myanmar, is planning to install another 1000-1500 base stations, starting from 2016. At these base stations, solar panels will be installed as stable power supply.
Solar systems at base stations will be around 8-10kW, which requires approximately 40-45 solar panels. At these base stations, solar power system is not connected to the grid, and it provides electricity completely off-grid. In some places, generators are installed with solar panels.
There are several benefits in photovoltaic system at base stations as JCM projects. The model has a wide scalability nationwide, and there is no cost associated with grid connection. On the other hand, however, the size of each project is very small, so operation and monitoring of these PV systems at hundreds of base stations will be the largest issue in this JCM project model.

Considering these possible projects, it was concluded that solar power placed at water treatment facilities had the largest potential as a JCM project. Further considerations for the model, such as power capacity and project area, are described below.

3.4 GHG Emission Reduction

3.4.1 Analysis of emission reduction of energy-derived CO2 & greenhouse gas

Methods of emission reduction of CO2 from fuel combustion and greenhouse gas of the solar power project were examined. Based on this, reduction volume of such energy-derived CO2 was calculated. The outline of the examination is described below.

(1) Reference

Generated electricity from solar power plant is supplied for electricity demand at the wastewater treatment facility in Pathein Industrial City. Since the industrial zone is connected to the grid, the reference value will consider electricity supply from the grid. There is no official government value of CO2 emission factor for the national grid in Myanmar, and acquisition of data for power stations connected to the grid is difficult as well at the moment. Under the circumstances, the CO2 emission factor for the grid was calculated with methods defined in CDM methodology, using IEA data. The result of grid average CO2 emission factor is as follows.

Table 3-4 CO2 emission factor of electricity generation in Myanmar according to fuel source (t-CO2/MWh)

	Coal	Oil	Gas	Grid Average
2009	1.055	0.864	0.729	0.202
2010	1.057	0.786	0.729	0.265
2011	0.979	0.853	0.729	0.192
2012	0.961	0.826	0.729	0.219
2013	0.956	0.825	0.729	0.195
Average emission factor	-	-	-	0.215

Currently, installment of gas fired power plants are under consideration in Myanmar; the current model of hydroelectricity-dependent generation mix will gradually shift toward a thermal power plant oriented generation mix. With such trend, grid emission factor is likely to increase as well. Therefore, CO2 reduction volume of this project will increase accordingly; CO2 emission factor for the grid will be determined ex post.

(2) Project

There is no CO2 emission for solar power plant operation. Electricity consumption of controlling equipment, such as power conditioners and pyrheliometer, needs to be subtracted, but since electricity generation can be monitored as electricity sales to the grid, electricity consumption from such equipment is taken into account and does not need to be calculated as project emission.

(3) Reduction volume

Assuming the above, emission reduction is calculated as follows.

Table 3-5 Result of emission reductions calculation (Solar power project)

Capacity (Net)	1,000	kW
Annual power generation (Net)	1,542,344	kWh/year
Grid emission factor	0.215	kg-CO2/kWh
Reference emission	332	t-CO2/year
Project emission	0	t-CO2/year
Emission reductions (planned)	332	t-CO2/year

3.4.2 Project impacts besides emission reductions

Project benefits other than emission reduction, such as economic benefits (direct and indirect) and social benefits (direct and indirect), are as follows.

(1) Economic benefits

- Water quality management and land utilization
  The project plans to install solar panels on the large openings of wastewater treatment water tanks; it would contribute to water quality management and utilization of land.
- Constructing an independent and distributed power supply structure
  For economic development in Pathein Industrial City in the Ayeyarwady Region, power must be supplied at appropriate timing, such as at the timing of construction of the industrial zone and necessary infrastructure. Considering the current unstable power supply in Myanmar, creating a power supply structure of an independent distributed energy resource is needed.

(2) Social benefits

Emission reduction impact is calculated assuming that generated electricity in this project alters electricity supplied from the national grid. On the other hand, Pathein Industrial City is located at the end of the national grid, and electricity for construction and operation of industrial zone will not be supplied adequately. Therefore, considering the necessary amount and quality of electricity supply, it is natural to assume that generators using fossil fuel (mainly diesel generators) are installed. Thus, the project is considered important to the society, as it promotes renewable energy by installing solar power plant, a non-fossil fueled energy, instead of installing fossil fueled generators.

3.5 Project and policy proposal

3.5.1 Possible systems for installment

(1) Consideration of installed technology

Power capacity and necessary area were studied for solar power installed at water treatment facility.

1) Necessary capacity

As project area for Pathein Industrial City is large, its construction is likely to be divided into three phases. Construction area for phase 1 will be 400ha, which would require approximately 6,000m3/day of industrial water. Amount of waste water, generally around 80% of tap water, is estimated to be about 4800 m3/day.

<u>Electricity demand at water treatment plant</u>

Process for water treatment can roughly be divided into three phases: (1) “intake and ”transmission” process, which acquires water from rivers through intake pipe into reservoirs, (2) “treatment” process, which cleans water through precipitation and filtration, and (3) “pumping” process, which sends water to distribution pipes. In Pathein Industrial City, water distribution is likely finish at water receiving pit, so electricity demand for water transmission and distribution is not considered for necessary electricity at the facility. Total electricity demand at the facility, calculated according to data shown in Figure 3-3 and Based on Figure 3-3, total demand will be 0.53kW/m3, of which intake/transmission and treatment processes are 0.23kW/m3, 43%. Using these values, necessary electricity demand at water treatment plant can be estimated at 1,367kWh/day.

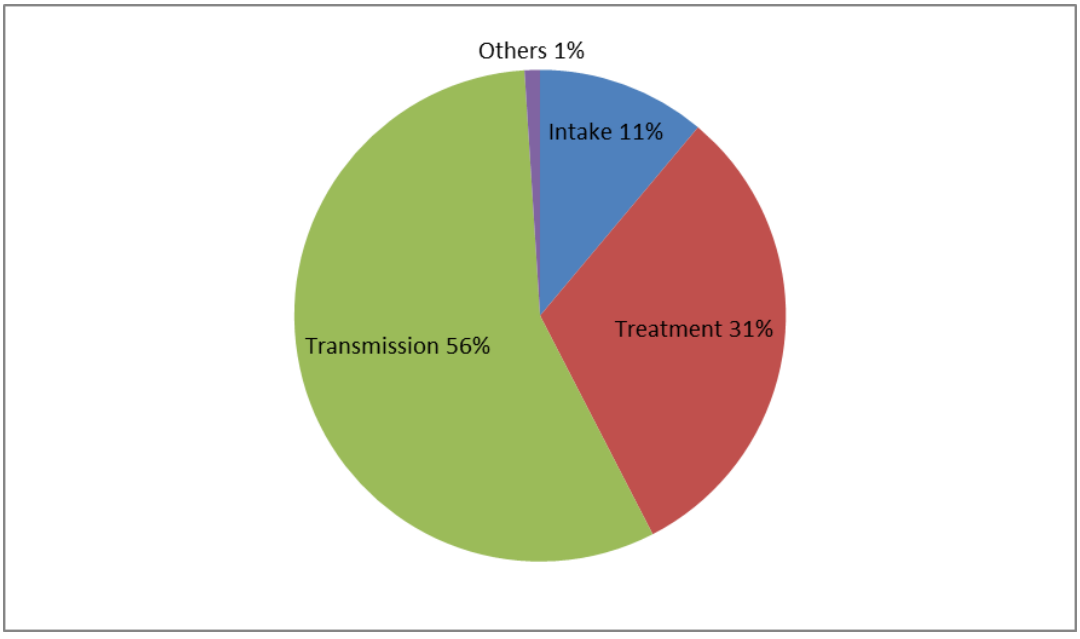


Figure 3-3 Electricity Demand at Water Treatment Facility by Process (%)

Source: Report by the Ministry of Environment (2014, Bureau of Waterworks Tokyo Metropolitan Government)

Table 3-6 Electricity Consumption by Process

	Intake	Treatment	Transmission	Others	Total
Demand (kWh/year)	87,370,000	256,330,000	458,190,000	12,170,000	814,060,000
Water Intake (m3/year)	-	-	-	-	1,523,000,000
Necessary electricity (kWh/m3)	0.06	0.17	0.30	0.01	0.53
Electricity share (%)	11	31	56	1	100

Source: Report by the Ministry of Environment (2014, Bureau of Waterworks Tokyo Metropolitan Government)

Electricity demand at wastewater treatment plant

Electricity demand at wastewater treatment plant is roughly divided into five locations: (1) pump lift station to transfer wastewater, (2) each pump within the plant, (3) treatment using blower, (4) sludge treatment, and (5) others. Electricity demand at wastewater treatment plant in Pathein Industrial City is estimated to be 2,361kWh/day, assuming that necessary electricity for wastewater treatment is 0.49kW/m3 (Figure 3-4 and Figure 3-5).

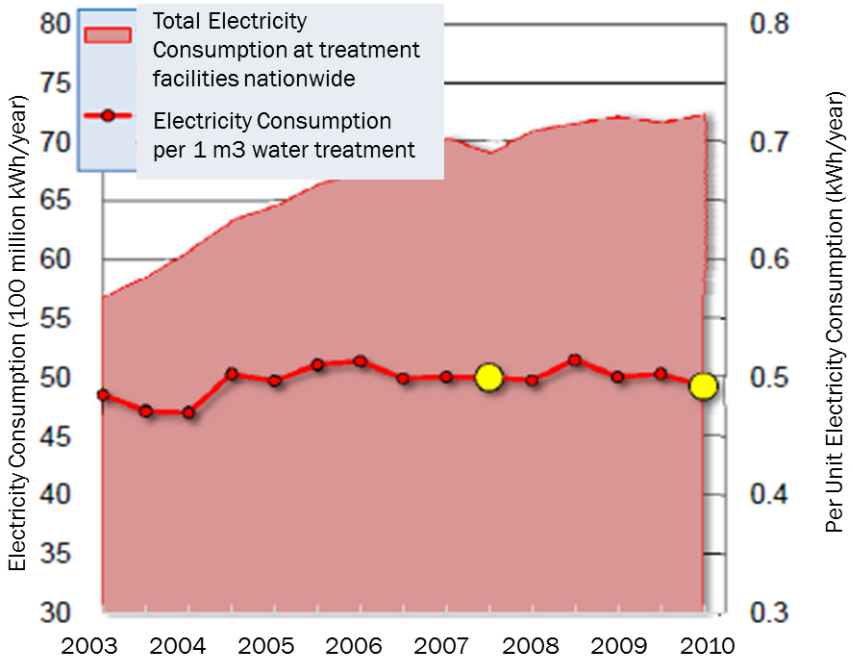


Figure 3-4 Necessary Electricity per 1m3 of Wastewater

Source: Ministry of Land, Infrastructure, and Transportation : Analysis on Current Policies on Resources and Energy in Waste Treatment" translated by MRI

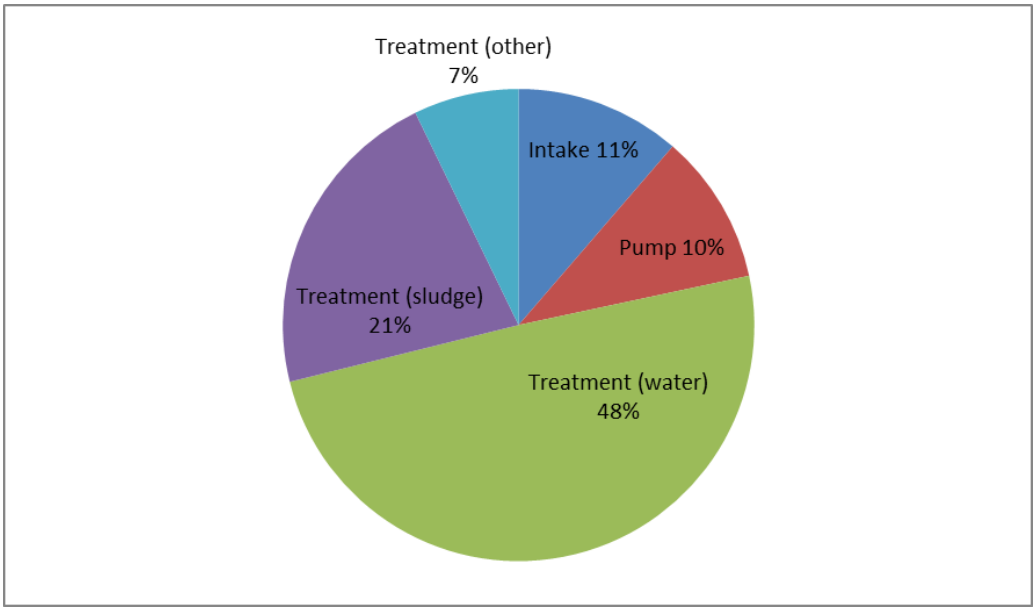


Figure 3-5 Electricity Demand at Wastewater Treatment Facility by Process (%)

Source: Ministry of Land, Infrastructure, and Transportation : Analysis on Current Policies on Resources and Energy in Waste Treatment" translated by MRI

2) Overview of solar power system

During phase 1 of Pathein Industrial City construction, electricity demand at water treatment facilities is estimated to be 3,728kW/day (water treatment: 1,367kWh/day and wastewater treatment: 2,361kWh/day). In order to install a solar power system that can meet this electricity demand, its installment area will be approximately 10,000m2.

Table 3-7 Overview of Solar Power System

Output	1,000	kW
Average radiation	19	MJ/m2/day
	5	kWh/m2*day
Annual cumulative radiation	1,928	kWh/m2*year
Radiation intensity	1	kW/m2
Overall efficiency	0.8	
Annual power generation	1,542,344	kWh/year
Power generation (day)	4,226	kWh/day
Area per power unit	10	m2/kW
Total area	10,000	m2

3) Possible project sites

Normally, at water treatment facilities, water tanks with large openings, such as filtration area and sedimentation basin at purification plants are left open. Therefore, countermeasures against algae that can have a negative impact on water quality and

operation and maintenance are urgent issues. Installing solar panels on these water tanks is beneficial both from the water quality management aspect and land utilization aspect. There are roughly two installment methods.

- Covered PV system
  The modules are installed and generate electricity on the movable FRP covering on the water tanks. The coverings are often attached to a rail to make them movable so that the PV system would be able to keep generating electricity during maintenance periods.

Figure 3-6 Covered PV System

Source: Yokohama Regional Energy Vision

- Floating covered PV system
  This system does not require a trestle. Therefore, its installment is simple.

Figure 3-7 Floating covered PV system

Source: Yokohama Regional Energy Vision

There are many cases in Japanese water treatment facilities that install these covered PV systems. For example, Figure 3-6 shows water treatment facilities in Tokyo with a covered PV system installed. Installation of covered PV system in wastewater treatment facilities, such as sedimentation basin and aeration tank, are under consideration in Osaka City and Yokohama City.

Table 3-8 Covered PV System Installed Treatment Facilities in Tokyo

Facility	Installment Site	Year	Capacity(kW)	Electricity Generation (thousand kWh/year)
Takatsuki treatment facility	Filtration area	2003	20	15
Asaka treatment facility	Filtration area	2004	1,200	818
Misono treatment facility	Filtration area	2004	400	317
Ozaku treatment facility	Filtration area	2004	280	210
Higashimurayama treatment facility	Filtration area	2006	1,200	848
Nagasawa treatment facility	Filtration area	2006	200	171
Kanamachi treatment facility	Filtration area	2006	800	644
Misato treatment facility	Filtration area	2006	1,080	376
Total			5,180	3,399

Source: Environment Report (Tokyo Metropolitan Government, 2014)

In the first phase of Pathein Industrial City development, covered PV system can be installed at sedimentation basin, filtration area, and distribution reservoir at the service water treatment plant, and it can be installed at aeration tank and final sedimentation basin at the waste water treatment plant. Under this condition, area that can be provided for solar panel installment is estimated to be around 1,860m2, which amounts to about 786kWh/day, approximately 20% of the total electricity demand at water treatment facilities (3,728kWh/day).

Construction of a PV system is planned in accordance with infrastructure construction (water treatment facilities). Approximately 20% of the total 1MW PV system will be installed at water treatment facilities, and the remaining 80% will be installed on the ground nearby. When the same amount of PV system is installed in the remaining two phases of Pathein Industrial City development, about half of the total electricity demand at water treatment facilities at Pathein Industrial City will be supplied by the PV system.

Table 3-9 Estimation of Possible Area for Installment

	Installment Location	Installment Area	Notes
Service water treatment facility	Sedimentation basin	420 m2	Single layer, processing speed of 10mm/min (*1)

	Installment Location	Installment Area	Notes
	Filtration area	50 m2	Filtration speed: 120m/day(*1)
	Distribution reservoir	750 m2	Water storage hours: 12, tank height: 4m(*2)
Waste water treatment facility	Aeration tank	400 m2	8 hrs aeration, tank height 4m
	Final sediment basin	240 m2	Water surface load 20m3/m2/day (*3)
Total		1,860 m2	

Source: *1: Japan Water Works Association "Guideline for Planning Water-Related Facilities 2012"
*2: Japan Water Works Association "Guideline and Explanation for Planning Water-Related Facilities 1998"
*3: Japan Sewage Water Association "Sewage Facility Plan: Planning Guidelines and Explanations"

3.5.2 Project implementation arrangements

(1) Project organization and operation

The project scheme discussed above uses generated power at water treatment facilities. Since water treatment facilities are constructed as part of infrastructure for Pathein Industrial City development, the project owner should be the developer of Pathein Industrial City. However, currently, there is no water treatment facility in Pathein; even in Yangon water treatment is inadequate. Needless to say, private companies do not have the experience of operating water treatment facilities either, so operation of the facility by a single company in Myanmar is challenging.
Two different organizations can separately operate water treatment facilities and solar power generation facility. However, considering the characteristic of electricity demand at water treatment facilities, unified operation would be better. In addition, considering the utilization of JCM scheme, SPC formed by a Japanese company and the developer of the Pathein Industrial City would be the best option (investment ratio of each will be discussed later.) (Figure 3-8)

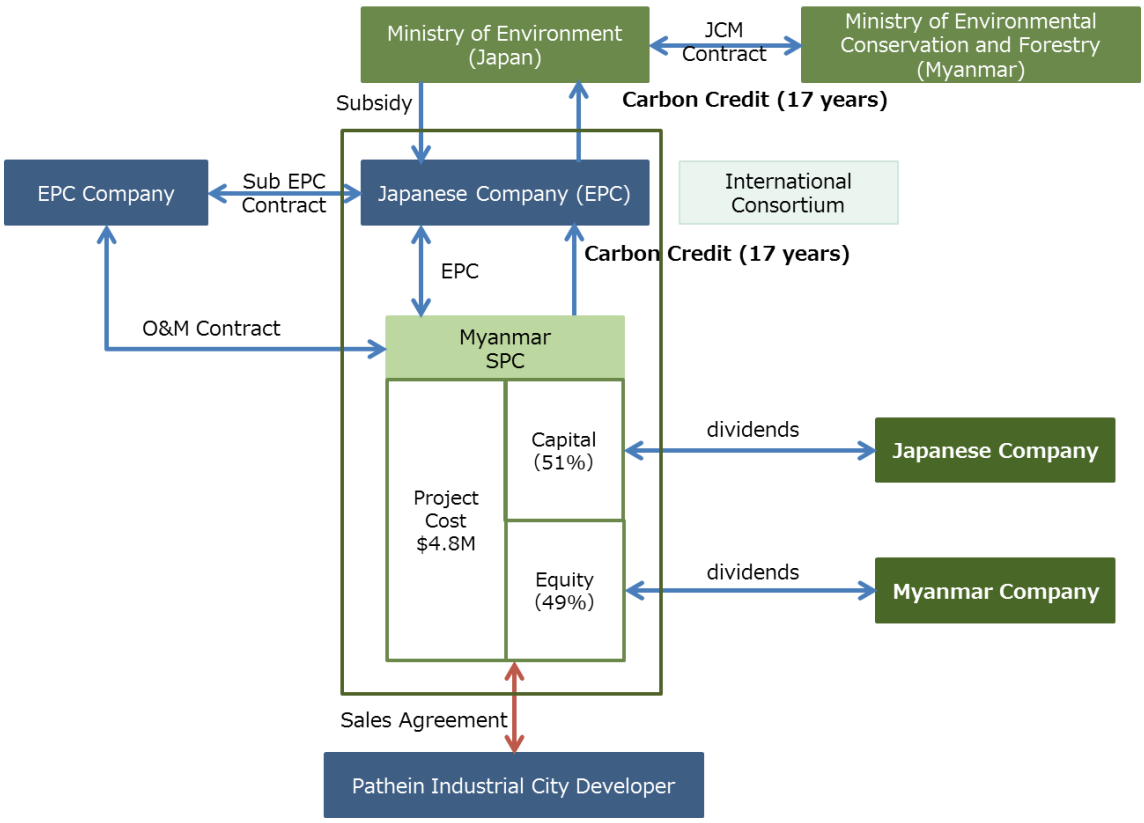


Figure 3-8 Project Organizational Structure

(2) Finance plan

Project investment based on the investment ratio of the SPC is under consideration. Although the detailed investment amount is not determined yet, the PV system currently under consideration (1MW), requires approximately 281,000JPY/kW (total of 281,000,000JPY). Utilizing relatively low-priced Indian module (40% of the total cost) and minimizing the initial cost is under consideration as well.

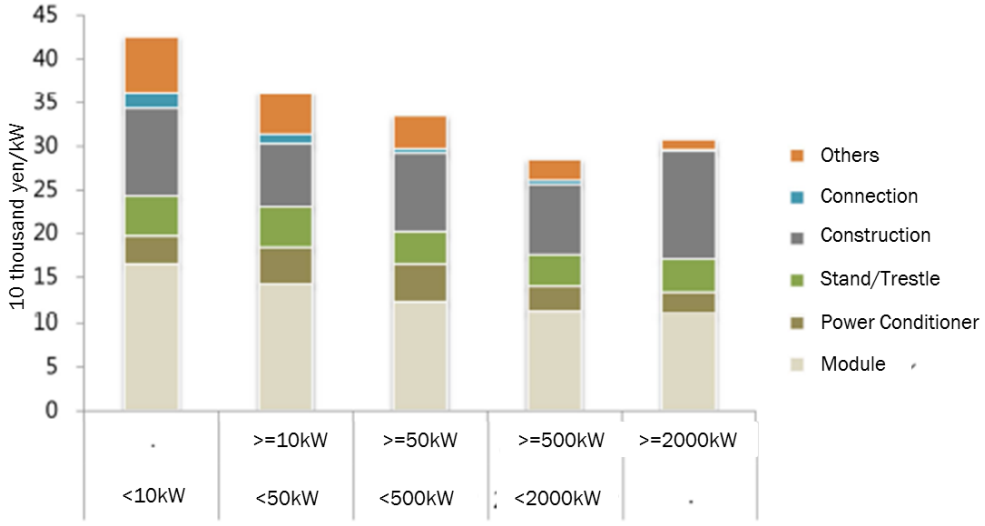


Figure 3-9 System Cost Composition by Size

Source: "Situation and Cost of Solar Power" Japan Renewable Energy Foundation 2014

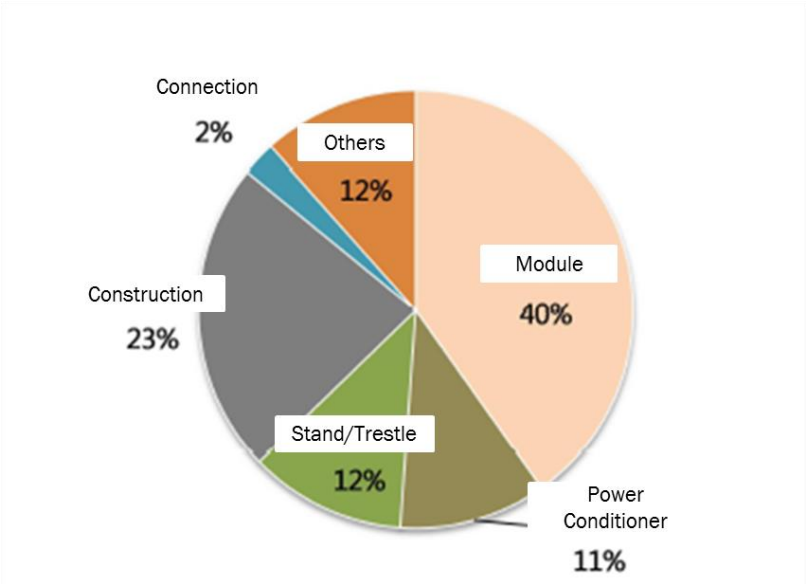


Figure 3-10 Composition of System Cost by Size (%)

Source: "Situation and Cost of Solar Power" Japan Renewable Energy Foundation 2014

(3) Operation and maintenance arrangement

Although solar power does not require much technical knowledge or experiences for operation, there is no mega solar installed in Myanmar, so those who will manage the plant may not have the capability to manage a mega solar. Since stable operation of at least 17 years of legal duration is necessary, consigning operation and maintenance work to an EPC company is under consideration.

3.5.3 Project development and measures for JCM project formulation

(1) Consideration of environmental and social measures

In principle, it is required to obey the local legislation where investment and business is conducted. However, in the case of Myanmar, since its legislation is underdeveloped, individual negotiation with relevant organizations, including the Investment Committee, is necessary. Therefore, at this moment, it would be appropriate to consider environmental and social measures in accordance with the international standards (such as JICA socio-environment consideration guideline, IFC Performance Standards, ADB Safeguard Policy Statements 2009, etc.).
Since the project under consideration is installed at water treatment facilities in Pathein Industrial City, it is assumed that environmental nor social issues would arise as a result of this individual project.

(2) Development of project and its measures

Through discussions in workshops and local surveys under inter-city cooperation, the stakeholders agreed upon the following concept.
For regional economic development, stable power supply is the issue of utmost importance. Pathein Industrial City plans to provide electricity from the national grid. However, as national electricity demand is increasing, it would be difficult to provide the whole electricity demand in industrial zone from the national grid. Therefore, some of the electricity needs to be supplied elsewhere from generation resource that does not rely on the national grid; therefore, there is strong interest in renewable energy as a locally distributed energy resource..
On attracting factories, preparation of power supply system is essential. Preparation of an independent power supply system within the industrial zone at an early stage, before the factories move in, is necessary. “Power plant project utilizing waste such as rice husks” (described later in this report) is one power supply facility prepared in advance for such demand. In addition, possibility for installment of solar power, with high potential in Myanmar with rich radiations, will be considered. With solar power, once its facility is constructed, it is able to supply stable power for a long term; development of the model within the industrial zone and its surrounding area is possible, so promotion and diffusion is expected, once its regional installment model is established.

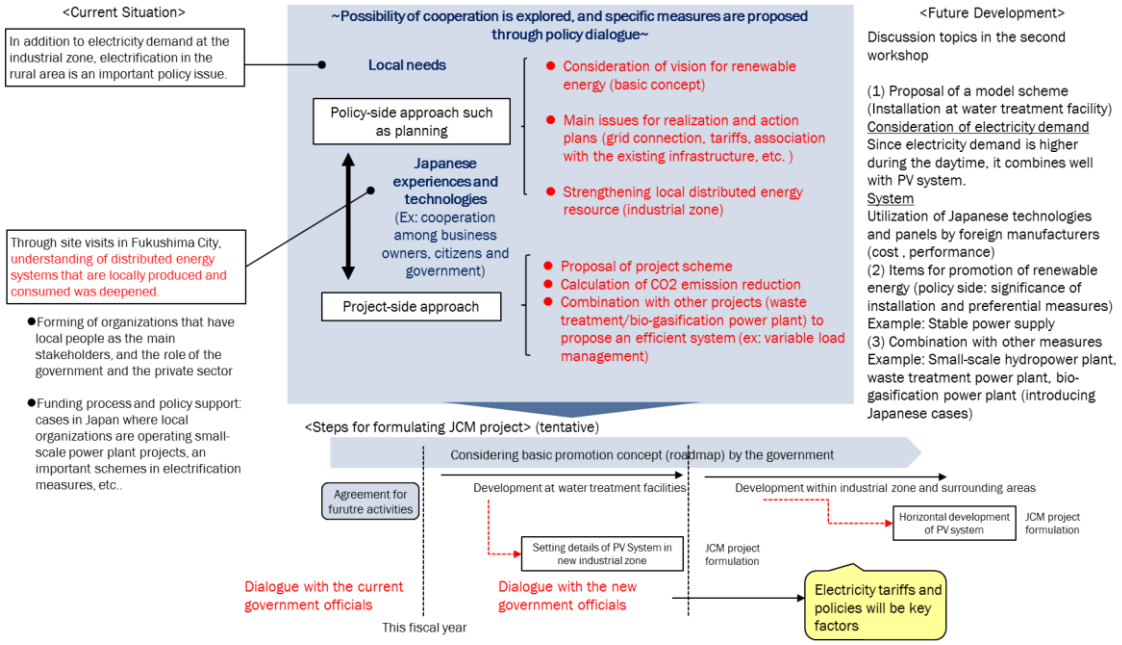


Figure 3-11 Project Development in Renewable Energy Sector

<Project development in renewable energy sector>

- Project formulation approach

Detailed considerations for formulation of a mega solar project installed at water treatment facilities in Pathein Industrial City will be conducted. In specific, a mega solar of approximately 1MW scale is planned; detailed power plant systems, business feasibility analysis, CO2 emission reductions, project benefits, operation and finance plans, and MRV plans are to be considered. In addition, details of JCM project organizational structure will be determined through discussions with the regional government officials and industrial zone developers (including discussions for SPC formation).

- Policy-side approach

Pathein, as the capital and central city of the Ayeyarwady Region, is expected to undergo rapid economic growth, and its industrial and residential electricity demand is expected to increase as well; therefore, acquisition of power supply is an urgent issue. The Ayeyarwady Region in particular is located at the end of the transmission grid of the national grid, with low electrification rate; expansion of electrified areas is a serious policy issue from the aspect of regional development and the living standards of the local residents.

Therefore, the necessity and the desired standard of energy self-sufficiency at the local level will be discussed, utilizing Japanese policy forming experiences and with regard to the local aspects of Pathein; specific measures (e.g. preferential measures including electricity tariffs, policy goals, public-private partnership, etc.) will be considered at the same time. Fukushima City has been promoting renewable energy installations and has an experience of creating “Fukushima City Renewable Energy Promotion Plan.” The plan was created as one measure to realize the establishment of “Cutting-edge Environmental

City Fukushima," with the unified cooperation of the city, citizens, and business owners; the plan defines direction of renewable energy installment that matches local characteristics and specific measures for installment. There are high expectations for sharing such policy-side experiences with Ayeyarwady Region and Pathein City in this project.

4 Possible Projects in Waste Treatment Sector

4.1 Overview and local needs

4.1.1 Waste treatment in Myanmar

<Overview of generated waste in Myanmar>
According to Myanmar presentation in Regional 3R Forum in Asia, hosted by United Nation Centre for Regional Development (UNCRD), composition of non-industrial waste In Myanmar is as follows: 73% organic waste, 18% paper, 4% wood, 4% plastic and textiles, and 1% others. Sector composition is as follows: 55% from residential sector, 35% from industrial sector, 7% from hospitals, and 3% from other sectors.

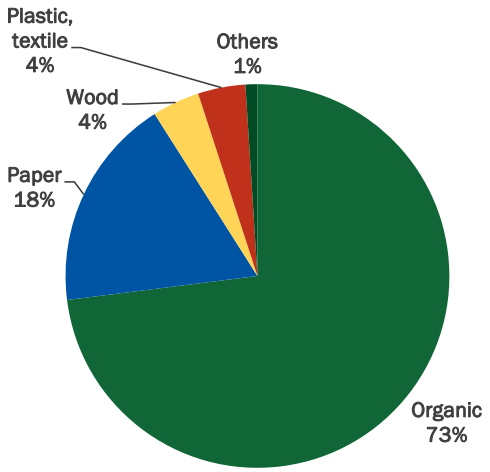


Figure 4-1 Composition of Non-Industrial Waste in Myanmar

Source: Country Presentation for 2nd Meeting of the Regional 3R Forum 2010

According to Green Lotus, a French think-tank, most of generated waste in Myanmar is sun non-industrial waste. Waste generated per capita in Myanmar is 0.45kg/day, and in Yangon the average is 0.53kg/day; the amount is increasing with population.In addition, generated waste in urban areas is expected to double by 2025. According to the Ministry of Environmental Conservation and Forestry, most of waste in Myanmar is municipal waste. Industrial waste management in Myanmar is the responsibility of each municipality, and it is hard to gather nationwide data of waste treatment. As an example, Mandalay generates approximately 4,792t of industrial waste from the light industry sector. More than half of Mandalay's industrial waste is from the food industry.

Reference

Rice Husks in Myanmar

Rice production in Myanmar is the seventh highest in the world. According to FAO, production is three times that of Japan (unofficial data in 2013: 29 million ton). Therefore, large amount of rice husks is generated at rice mills as well and their utilization is recognized as an issue.

Table 4-1 Number of Rice Mills and their Processing Capabilities

		2010 - 2011		2011 - 2012		2012 - 2013	
		# of Mills	Capability (t/day)	# of Mills	Capability (t/day)	# of Mills	Capability (t/day)
DELTA ZONE	Ayeyarwady	3,892	19,460	3,927	19,804	3,927	19,804
	Bagot	1,508	5,450	1,528	5,632	1,564	5,711
	Yangon	764	2,292	775	2,413	681	2,886
	subtotal	6,164	27,202	6,230	27,849	6,172	28,401
DRY ZONE	Naypyitaw	906	2,716	909	2,723	914	2,742
	Magwe	1,276	6,380	1,280	6,421	1,275	6,395
	Mandalay	1,504	7,520	1,517	7,635	1,571	7,855
	Sagaing	3,686	16,618	3,706	16,779	3,760	16,992
COASTAL	subtotal	539	1,364	539	1,364	518	1,295
	Mon	1,354	5,246	1,354	5,246	1,354	5,246
	Rakhine	1,119	2,238	1,118	2,236	1,117	2,234
	Taninthary	3,012	8,848	3,011	8,846	2,989	8,775
MOUNTAIN-OUS	subtotal	1,652	4,956	1,652	4,956	1,652	4,956
	Chin	44	220	44	220	44	220
	Kachin	21	63	21	63	21	63
	Kayah	813	1,647	813	1,647	835	1,669
	Kayin	2,530	6,886	2,530	6,886	2,552	6,908
TOTAL		15,392	59,554	15,477	60,360	15,473	61,076

Source: Myanmar: Capitalizing on rice export opportunities, The World Bank, Report number 85804 dated 28 February 2014

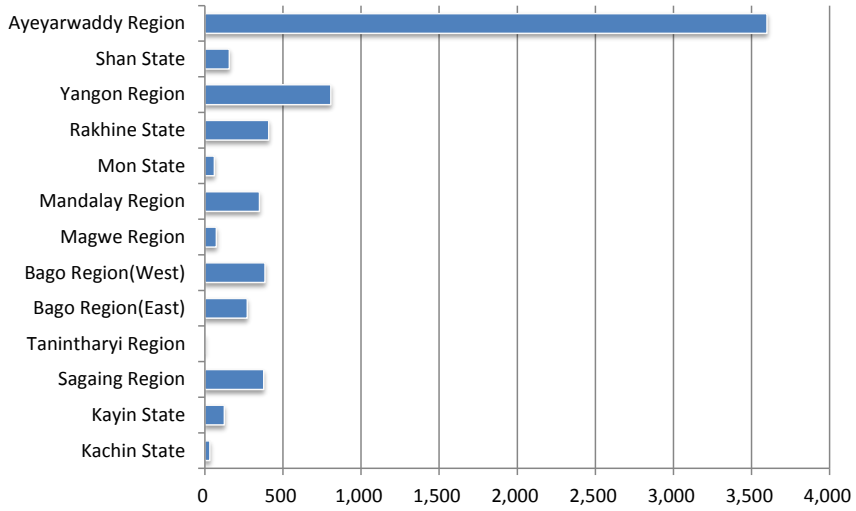


Figure 4-2 Number of Rice Mills by Region and State

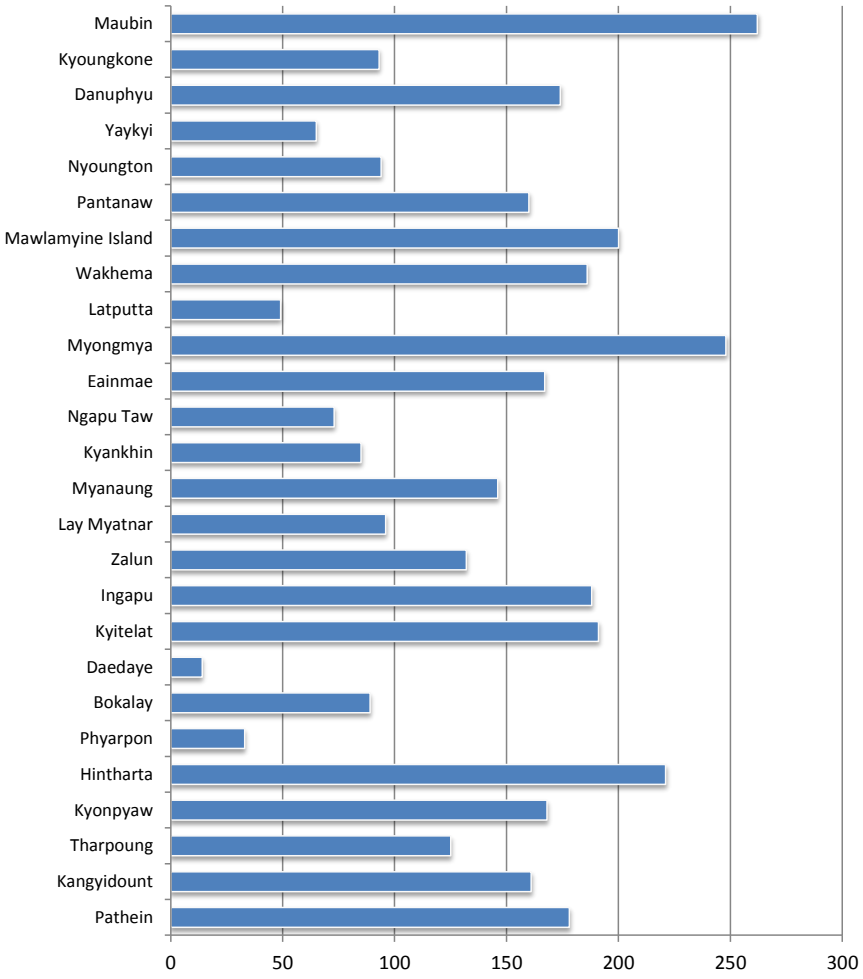


Figure 4-3 Number of Rice Mills in the Ayeyarwady Region

Source: MRMA

<Environmental laws and regulations in Myanmar>[4]

Since current primary industries in Myanmar are agriculture and textiles, there is limited amount of industrial waste generation. Therefore, waste management has not been recognized as a major environmental issue, and its treatment system is not appropriately organized either. However, industrialization is expected in Myanmar along with national economic development; therefore, establishing regulations and systems for waste treatment should be considered as an urgent issue.

Industrial waste treatment in economic zones is the responsibility of the management committee of the industrial zone under Special Economic Zone Law.

Environmental Conservation Law enacted on March 30th, 2012 is a waste treatment related law in Myanmar. According this law, roles of various organizations and institutions (ministries and business owners) are defined. However, specific policies, systems, and plans are yet to be defined.

According to MOE, capabilities of institutions under Environmental Conservation Law stated above are underdeveloped; in reality it is often the case that waste treatment is conducted inappropriately. However, it is important to note that many international companies, including Japanese companies, are conducting waste treatment properly according to their own standards or global standards.

In addition, MOE also reports that participation process into waste treatment business in Myanmar is unclear, as public tender or international tender process are not conducted.

4.1.2 Waste related projects and JCM needs

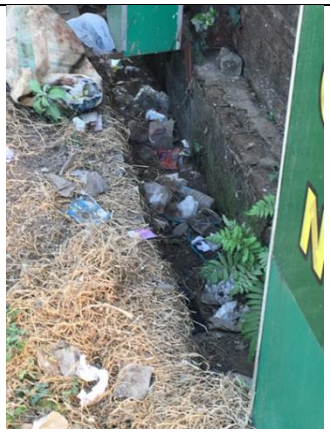
In the workshops held in Pathein and Fukushima City, those from Myanmar showed a fairly high level of interest in waste treatment. When they visited Japanese waste treatment facility, there was involved discussion on the incineration and recycling process and methods between the participants.

There is a waste collection system in Pathein, and packer trucks collect waste every day (according to local survey, there are nine trucks that collect waste in the morning and at night every day, with the same route). However, in reality, only limited amount of waste can be collected by these trucks. In addition, the collected waste is compiled at the treatment site which is already full. Municipal waste and industrial waste are not separated, and there is no categorization of waste (such as categorization of burnable and non-burnable waste in Japan) at all. Waste separation scheme has been demonstrated before, but since the scheme could not be enforced upon the local residents, the scheme was not implemented. If waste separation scheme is promoted in the local area, waste with high energy potential such as food waste can be utilized to formulate projects. Waste separation scheme that has been implemented by the government on a trial basis had a challenge in enforcing the

[4] Community-based 3 Rs Practices in Myanmar, E-waste Situation in Myanmar, Support for Establishing a Recycling-Based Society and Feasibility Study for Waste to Energy Business in Greater Yangon, Myanmar," https://www.env.go.jp/recycle/circul/venous_industry/pdf/approval_china.pdf http://www.meti.go.jp/meti_lib/report/2014fy/E004080.pdf

scheme upon the residents; therefore such projects would be considered as a mid-term project, but is a topic that must be worked on.
On the other hand, there is a large amount of rice husk waste generated in Pathein and the Ayeyarwady Region. In the workshops held in Pathein, there was high interest in formulating JCM projects utilizing these rice husks.

Landfill Site in Pathein



Scattered Waste in Pathein

4.2 Japanese experiences and technologies for application

(1) Basic plan for waste treatment

Fukushima Prefecture establishes its waste treatment plan under the national legislation, and Fukushima City, in accordance with this plan, establishes its Fukushima City Waste Treatment Basic Plan. This plan defines basic rules from waste generation and emission regulations. The plan applies to non-industrial waste. On top of this plan, there are Fukushima City Basic Environment Plan and Fukushima City Comprehensive Plan.

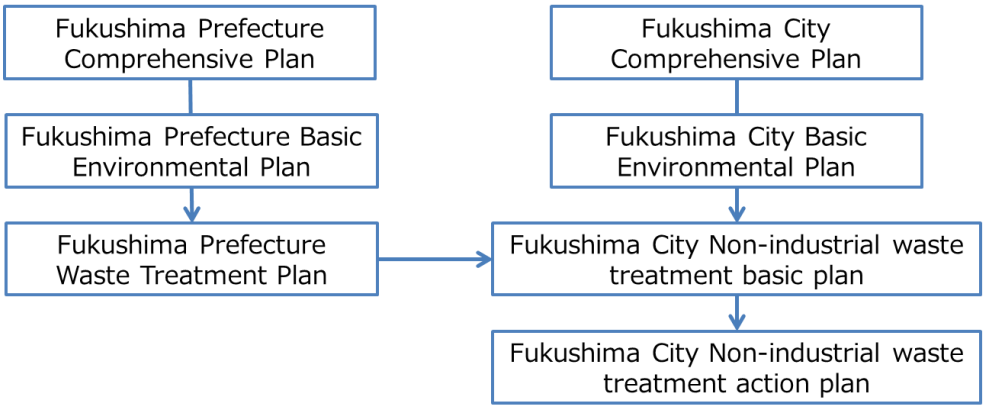


Figure 4-4 Prefecture and City Plans Related to Waste Treatment

Source: Fukushima City Waste Treatment Basic Plan (2014~2020)

The basic waste treatment plan in Fukushima City analyzes the total waste generation within the city in the past, and identifies several issues related to waste management. Based on these, it establishes the basic concept of the plan. The plan is composed of the following three concepts: (1) promotion of recycling-based society, through 3R activities of waste generation reduction, reuse, and utilization of renewable energy, (2) establishment of a safe and comfortable living environment through promotion of appropriate waste treatment, and (3) environmental conservation by citizens, business owners, and the government. The plan also determines its goal for waste generation, in order to reduce waste generated from 2014 to 2020.

Table 4-2 Goals in Fukushima City Basic Waste Treatment Plan

Category	FY2010	FY2020
Daily waste generated per capita (g/capita*day)	1,109	890
Total waste generated (t)	117,971	91,600
Recycling rate (%)	16.1	26.0 or more
Final treatment amount (t)	12,983	9,000

Source: Fukushima City Basic Waste Treatment Plan

In order to accomplish these goals, the plan identifies various measures and projects. There are four types of these measures: (1) reduction in waste generation and promotion of recycling, (2) transportation of waste, (3) intermediate treatment, and (4) final treatment.

The projects are considered from a wide perspective, from environmental education to facility construction.
In this way, in order to promote waste treatment in the area, there is a basic plan to grasp the current situation, set goals, and propose related measures; it is important that such plan is under coordination with those established by the country and the prefecture.

(2) Overview of the treatment facility in Fukushima City

Abukuma Clean Center (in operation from 1988) and Arakawa Clean Center (in operation from 2008) are intermediate treatment facilities in Fukushima City, The overview of Arakawa Clean Center is described below.

Overview

Table 4-3 Overview of Arakawa Clean Center

Business Owner		Fukushima City
Facility Name		Arakawa Clean Center
Total Area		33,495.10m2
Processing ability	Incinerator Plant	Incineration facility: 110t/day x 2 incinerators= 220t/day Ash melting facility: 20t/day
	Recycling Plant	Treatment of recyclables: 42t/5h Treatment of large waste: 60t/5h

Source: Arakawa Clean Center Brochure

Arakawa Clean Center is composed of three facilities: the incinerator, recycling facility, and recycle plaza. The burnable and non-burnable waste is incinerated at the incinerator, and the waste is later recycled or landfilled at the final treatment site. Recyclable waste is recycled. The recycle plaza provides resources for citizens to explain the role of the facility, and shows items taken out from the bulky items for waste that can be reused.

(3) Waste treatment process in Fukushima city

In Fukushima City, waste is separated into four categories: burnable garbage, non-burnable garbage, recyclables, and bulky items. Recyclables are collected in nine categories (cans, bottles, PET bottles, paper containers and packaging, cartons, cardboard boxes, newspapers and newspaper inserts, and magazines and books). The city promotes the concept “waste if mixed together, but resource if separated.”
The burnable garbage is brought to the intermediate treatment facilities and finally landfilled or recycled. Non-burnable garbage is transported to the recycling factory and partly recycled, and partly landfilled. Recyclables are recycled at the factory. Part of bulky items are repaired at the recycle plaza and provided for the citizens, and rest are treated at recycling factory and clean center.

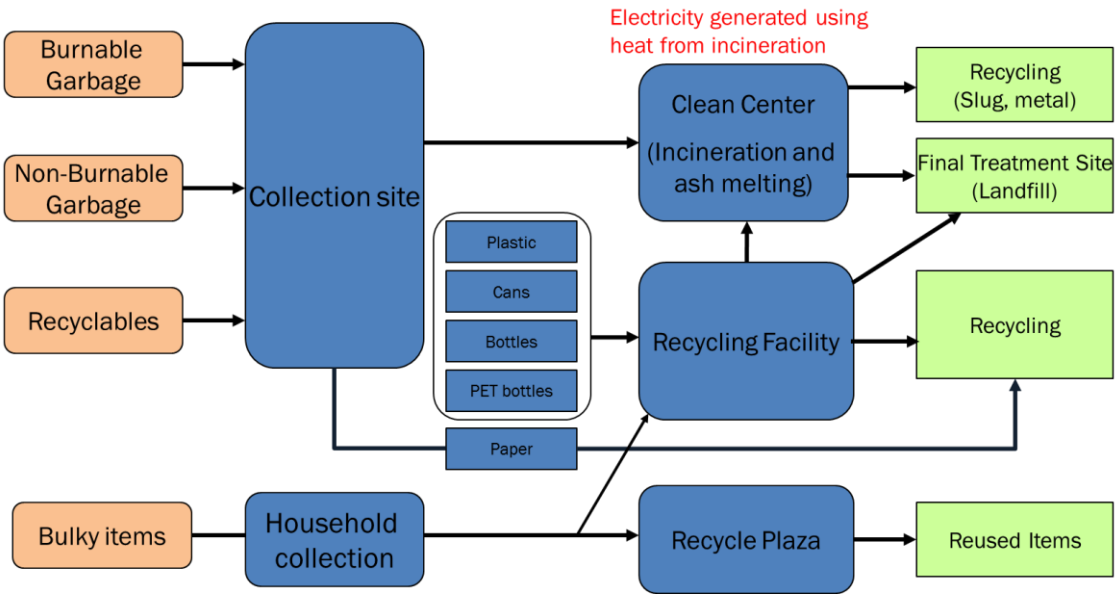


Figure 4-5 Waste Treatment Process at Fukushima City

4.3 Possible JCM projects

Multiple possible JCM projects in the waste treatment sector in Pathein were examined.

(1) Power generation at waste incinerators

Development of the residential area proceeds with the development of Pathein Industrial City; as the living standard is improved, higher demand for waste treatment is predicted to arise. Currently, waste treatment method is mainly landfill, but from the environmental aspect, necessity for construction of an incinerator and implementation of incineration method is predicted the future,
Waste power generation at the incinerator facility can promote efficient use of generated heat. Generated electricity can be self-consumed in the facility, sold to the factories off-grid, or can be sold to the grid.
However, it will take some time for the demand of incinerators to arise, as construction of waste treatment facilities and collecting adequate amount of waste from residents will require time. Therefore, this JCM project can be considered as a mid to long term project.

(2) Waste treatment project for organic waste (bio-gasification project)

Another possible JCM project is a bio-gasification project. Food waste generated from food industry factories in Pathein Industrial City, and organic waste generated from the residential area are both collected and utilized for bio-gasification in this project.
Japanese bio-gasification technology has higher system safety and credibility, compared with that in Germany and northern European countries. Considering that power plant will be built within the industrial zone, it is important to be able to stably and safely supply power in this project; Japanese technology with high system safety and credibility is appropriate for this project.
However, this project must wait for the factories to move in to the industrial zone as well. It will take several years for factories to start moving in; the bio-gasification project can only take place after this. Therefore, this project can be considered as a mid to long term project.

(3) Rice husk biomass power plant within the industrial zone

Rice husk biomass power plant within the industrial zone is another possible JCM project. As already stated, the Ayeyarwady Region is an agricultural region that generates a large amount of rice husks, and there is a high local demand for their utilization. In addition, considering that distributed energy system is needed in the industrial zone as well, rice husk biomass power plant within the industrial zone is an appropriate JCM project that well integrates the local characteristics. Since the rice husks are already generated in the area, there is no need to wait for new factories to move in, and the generated electricity can be supplied for construction of the industrial zone; the project can start in a relatively short term.
However, demand for waste separation and collection scheme in the area cannot be neglected. Since it is difficult to conduct a large-scale waste collection and separation scheme under current conditions, in which the residents still do not share the importance

of the scheme, plastic waste will be collected at certain sites and co-fired in the plant. From the educational aspect and the ease of collection, schools and temples are currently considered for collection sites. When designating schools as collection sites, environmental education that utilizes experiences in Fukushima City can be conducted at the same time. In this way, JCM project that co-fires plastic waste at rice husk biomass power plant has various benefits, that it can be implemented in a relatively short term, and that the project may lead to further project formulation utilizing waste collection and separation scheme.

4.4 GHG Emission Reduction

4.4.1 Analysis of emission reduction of energy-derived CO2 & greenhouse gas

Methods of emission reduction of CO2 from fuel combustion and greenhouse gas of the rice husk biomass power plant project were examined. Based on this, reduction volume of such energy-derived CO2 was calculated. The outline of the examination is described below.

(1) Reference

Generated electricity from rice husk biomass power plant is supplied to the industrial zone. Since the industrial zone is connected to the grid, the reference value will consider electricity supply from the grid. As stated in the solar power plant section, CO2 emission factor for the grid was calculated with methods defined in CDM methodology, using IEA data.
It is important to note that monitoring point must be created in order to properly measure the amount of electricity sold to the grid, not including the amount that was consumed within the power plant. In addition, if heat was to be supplied as well, then the boilers used at the heat consumption site, or the most efficient boiler are considered to be altered. On the other hand, if rice husks are dried in a conventional manner under the sun, then it would not be part of CO2 emission reduction, and must not be considered.

(2) Project emission

1) CO2 emission from transport

CO2 emission from fuel use for transporting rice husks and plastic waste used for power generation is estimated. Most of them will be transported by human power, but for conservativeness, default value of CDM tool (for light vehicles), 245g-CO2/t-km may be applied.

2) Electricity consumption within the power plant

When the electricity is supplied for equipment in the rice husk biomass power plant as backup power, the amount of emission from fuel consumption must be considered. Monitoring is done according to the sales receipt of fuel.

(3) Other sources of emission

1) Methane generated from rice husk disposal

Methane emissions arising from disposal of rice husk under anaerobic condition may be considered as part of the reduction in this project by utilizing these rice husks. However, rice husk disposals in Myanmar are not always under anaerobic condition; therefore for conservativeness, they are not part of emission reduction in this project.

2) Emission from plastic waste disposal

Emissions from plastic waste disposal that would have been generated without this project may be considered as part of the reduction in this project. However, most of plastic waste disposal is not incinerated but landfilled, and the amount of plastic waste co-fired in this project is extremely small; therefore, it is not calculated as part of the emission reduction in this project.

(4) Emission reductions

Assuming the above, emission reduction is calculated as follows.

Table 4-4 Result of Emission Reductions Calculation (Biomass Power Plant Project)

Capacity (Net)	3.0	MW
Annual power generation (Net)	21,600	MWh/year
Grid emission factor	0.215	kg-CO2/kWh
Reference emission	4,644	t-CO2/year
Fuel transport	15,840	t/year
Co-fired plastic waste transport	79	t/year
CO2 emission factor (transport)	0.245	kg-CO2/t-km
Project emission	20	t-CO2/year
Emission reductions (planned)	4,624	t-CO2/year

4.4.2 Project impacts besides emission reductions

Project benefits other than emission reduction, such as economic benefits (direct and indirect) and social benefits (direct and indirect), are as follows.

(1) Economic benefits

- Electricity supply in the construction phase of the industrial zone
  Demand for utilization of rice husks already exists in the surrounding area of the industrial zone; therefore, generated power can be supplied for electricity demand for industrial zone construction. Generated power in this project, considering its added value, can be bought by the transmission and distribution utilities at a higher price; so, there are economic benefits from the construction phase of the industrial zone.
- New business opportunities
  Regional industrialization is becoming an issue in economic development; it is important to develop new industries (rice processing products, agricultural processed products, distribution of fishery products, etc.). Rice husk biomass power plant in this project can supply heat as well as electricity. Heat supply, for example, can be utilized for various purposes, such as for drying rice husks to improve their quality and for other beans and fishery products. In this way, the project is expected to create various new industries.

(2) Social benefits

As already stated, there is waste collection system in Pathein, but its separation is not appropriately conducted. This project will install technology that is capable of co-firing; as the first step for introducing waste separation scheme, one of the project goals is to establish an organizational structure for stationary plastic waste collection. Through plastic waste separation, understanding and practice of waste separation and collection by citizens will be promoted, in order to create a middle-to-long-term waste collection and separation scheme.

4.5 Project and policy proposal

4.5.1 Possible systems for installment

The local government in Pathein has shown strong interest in collecting and sorting non-industrial waste in Pathein/Fukushima workshops. In addition, the largest waste generated in the area is rice husks, with large environmental impact. Therefore, the local government also shows strong interest in treatment and utilization of rice husks.
Considering these topics of government interest, rice husk biomass power plant co-firing plastic waste would be the appropriate first step towards establishment of low carbon society in this area in particular.
Considering the characteristics of rice husks, possible choices of power generation systems are gasification type and direct burning type (Boiler Turbine Generator: BTG, Figure 4-6). For small scale power plants, efficiency is generally low for BTG, and gasification plants are considered favorable. Even though latest Japanese gasification systems offer adequate considerations for environmental impact, there are still some skeptical opinions about gasification plants, as they have short implementation history, and many of the local gasification systems are hand-made with heavy environmental impact due to tar and ashes. Recently, Japanese engineering companies have been manufacturing BTG systems below 3 MW with 20% efficiency; this system will be utilized for the project.
Rice husks are the primary fuel for this power plant; amount of plastic waste that can be collected is very limited. Thus, the system will prioritize efficiency for rice husk power generation.

Figure 4-6 Boiler Turbine Generator (BTG)

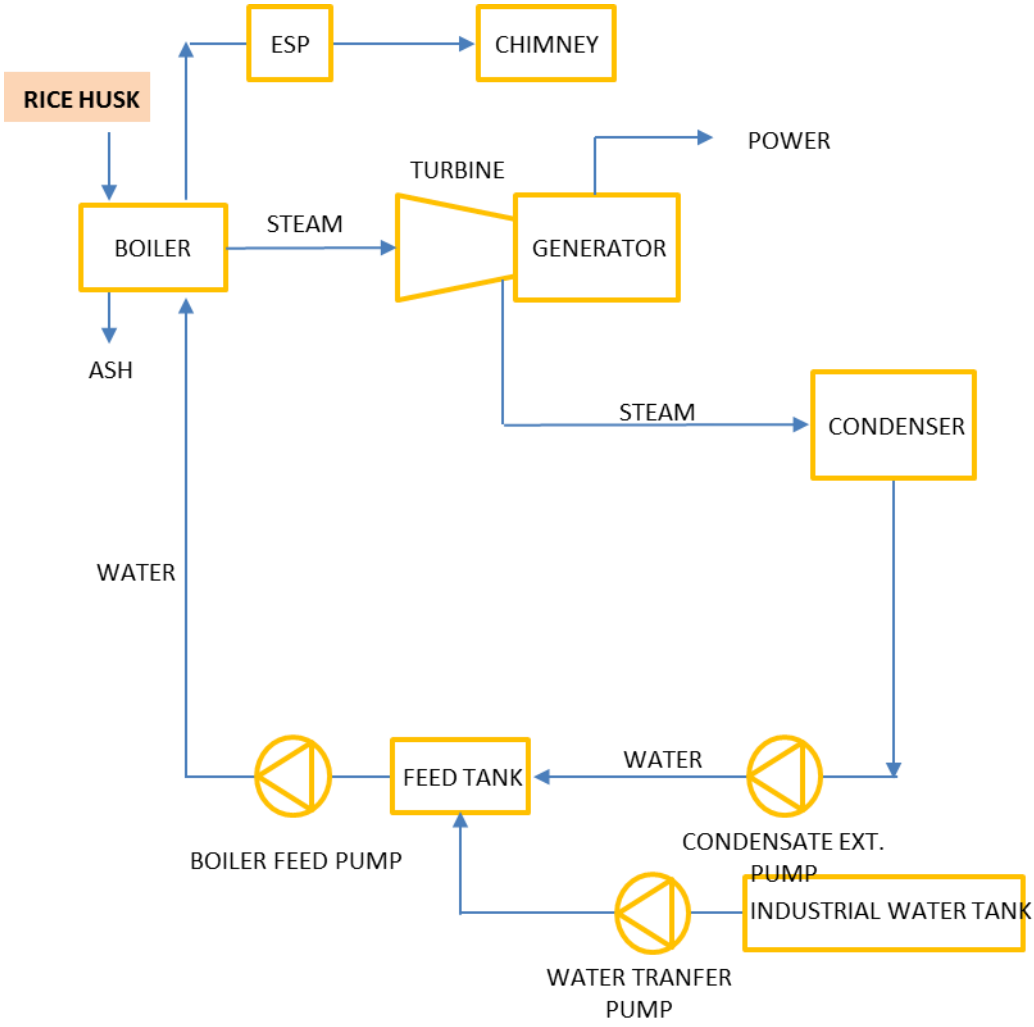


Figure 4-7 Boiler Turbine Generator (BTG) Power Generation Flow

Table 4-5 Power Plant Specifications

Output	3,333	kW
Self-Consumed	333	kW
Sold	3,000	kW
Operation	24	hrs/day
	300	days/year
Generated amount	71,993	kWh/day
	21,597,840	kWh/year
Rice husks	2.2	t/h
	52.8	t/day
Plastic waste (PET bottles)	0.011	t/h
	0.264	t/d
	79.2	t/year

(1) Consideration of project site

The project will be placed in Pathein Industrial City construction area. To select a project site within the area, the following two aspects are considered.

- Many of the rice mills that generate the plant's fuel, rice husks, are placed along the river, as rice have been transported via ships for a long time. Therefore, ships can be used to transport rice husks in this project as well, which makes areas near the river a major candidate for the project.
- There is high electricity demand in Pathein Industrial City. The Ayeyarwady Region is at the very south of Myanmar, in which the primary source of energy is hydropower mainly placed in the northern part of the country, placing the region at the end of the national grid. In addition, the Ayeyarwady Region is a delta region with many paddies, which adds to low electrification rate of the area. Thus, power supply from the national grid is expected to be insufficient for electricity demand in Pathein Industrial City. Therefore, Ayeyarwady Development is planning to construct its own power plant in the industrial city. Its fuel is likely to be transported by ships, so the power plant is placed near the river port.

Considering the two aspects above, areas around the power plant that is being planned can be considered as the appropriate project site.

(2) Consideration of installed technology

Installed technology was considered from two aspects: (1) practical amount of rice husk collection (which enables sustainable operation of the power plant) and (2) electricity demand within Pathein Industrial City.

1) Possible amount of rice husk to be collected

From the viewpoint of a power plant business, the larger the plant the better economic feasibility. However, in cases of renewable energy power plants such as rice husk biomass power plant, stable procurement of fuels and maintaining stable prices are one of the keys for project success. Many of the projects that failed in Southeast Asia are due to difficulty in procurement of rice husks.
In utilizing JCM scheme, stable operation of the power plant during its legal duration period is necessary. To achieve this, rice husks should be collected from a limited, reachable areas. First, the amount of rice husks in the area was investigated.
Total amount of rice husks generated in Pathein district, estimated from the amount of rice produced, is 112,400t/year. Not all of this amount can be utilized. 90% of the rice husks generated during rice polish process in Pathein district are utilized as fuels for boiler and diesel generator. When utilizing them as boiler fuels, they are either used for acquiring heat or steam. Heat is for drying rice. Steam is used either for producing parboil rice, or for dynamo power generation by changing piston movement into rotating movement with steam engine. There is little change expected in rice husk demand for drying and producing

parboil rice, but demand for dynamo power, as its electricity efficiency is low, is expected to decline in the future.
In this way, rice husks may continue to be utilized as boiler fuels in rice mills. However, if 25% of small, self-manufactured gasification plants are expected to be changed into national grid use (due to environmental regulations and low efficiency), there will be rice husk surplus, which amounts to 28,000t/year of rice husks available for use. This assumption is agreed to be realistic by the local stakeholders as well. The amount above enables 3.1MW of power generation.
As for electricity demand in Pathein Industrial City, its primary source of power will be supplied from the national grid and the power plant planned by the developer of Pathein Industrial City. During the operation phase of the factories, power will be supplied from these primary sources, but not all of the electricity demand will be supplied in the early stages of development, from the viewpoint of investment efficiency and national grid construction priorities. Insufficient power supply during construction phase is even more likely.
In general, factories have steel-frames, which require large amount of electricity for construction. Even in countries like Japan that have stable power supply, private power generators are often utilized during construction phase. The need for such source of power would be stronger in Myanmar. For construction companies, acquiring stable source of power and fuels for generators is critical. Therefore, electricity demand for Pathein Industrial City construction, considering its schedule, was estimated. Considering various conditions, if 3MW of electricity can be supplied, more than 50% of peak demand can be met. It is necessary to acquire places for supplying electricity when there is electricity surplus after supplying for construction demand; discussion for transmitting electricity to the local government and neighboring villages has therefore begun.

2) Amount of PET bottles for co-firing

Since the primary fuel of the power plant is rice husks, increase in construction cost and maintenance/operation cost due to co-firing fuels with different compositions and physical characteristics should be kept minimal.
Although there is local scheme for recycling 1L PET bottles (for reuse after cleaning), amount that can actually be collected in Pathein, with no official sorting rules or recycling schemes, can be estimated according to population and number of households.
Population in Pathein is approximately 360,000, with 76,000 households; approximately 4.7 people per household. When each household collects and brings one PET bottle per week, 10,200 PET bottles can be collected per day. There are 1,481 elementary schools in Pathein district, with 493,650 students. If each student participates in the collection scheme by bringing one PET bottle a month, approximately 16,000 PET bottles can be collected per day in the district.
According to these estimates, it was decided that 10,600 PET bottles (500mL) per day would be crushed and co-fired in the power plant. Co-firing rate (weight base) would be 0.5%, which would not affect change in plans for equipment such as boiler. However, it

should be noted that crushed PET bottles would be around 7~10mm, while rice husks are around 4mm in size; therefore, co-firing method would need to be further considered.

4.5.2 Project implementation arrangements

(1) Project organization and operation

This project is part of the infrastructure plan for Pathein Industrial City; therefore, its project owner should be the developer. However, considering the history of private industries in Myanmar, forming SPC with a knowledgeable company in conducting the project would be appropriate. Hence, taking into account that JCM scheme would be utilized, formulation of SPC with Japanese and Myanmar investment is under consideration (Figure 4-8).

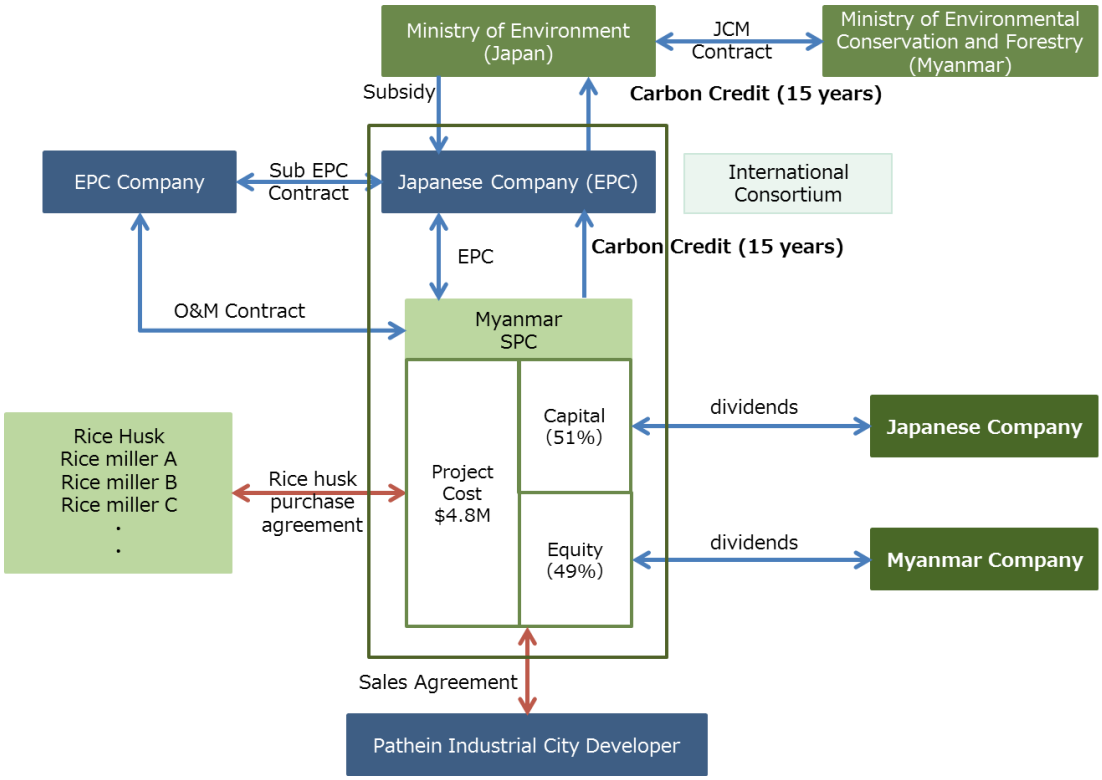


Figure 4-8 Project Organizational Structure

(2) Finance plan

Project investment according to share of SPC is under consideration.

(3) Operation and maintenance arrangement

The installed technology requires specific knowledge and experiences. Consigning the whole operation and maintenance process to an EPC company is planned.

4.5.3 Project development and measures for JCM project formulation

(1) Social and environmental considerations

The possibility of environmental impact caused by rice husk power generation (ex. air pollution, water contamination) and its countermeasures, requirements and procedures of EIA, social impact of the project location and its countermeasures, with reference to relevant local laws and regulations are considered.

<u>Environment-related legal framework of Myanmar</u>

It is normally the case to obey the environmental and social regulations of the project location. However, in Myanmar, individual negotiations with relevant organizations, including the Investment Committee, are necessary because of the country's underdeveloped legislation. Therefore, at this moment, it would be appropriate to consider in accordance with international standards (such as JICA socio-environment consideration guideline, IFC Performance Standards, ADB Safeguard Policy Statements 2009).

Myanmar's basic environmental law is "Environmental Conservation Law 2012" (Law 2012). The Ministry of Environmental Conservation and Forestry (MOEFCAF), as the competent authority of environmental management and environmental harmonization, has created the following draft of laws as listed below, under the Environmental Conservation Law 2012.

(1) Stipulation of environmental standards (exhaust gas, water discharge)
(2) Restriction of exhaust gas, drainage and water discharge methods
(3) Legislation of EIA for proposed projects
(4) Evaluation of compliance and compensation for damages by environment polluters

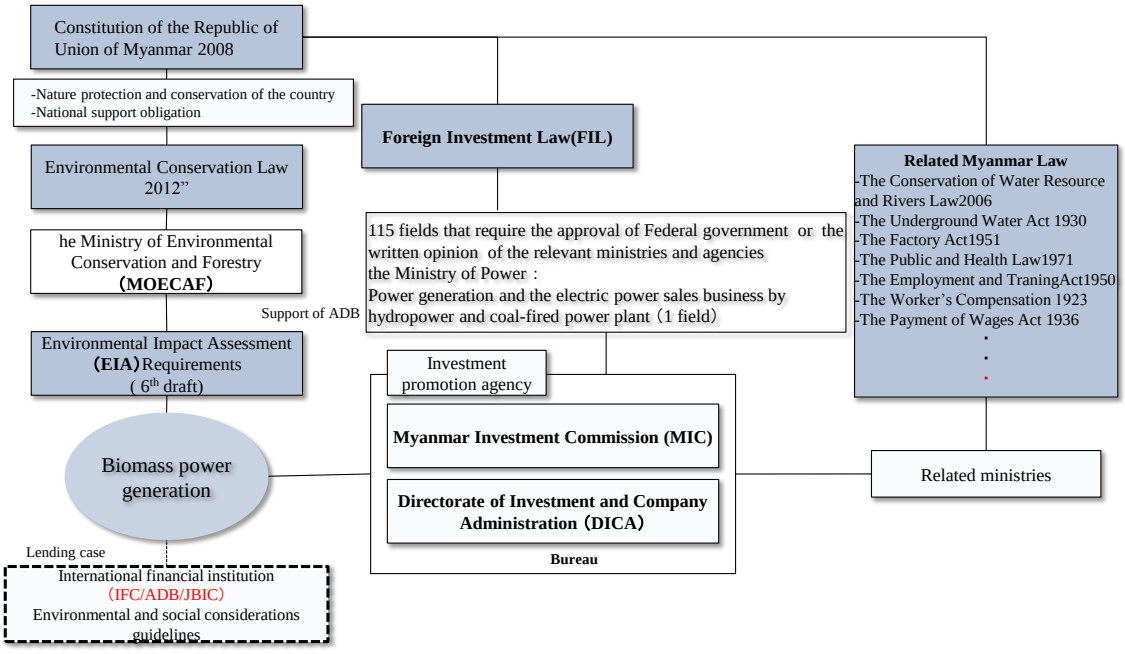


Figure 4-9 Environmental and Social Legislations and Regulations

Environmental standards to be applied

In terms of individual environmental standards, such as ambient air quality, industrial effluent, water contamination and noise, compliance with the guideline of exhaust gas emission from small scale combustion facilities, in the general and thermal power IFC EHS Guideline (International Finance Corporation Environmental Health and Safety).
Small scale combustion process points to the system designed to supply electricity, machinery power, steam, heat and/or the combination of these equivalent to 3-50MW in thermal output derived from the total of rated value heat capacity, irrespective of types of fuel.

Environmental protection of power plant

<Exhaust emission>

- IFC EHS Guidelines (general)
- Assuming compliance with "Exhaust gas guidelines of small-scale combustion facility （Heat output3-50MW, Solid fuel ）"
  - Particulate matter: Cyclone dust collector
  - NOx and Sox: Since nitrogen and sulfur component of rice husk is small, special processing is unnecessary
  - Dioxin: Although rice husk hardly contain chlorine, it is assumed that it is shifted to rice hulls by absorbing dioxin of soil (no guideline value)

<Ash>

- Fry ash: Considering the introduction of bag filter or electrostatic precipitator (include assume dioxin measures also)

Main ash: Study multiple reuse (Cement, fertilizer, Building material, other)

Consideration of plastic waste collection model

Collection of plastic waste, as well as rice husk power generation, is part of this proposed JCM model. Therefore, as procedures for constructing a rice husk biomass power plant are conducted, collection method of plastic waste must be considered, in order to propose an appropriate collection model.
Currently, schools and temples are expected to be an effective collection site. When considering schools as collection sites, environmental education, such as lectures on waste separation/collection and recycling, would be effective; experiences of Fukushima City would be insightful. Environmental education needs to be well planned, with respect to the local aspects.
Furthermore, in order to successfully collect plastic waste at sites, schools designated as collection sites need incentives and motivation for participation in the scheme as well. Considering an incentive that would best contribute to the improvement of school education and environmental consciousness, incentives such as provision of educational resources, is necessary.
In order to estimate the collectable amount of plastic waste, several sites could be chosen as model sites for demonstration. In addition, collection model of resources other than plastic waste, can be considered as well.

(2) Development of project and its measures

Through discussions in workshops and local surveys under inter-city cooperation, the stakeholders agreed upon the following concept.
All waste generated in Pathein is currently landfilled, but the landfill site is already occupied; a new measure for waste treatment must be considered. Japanese waste collection system, utilization of waste material as energy, and recycling of waste are approaches with high interest; these approaches will be considered under cooperation with Japan. In addition, Myanmar is now facing a period in which environmental measures must be strengthened; methods of appropriate waste treatment will be discussed, in order to realize a city with low environmental impact. For example, disposal of rice husks from rice mills is a serious issue, and power plant project utilizing biomass such as rice husks will be planned in detail at an early stage.

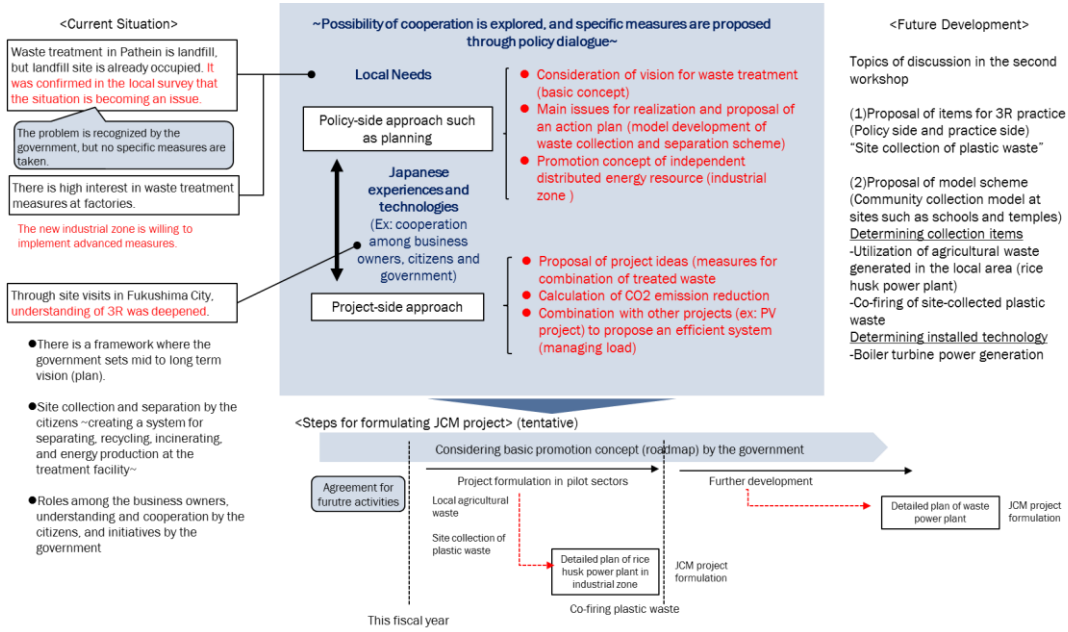


Figure 4-10 Project Development in the Waste Treatment Sector

<Project development in the waste treatment sector>

- Project formulation approach
  Rice husk biomass power plant in Pathein Industrial City and its feasibility will be analyzed in detail.
  Rice husk biomass power plant in Pathein Industrial City will be considered in detail from the aspects of boiler generation facility at rice mills, the feasibility of project scheme from rice husk procurement and utilization of ashes, CO2 emission reductions, operation and maintenance plan, and MRV plan. In addition, there will be discussions with the regional government officials and those working in the rice mill sector, in order to specify the organizational structure of JCM (e.g. Details of SPC)
- Policy-side approach
  Overview of municipal waste generated in Pathein and industrial waste such as rice husks will be surveyed. Based on the Japanese experiences of waste treatment,

predicted issues and their countermeasures (basic concept) will be planned in detail through policy dialogue.
Clarifying the basic concept of the whole waste treatment process may take a long time; therefore, certain items and areas may be focused as a start, and the model can be developed. For example, plastic waste can be collected at schools as a pilot model, in order to consider the feasibility and challenges of the model.
In addition, sustainable and stable supply of rice husks in the area is essential element for the rice husk biomass power plant project under consideration. It is important to lead the rice mills to properly dispose their rice husks through policy-side approach; discussions for regulations need to take place (e.g. Reinforcing the regulations for gasification of rice husks, which has a large environmental impact).

5 Future Development

- **Future plans for determining the details of JCM projects**
  ~Two projects and measures for their early implementation~
  As a result of this research, the following projects were identified as possible JCM projects in Pathein Industrial City: “power plant using biomass such as rice husks (estimated output of 3 MW)” and “mega solar project installed at a water treatment facilities (estimated output of 1 MW). In 2016, details of the plan will be discussed to achieve early implementation of the projects using equipment subsidies from JCM through communication between the local stakeholders.

- **Strategies toward the simultaneous achievement living standard improvement under economic development with low-carbonization**
  ~Realization of low-carbon model in a regional core city~
  According to the Paris agreement from COP21 in December 2015, the goal of “keeping a global temperature rise this century well below 2 degrees Celsius” was proposed, raising the need for mid-to-long term countermeasures for global warming. In specific, low carbonization of urban areas in developing countries under economic development is one of the most important challenges. As an approach for the urban area under rapid economic development, realization of ”leapfrog development,” in which living standard is improved under economic development and a low carbon, recycling, and naturally-symbiotic society are both achieved, is gathering attention.

  (Reference) Leapfrog development
  “Leapfrog development” is a simultaneous achievement of a low-carbon, resource recycling, and naturally-symbiotic society while also improving lifestyle levels through economic development, without following the development trajectory of developed countries in wasting energy and resources. In order to avoid the serious adverse effects of climate change, it is necessary to achieve this type of development in developing countries in Asia, where emissions are rising.

The project site, Pathein in the Ayeyarwady Region is experiencing of economic development as the regional core city in Myanmar. In the industrial sector, industrial zones are being constructed, local industries are being developed, and industrial infrastructure (road, electricity, service and wastewater/waste treatment facility, etc.) is being prepared. In addition, in the residential and commercial sector, urbanization speed far greater than that experienced in Japan is predicted, including increased electrification rate, renewal of buildings, and diffusion of electronic products.
Therefore, Pathein will face a challenge of balancing between improving living standards along with economic development, and achieving a low carbon, recycling and naturally-symbiotic society.
In order to discover the solution to this challenge, a mid-to-long term vision of the city must be drawn, in order to clarify the future potential challenges and their countermeasures at an early stage (“countermeasures in advance”)

Japanese municipalities, based on past economic development, have experience-based knowledge of challenges that cities face, and know-how of various solutions.
In Fukushima City, for instance, Fukushima City Comprehensive Plan is established on top of the various plans in the city. The plan shows principles in urban development based on the characteristics and issues of the city; it is composed of basic concept, basic plan, and action plan. The basic concept shows an ideal vision of the city and the direction of the policies, and defines the structure of specific measures in the basic plan.
In the action plan, the schedule, content, and funding for various projects are defined in detail. Under the comprehensive plan, individual plans in each policy sector are created in order to shape the concept in comprehensive plan. The individual plans are associated with each other; in Fukushima City, development is promoted with each individual policy sharing the big picture (vision).

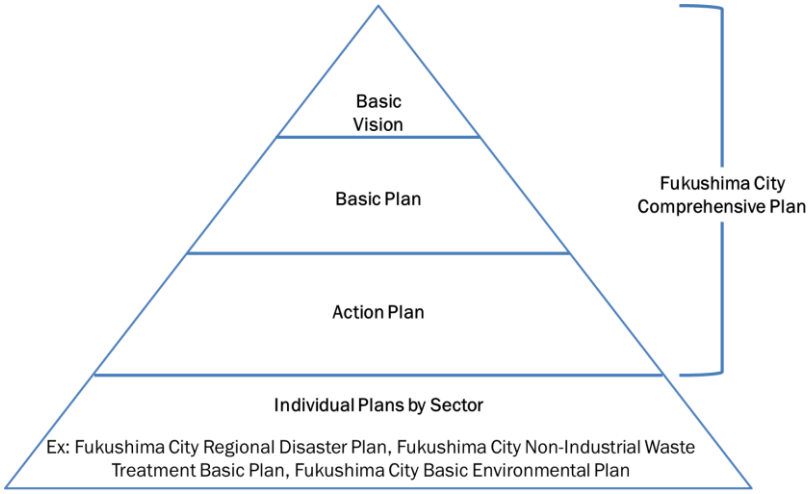


Figure 5-1 Component of Fukushima City Comprehensive Plan

Source: Fukushima City Comprehensive Plan, edited by MRI

It would be effective to draw a grand design of development in Pathein Industrial City and its surrounding area. Leapfrog development utilizing advanced low-carbon technologies would be achieved through specific plans for realization of the grand design vision. In particular, low-carbon development model established in Pathein can be diffused to other Asian regional cities. In Asia, economic development is often focused in the urban area, and population outflow from the rural area to the urban area is escalating waste treatment issues and transportation congestion issues. From this aspect, realizing a leapfrog development and establishing a diffusion model in a regional core city is an extremely important and urgent issue.

Thus, the 2015-2016 research focused on deepening the understanding of such masterplan and their effect among the developers of Pathein Industrial City and Pathein City government officials. Japanese experiences, such as activities in Fukushima City, were utilized in order to promote such understanding. As a result, the importance of creating a

masterplan was shared among the stakeholders, and cooperation for further activities was requested.
Therefore, the following steps will be taken in order to achieve a low-carbon city.

(FY 2016)
As a vision planning phase, based on the understanding of a masterplan, the vision of Pathein Industrial City and measures for its realization will be considered.
(FY 2017)
As a detailed planning phase, possibilities for inter-city cooperation utilizing various tools including those from JICA will be considered.

- **Expansion of approach: "Low carbonization of city and region as a whole" (Horizontal expansion onto surrounding areas and other sectors)**

As a result of this research, the following projects were identified as possible JCM project candidates in Pathein Industrial City: "power plant using biomass such as rice husks (estimated output of 3 MW)" and "mega solar at a water treatment facility (estimated output of 1 MW).
Pathein Industrial City has a comprehensive regional development plan that will develop residential and commercial facilities with the industrial zone at the center. Details of these possible projects will be planned in the early stage of industrial zone construction. It is important to note that various low carbonization projects (JCM projects) for urban planning and their needs can be investigated, such as installment of energy efficient products (e.g. high efficiency air conditioning systems and thermal insulation of buildings), low-carbonized water treatment facilities, electricity infrastructure (e.g. high efficiency transformers), transportation, and treatment of municipal waste (waste incineration and waste power generation).
Such formulation of JCM projects for achieving the low carbonization of city as a whole, may include cases where a large number of small-scale equipment is introduced (e.g. installment of energy efficiency products and transformers), which have various challenges for JCM formulation (monitoring of emission reduction, managing installed equipment etc.); creating a JCM development scheme for such projects is necessary.

Appendix I

Appendix 1: Overview of Partnership for Low Carbon Initiative in Ayeyarwady

<Presentation explaining the objectives, the backgrounds of the project>

The objectives, the backgrounds and the update of the JCM F/S under the City to City Collaboration in Pathein City, Ayeyarwady Division, Republic of Myanmar

Partnership for Low Carbon Initiative in Ayeyarwady under Collaboration of Fukushima City and Pathein City

Ayeyarwady Division

Location

Southernmost region of Central Myanmar
Delta region of Ayeyarwady river

Land profile

Plains and low-land
River and creeks

ADMINISTRATION

Number of	Units
Districts	6
Townships	26
Towns	13
Wards	273
Village Tracts	1919
Villages	11908

1

Pathein City is the capital city of Ayeyarwady Division. Population is about 300,000 people.

PATHEIN

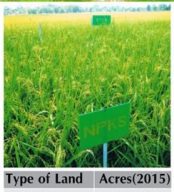
- Capital of Ayeyarwaddy Region
- 300,000 people
- Established city
  - Own airport
  - Railway connectivity
  - Road network
  - Port and river way access
- To be developed into future urban city

2

Ayeyarwady region is known as the largest agricultural area in Myanmar

AGRICULTURE LAND USE

Crop	Acres(2015)
Monsoon Paddy	3.6 million
Summer Paddy	1.2 million
Beans/Pulses	1.1 million
Sugar cane	195
Yellow maize	24598
Rubber	33570
Pepper	6945
Oil Crop	
Groundnut	113395
Sunflower	43307
Mustard	110
Jetropha	134559



Type of Land	Acres(2015)
Cultivable Land	4.9 million
Waste Land	54976

Produces 35% of Myanmar's Rice Production

3

Ayeyarwady facilitates industrial development.
Three industrial zones has been developed.

4

Outline of Pathein Industrial City

- Ayeyarwady region is planning to develop a new industrial zone in order to facilitate industrial development primarily in Pathein district.
- The new industrial zone plan shows development of apartments, large-scale commercial properties, and hotels and leisure facilities, coupled with relevant infrastructures.

5

Study for building a sustainable low carbon city around the industrial zone in Pathein city, Ayeyarwady Division, Myanmar

Goal of the study

- **Finding candidate projects for Low Carbon Initiative in new industrial zone in Pathein city**
  - Low-carbon waste disposal projects (e.g. biogas production from organic waste)
  - Distributed power generation/Renewable energy system projects (e.g. solar power)

- **Formation of a low-carbon city under inter-city cooperation, as well as public-private partnerships, and formulation of JCM projects, will be promoted.**

6

Background and Current Activities

The dawn of economic development, lack of knowledge and skills in various fields is evident in Myanmar.

Japanese technology and knowledge in the aspects of industrial infrastructure, energy, and environment are necessary in the development of industrial zone in Pathein district.

Chief Minster Ayeyarwady Region visited Japan
April 2015

Chief Minister had chance to know challenges for "Cutting-edge Environmental City" in Fukushima City.

Letter of Intent (June 2015)

From Chief Minster Ayeyarwady Region
To Mayor of Fukushima City

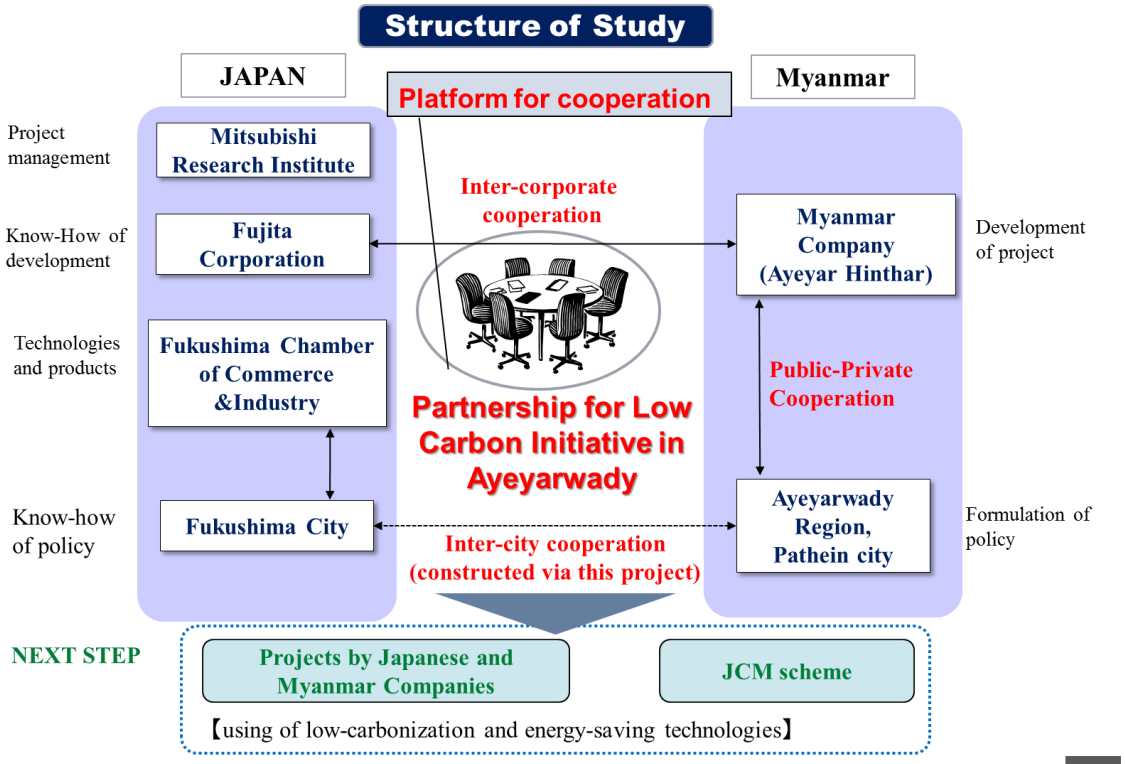
to establish an inter-city cooperation with the city of Fukushima for building a sustainable low carbon city.

Starting "Partnership for Low Carbon Initiative in Ayeyarwady"

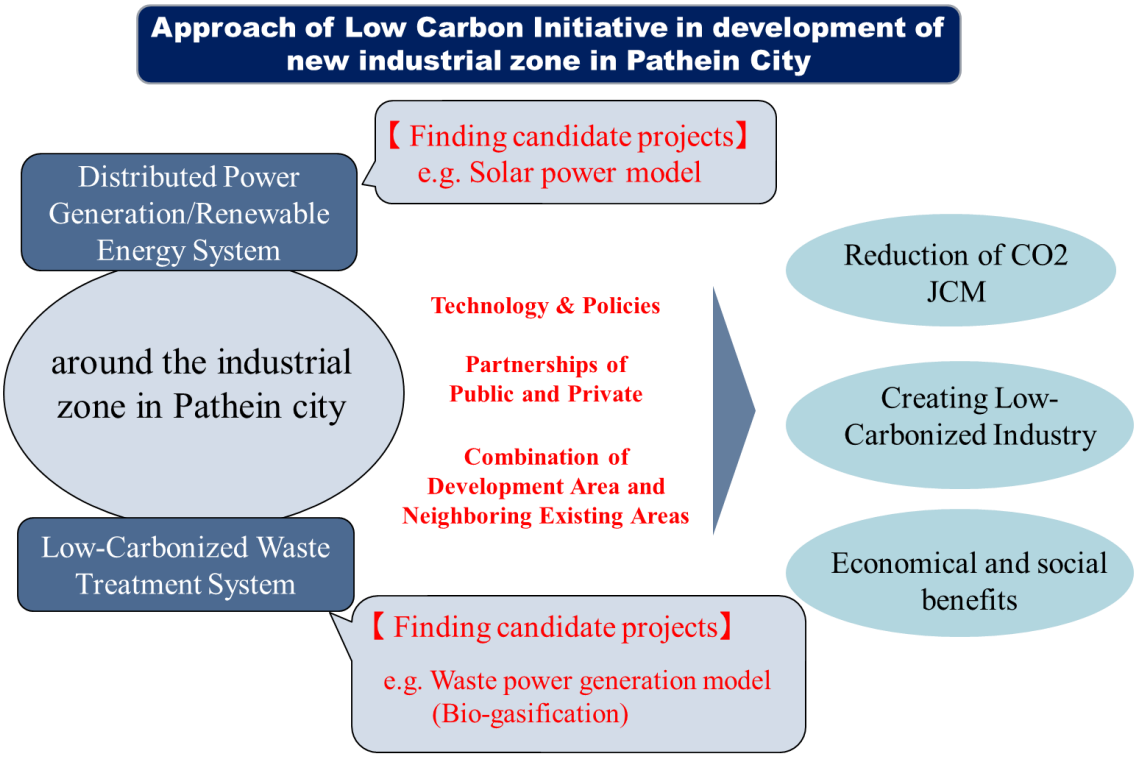
- Dialogue in workshop (Pathein, and Fukushima)
- Site visiting (Pathein, and Fukushima)

Workshop in Pathein city, Ayeyarwady Division (29th, September, 2015)

7


Structure of Study
JAPAN
Platform for cooperation
Myanmar
Project management
Mitsubishi Research Institute
Know-How of development
Fujita Corporation
Technologies and products
Fukushima Chamber of Commerce &Industry
Know-how of policy
Fukushima City
Inter-corporate cooperation
Partnership for Low Carbon Initiative in Ayeyarwady
Inter-city cooperation (constructed via this project)
Myanmar Company (Ayeyar Hinthar)
Development of project
Public-Private Cooperation
Ayeyarwady Region, Pathein city
Formulation of policy
NEXT STEP
Projects by Japanese and Myanmar Companies
JCM scheme
【using of low-carbonization and energy-saving technologies】

8


Approach of Low Carbon Initiative in development of new industrial zone in Pathein City
【Finding candidate projects】
e.g. Solar power model
Distributed Power Generation/Renewable Energy System
around the industrial zone in Pathein city
Low-Carbonized Waste Treatment System
Technology & Policies
Partnerships of Public and Private
Combination of Development Area and Neighboring Existing Areas
Reduction of CO2 JCM
Creating Low-Carbonized Industry
Economical and social benefits
【Finding candidate projects】
e.g. Waste power generation model (Bio-gasification)

9

Expected Outcomes of Our Collaboration for Low Carbon Initiative

- Collaborate with Fukushima City etc. under JCM Project for reducing carbon dioxide emission, Idea of Low Carbon Initiative, for New coming Industrial City Project in Pathein.

→ **Finding best methods of reducing carbon dioxide in industrial area**

Trial in Industrial City Project in Pathein

- Although some of huge industries and factories are being able to reduce carbon dioxide, Myanmar cannot be able to perform this process for the whole country yet due to lack of technology as well as limited budget.

→ **Solving key obstacles**

lack of technology as well as limited budget

10

Challenges of Low Carbon Initiative

(Tentative analysis)

Approaches

- Accelerating energy access (for industry and local communities)
- GHG reduction in local development

catalytic

Expectation of city-to-city cooperation, and JCM

- Knowledge (i.e. policy) and Technology transfer
- Financial support
- Platform for cooperation in project base

catalytic

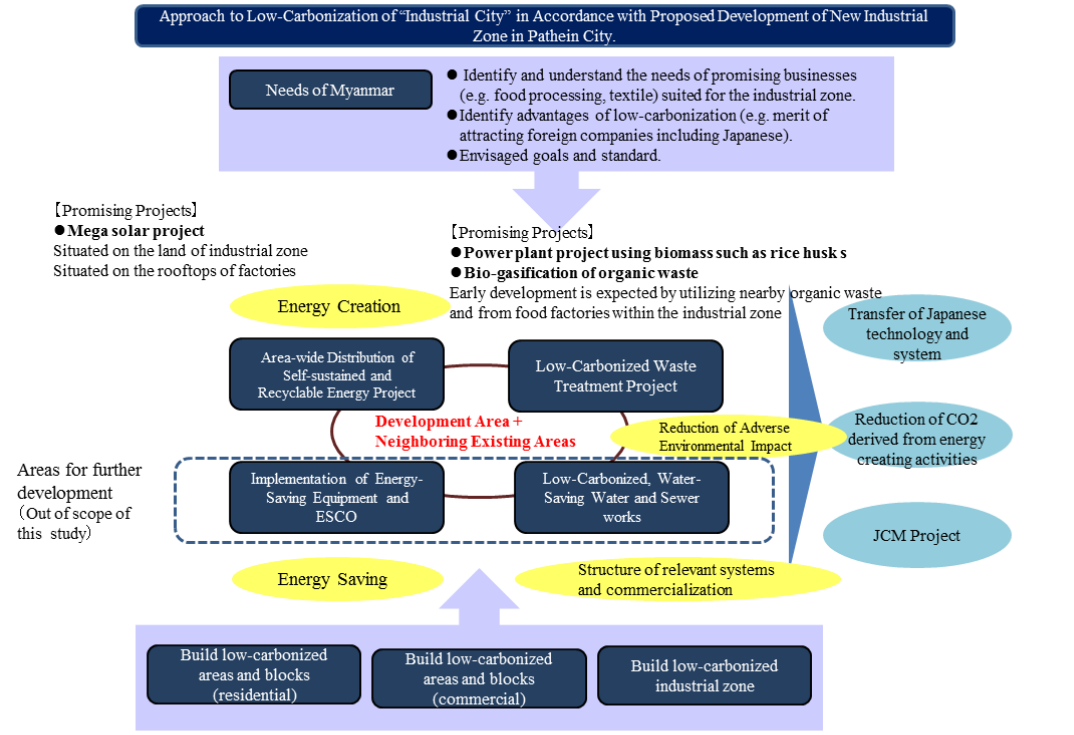
Key issues

- Vision (especially long term)
- Experience for best available solution adapted to the current local situation (both of technology and policy)
- Financial resources
- Collaboration of public, private, and community

11

Study for building a sustainable low carbon city around the industrial zone in Pathein city, Ayeyarwady Division, Myanmar

Mitsubishi Research Institute, Fujita Corporation
Fukushima City, Fukushima Chamber of Commerce & Industry



Effective use of know-how in low-carbonized areas, residential and commercial areas/blocks, and industrial zone in Fukushima City

【Examples of Know-How】
- Provide master plan, system, and relevant standards.
- Combine relevant technologies and structure for inter-factory/area cooperation
- Coordinate business types to attract
- Developing relevant infrastructure projects in industrial zone (PPP Scheme)

Appendix 2: Letter of Intent

<From the Chief Minister of the Ayeyarwady Region to the Mayor of Fukushima City>

The Public of the Union of Myanmar
Regional Government
Ayeyarwady Region

No. 100/ 3 - 1/ Government(Ayeyarwady)
Date. June 27th , 2015

Letter Of Intent

To

Mr.Kaoru Kobayashi
Mayor of Fukushima City
Fukushima Prefecture, Japan

Dear Mr Kobayashi,

Ayeyarwady region, which is known as the largest agricultural area in Myanmar, is planning to develop a new industrial zone in order to facilitate industrial development primarily in Pathein district. With the industrial zone at the center , the plan envisages development of apartments, large-scale commercial properties, and hotels and leisure facilities, coupled with relevant infrastrustures such as wastewater treatment plant.

At the dawn of economic development, lack of knowledge and skills in various fields is evident in Myanmar. We wish to cooperate in these regards with our friendly nation, Japan.

In order for the government of Ayeyarwady region to promote the development of industrial zone in Pathein district, technology and knowledge of the city of Fukushima and the cooperation in the aspects of industrial infrastructure, energy, and environment are necessary. Hence, we wish to establish an inter-city cooperation with the city of Fukushima for building a sustainable low carbon city.

Sincerely,

(Thein Aung)
Chief Minister
Ayeyarwady Region Government

<From the Mayor of Fukushima City to the Chief Minister of the Ayeyarwady Region>

February, 2016

Letter of Intent

His Excellency Thein Aung

Chief Minister of Ayeyarwady Region

Republic of the Union of Myanmar

Dear Excellency:

Fukushima City is the capital of Fukushima Prefecture, a region blessed with abundant nature and warm people. It is a beautiful city with hot springs, where nature, culture, politics, and economics exist in harmony.

Our city has a vision of the environment: “Creating together and handing down to the future a people-and-environment friendly city.” In order to form a recycling-based society where people and nature co-exist in a healthy manner, and where sustainable development with low environmental impact is possible, we promote activities, such as waste reduction and recycling in the city. In addition, since the Great East Japan Earthquake we have been establishing what we call a “Cutting-Edge Environmental City.” We are working towards the formation of a society that does not rely on nuclear power, by promoting renewable energy such as solar and small scale hydropower.

We received the letter of intent from the Chief Minister of Ayeyarwady Region Government, asking for cooperation in building a sustainable low-carbon city around the new industrial zone in Pathein district. Fukushima City is pleased to offer its rich experiences in environmental city planning to realize a sustainable low-carbon city in Pathein district. We are willing to provide cooperation in various areas, not only in areas such as renewable energy and waste treatment, but also in formulation of a master plan.

We are glad to have the opportunity to work together with the Ayeyarwady Region, to establish Pathein as the “Cutting-Edge Environmental City” in Myanmar.

Sincerely,

(Kaoru Kobayashi)

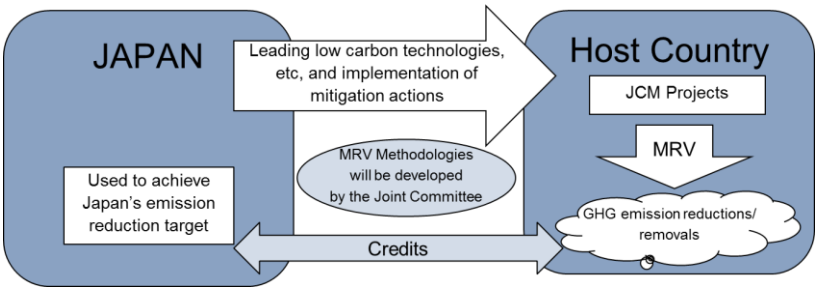
Mayor of Fukushima City

Fukushima Prefecture, Japan

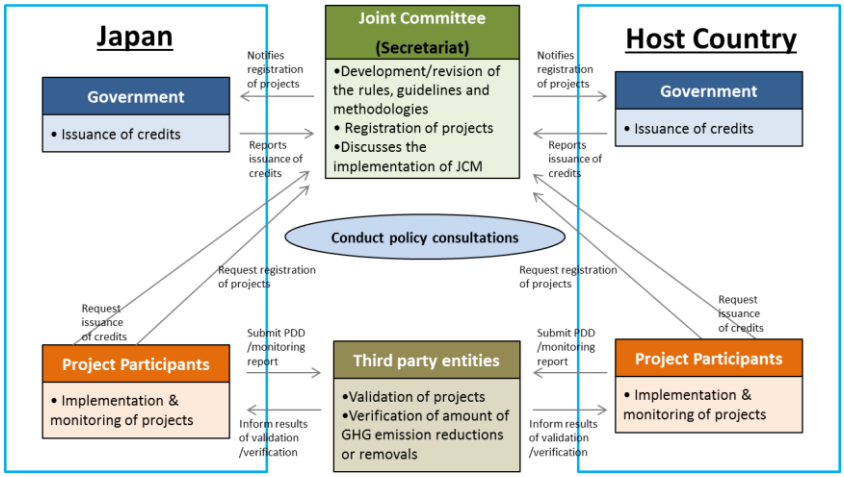
Appendix 3: Concept of the JCM[1]

Basic Concept

- 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, by applying measurement, reporting and verification (MRV) methodologies, 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, complementing the CDM.



Scheme of the JCM



[1] Government of Japan Ministry of the Environment, "Recent Development of Joint Crediting Mechanism (JCM)"

Features of the JCM

(1) The JCM starts its operation as a non-tradable credit type mechanism.

(2) Both Governments continue consultation for the transition to a tradable credit type mechanism and reach a conclusion at the earliest possible timing, taking account of implementation of the JCM.

(3) The JCM aims for concrete contributions to assisting adaptation efforts of developing countries after the JCM is converted to the tradable credit type mechanism.

(4) The JCM covers the period until a possible coming into effect of a new international framework under the UNFCCC.

Appendix 4: Overview of Myanmar and Ayeyarwady Region

Geographical situation (Rivers of Ayeyarwady region)

The Ayeyarwady River is the largest river in Myanmar and has a length of approximate 2,170km. The river originates in northern Myanmar, flows southward through the country and splits into nine river mouths which forms the delta. The westernmost distributary is the Pathein

River whilst the easternmost stream is the Yangon River. In total, the distributary comprises:

- **Pathein River**
- **Ywe River**
- **Pyamala River**
- **Pyinzalu River**
- **Ayeyarwady River**
- **Myitmaka River**
- **Bogale River**
- **Thande River**
- **Yangon River**

The rivers are reported to be heavily silted. The river, networks and water bodies in the Ayeyarwady region can be seen in Figure 5.4 (water ways shown in blue and roads in yellow). Discharge parameters are reported12 as follows:

- **Average: 13,000 m3/s;**
- **Maximum: 32,600 m3/s; and Minimum: 2,300 m3/s.**

Monsoon rains occurring from May to October result in large variations in the volume of water within the Ayeyarwady River and its tributaries.

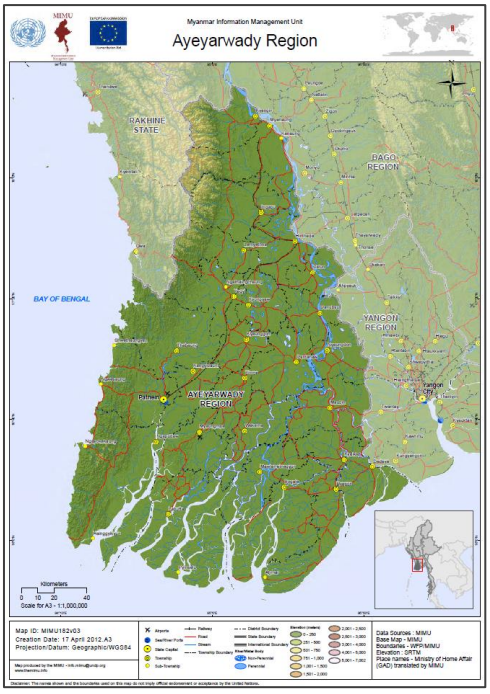


Figure 4-1 Ayeyarwady's water bodies

Source: Myanmar Information Management Unit

Regional administration

Divisions	States
Ayeyarwady	Kachin
Sagaing	Kayah
Tanintharyi	Kayin
Bago	Shan
Magway	Chin
Mandalay	Mon
Yangon	Rakhine

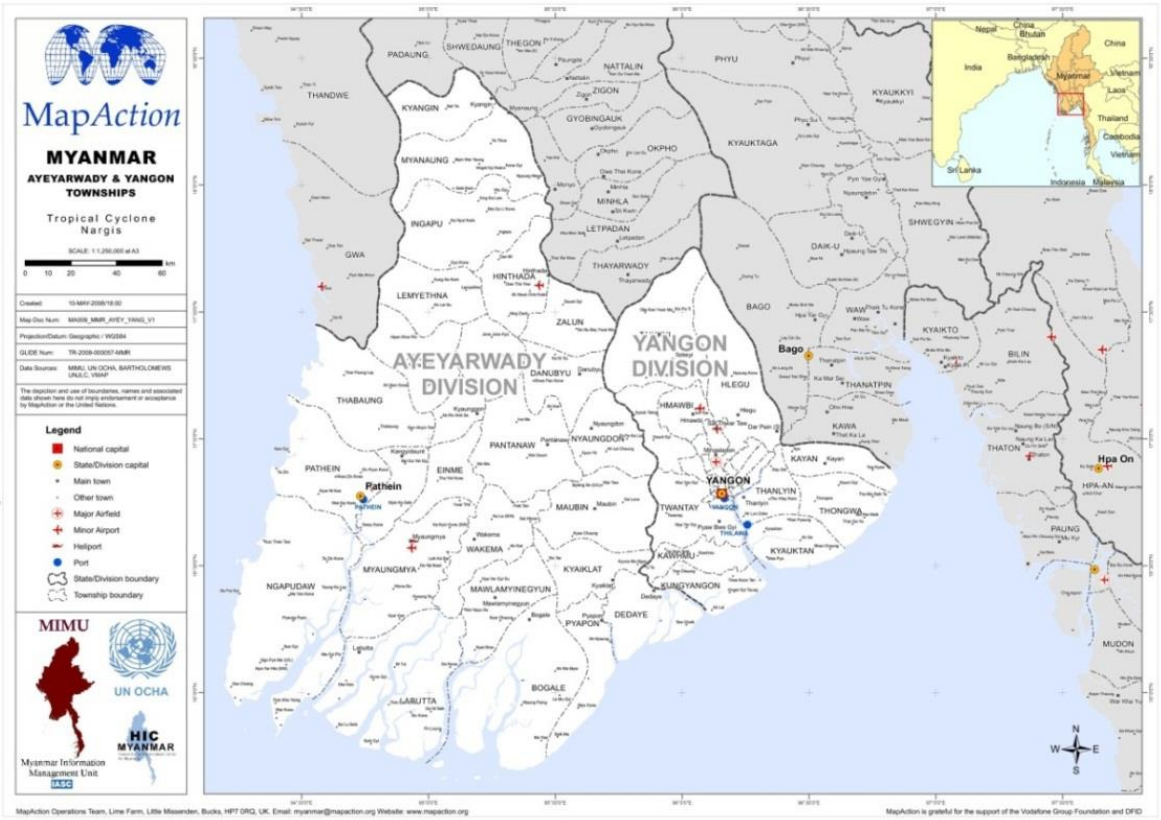


Figure 4-2 Map of Ayeyarwady Division and Yangon Division

Source: Myanmar Information Management Unit

Appendix 5: Renewable Energy Potential in Myanmar

ADB has published its report, "Renewable Energy Developments and Potential in the Greater Mekong Subregion" in 2015. The report covers the overview of the renewable energy sector in Myanmar. Relevant information from the report is summarized below.

Solar Energy Potential

Sixty percent of land in Myanmar is considered suitable for PV project, and the country has Global Horizontal Irradiation (GHI) levels of between 1,600 and 2,000kWh/m2/year. Its average Direct Normal Irradiation (DNI) is around 1,400kWh/m2/year. Based on available land, installable capacity per unit of land area of 0.06kWp/m2 and other factors, Myanmar's maximum solar potential is estimated at 40TWh/year (Table 5-1).

Table 5-1 Technical Solar Energy Potential in Myanmar

Area (km²)	Potential Suitable Area ('000 km²)	% of Total Area	Technical Potential		LCOE ($/kWh)
			MWp	MWh/yr	
Unsuitable area	227.83	33.58	...	...	...
Less than 1,000	0.00	0.00	...	...	...
1,000–1,100	0.01	0.00	0.8	705	0.294
1,100–1,200	0.11	0.02	6.8	6,517	0.268
1,200–1,300	0.65	0.10	39.2	41,044	0.247
1,300–1,400	3.07	0.45	184.0	208,239	0.228
1,400–1,500	8.72	1.29	523.0	635,790	0.213
1,500–1,600	22.33	3.30	1,339.0	1,741,119	0.199
1,600–1,700	73.70	10.89	4,421.8	6,116,427	0.187
1,700–1,800	199.07	29.42	11,944.1	17,523,061	0.176
1,800–1,900	131.71	19.47	7,902.6	12,256,255	0.167
1,900–2,000	10.00	1.48	600.2	981,211	0.158
Over 2,000	...	...	...	...	0.154
Total			**26.962**	**39,510,368**	

The levelized cost of electricity (LCOE) for solar power in Myanmar is around $0.16~0.19/kWh. Electricity tariffs for grid-connected supply are around $0.035~0.075/kWh, and $0.10~0.30/kWh for off-grid supply. Considering these circumstances, solar power in Myanmar is only feasible for off-grid supply. However, there is still a strong demand for PV in Myanmar because much of its rural area is still off-grid. Therefore, currently in Myanmar, utilization of PV is mostly limited to small-scale use, such

as for battery charging stations, solar lighting, solar home systems, and village minigrids with solar components.

Wind Energy Potential

Theoretical wind potential in Myanmar, based on the average wind speed, and its land area was estimated to be around 80TWh/year.

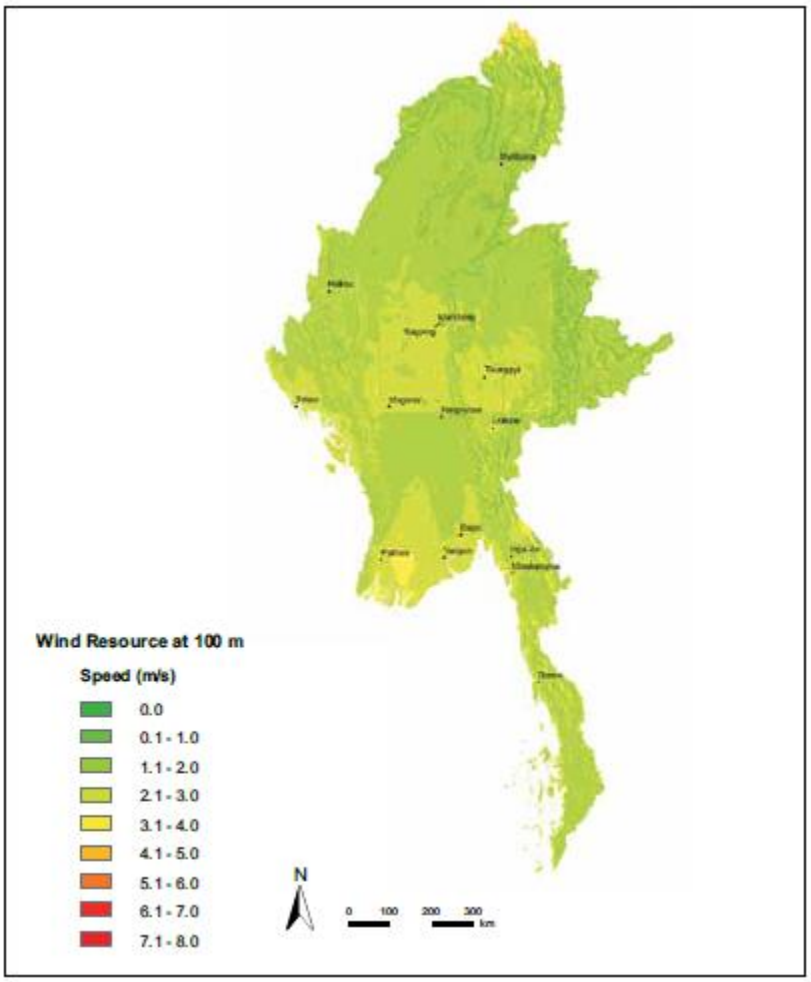


Figure 5-1 Wind Resources in Myanmar

Item	Average Wind Speed					Total
	Low (< 6 m/s)	Medium (6–7 m/s)	Relatively High (7–8 m/s)	High (8–9 m/s)	Very High (> 9 m/s)	
Area (km^2)	673,194	3,382	0	0	0	
Area (%)	99.95	0.05				
Theoretical potential (MW)		33,829				33,829
Indicative theoretical potential (TWh/yr)		79.5				79.5

km^2 = square kilometer, m/s = meter per second, MW = megawatt, TWh = terawatt-hour, yr = year.
Source: Lahmeyer International.

Figure 5-2 Theoretical Wind Potential in Myanmar

There are several challenges facing wind power generation in Myanmar. First, its wind speed is slow and irregular. In addition, Myanmar's national grid may not have the capability to support connection of wind power plants, which are relatively large in capacity, LCOE of wind power in Myanmar is estimated to be around $0.093~$0.114/kWh. As mentioned above, electricity tariffs for grid-connected supply are around $0.035~0.075/kWh, and $0.10~0.30/kWh for off-grid supply, indicating that wind power is only economically viable off-grid.

Biomass and Biofuel Energy Potential

Agriculture in Myanmar is concentrated in the lower and middle basins of the Ayeyarwady River, and the lower Chindwin River, Sittaung River, and Bago River basins. The Coastal Region is suitable for perennial crops (ex. Coconut, palm, oil, rubber, and so on). There has been increased amount of agricultural output in Myanmar in recent years; it has increased by 50% compared to 2000.

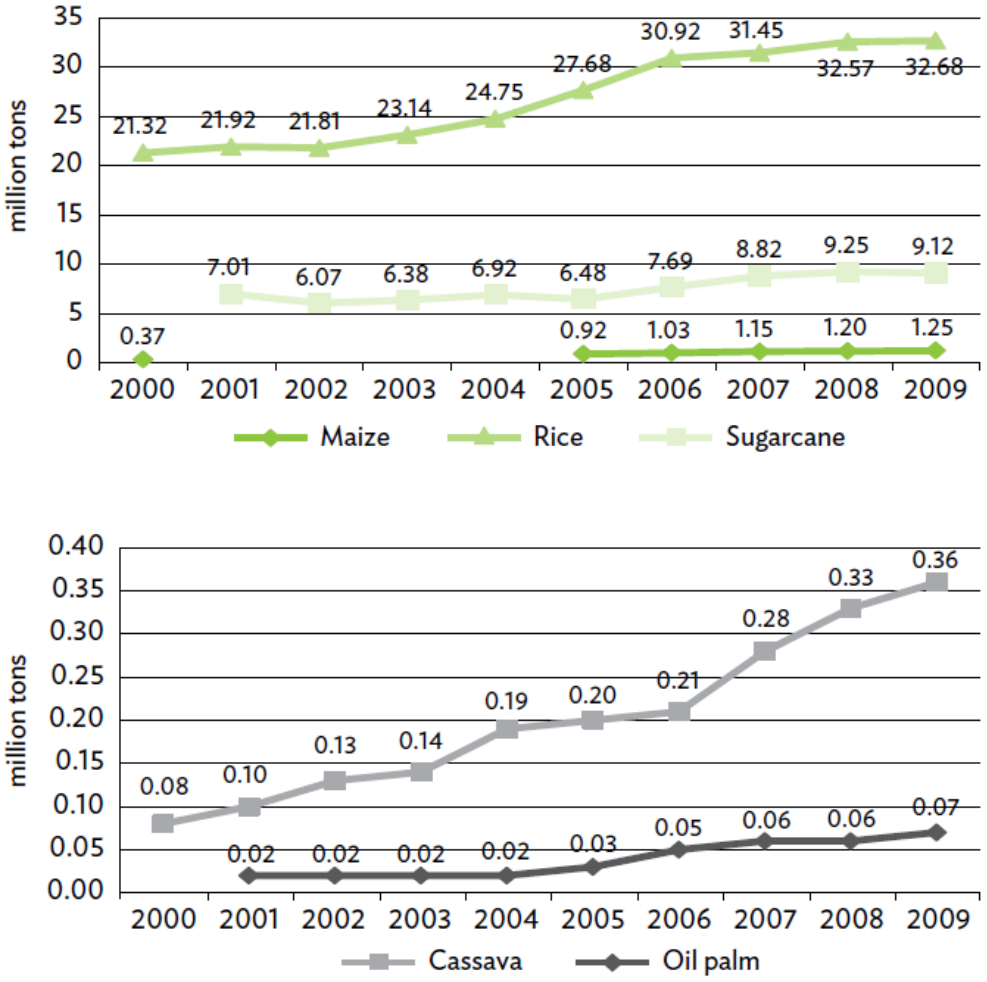


Figure 5-3 Crop Production Trends, 200-2009, Myanmar

The estimated theoretical potential of these agricultural residues is nearly 60,000GWh, and 80% of this potential is derived from rice residues.

However, there are challenges to utilization of biomass resources. Since demand for food products and animal feeds are increasing, utilization of food products for biomass will compete against demand. In addition, installation of biofuel plants requires capital investment, but there is no adequate source to make these investments.

Biogas Energy Potential

Based on livestock production and poultry production in Myanmar, the theoretical energy potential for biogas production per day was calculated, for each type of animal.

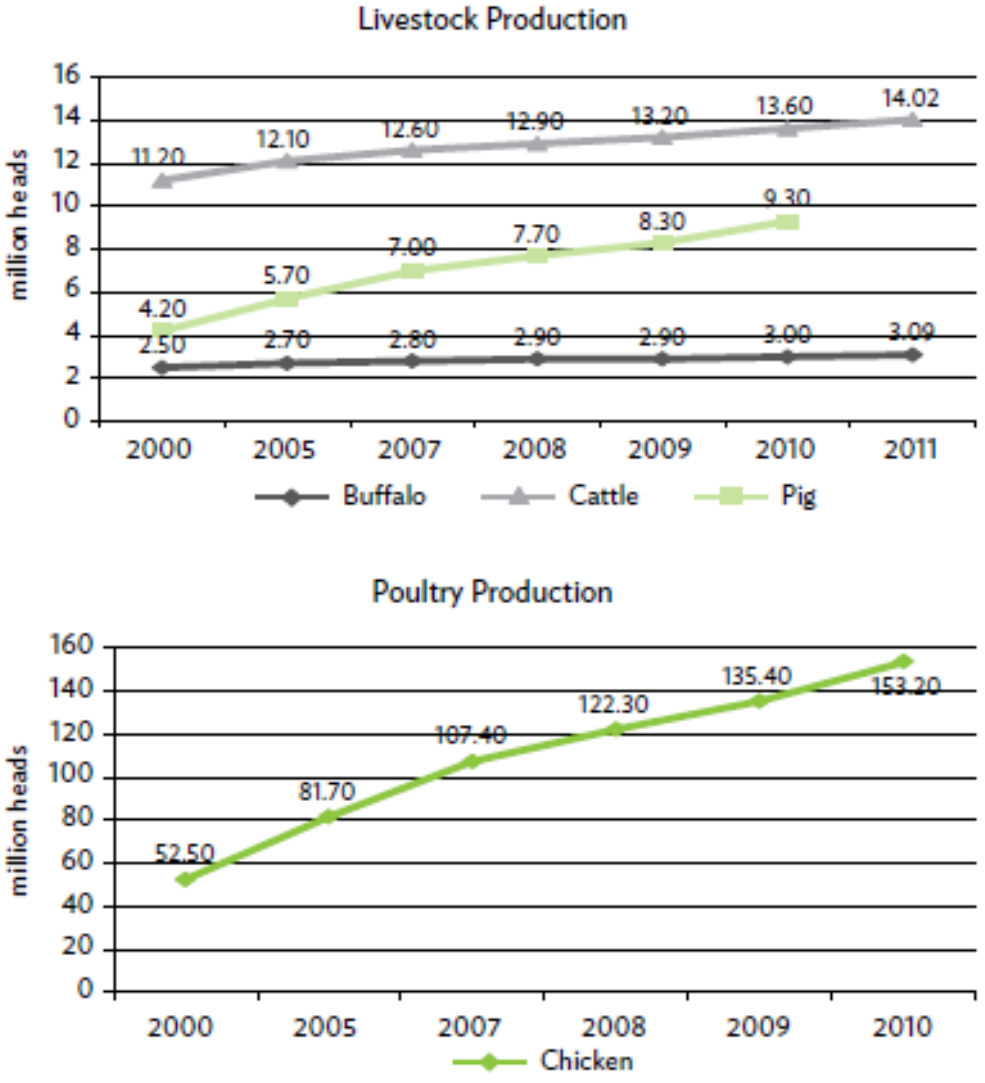


Figure 5-4 Livestock and Poultry Production: Myanmar

Table 5-2 Theoretical Biogas Energy Potential: Myanmar

Livestock	2010 Production[a] (million heads)	Daily Manure Production Factor (kg/animal)	Substrate Quantity (kg/day)	Dry Matter Factor (%)	Total Dry Matter Available (kg/day)	Mean Biogas Yield Factor (m^3/kg dry matter)	Daily Biogas Production (m^3/day)
Buffalo	3.09	8.00	24,720,000	16	3,955,200	0.250	988,800
Cattle	14.02	8.00	112,160,000	16	17,945,600	0.250	4,486,400
Pigs	9.30	2.00	18,600,000	17	3,162,000	4.200	13,280,400
Chicken	153.20	0.08	12,256,000	25	3,064,000	0.575	1,761,800
Total							**20,517,400**

kg = kilogram, m^3 = cubic meter.

[a] buffalo and cattle production figures are 2011/2012 statistics.

However, the theoretical potential, which accumulates to 20,517,400m3/day, overestimates the realistic potential in Myanmar for several reasons. First, most of the livestock is owned by farm households, and commercial-scale livestock production is limited. Second, animal weight and percentage of dry matter is low in Myanmar. Last, even if there is high technical potential of biogas energy, it is not economically competitive with conventional fuels.

Nonetheless, the government has been promoting the use of biogas, by building small scale biogas digesters; it has been installing around 1,200 biogas plants since 2000, but 80% of them are no longer in operation.

Table 5-3 Installed Biogas Projects

Institution/ Organization	Brief Description	Installation Date	No. of Plants Installed
GoRUM (Myanmar government)	Initial demonstration through the installation of floating-drum biogas plants; currently not in operation	1980–2000	867
Mangrove Service Network (MSN)	Demonstration plants installed in Delta under the Human Development Initiative; currently not operating	1996–2002	3
Economically Progressive Ecosystem Development (ECODEV)	One rectangular biogas plant was installed in the training center of ECODEV; currently not in operation	2000	1
Metta Development Corporation	In 2003, Metta organized a practical training course in biogas installation; 27 participants attended this course and installed one fixed-dome biogas plant (6 m^3) in the Metta training center in Myitkyina (Kachin State)	2003	1
Myanmar C. P. Livestock Co.	Medium-scale biogas plants (batch type) costing $12,500 have been installed; these convert biogas into electricity through a generator (25 kW) to power lamps, fans, and pumps. All systems are in operation.	2008	9
Myanmar Agricultural Produce Trading (MAPT) under the Ministry of Commerce	Low-cost community biogas plants made from liquid rubber–coated bamboo mats or plastic (tunnel type) costing $875 (excluding transmission) installed in South Shan State (52 units), Delta (2), Magway division (2), and Northern Rakhine State (10) to produce electricity using petrol engines (2 kW). Activities were cofinanced by Kanbawza Bank; cost-free for the villages. Currently the systems are not in operation.	2009–2011	66
Ar Yone Oo	Cement biogas plants premanufactured in Yangon (100 units) costing about $550 each. One demonstration unit has been installed outside Yangon.	2010–2011	1
FAO	Fiberglass biogas plants premanufactured in Yangon installed in Northern Rakhine State to produce electricity. Currently the operation rate is 60%.	2009–2011	75
MOST	In 10 different divisions and states, various fixed-dome plants ranging in size from 5 m^3 to 100 m^3 have been installed. Almost 90% of all systems with a size of 15 m^3 or more are used to produce electricity for villages, most of them in Mandalay division; 80% to 90% of the plants are reported to be in operation.	2002–2010	174
Total			**1,197**
	Projects still operating	**From 195 to 213**	

Appendix 6: Current Power Situation in Myanmar

Summary of Power Supply Situation in Myanmar

Compiled by Mitsubishi Research Institute
Based on information from various sources

Electricity Demand and Consumption in Myanmar

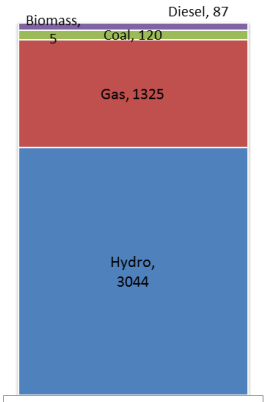
- Electricity consumption per capita: 160kWh/year (1/20 of world average)
  The amount has tripled in the last ten years
- Peak Load: 2,100 MW (2014)
  An average increase of 14% in the last five years
- Serious power shortage (shortage equivalent to 30% of peak load in 2012-2013)
  Delayed investment in power sector infrastructure
  Dependence on hydropower, a variable energy resource
- Power shortage in rural areas is especially critical
  Power sector and regulation framework do not have enough institutional capacity
- National Electrification Plan aims universal electrification by 2030.

Source: Myanmar National Electrification Project: Environmental and Social Management Framework

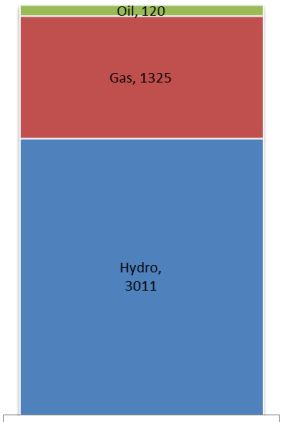
Generation Mix in Myanmar

- Dependence on hydropower is an issue (65% of installed capacity is hydropower)

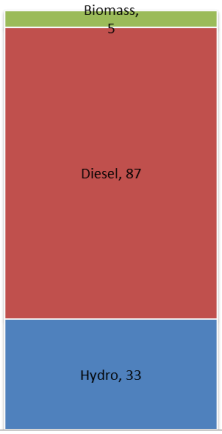
Installed Capacity (MW)



	On&Off Grid
Biomass	5
Diesel	87
Coal	120
Gas	1325
Hydro	3044



	On Grid
Oil	120
Gas	1325
Hydro	3011



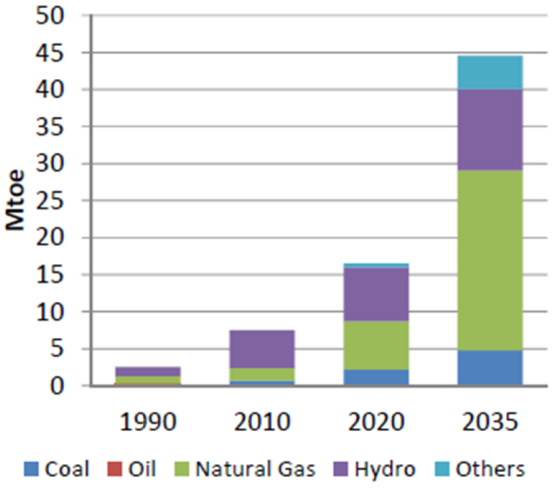
	Off Grid
Biomass	5
Diesel	87
Hydro	33

Status of Myanmar: Electric Power and Hydropower Planning January 2015

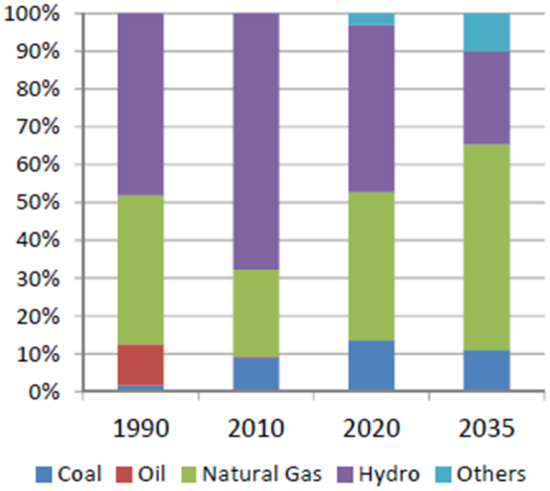
Future Generation Mix in Myanmar

- Limiting the dependency on hydropower, natural gas and other fuels will be used for power generation

Outlook of fuel demand for generation



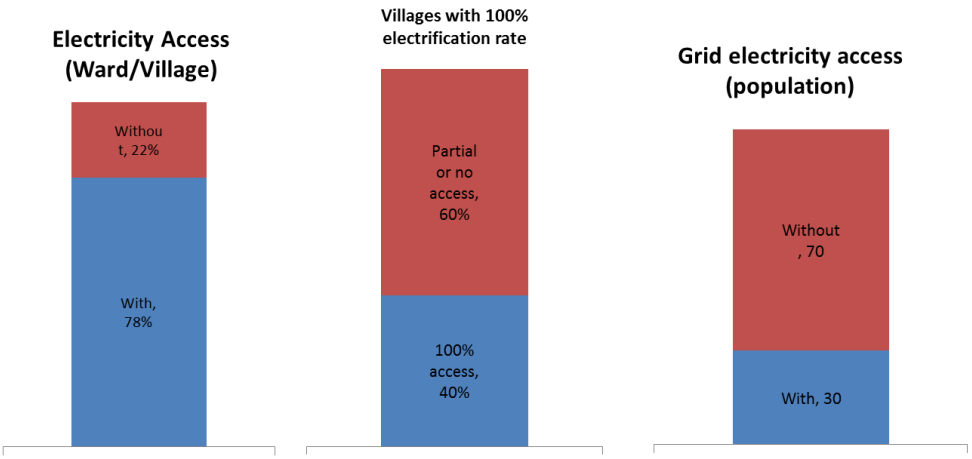
Outlook of Fuel Shares



ERIA (2013.12) Myanmar Energy Outlook A Country Report from EAS Energy Saving Potential Project 2013

Electrification in Myanmar

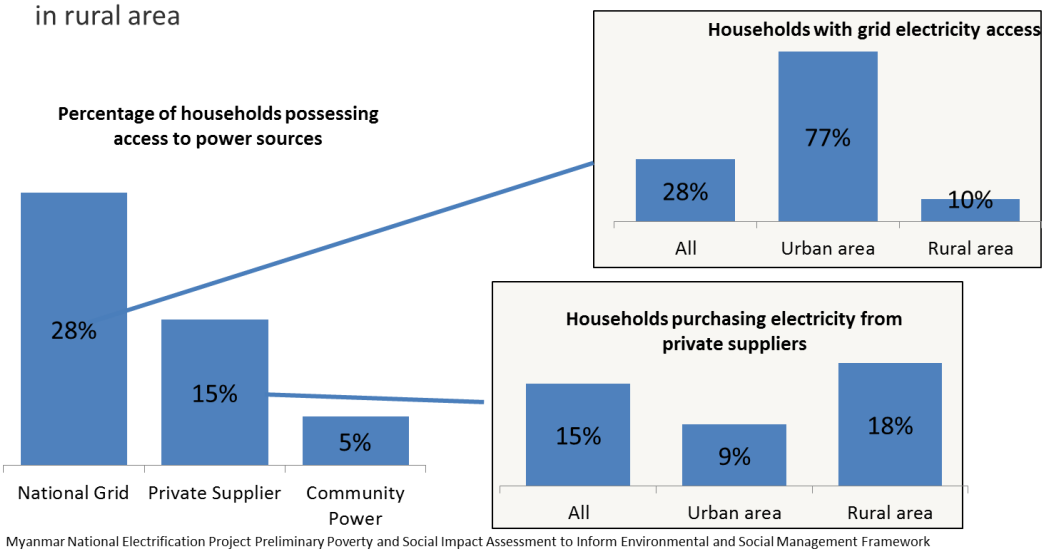
- Wards and villages with electricity access: 78%
  Only 40% of these wards and villages have 100% household electrification
- Only 30% of the population have grid electricity access



Myanmar National Electrification Project: Environmental and Social Management Framework

Electrification in Myanmar by Region

- Higher access to grid electricity in urban area (approximately 80%), but low access rate in rural area (approximately 10%)
- Higher proportion of households purchasing electricity from private power suppliers in rural area

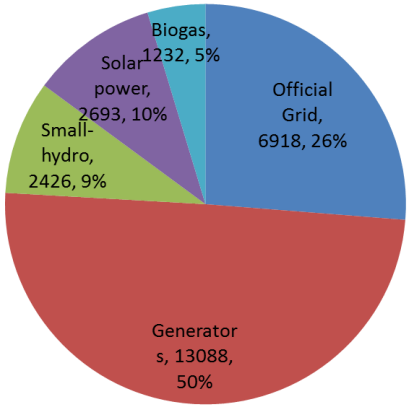


Myanmar National Electrification Project Preliminary Poverty and Social Impact Assessment to Inform Environmental and Social Management Framework

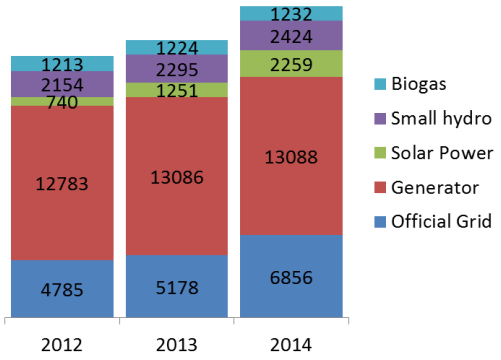
Electrification in Rural Areas

- Rural areas are dependent on private suppliers and community generators (by private suppliers and community operators). Access to official grids are limited (Only 26% of villages have electricity access of official grid (Only 25% of villages have access to the grid.)
- Villages with grid access have increased from 2012 to 2014 due to rural electrification plan.

2014年 % of villages connected to electricity sources



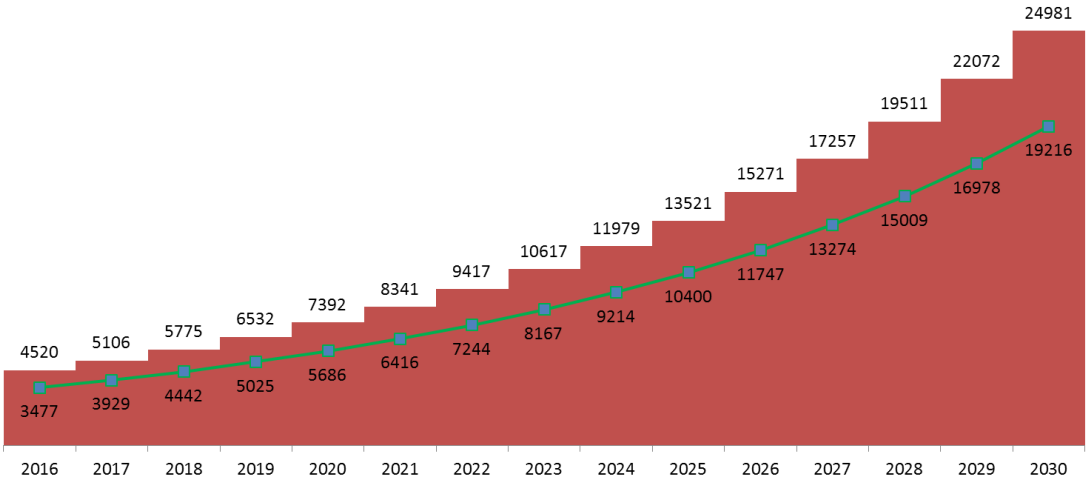
Villages connected to electricity sources



Rural Electricity Access by MOLFRD 2015.1

Installed Capacity and Electricity Demand Outlook

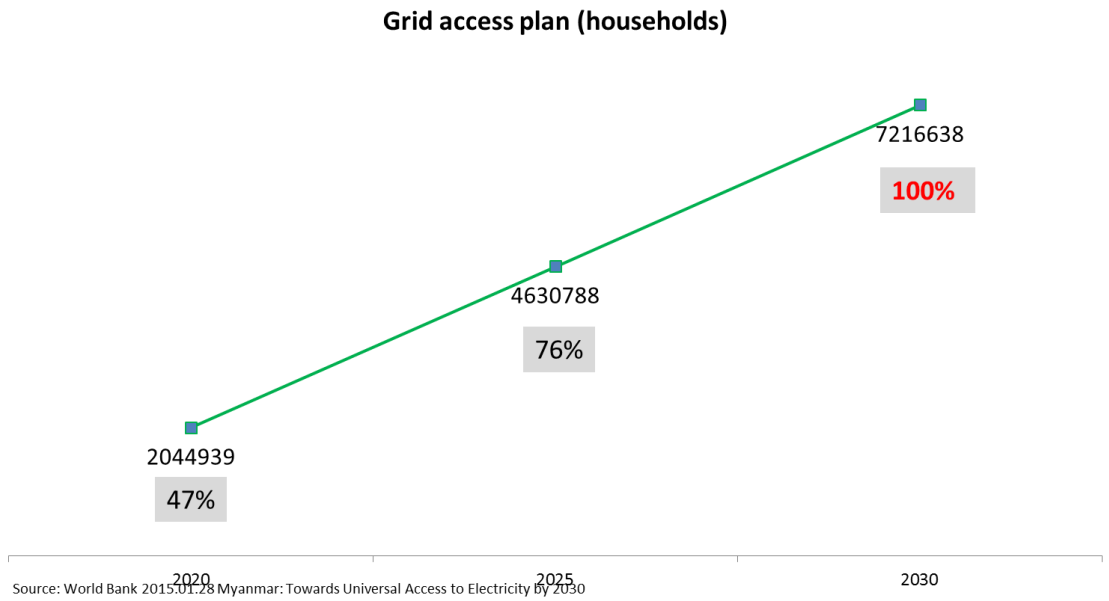
2016-2030 Installed Capacity and Electricity Demand (MW)



Country Presentation of Myanmar (Ministry of Electric Power) 2013

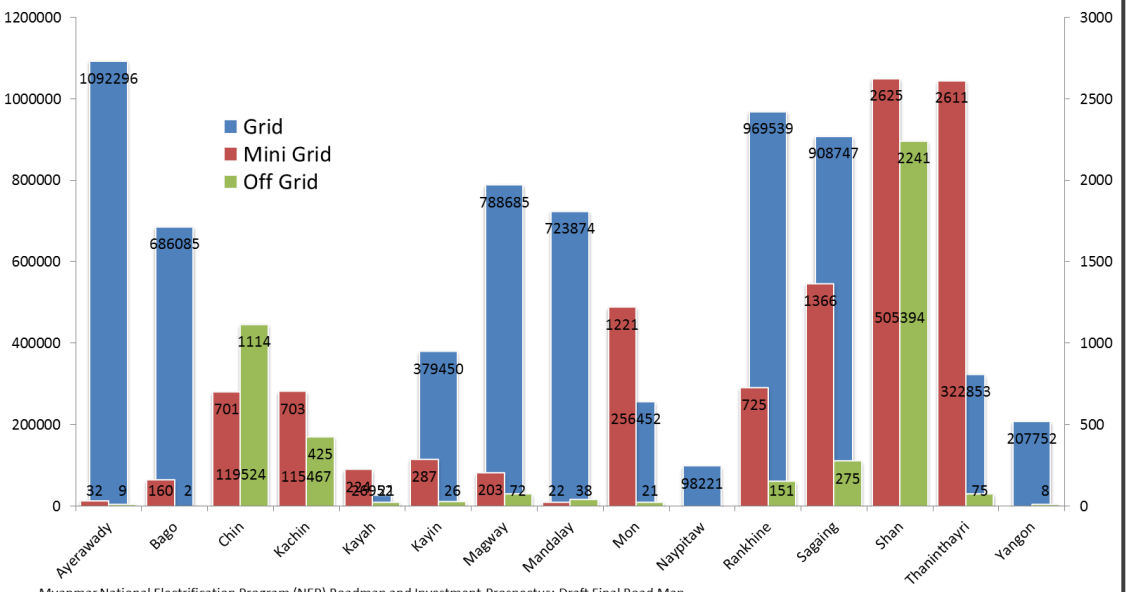
Electrification Goal

- In order to achieve 100% electrification by 2030, electrification must be proceeded double the current speed. (currently 33%)



Source: World Bank 2015.01.28 Myanmar: Towards Universal Access to Electricity by 2030

Household with grid access in 2030



Myanmar National Electrification Program (NEP) Roadmap and Investment Prospectus: Draft Final Road Map and Investment Prospectus 2014.08

National Electrification Plan（NEP）

<table>
<tr><th colspan="3">National Electrification Plan
Goal: 100% Electrification Rate by 2030</th></tr>
<tr><td colspan="2">Part 1. Grid Rollout (Urban Areas)</td><td>Part 2. Off-Grid Pre-electrification
(Rural Areas)</td></tr>
<tr><td colspan="2" rowspan="2">Investment support for grid rollout
Goal: Six million connections by 2021 (Five phases)
● Rehabilitation and construction of medium voltage substations
● Rehabilitation and construction of medium/low voltage power lines and transformers
● Connecting housings with distribution lines and meters</td><td>Investment support for off-grid electrification (targeting areas where power will not be supplied from the grid in ten years)</td></tr>
<tr><td>50 households or more:
Minigrid</td><td>Less than 50 households:
Household energy systems such as solar power, mini hydro, diesel, hybrid system, etc.</td></tr>
<tr><td colspan="3">Part 3. Capacity Building and Technical Assistance
● Capacity building and advisory support for electricity related authorities
● Technical design, economic and financial analysis, environmental and social impact management, procurement and financial management</td></tr>
</table>

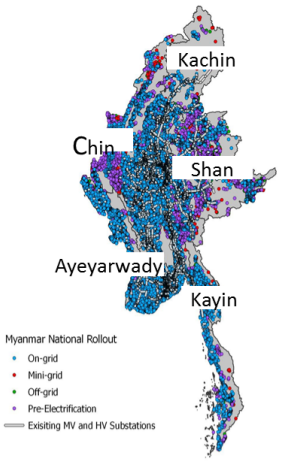
Myanmar National Electrification Project: Environmental and Social Management Framework資料より

Pre-electrification (Off-grid)

- Rural areas remote from the central part of Myanmar need longer transmission lines that require more cost, placing them in the later stages of electrification plan.
  Chin, Shan, Kachin, Kayah Regions have the highest cost, placing them in the final phase of electrification plan.
- 3-4% of the villages planned for grid connection in the final phase will be part of pre-electrification plan by mini-grid and solar home systems.

2015-2016 Solar Home Systems、
Mini-Hydro Installing Township/Village

		Solar Home Systems		Mini-Hydro	
Region	Township	Village	Household	Village	Household
Ayearwaddy	3	12	2,668	-	-
Chin	9	115	5,344	10	793
Kachin	3	28	4,000	-	-
Kayah	3	15	750		
Kayin	2	62	3,333	-	-
Shan(East)	9	108	5,298	3	821
Shan(North)	8	66	4,000	1	600
Shan(South)	5	41	4,000	2	600
Grand Total	42	447	29,393	16	2,814



Grid by Region

Source: World Bank 2015.01.28 Myanmar: Towards Universal Access to Electricity by 2030

Appendix 7: Overview of the New Industrial Zone

About the Development Site

The planned construction site and plan for phase 1 of construction are shown below.

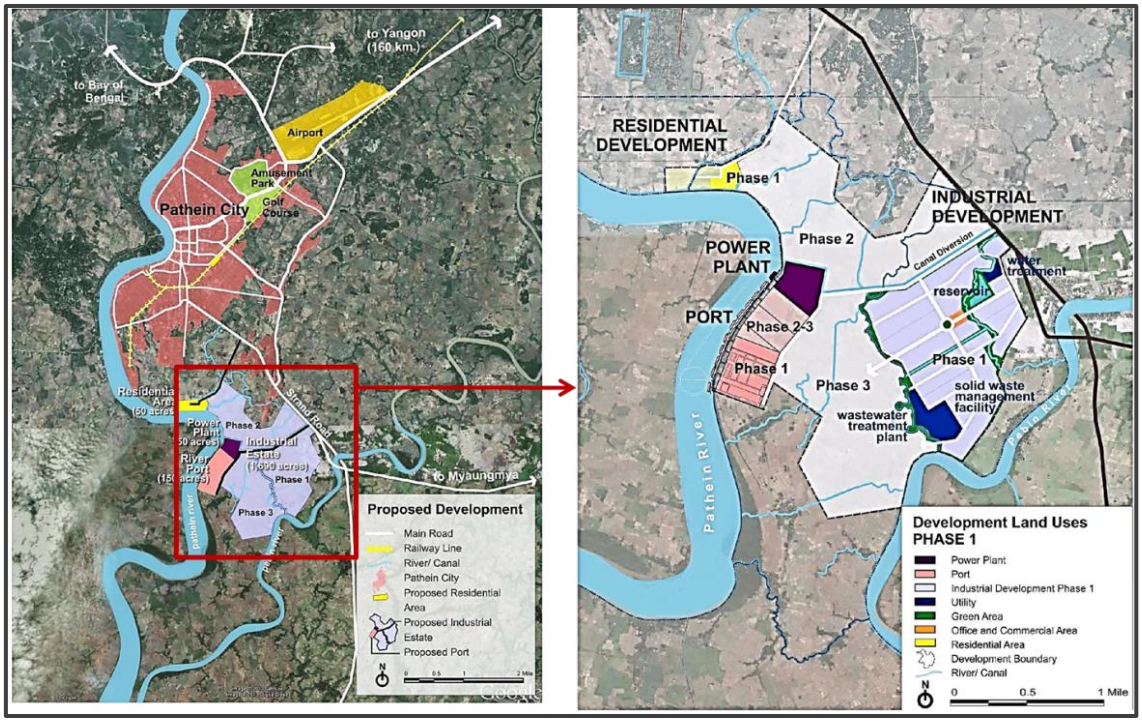


Figure 7-1 Construction Site Map and Plan

About the Power Plant and Port

To construct an industrial zone of an international standard, power plant of 15 MW and a port are planned for construction in phase 1 of Pathein Industrial City development. The power plant may add to its capacity according to the demand of the tenants. Project sites for power plant and a port are shown below.

Figure 7-2 Construction Plan of a Power Plant and a Port

Power Supply Situation at Pathein Industrial City

Electricity demand at Pathein Industrial City was estimated based on the electricity demand at other industrial zones in Myanmar. Area of each industrial zone and its power capacity was analyzed (Thilawa Special Economic Zone was taken out of the analysis, as it has a vast area of 2,400ha which results in an extremely large power capacity unit per area); electricity demand (MW) was estimated to be 0.036*area(ha)^1.0917. Therefore, electricity demand at Pathein Industrial City is estimated to be approximately 25MW.

Table 7-1 Area and Electricity Capacity at Industrial Zones in Myanmar

Total area (ha)	MVA	MW
81		12.24
43	1	1.00
489		22.00
44	3.315	3.32
87	6.1	6.10
317	15	15.00
66	1.9	1.90
177	10	10.00
400	30	30.00
540	40	40.00
2,400		1,000.00
737	20	20.00

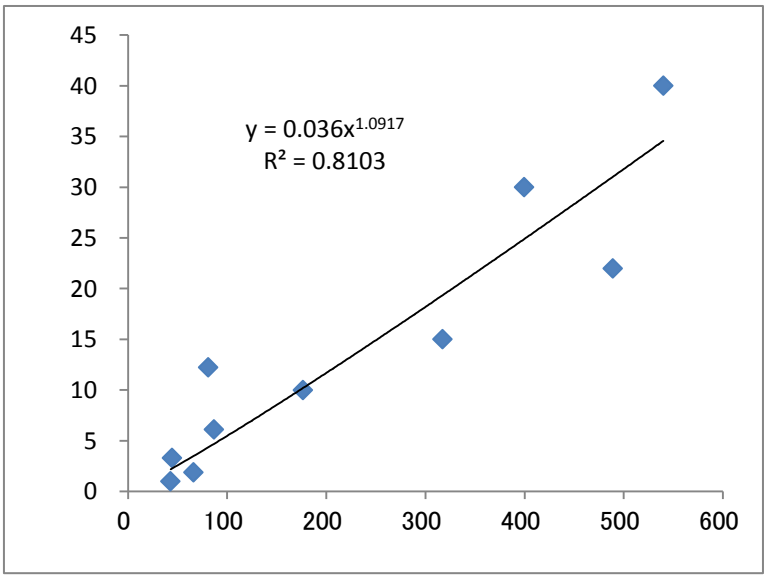


Figure 7-3 Relationship between Areas and Electricity Demand at Industrial Zones (Not including large scale industrial zones)

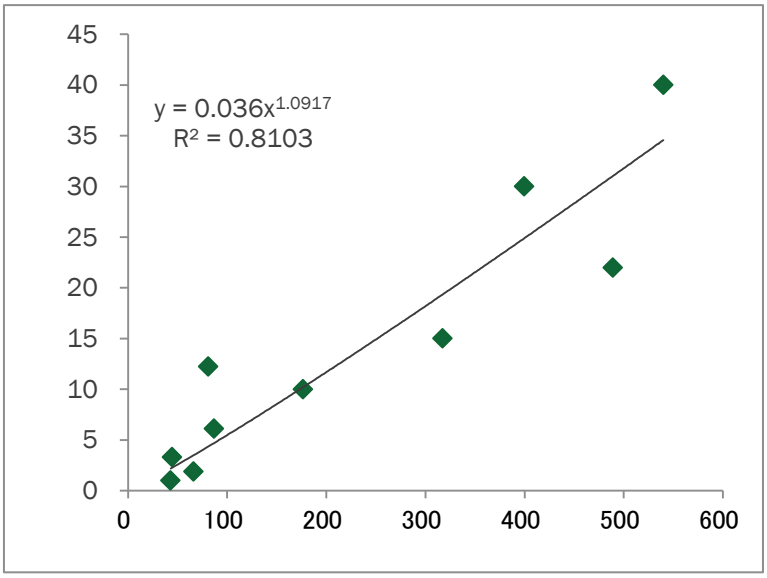


Figure 7-4 Relationship between Areas and Electricity Demand at Industrial Zones (Including large scale industrial zones)

Appendix 8: Waste Collection Scheme in Fukushima City

Garbage Sorting and Disposal Rules

Burnable garbage | Corrected twice a week

Kitchen waste	Food scraps, left-over foods, vegetable scraps, fish scraps, used tea leaves, egg shells, fruit scraps, seashells, etc.
Paper and wood waste	Tissues, disposable diapers, paper containers and packaging with irremovable stains or smells, other small paper containers and packaging, pruned branches, etc.
Others	Rubber and leather products, cloths and clothes, videotapes, disposable body warmers, soft plastic containers and packaging with irremovable stains, etc.

Source: Fukushima city website "Garbage Sorting and Disposal Rules"
http://www.city.fukushima.fukushima.jp/

Garbage Sorting and Disposal Rules

Non-burnable garbage | Collected twice a month

Metal items and glassware	Spray cans, gas canisters, pans, bottle caps, other small metal items, broken bottles, electric bulbs, metal tableware, heat-resistant glassware, etc.
Hard plastic products and ceramic items	Toys, plastic containers and packaging with irremovable stains or smells, plastic and ceramic tableware, flowerpots, etc.
Home Appliances	Electric ovens, juicers, rice cookers, electric heaters (Empty kerosene from the tank and remove batteries.), etc.
Others	Umbrellas, electric pots, tricycles, legless chairs, dry-cell batteries, oily bins and containers, etc.

Source: Fukushima city website "Garbage Sorting and Disposal Rules"
http://www.city.fukushima.fukushima.jp/

Garbage Sorting and Disposal Rules

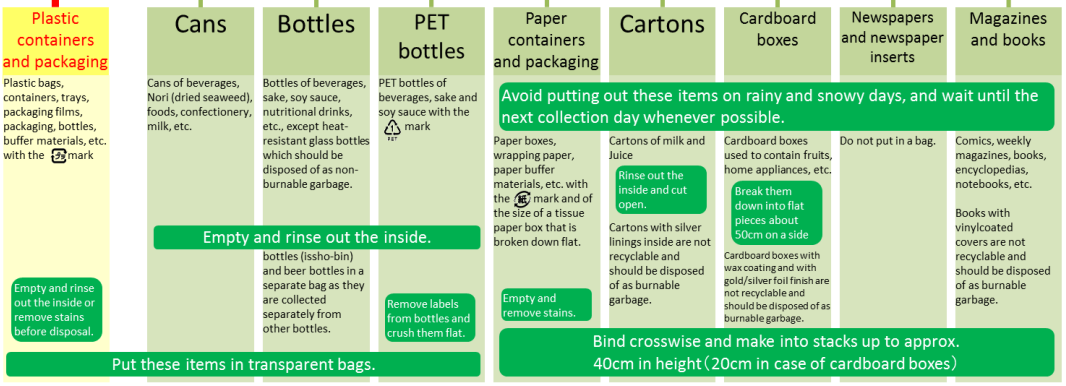
Recyclables

Plastic containers and packaging: Four times a month

Recyclables without the mark: Twice a month

Plastic containers and packaging with the mark are collected four times a month.
(Not on the fifth collection day of any month.)

Plastic containers and packaging without the mark are collected twice a month.



Place used small home appliances in collection boxes provided at public facilities and private commercial facilities in the City.

Source: Fukushima city website "Garbage Sorting and Disposal Rules"
http://www.city.fukushima.fukushima.jp/

Garbage Sorting and Disposal Rules

Bulky items
(Collected upon request)

Call Fukushima City Recycling Plaza to request a bulky item collection. Bulky items are collected on a specified day at the door. Up to five items per household are accepted in one collection.
You cannot put out bulky items at your local garbage collection point.

Home appliances	Microwave ovens, dehumidifiers, etc.
Furniture and Equipment	Desks, closets, sewing machines, sofas, shoe cupboards, shelves, organs, etc.
Bedding and carpets	Beds, futon bedclothes, mattresses, rags, carpets, etc.
Housing equipment	Sinks, bathtubs, washbasins, etc. (excluding equipment fixed to housing structure)
Vehicles	Bicycles, bicycle-drawn carts, baby carriages, etc.
Others	Swings, skis, golf gear, laundry poles, etc.

Items up to 60cm to 200cm in height and 10kg to 100kg in weight are treated as bulky items. You may opt to bring bulky items directly to Fukushima City Recycling Plaza on weekdays, between 8:45 AM and 11:30 AM and 1:00 PM and 4:30 PM.

Source: Fukushima city website "Garbage Sorting and Disposal Rules"
http://www.city.fukushima.fukushima.jp/

Garbage Sorting and Disposal Rules

Items not covered by the City's garbage collection service

Items that cannot be disposed of by the City	Automobile parts, safes, farm equipment, pesticides, construction waste, agricultural vinyl products, metal blocks, medical waste, etc. Pianos, Concrete blocks, Vehicle batteries, Thinner, Gas cylinders, Waste tires, Drums, Fire extinguishers, Gasoline, Oil	Ask retail stores for pick-up or use private garbage collection and transport service.
Home appliances specified in the Home Appliance Recycling Law	Air conditioners, cathode-ray tube TVs, liquid crystal display TVs, plasma display panel TVs, refrigerators, freezers, washing machines, clothes dryers	Ask home appliance retail stores or use private garbage collection and transport service. You can also bring these items directly to a designated disposal site.
PCs	Manufacturers and other entities collect and recycle used PCs.	Ask the relevant manufacturer or entity for pick-up.
Motorcycles	Manufacturers and other entities collect and recycle used motorcycles. Payment of a recycling fee is not required for disposal of motorcycles sold in Japan by any of the 16 companies participating in the Motorcycle Recycling Program, regardless of whether with or without the recycling mark. Note, however, that if you bring your motorcycle to a used motorcycle dealer, you have to pay for collection and transport.	Ask a used motorcycle dealer for disposal or bring the motorcycle directly to a designated disposal site.
Commercial/ business waste	Waste from commercial/business sources such as stores, restaurants, and company offices	Bring the waste directly to the Clean Center or use private garbage collection and transport service.(In case of waste from commercial/business sources, only burnable waste is accepted by the Clean Center with a charge.)
Large quantities of garbage	Waste generated in large quantities from housing move-in/move-out, etc.	

Source: Fukushima city website "Garbage Sorting and Disposal Rules"
http://www.city.fukushima.fukushima.jp/

Appendix 9: Business Model of Rice Husk Power Plant and Details of Installed System

Overview of the Business Model

1. Conditions of the project

The following four conditions are to be met for this project.

A. To mitigate risks of price increase due to competition in procurement of rice husks, the project area will generate a larger amount of rice husks than the amount needed for power plant.
B. To decrease fuel procurement cost (fuel purchase cost and transportation cost), there will be a limitation of total distance for rice husk collection and transportation.
C. To be competitive in development of rice husk biomass power plant and rice husk procurement, advanced and established technology with low environmental impact will be installed.

2. Project Implementation Plan

I. Operation by a Local Enterprise

For the operation of the rice husk biomass power plant, a local SPC will be established with a company in Myanmar, which will be responsible for direct management of the project and the power plant.

II. Initial investment and capital cost

EPC cost: planning of rice husk biomass power plant, procurement of equipment, and construction will be ordered to an EPC (Engineering Procurement Construction) contractor.
Opening expenses: based on discussions with the government institutions, cost for establishing SPC and various cost during the construction phase will be accounted for.
The total project cost (capital cost) will be the total of EPC cost and opening expenses.

III. Finance Plan

In this project, utilization of JCM scheme is assumed; besides the 50% equipment subsidy, the project will be funded through own resources.

IV. Construction Agreement

All works regarding the construction of a rice husk biomass power plant will be ordered to the EPC contractor.

V. Fuel Procurement Plan

The price of rice husks are based on the balance between demand and supply. A sharp increase in the price of rice husks, which were originally traded at cheap price, may be predicted due to their application for commercial use. Their price has a large impact on the economics of the project; therefore, a long-term contract between the suppliers is necessary to mitigate the risks of price fluctuations.

This project is relatively large in scale, consuming a large amount of rice husks; procurement of rice husks from more than ten rice millers is predicted. Forming an SPC and maintaining a stable supply for as long as 15 years will be a challenge; since the project site is placed at Pathein Industrial City, which receives rich support from the rice mill business owners and the Ayeyarwady Region, cooperation from these stakeholders will be coordinated in order to accomplish stable supply.

VI. Electricity Sales Plan

Subsidy is applied for electricity tariff in Myanmar; it is sold at its wholesale price to MOEP, which is then supplied to Yangon City Electricity Supply Board (YESB) and Electricity Supply Enterprise (ESE). In January, 2012, YESB and ESE had two categories of electricity tariffs: for residential sector (35MMK/kWh) and for industrial sector (75MMK/kWh). Electricity tariffs for off-grid power sources were from 100~300MMK/kWh, depending of the LCOE of each power source (diesel, solar power, small-scale hydropower, etc.) [2].

However, due to a rapidly increasing electricity demand, the national government in Myanmar changed its electricity tariff system from April 2014 to a measured rate system.

Table 9-1 Electricity Tariff in Myanmar

Sector	~March 2014		April 2014~		
			Monthly consumption	Tariff	
	MMK	USD	kWh/month	MMK	USD
residential	35	0.027	1~100	35	0.0268
			101~200	40	0.0307
			201~	50	0.0383
Industrial	75	0.057	1~500	75	0.0575
			5,001~10,000	100	0.0766
			10,001~50,000	125	0.0958
			50,001~200,000	150	0.1150
			200,001~300,000	125	0.0958
			300,001~	100	0.0766

Source: Myanmar Newspaper website https://www.digima-japan.com/news/22679/20140708-5.html

*1MMK=0.00077USD (2016.1.25 exchange rate) MMK: Myanmar Kyat

The generated electricity of the project is assumed to be utilized for construction of factories at first, and later used for supplementary power source for electricity demand within Pathein Industrial City. Therefore, electricity will be sold to developer of Pathein Industrial City; the electricity sales price is predicted to be a mix of national grid and self-possessed power plants.

VII. Operation Plan

Operation hours: 24 hours/day

Annual operation: 300days/year (excluding one month for maintenance of the facility and holidays in Myanmar)

VIII. Operation and Maintenance Plan of Rice Husk Biomass Power Plant

All work regarding the operation and maintenance of the power plant, including daily operation at the rice husk biomass power plant, maintenance, and equipment repairing,

[2] Myanmar Energy Sector Initial Assessment, ADB, October2012

will be ordered to the O&M contractor. Possible O&M contractors for this project are Japanese companies that have experiences in the operation and maintenance of rice husk biomass power plant utilizing direct burning steam turbine technology in neighboring countries such as Thailand.

Table 9-2 Overview of Project Plan

Project Area	6,400m2
Power Plant System	BTG: Boiler Turbine Generator
Fuel	Rice husk 100% (Co-firing plastic waste 0.5w%)
Generated Heat	Rice husk: 14.2MJ/kg, plastic waste: 23.0MJ/kg
Installed Capacity	3.3MW (Gross), 3.0MW (Net)
Efficiency	Approximately 20%
Rice husk consumption	3.75 ton/hour
Plastic waste consumption	0.011 ton/hour
Total project cost	6.54 million USD (including opening expenses)
Daily operation hours	24 hours/day
Annual operation days	300 day/year
Annual operation hours	7,200 hours//year
Annual electricity generation	21,600MWh/year
Annual electricity sales	21,600MWh/year
Annual rice husk consumption	27,00 ton/year
Annual plastic waste consumption	79.2 ton/year
Project period	15 years (Japanese legal duration of a power plant facility)

3. Impact on the project plan under risk occurance

Of the main risks that may occur in this project, fuel shortage, exchange rate, and decreased electricity sales price were considered.

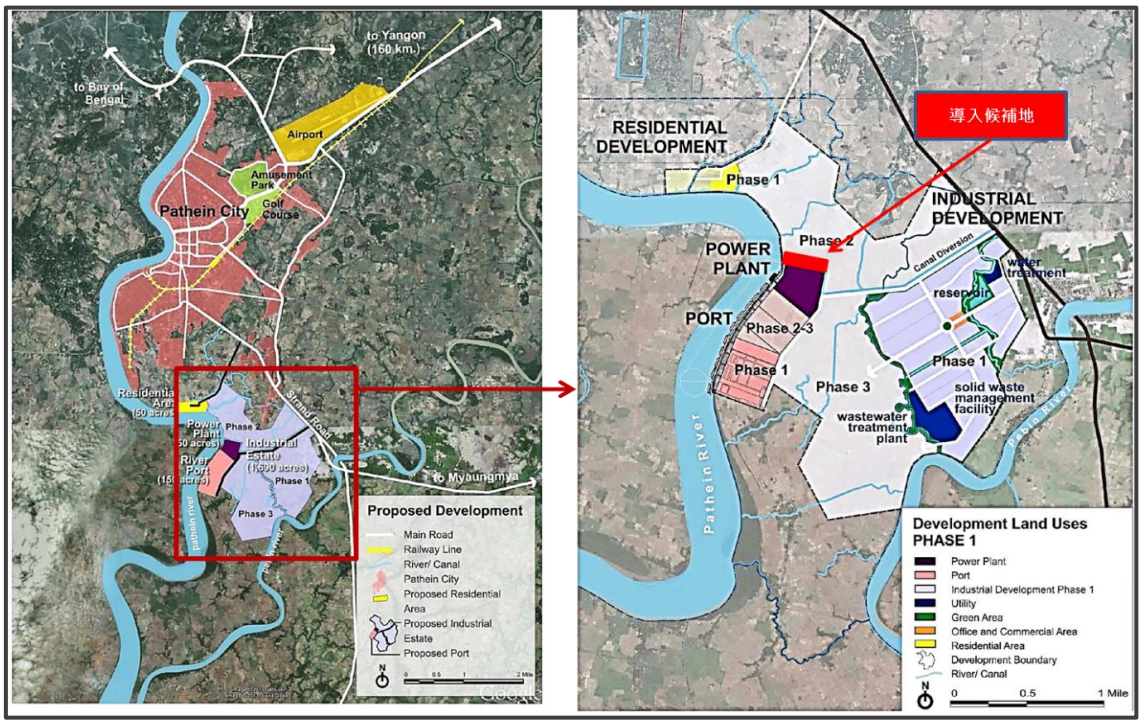
1. Fuel shortage
   As stated above, the project is relatively large in scale, consuming a large amount of rice husks, requiring rice husk procurement from more than ten rice millers. Therefore, fuel shortage due to increased price of rice husks can be predicted. In order to mitigate such risk, the project can be supported as a means of regional development by rice millers and the Ayeyarwady Regional Government, which will support stable supply of rice husks.
2. Currency Fluctuations
   Currency used in Myanmar is MMK, but USD is used as well. Since USD is used in the country, MMK is relatively decreasing its value; there is no risk mitigation for this. However, according to those in the Japanese financial sector, use of USD will gradually

be forbidden in the country, which will stop MMK value to decrease. Japan does not have a tax treaty with Myanmar yet. If there is no tax treaty when the project starts, investment from Singapore will be considered as well.

3. Electricity Sales Price Decrease

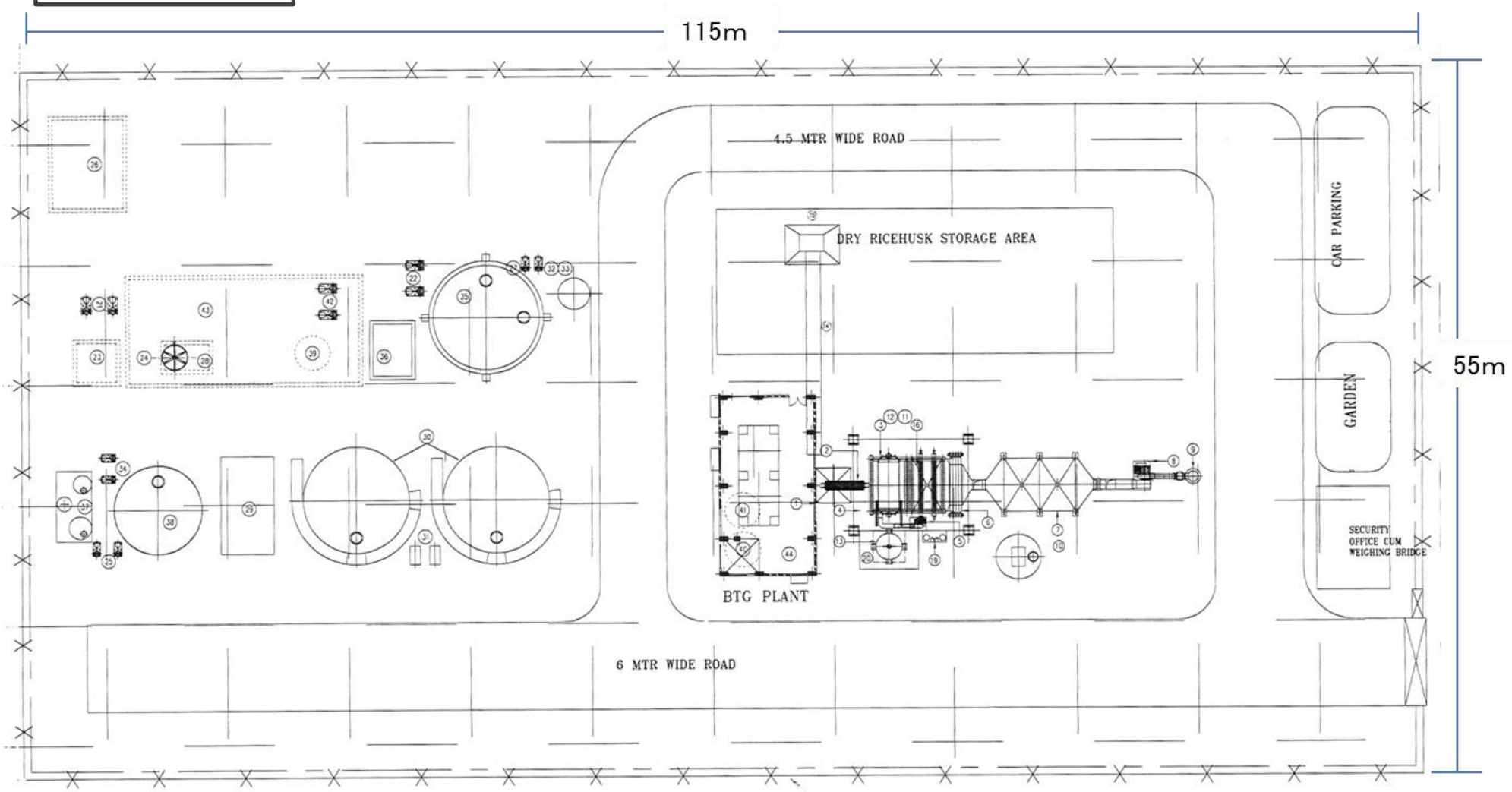
   Currently, hydropower is the main source of electricity in Myanmar, which has a lower LCOE compared with other power systems. This situation and policy measures have resulted in a non-economic electricity supply. Such trend may continue for a while, but considering the rapid economic growth in the last several years, it is highly likely that electricity sales price will decrease.

Project Site Candidates (Tentative)



Rice Husk Biomass Power Plant (3 MW) Layout (Tentative)

Project Area: 6,325m2



Appendix 10: Project Environment and Investment Environment in Myanmar

Ease of Doing Business

For investors, knowing where their country's economy stands in the aggregate ranking on the ease of doing business is useful. The economy's rankings on the topics included in the ease of doing business index provide another perspective. The following describes the constraints of business by foreign capital

Business of foreign capital

No regulations as law(Foreign Investment Law, FIL, Article 9) with respect to foreign investment in Myanmar (Possible investment in foreign capital 100%). But in Enforcement Regulations of the Foreign Investment Law, their associated circulars and their administrative operations (licensing), there are many fine individual regulations as such industry regulation, joint venture stake regulation, minimum investment regulations, regulations with specific conditions, and approval permit system by individual authorities, there exists a practically foreign entry regulations.

Foreign Investment Legislation and Considerations

For Overseas company's business activities in Myanmar, it must comply with the Foreign Investment Law. Describes the matters related to the following.

Forms of Investment:

100% foreign investment is allowed in permitted business, joint venture (JV) with Foreigners/ Local individual or entity/ government entities.
Business performing under contract as agreed by parties.

Investment Requirements:

The investor has to form a company under existing laws.
If it is a joint venture company, the capital ratio shall be agreed to by both parties.
The minimum capital shall be determined by the Myanmar Investment Commission (MIC) based on the nature of business.
If business activities are in restricted areas, it must be carried out with a local Partner and the foreign capital must be in accordance with the ratio prescribed by Foreign Investment Rules.

Formation of Myanmar Industrial Commission (MIC):

MIC Chairman is the Union Minister.
MIC Members are experts from the relevant ministries, government departments/ organization, non-governmental organizations.
The MIC Vice Chairman, Secretary, Joint Secretary will be appointed from the members of MIC.
The establishment and nature of the MIC will be broadened with the involvement of experts from non-governmental organizations and entrepreneurs from the business sector

Restricted Activities:

Foreigners are prevented from holding 100% of a venture in certain sectors. The following activities are included in these restricted sectors.
Activities that can affect traditional culture, or customs of ethnic, public health, natural resources and the environment.
Activities related to manufacturing and services that can be done by Myanmar citizens that will be specified in the FI rules.
Activities that involve agriculture, livestock breeding or fisheries (also the activities specified in FI Rules are included).
Activities within at least ten miles of the boundary demarcation within the state territory except economic zones specified by the Union Government. Electricity Generation is considered a "Reserved Industry" and therefore would require Government Approval. 100% foreign ownership may be possible but would need discussion/negotiation with MIC, DICA, and Relevant Ministries and ultimately Government (as part of the MIC application).

Foreign Employees:
Investors must appoint and employ staff based on the percentage which has been determined in the formation of the company with the local partner for skilled workers, technicians and staff as follows:
At least 25% local staff during the first two years.
At least 50% of local staff within the next two years.
At least 75% of local staff in the third two year.
However, the regulator may amend the above time limit for knowledge-based enterprises.

Tax incentives and guarantees:
5 years tax holiday is applicable to all investors, plus additional tax incentives may be granted by the MIC.
An exemption of Commercial Tax for export activity
Exemption of customs duties for 3 years on machinery and raw materials, if granted by the MIC.
An additional customs duty and other internal tax exemption in case of the expansion of an existing investment.

Use of Land:
Lease of land from the government or private sector is allowed for a period of land use or grant for (50) years initially which is necessary for the economic or industry depending on type and volume of investment.
It can be extended twice additionally with 10 years period consecutively after expiration of the previously allowed under section 31, depending upon volume and type of investment.

Foreign Capital & Rights to Transfer:
The commission will register the name of investor according to the foreign currency accepted by the bank as foreign capital. The type of foreign capital must be described when it is being registered.
Repatriation or remit out the foreign capital will be designated by the commission within stipulated period upon termination.

The investor has the right to remit abroad through a local bank which has the right to deliver service for foreign banking activity at the prevailing exchange rate for the relevant currency.

Administrative penalty

MIC may award the following administrative penalties to investors who violate the provision of the law, rules, regulations, procedure, notification, order or directive or any condition of the permit:

Warning

Temporary suspension of tax exemption and relief

Revocation of permit

Black listed with the punishment of no further issue of permit

Application of the law of foreign investment regulation of this rice biomass husk power generation business (Law applicable on foreign investment regulations of this rice husk biomass power generation business)

Within the framework of foreign investment regulations, such as the above, describe the formal law applied to the Rice husk biomass power generation business.

First, there is “power generation business” in some state monopoly 11 industries of state-owned Enterprise Law (“except for the private and co-generation projects”).

There is provision "Manufacturing and service industries that can Myanmar foreigners only do" in Foreign Investment Law Article 4, and hence foreign capital cannot be entered. This is the maximum of the neck.

There is “Management of electricity distribution network, commercial trading of electricity, electrical-related inspection services” in the “11 foreign entry prohibition industries” as regulations related to the peripheral business areas.

Furthermore, In MIC Notice, “Large-scale power generation business, transmission line construction” are required environment assessment. But 50MW smaller power generation business does not fall into the category of large-scale power generation. In advancing the commercialization of this project, Individual hearing is essential to the Ministry of Power and relevant ministries and agencies.

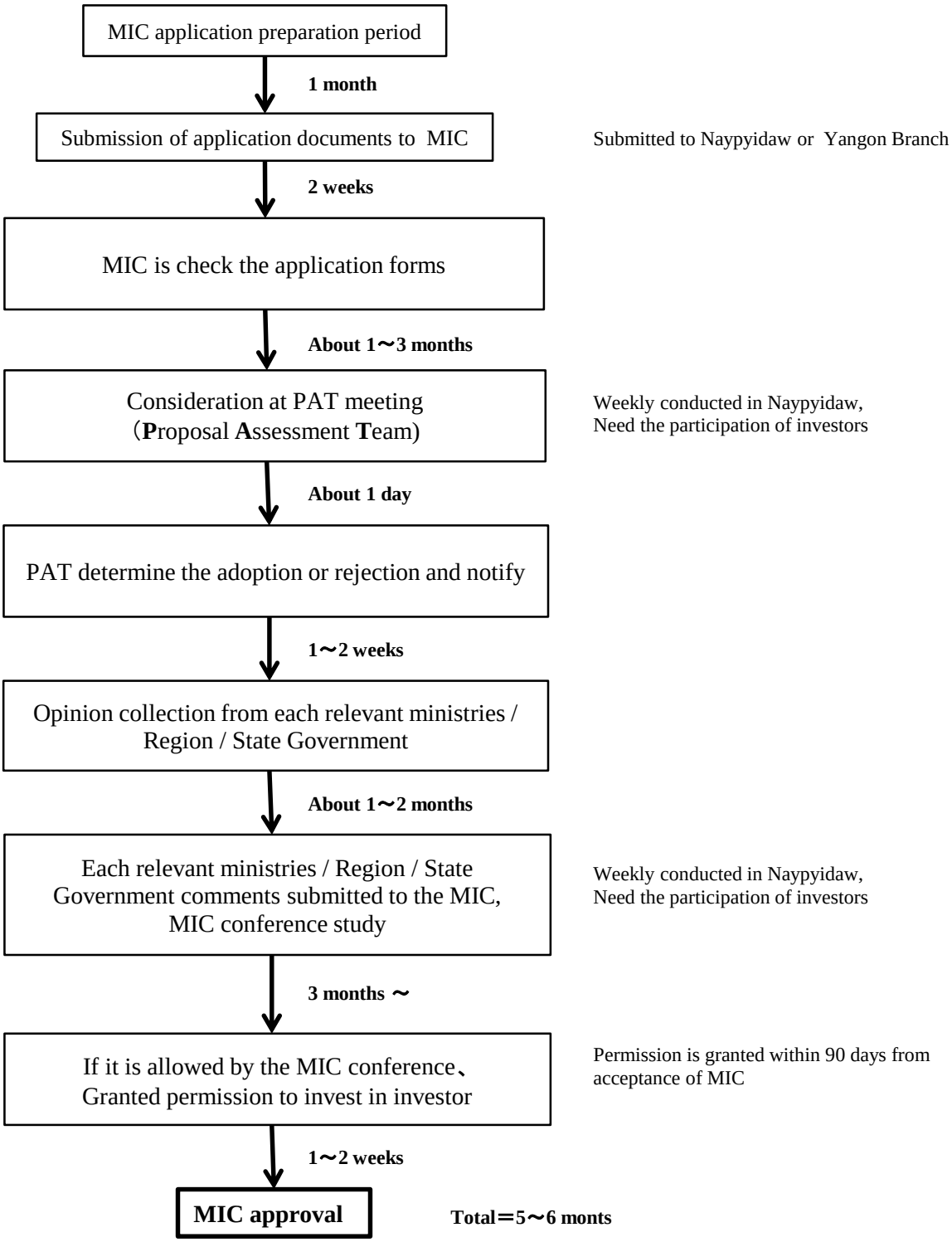


Figure 10-1 Procedure and the required period of MIC application

Appendix 11: Project development schedule

Regarding the development of Pathein Industrial City, though changes may occur, it was assumed that construction of factories moving in will start in early 2019; projects considered in this research were planned accordingly.

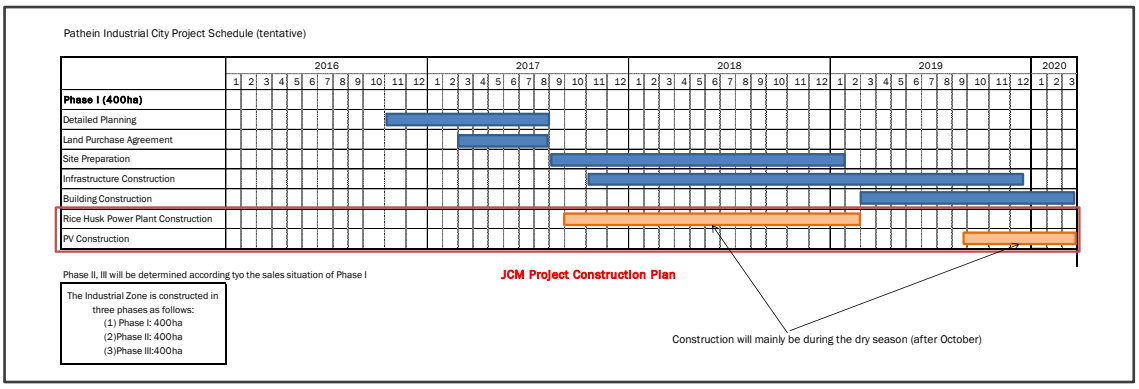


Figure 11-1 Pathein Industrial City Development Schedule and Rice Husk/Solar Power Plant Project Schedule (Tentative)

Rice husk biomass power plant was planned with the first phase of the factory construction. Normally, the factories have steel structure, consuming a large amount of electricity for construction. Even in countries like Japan where there is stable power supply, construction contractors use their own power generators in most cases during the construction phase. Demand for such generators is even larger in Myanmar. Acquiring adequate fuel and stable power supply is an important issue for construction contractors.

Therefore, electricity demand for Pathein Industrial City development was estimated. Assuming that sales area is approximately 75% of the 400ha of the first phase, and that each construction unit is divided into 7.5ha with four construction phases, there will be ten construction units in each phase. Assuming that two generators of 250kVA with 60% operation rate will be installed, electricity demand is estimated to be 3MVA. Peak electricity demand for construction cannot be completely met, but 3MW will supply more than 50% of the electricity demand. Place for supplying electricity surplus (transmission of electricity to a local village) is being discussed with the regional government. Supplying electricity demand at facilities for construction workers is a possible idea. There will be electricity demand for construction workers living, and as there is no village in the nearby area of the industrial zone, new electricity demand is likely to arise.

Solar power project will be constructed according to the construction of infrastructure (water treatment facility). Of the total 1 MW capacity, 20% will be placed at the water treatment facility and the remaining 80% will be placed at a nearby area. Assuming that solar power plant was installed at water treatment facilities in the two following phases of construction, the project will be able to supply half of electricity demand at water treatment facility in Pathein Industrial City. (Note: self-sufficiency rate of solar power plant at water treatment facility: 0.2MW*3sites/ (1MW/site)*3sties=47%)

If it was assumed that electricity demand by construction workers was of a fairly large size, equipment subsidy and construction may start a year before the planned schedule.

Rice husk biomass power plant will prepare for equipment subsidy application in 2017, start construction in autumn 2017, and start operation in early 2020.

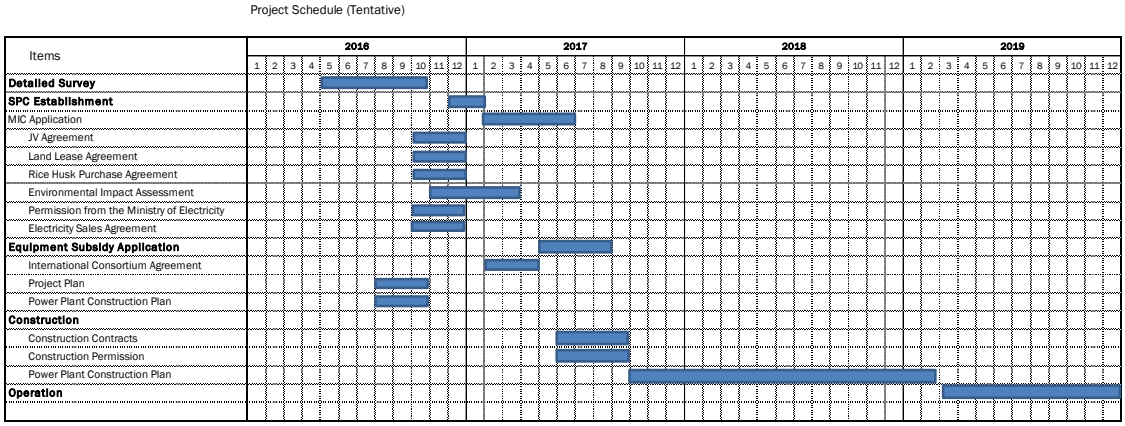


Figure 11-2 Schedule for Rice Husk Biomass Power Plant Project

Solar power project will prepare for equipment subsidy application in 2019, start construction in autumn 2019, and start operation in early 2020.

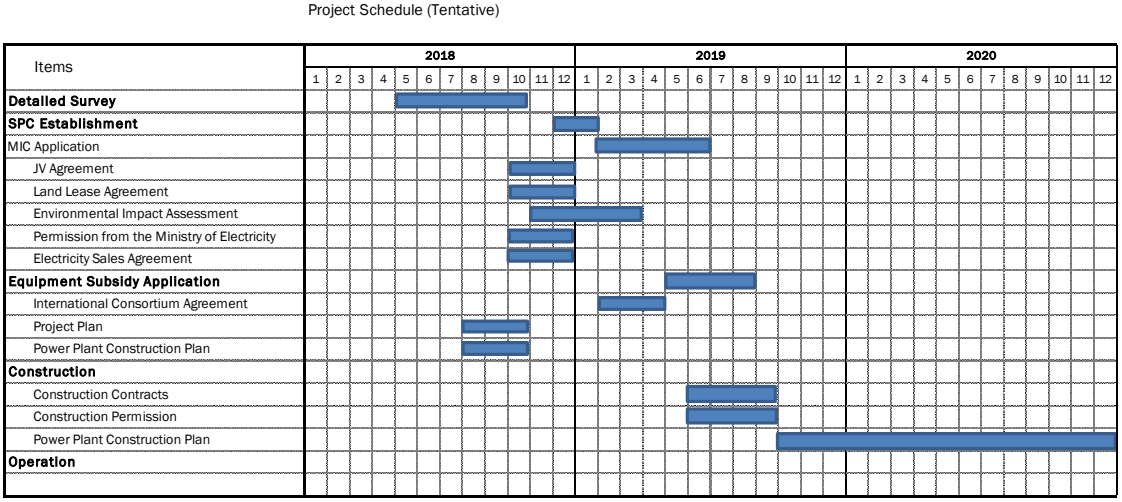


Figure 11-3 Schedule for Solar Power Plant Project

Appendix II

Appendix 12: Meeting in Fukushima City (2015.9)

Date: September 1st, 2015 15:00~16:00

Place: 8F Meeting Room, Corasse Fukushima

Participants:

- Fukushima City: Susumu Endo
- Fukushima Chamber of Commerce & Industry: Ayako Wago, Hiroshi Ishikawa, Masahiro Honda, Takashi Ito
- Mitsubishi Research Institute: Koji Kojima
- Fujita Corporation: Naoaki Uchiyama, Yuki Abe, Yasuhiro Toyoda

1. Opening Remarks

Fukushima City

This project has high expectations from the MOE, as an inter-city cooperation of a municipality that is not a government-ordinance designated. As Fukushima City, we are hoping that this project will be a good PR. Activities in Fukushima City will be used to achieve practical inter-city cooperation.

2. Explanations of the Project

(1) Content of the research and its basic concept were described using the following documents.

- Document 1: Support and measures for achieving low-carbon society in Asia (from Clean Asia Initiative Newsletter, January 2015)
- Document 2: Latest trend in JCM (from MOE document)
- Document 3: Overview of the research
- Document 4: Overview of Pathein City, Ayeyarwady Region, Myanmar
- Document 5: Document from kick-off meeting

(2) Organizational structure for cooperation was described with the following documents.

- Document 6: Basic structure for cooperation (tentative)

(3) Workshops to be held in Fukushima were explained.

- Document 7: Overview of Fukushima Workshop

3. Q&A Session

Fukushima Chamber of Commerce & Industry:

- It would be a wonderful opportunity if cooperation with the industries in Fukushima Prefecture was realized. With further cooperation, economic benefits can be expected as well.
- Myanmar and Ayeyarwady Region may have high potential for economic development, but since there are no interaction history between Myanmar and Fukushima City, an explanation of "Why Myanmar? Why Ayeyarwady Region?" would be necessary (especially for explanation to Fukushima City diet).
- Understanding would be obtained if this project leads to actual businesses.

Fukushima City

- We are still in the phase of exploring opportunities. This year, the city does not need to procure its budget for this research, so I believe it is still too early to hold an official explanation to the city diet. Explanation has been done to the former chairman.
- This project is expected to continue into the next fiscal year as well, so understanding among the diet members will be obtained as the projects are discussed more in detail.

Fujita

- Through communication with the Chief Minister of the Ayeyarwady Region, Fukushima City was introduced as a municipality that implements advanced measures in renewable energy promotion; as a result, the Chief Minister sent his request for cooperation, which led to such cooperation.

Mitsubishi Research Institute

- As Ayeyarwady Region is a major production site for rice in Myanmar (as well as in Asia), Pathein City and Fukushima City have some characteristics in common.

Fukushima Chamber of Commerce & Industry

- What sort of vision is held under the inter-city cooperation? What is the role of Fukushima City?

Fukushima City

- Various forms of cooperation as Fukushima City are being considered: its role can be an advisor, or it can propose plans for improving consciousness among citizens. As

Fukushima City, we have created various plans and established various projects accordingly; such know-how will be insightful for Myanmar as well.

- There will be a workshop held in Yokohama City regarding the inter-city cooperation in October, held by MOE, and cases of inter-city cooperation will be introduced. In addition, a guidebook will be created by MOE as well; these will be used as references to consider what sort of cooperation would be the best.
- Cooperation in sectors other than environment and energy will be explored as well.

Fukushima Chamber of Commerce & Industry

- What is the construction schedule of the industrial zone? How fast will it proceed?

Fujita Corporation

- Completion of the industrial zone will take some time, but land acquisition and construction will proceed phase by phase. Considering other industrial zones in Myanmar, the construction speed will be remarkable. Therefore, electricity demand must be considered phase by phase. In the future, electricity supply including large power plants (e.g. coal and gas), as well as renewable energy power plant, will be necessary.

Fukushima Chamber of Commerce & Industry

- Has Fukushima City promoted its environmental aspect in the past?

Fukushima City

- Fukushima City has established its renewable energy promotion plan, and it has held its vision of achieving a “Cutting-Edge Environmental City.” Fukushima has conducted various activities such as waste power generation at Arakawa Clean Center and supplying the electricity to local areas, but it has not been able to promote this aspect to the public well.

Mitsubishi Research Institute

- There is a public image of Fukushima being an advanced place for renewable energy and locally produced and consumed energy. The project will be a good breakthrough in promoting Fukushima as well.

Fujita Corporation

- When inviting those from Myanmar to Fukushima City in October, members of the diet could participate as well.
- The aspect of raising citizen consciousness can be considered as well.

4. Opinions

- It is important to identify local companies that can be involved through this project. (Kitashiba, Nakagawa Hydropower are possible candidates in the renewable energy sector.) The project is an opportunity for local companies.
- It would be great if Japan can learn something from Myanmar as well.
- Why the project is focused on Myanmar and renewable energy must be shared among the members.
- When local companies are involved in the project development, support from the city is important (not from the budget aspect, but from the aspect of inter-city cooperation)

5. Workshop in October

- Site visit to Arakawa Clean Center is planned on the 21st.
- Renewable energy related facilities: Site visit at Kitashiba factory (PV system installed on factory rooftop), wind park in Azuma are candidates

Appendix 13: Workshop in Pathein City (2015.9)

Overview of the local survey

The first workshop was held in Pathein and local survey was conducted in industrial zone, waste management facility, and substations in Yangon from September 29th to October 2nd. The workshop and the local survey were conducted as below.

Date: September 29th ~ October 2nd, 2015

Venue:

Date	Location	
September 29th	Pathein City	Workshop
September 30th	Pathein City	Local survey (industrial zone, waste management facility, substations)
October 1st and 2nd	Yangon	Local survey (industrial zone, waste management facility)

Location: Pathein City and Yangon

Overview of the workshop

Date September 29, 2015. 13:30~17:00

Place Meeting room of Pathein Hotel, Pathein district.

Program

Opening remark

13:30 - 13:35 Opening & Greeting (Japanese side)

13:35 - 13:45 Greeting & Speech (Myanmar side)

Presentations

13:45 - 14:05 Background and Outline of Project

14:05 - 14:20 Overview of Ayeyarwady region

14:20 - 14:40 Waste Management in Pathain

14:40 - 15:00 Electricity Supply in Pathain

15:00 - 15:20 Coffee Break

15:20 - 15:35 Outline of Pathein Industrial City

15:35 - 15:55 Overview of Fukushima City

15:55 – 16:15 Renewable energy system in Fukushima and Japan

Discussion and Closing

16:15 - 17:00 Discussion

17:00 Closing Remark

In the beginning, high expectation for inter-city cooperation between Pathein City and Fukushima City was pressed from Myanmar. The Japanese team explained the various policies in Fukushima City and related policies. The two representatives exchanged opinions on these topics.

The following were expressed as local needs:

- High expectations for utilization of JCM scheme
- Electricity supply is one of the most serious issues in Myanmar
- Japanese experiences in renewable energy would help
- Japanese experiences in waste management, considering environmental impact by factories
- Utilization of agricultural waste (ex. Rice husks)

<Waste management in Pathein City>

- There is a collection system for waste. However, only part of the waste is collected by the garbage trucks.
- There is no categorization of residential and industrial waste.
- Waste is not separated at all. The local government has tried the separation scheme on float market, but it was not successful.
- There is high interest in separation and collection of waste and waste power generation, but it is considered challenging due to technological and financial issues.

<Electricity situation in Pathein City>

- Meeting electricity demand is an issue. There is high interest in power plant proejcts.
- Power plant project, such as rice husk power generation, is necessary in Pathein City.

<u>Overview of the site visit: 1.Pathein Industrial Park</u>

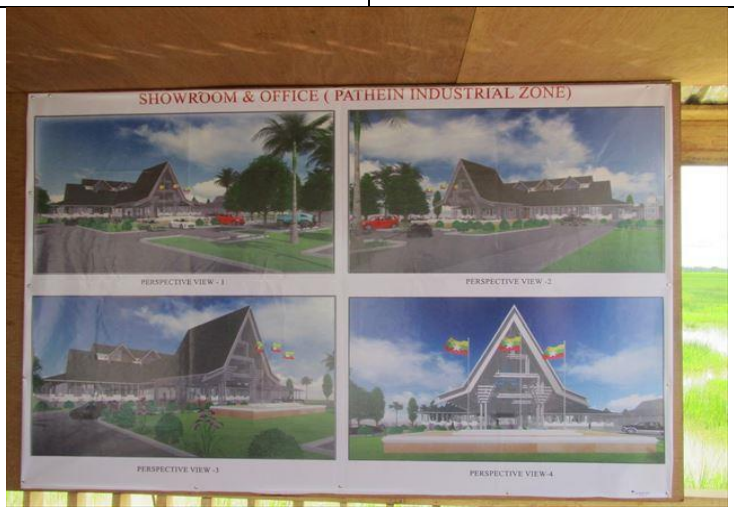
Pathein Industrial Park, the industrial zone that has already been constructed, did not have sufficient infrastructure, and only few Taiwanese and Chinese companies had moved in. There were many landowners, with many out-of-purpose constructions. There was a blackout of around 5-10 minutes every day. The blackout was compensated by diesel generator. The construction site is 24,000m2 and there was electricity of 800kVA in the industrial zone.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Taiwanese Textile Factory</td><td>Generator for Blackout</td></tr>
<tr><td colspan="2">  </td></tr>
<tr><td colspan="2">Substation</td></tr>
</table>

Following this visit, Pathein Industrial City, the project site, was visited. This industrial city is still under development, but a showroom will be completed in January 2016. Electricity will by supplied from the national grid at around 11kV.

Overview of Pathein Industrial City

Pumping Soil for Land Development



Showroom Plan

In addition to Pathein Industrial City, waste management facility in Pathein City was visited. In Pathein City, residential and industrial waste are not separated; garbage trucks collect around 30t every day. This amount of waste is only a part of the waste that has been generated by the residents. Separation of waste was attempted in the area once, but it was unsuccessful. Waste power generation is attractive, but considering that there is still abundant amount of land for waste management, it would be challenging from financial and technological aspect.

	
Landfill Site (outside)	Landfill Site (inside)
	
A Hut across Landfill Site	Collection of Organic Waste for Reuse

<u>Overview of the site visit: 2.Yangon</u>

Local survey was conducted at industrial zone and waste management facility in Yangon and neighboring area.

As an implication for future Pathein Industrial City, Mingaladon Industrial Park and Thilawa Special Economic Zone were surveyed. Both are industrial zones of international standard about an hour away from central Yangon. Access road from Yangon is still underdeveloped, but road within the industrial zone has been prepared. There are more than ten agreements, but only few of are in construction stage.

Mingaladon Industrial Park

Electricity Grid in the Industrial Park

Entrance of Thilawa Special Economic Zone

Service Water Management Facility

In addition, Hlaing tharyar Industrial Zone in Yangon City was visited as well. Tenants in ま this industrial zone is mainly of Myanmar investment, which is close to the future image of Pathein Industrial City. Currently, increase of land price and land contamination are major issues at this industrial zone.

Scene from the Industrial Zone

Open Area in Industrial Zone

Housing within the Industrial Zone

Housings within the Industrial Zone (without permission)

Waste management facility in Yangon was visited as well. After landfill is completed, treated waste is dug out once again from the final treatment site and utilized as a site to grow seedling. Final treatment site near Mingaladon Industrial Park was visited as well. Here, dry and wet waste were separated using different garbage bags, but they were to be landfilled together in the end.

Final Treatment Site (After Landfill Completion)

Final Treatment Site (Landfilling)

Garbage Bags for Separate Collection

FY2015 Feasibility Studies on Joint Crediting Mechanism
Projects towards Environmentally Sustainable Cities in Asia

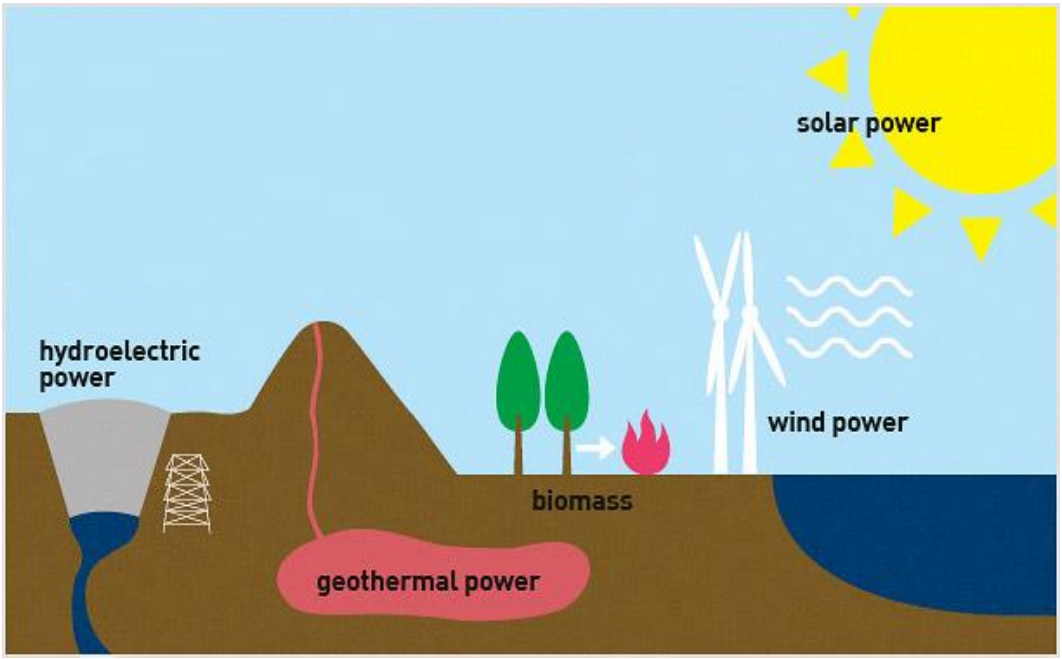
Low Carbon technology around the industrial zone

Idea of Low Carbon Initiative

Sep. 29, 2015

Contents

Renewable technology



Renewable technology

Roof-mounted solar panel


Wall-mounted solar panel

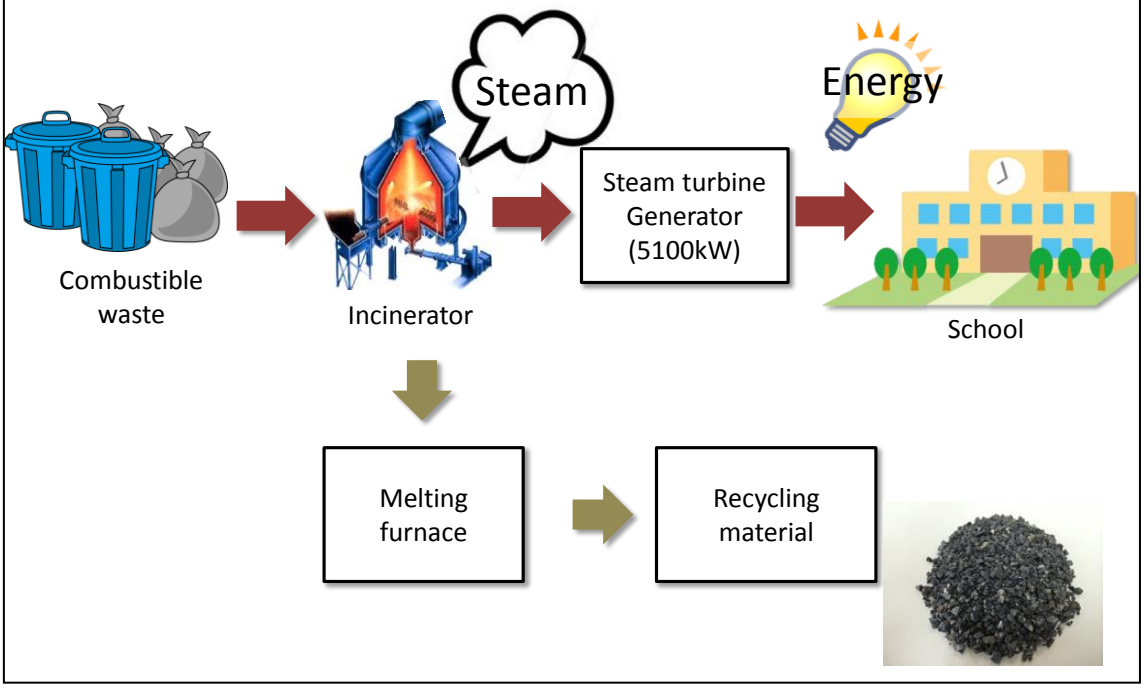

Wind power


Hydroelectric power(generator)

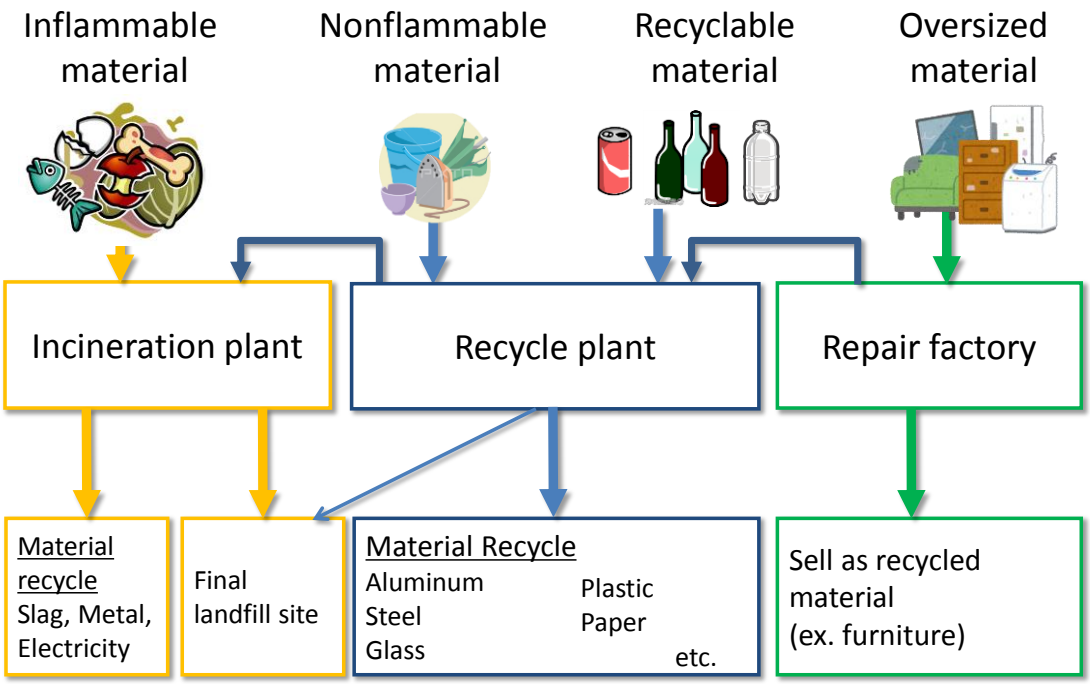
Contents

1. Example of adoption of technology in Japan
   - Renewable technology
   - Waste power generation technology
     - Waste incineration power generation in Fukushima city
     - Bio-gasification of organic waste
2. Idea of Low Carbon Initiative in industrial park

Waste incineration power generation in Fukushima city



Waste disposal system /FUKUSHIMA City



Material recycle

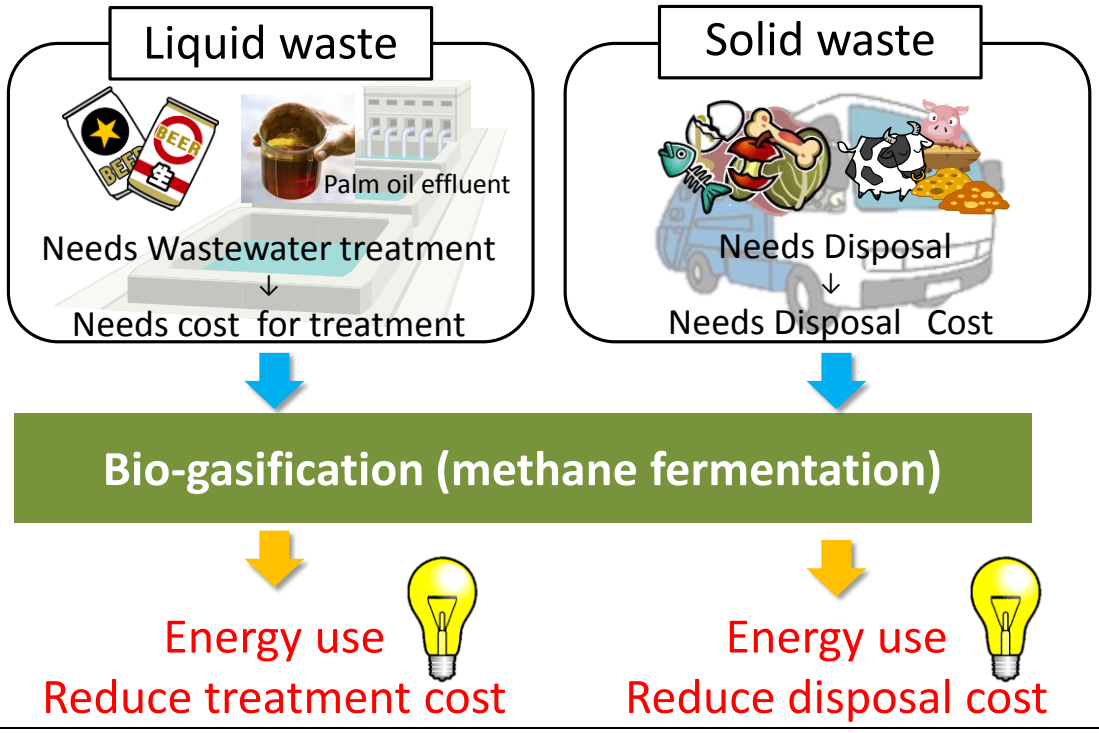
Molten slag

Asphaltic pavement

Aluminum cans

Pet bottle

Bio-gasification of organic waste

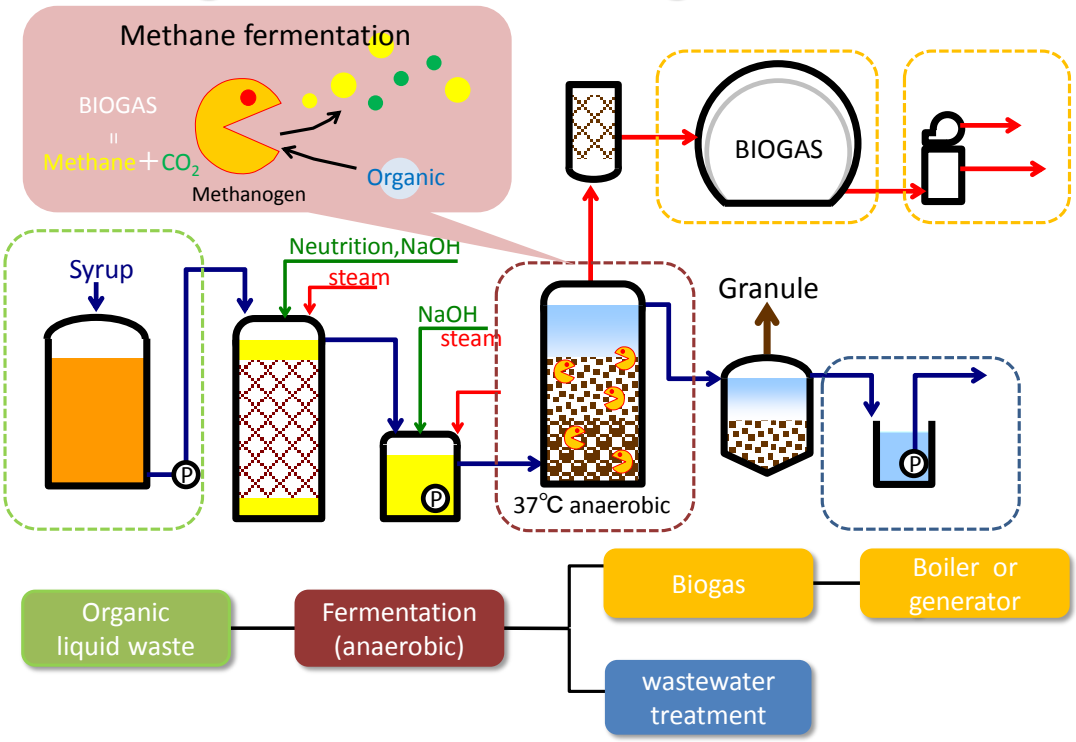


Bio-gasification of organic waste

UASB methane fermentation for liquid waste

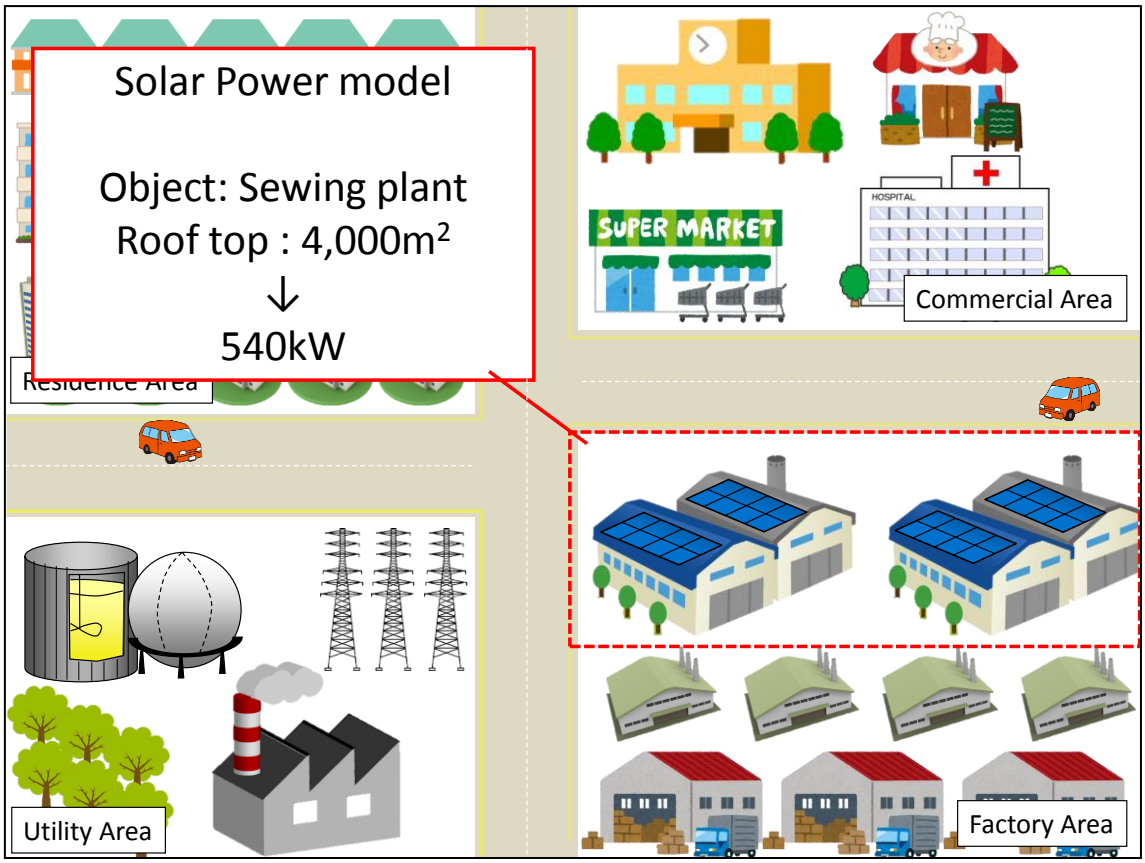
UASB : Upflow Anaerobic Sludge Blancket

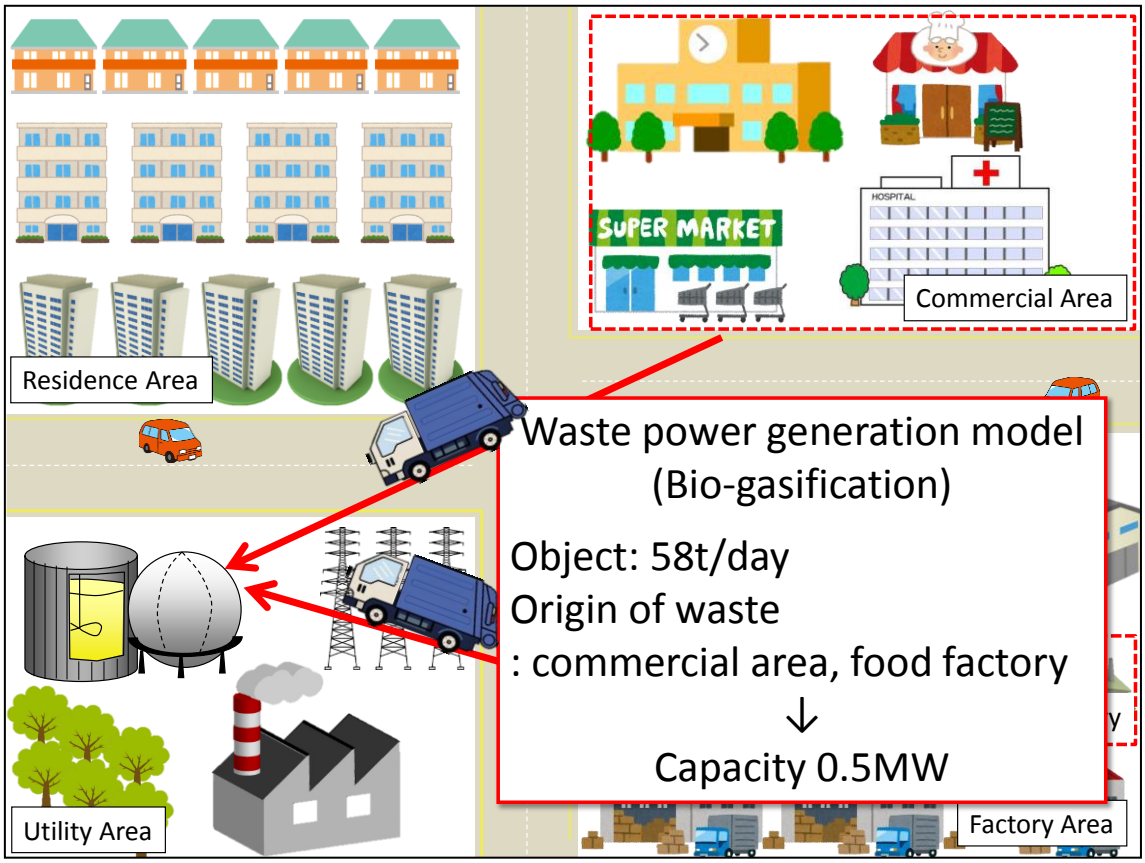
Bio-gasification of organic waste

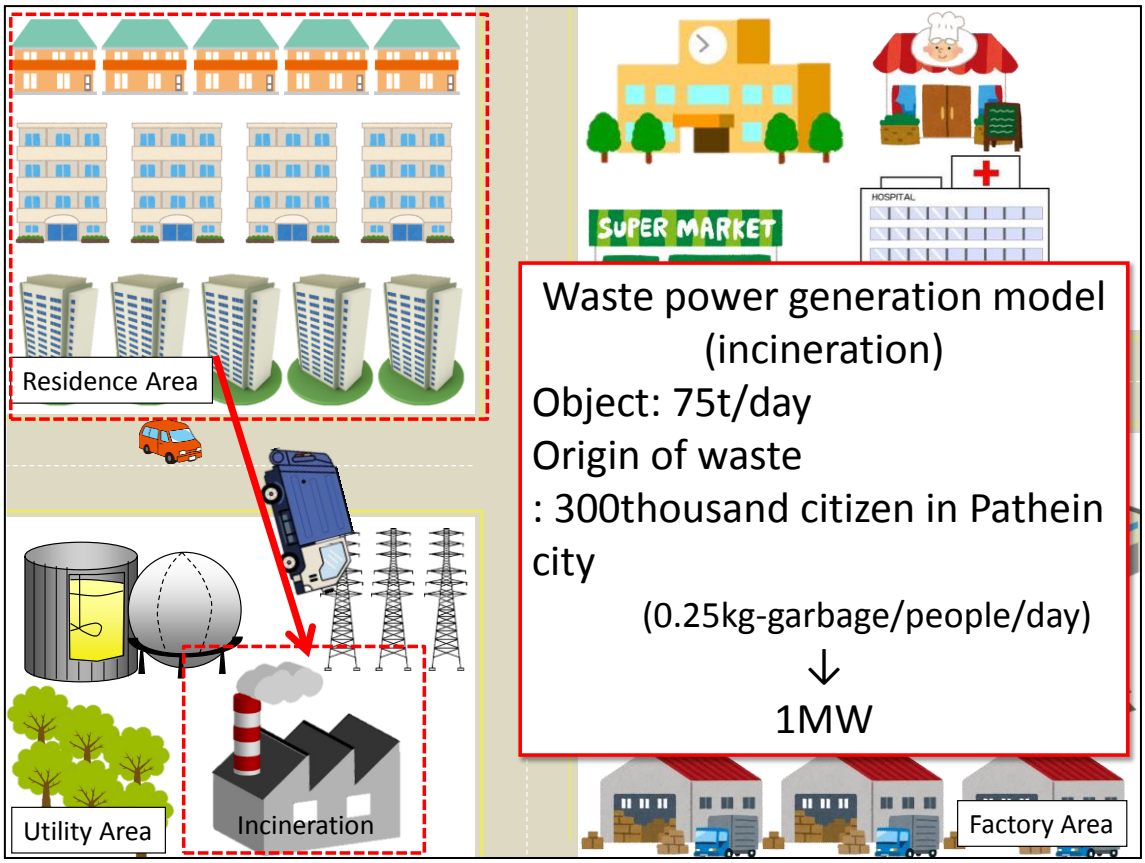


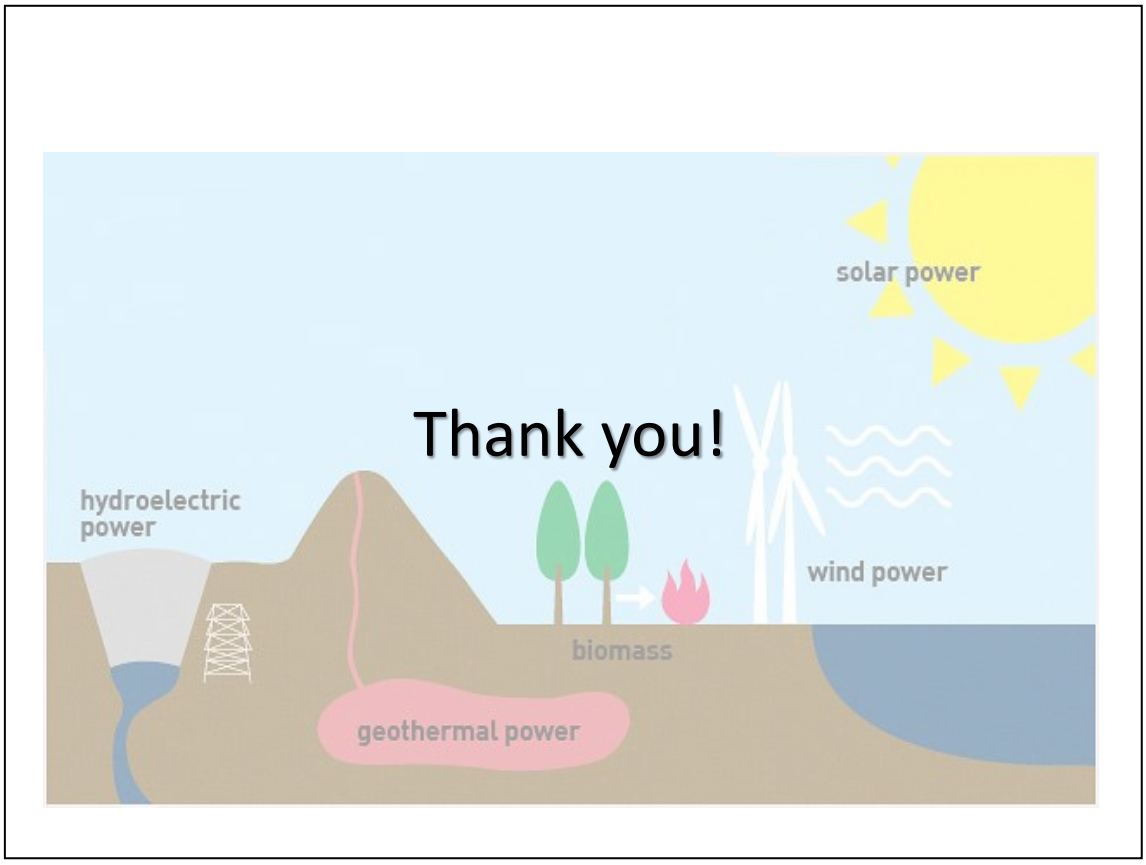
Contents

1. Example of adoption of technology in Japan
   - Renewable technology
   - Waste power generation technology
     Waste incineration power generation in Fukushima city
     Bio-gasification of organic waste
2. Idea of Low Carbon Initiative in industrial park


Solar Power model
Object: Sewing plant
Roof top : 4,000m²
↓
540kW
SUPER MARKET
HOSPITAL
Commercial Area
Utility Area
Factory Area


SUPER MARKET
HOSPITAL
Commercial Area
Residence Area
Waste power generation model
(Bio-gasification)
Object: 58t/day
Origin of waste
: commercial area, food factory
↓
Capacity 0.5MW
Utility Area
Factory Area


Residence Area
SUPER MARKET
HOSPITAL
Waste power generation model
(incineration)
Object: 75t/day
Origin of waste
: 300thousand citizen in Pathein city
(0.25kg-garbage/people/day)
↓
1MW
Utility Area
Incineration
Factory Area


Thank you!
solar power
hydroelectric power
wind power
biomass
geothermal power

Appendix 14: Workshop in Fukushima City (2015.10)

Overview of the Fukushima City visit

Date: October 20th~22nd, 2015

Agenda:

Date	Place	Agenda
October 20th	Fukushima City	■ Site visit: waste collection site ■ Site visit: industrial zone
October 21st	Fukushima City Hall Arakawa Clean Center Corasse Fukushima	■ Visit to the Mayor ■ Site visit: waste treatment and recycling facility ■ Workshop and seminar
October 22nd	Tsuchiyu Hot Spring	■ Site visit: Binary Cycle Geothermal Power Plant

Participants:

Name	Organization	
Myo Lwin	Ministry of Industry Directorate of Industrial Supervision & Inspection	Director
Zaw Htay	Ministry of Environmental Conservation and Forestry Forest Department	Director Ayeyarwady Region
Moe Han Soe	Ayeyar Hinthar Ayeyarwady Development, Business Development & Strategic Planning Department	General Manager

*Interpreter: Nway Nway Htut, Fujita Corporation Yangon Branch

Overview of the workshop

Date	October 21st, 2015 13:00~15:00
Place	Corasse Fukushima Meeting Room (5F)
Program	13:00~13:15 Opening Remarks from Japan and Myanmar 13:15~13:25 Activities in the Ayeyarwady Region and Pathein City 13:35~14:25 Activities in Fukushima City 14:25~14:55 Local Survey in Pathein City, followed by discussion 14:55~15:00 Closing Remarks

Overview of the seminar

Date	October 21st, 2015 15:30~17:00
Place	Corasse Fukushima Meeting Room (5F)
Program	15:30~15:40 Opening Remarks from Japan and Myanmar 15:40~15:55 Overview of Myanmar 15:55~16:30 Industrial Zone Development in Pathein City 16:30~16:55 Q&A Session and Discussion 16:55~17:00 Closing Remarks

<Fukushima City Presentation>

FY2015 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia
Study for building a sustainable low carbon city around the industrial zone in Pathein City, Ayeyarwady Division, Myanmar

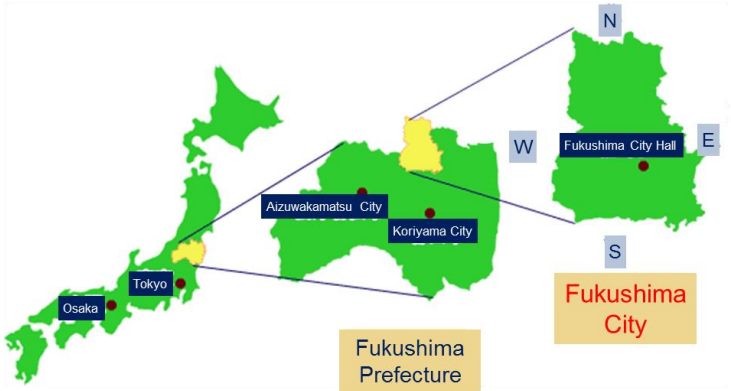
Partnership for Low Carbon Initiative in Ayeyarwady
Workshop in Fukushima

Outline of Initiative in Fukushima
in the fields of renewable energy and waste management

21th October, 2015

FUKUSHIMAမြို့.၏ အကျဉ်း

- FUKUSHIMAမြို့.သည် FUKUSHIMAခရိုင်၏ prefectural capitalဖြစ်သည်။
- TOKYOအစရှိသည်တို့.၏ မြို့.ကြီးနှင့်လည်း နီးပြီး(TOKYOမှ အကွာအဝေးသည် ခန့်.မှန်းခြေ 270㎞)အရှေ့.ဂျပန်၏အလယ်ဗဟိုတွင် တည်ရှိသည်ဟူသော ပထဝီဂင်အနေအထားတွင်လည်း သာလွန်မှုများရှိနေပြီး ကုန်းလမ်း၊ရေလမ်း၊လေလမ်းဘက်စုံမှ လမ်းပန်းဆက်သွယ်ရေး တွင်လည်း လွန်စွာအဆင်ပြေသည်။
- Iizaka, Takayu, Tsuchiyuအစရှိသည့်ရေပူစမ်းများစွာရှိပြီး သဘာဝအလှအပနှင့် ယဉ်ကျေးမှု၊ ကုန်ထုတ်လုပ်ငန်းများ သဟဇာတကျကျတည်ရှိနေသော မြို့.တစ်မြို့.ဖြစ်သည်။
- လူဦးရေ 283,415ယောက်၊ အိမ်ထောင်စုအရေအတွက် : 117,390 (2015ခုနှစ် စက်တင်ဘာလ ၁ရက်နေ့. လက်ရှိ)
- ဧရိယာသည် 768km2



1

Outline of Initiative in Fukushima

2

FUKUSHIMAမြို့.ရှိRenewable Energyကလွှ ပေါ်လစီကိုမိတ်ဆက်ခြင်း

FUKUSHIMAမြို့.တွင် 2015ခုနှစ်ဖေဖော်ဂါရီလ「FUKUSHIMAမြို့. Renewable Energyထည့်သွင်းသုံးစွဲရေးရှေ.ဆက်မည့်အစီအစဉ်」ကို လုပ်ဆောင်နေသည်။

အစီအစဉ်ချမှတ်ရသည့်ရည်ရွယ်ချက်
Renewable Energyထည့်သွင်းရေးကိုပိုမိုရှေ.ဆက်ပြီး၊ မြို့.မြို့.သူမြို့.သား၊လုပ်ငန်းရှင်များကတစ်ထပ်တည်းကျပြီး「Environmental Advanced City FUKUSHIMA」လက်တွေ.အကောင်အထည်ဖော်ရေးကို မျှော်မှန်းရန်အတွက်နည်းလမ်းတစ်ခုအနေနဲ့.မြို့.၏ထူးခြားချက်နှင့်ကိုက်ညီသောRenewable Energyထည့်သွင်းရေးအတွက်အလားအလာနှင့် တိကျသေချာသောဖွဲ့.စည်းပုံကိုဖော်ပြထားသည်။

Renewable Energyထည့်သွင်းသုံးစွဲရေးစည်းမျဉ်းစည်းကမ်း
(1) ဒေသ၏ထူးခြားချက်ကိုအသုံးချပြီး Energy self-sufficiencyကိုမြှင့်တင်ခြင်း။
(2) Energy self consumption type facilitiesတိုးပွားရန်ရှေ.ဆက်။
(3) မြို့.၊မြို့.သူမြို့.သား၊လုပ်ငန်းရှင်များက တာဂန်ခွဲဝေခြင်းကို သိသာမြင်သာအောင်လုပ်ပြီး တစ်သားတည်းပေါင်းစပ်ဖွဲ့.စည်း။

အစီအစဉ်၏ကိန်းဂဏန်းရည်မှန်းချက်

Energy self-sufficiency
FY2020：30%
FY2030：40%
FY2040：50%

Energy self consumption type facilitiesတိုးပွားမှုနှုန်း
(public facilities)
FY2020：20%
FY2030：60%
FY2040：100%

(သာမန်လူနေအိမ်)
FY2020：13%
FY2030：25%
FY2040：40%

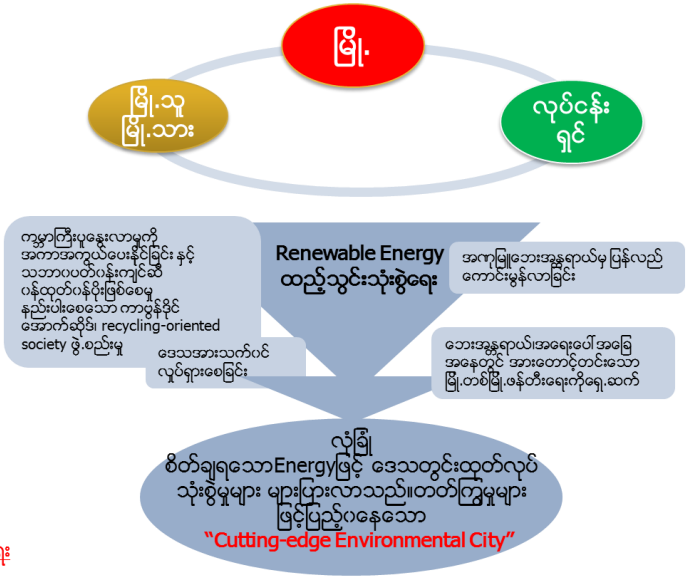
3

FUKUSHIMAမြို့.ရှိRenewable Energyကလွှ ပေါ်လစီစတင်ခြင်း

FUKSHIMAမြို့.၏ထူးခြားချက်များနှင့် ကိုက်ညီသောRenewable Energy ထည့်သွင်းအသုံးပြုရေးကို မြို့.၊ မြို့.သူမြို့.သားများ၊လုပ်ငန်းရှင်များက တစ်သားတည်းကျပြီး အားသွန်ခွန်စိုက် ရှေ့.ဆက်လုပ်ဆောင်ကြမည်။

တစ်ဖန် Renewable Energyထည့်သွင်း အသုံးပြုခြင်းကြောင့် ကွမ္ဘာကြီးပူနွေးလာမှုကို အကာအကွယ်ပေးနိုင်ခြင်း နှင့် သဘာဝ ပတ်ဝန်းကျင်ဆီ ဝန်ထုတ်ဝန်ပိုးဖြစ်စေမှု နည်းပါးစေသော ကာဗွန်ဒိုင်အောက်ဆိုဒ်၊ recycling-oriented society ဖွဲ့.စည်းမှုကို စတင်ပြီး၊ အဏုမြူဘေးအွန္တရာယ်မှ ပြန်လည် ကောင်းမွန်လာခြင်း၊ ဒေသလုပ်ရှား ဆောင်ရွက်မှုများ လုပ်ဆောင်ရင်းဖြင့် ဘေးအွန္တရာယ်၊အရေးပေါ် အခြေအနေတွင် အားတောင့်တင်းသော မြို့.တစ်မြို့. ဖန်တီးရေးကိုရှေ့.ဆက်ရန်အတွက် လုံခြုံ စိတ်ချရသောEnergyဖြင့် ဒေသတွင်းထုတ်လုပ် သုံးစွဲမှုများ များပြားလာသည်။တတ်ကြွမှုများ ဖြင့်ပြည့်ဝနေသော "Cutting-edge Environmental City"အကောင်အထည်ဖော်ရေး အတွက် ရည်ရွယ်ပြီး၊ အနာဂါတ်တွင် အဏုမြူ စွမ်းအင်မရှိသော မြို့.တစ်မြို့.ဖြစ်စေရန် ရည်ရွယ်သည်။

FUKUSHIMAမြို့.ကရည်ရွယ်ထားသောအနာဂါတ်ဇယား



source : FUKUSHIMA City Renewable Energy Introduction Promotion Plan

Specific Projects

Promoting Installation of Renewable Energy Generation Equipment

By installing solar power system equipped with storage cell in places giving priority to emergency evacuation sites, implementation of renewable energy and enhancement of function as disaster prevention base are both promoted.

Number of installation (as of March 2015) 14/145 facilities

By 2040 (long-term goal) 145/145 facilities =100%

6

Incentives for Installation of Solar Power Generation System

By providing incentives for installation of residential solar power generation system, implementation of renewable energy in households is promoted.

1. Amount of subsidy: 30,000JPY/kW (Max. 120,000JPY for 4kW)

2. Granted subsidy: about 600 permissions/year

***Installations as of March 2015: 5,021/80,893households**

7

Locally-Produced-and-Consumed Waste Power Generation Project

By utilizing electricity generated from remaining heat in waste incineration at incinerators and 69 local public schools, local production and consumption of renewable energy is promoted.

1. Maximum output: 5,100kW
2. Annual generation: 26,432kWh
3. Installed: August 2008

*Hot water supply to neighboring facilities is provided as well.

Steam turbine generator

8

Projects by Private Businesses (1)

○ Renewable Energy Project in Tsuchiyu Hot Spring Area

1. Small scale hydraulic power generation utilizing sand dam

1.Power output: 140kW
2.Annual generation: about 900,000kWh
3.Installed: May 2015

Sand dam

Cross-flow water turbine

9

2. Geothermal binary power generation utilizing hot spring heat

1.Power output: 400kW
2.Annual generation: about 2,600,000kWh
3.To be installed in November 2015

Projects by Private Businesses (2)

○Mega solar project utilizing idle land

Mega solar power plant in the city
（Photo credit: Apollo Gas）

FUKUSHIMAမြို့တွင် စွန့်ပစ်ပစ္စည်းဖြေရှင်းရေးကဏ္ဍ ပေါ်လစီ မိတ်ဆက်ခြင်း

FKUSHIMAမြို့တွင် သာမန်စွန့်ပစ်ပစ္စည်းများအား သင့်တော်သောဖြေရှင်းမှုနှင့် ပမာဏလျော့ချမှုကို ရှေ့ဆက်ရန်အတွက် 「FUKUSHIMAမြို့.သာမန်စွန့်ပစ်ပစ္စည်းဖြေရှင်းရေးအခြေခံစီမံချက်」ကို လုပ်ဆောင်နေသည်။

အခြေခံစဉ်းများစဉ်းစားကိန်း

(1)စွန့်.ပစ်ပစ္စည်းများပေါ်ထွက်လာမှုကိုထိန်းချုပ်ခြင်း၊ပြန်လည်အသုံးချခြင်း၊ပြန်လည်ပြင်ဆင်အသုံးချခြင်းတို့.ကို အခြေခံတစ်ရပ်အဖြစ်ထားသော 3Rလှုပ်ရှားမှုရှေ့.ဆက်ခြင်းဖြင့် Recycling-Oriented Societyကိုဖွဲ့.စည်း

(2)စွန့်.ပစ်ပစ္စည်းများကိုအသင့်တော်ဆုံးဖြေရှင်းမှုကိုရှေ့.ဆက်လုပ်ဆောင်ခြင်းကြောင့် လုံခြုံပြီးသက်တောင့်သက်သာရှိသောနေထိုင်မှုပတ်ဝန်းကျင်ကို ထိန်းသိမ်း

(3)မြို့.သူမြို့.သားများ၊လုပ်ငန်းရှင်များ၊အုပ်ချုပ်ရေးအဖိုင်းတို့.ပူးပေါင်းလုပ်ဆောင်ခြင်းကြောင့် ပတ်ဝန်းကျင်ကိုရှေ့ရှုည်တည်တံ့စေ

Source：FUKUSHIMA City Wastes processing basic plan(Summary version)

3Rဆိုသည်မှာ ကန်.သတ်ချက်ရှိသော ကမ္ဘာပေါ်ရှိသယံဇာတများကို အကျိုးရှိရှိအသုံးချခြင်းနှင့် ကမ္ဘာ့ပတ်ဝန်းကျင်ကိုရေရှည်တည်တံ့စေရန်အတွက် ပတ်ဝန်းကျင်နှင့်စီးပွားရေးနှစ်ခုစလုံးရပ်တည်နိုင်သော Recycling-oriented Societyဖန်တီးရန် Keyword

အမှိုက်ဖြေရှင်းရေးရည်မှန်းချက်

1ဒေါက်တာတွင်လူဝယောက်၏အမှိုက်စွန့်.ပစ်ပမာဏ (g/person･day)

FY2010：1,109 → FY2020：890

စုစုပေါင်းအမှိုက်စွန့်.ပစ်ပမာဏ(t)

FY2010：117,971 → FY2020：91,600

Recycling rate(%)

FY2010：16.1 → FY2020：26.0 and over

နောက်ဆုံးရှင်းလင်းခြင်းပမာဏ(t)

FY2010：12,983 → FY2020：9,000

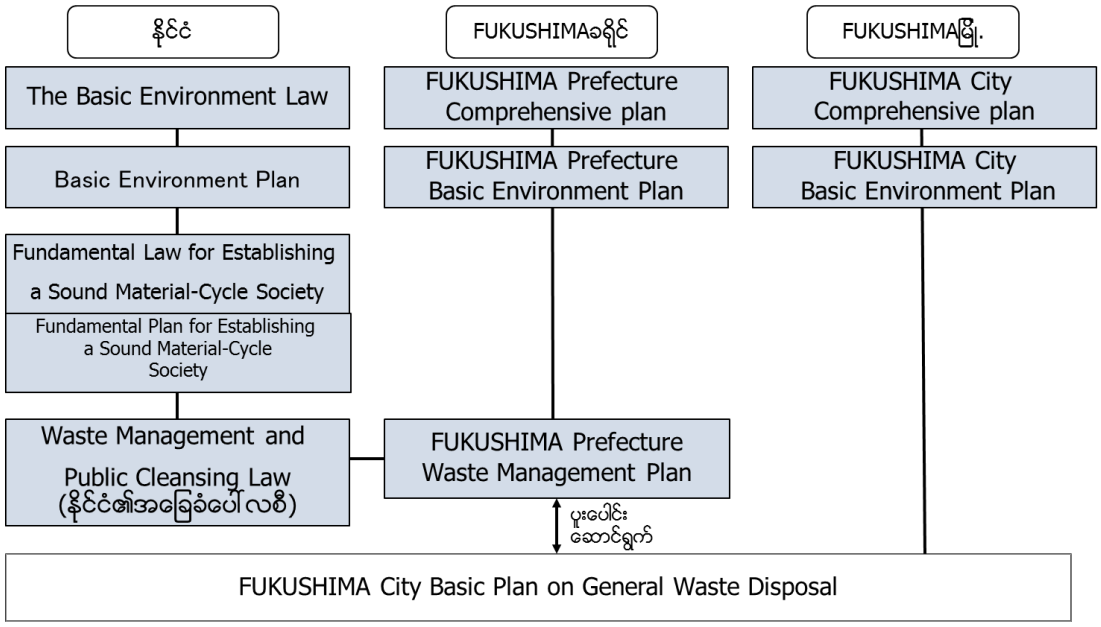
～နေ့စဉ်နေထိုင်မှုထဲမှထွက်ပေါ်လာသော အမှိုက်ပမာဏလျော့ချခြင်းကို～

Reduce
Reuse
Recycle

12

FUKUSHIMAမြို့.ရှိစွန့်.ပစ်ပစ္စည်းဖြေရှင်းရေးကဏ္ဍ ပေါ်လစီ မိတ်ဆက်ခြင်း

FUKUSHIMA မြို့. သာမန်စွန့်.ပစ်ပစ္စည်းဖြေရှင်းရေးအခြေခံအစီအစဉ်သည် FUKUSHIMA City Comprehensive Plan, FUKUSHIMA City Basic Environment Plan တို့.၏ low rank plan အနေဖြင့် နေရာယူထားသည်။



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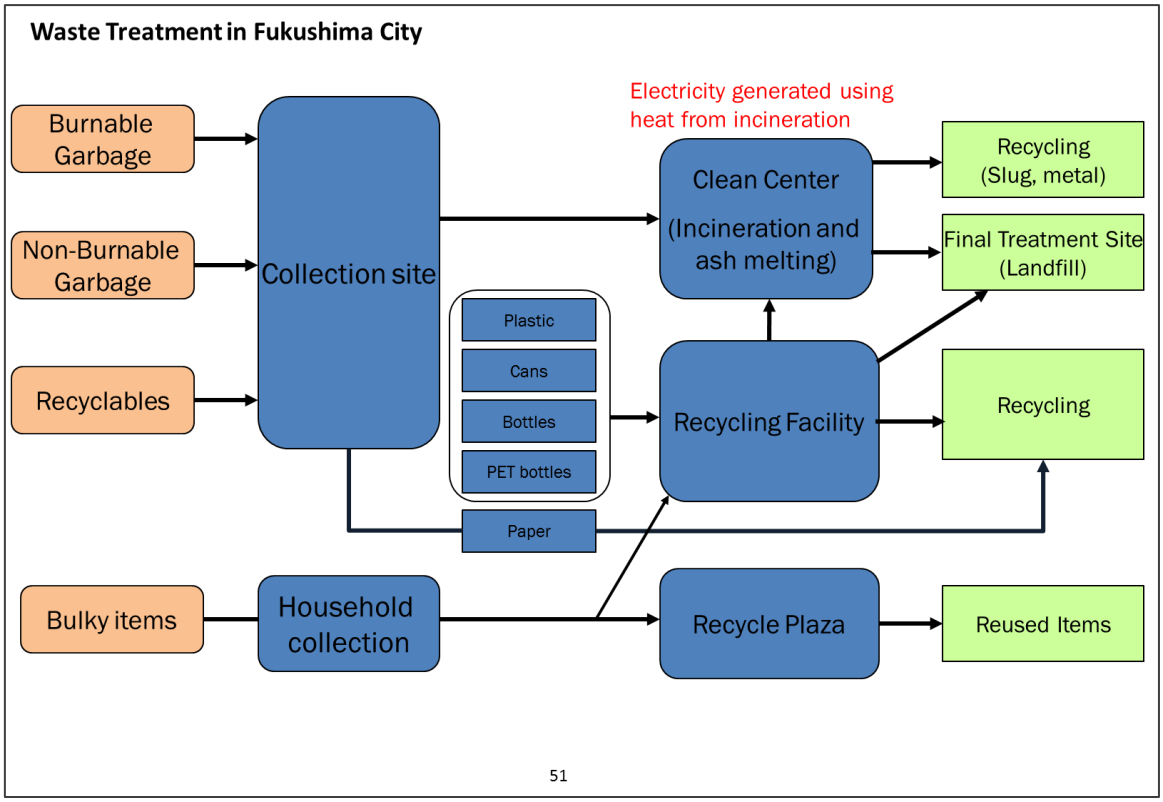
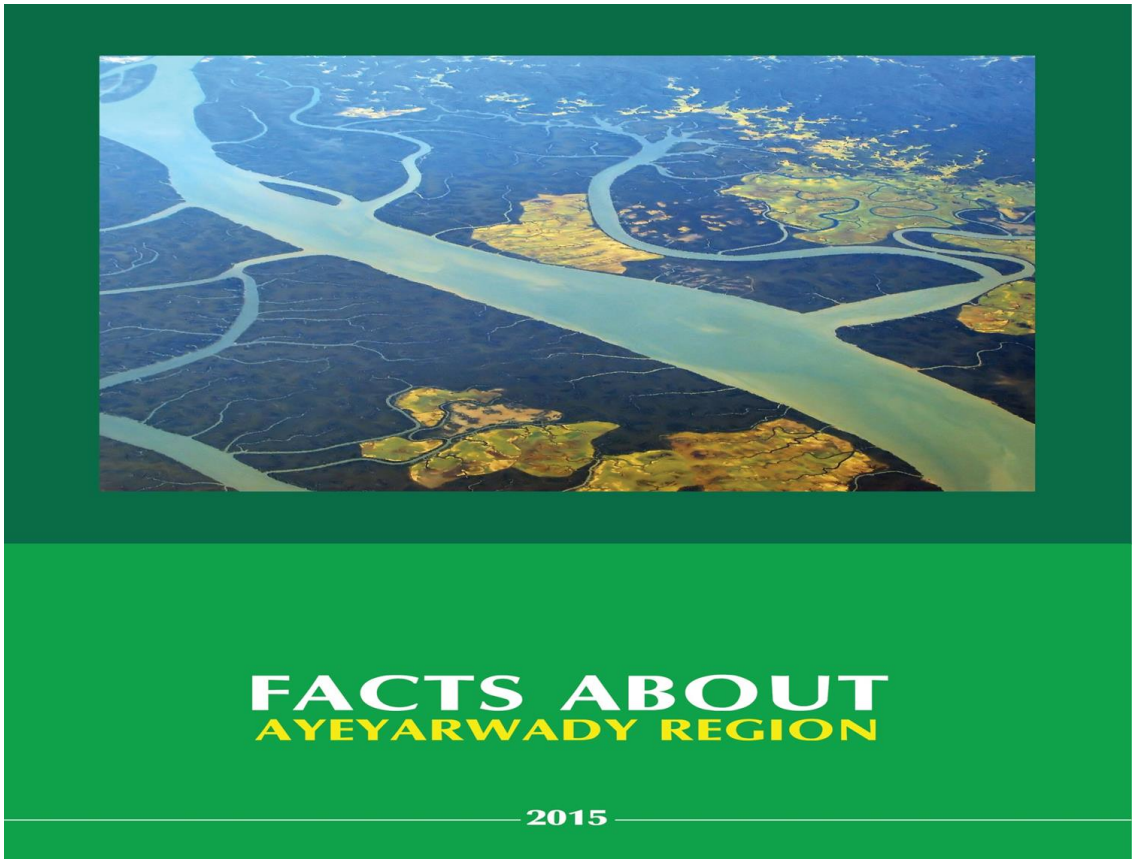

Waste Treatment in Fukushima City
Electricity generated using heat from incineration
Burnable Garbage
Non-Burnable Garbage
Recyclables
Collection site
Clean Center
(Incineration and ash melting)
Recycling (Slug, metal)
Final Treatment Site (Landfill)
Plastic
Cans
Bottles
PET bottles
Paper
Recycling Facility
Recycling
Bulky items
Household collection
Recycle Plaza
Reused Items
51

<Myanmar Presentation>



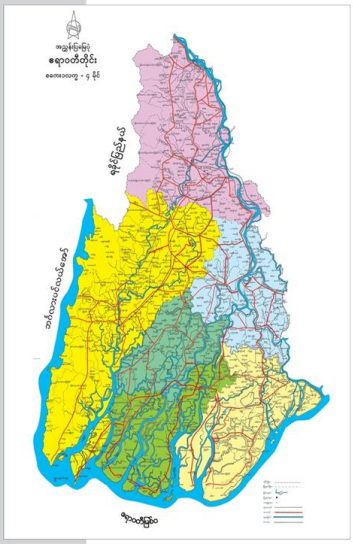
FACTS ABOUT
AYEYARWADY REGION

2015

CHIEF MINISTER'S PROFILE

- H.E. TheinAung
- D.O.B: 12 Feb. 1948
- Birth Place: Ingabu Tsp, Ayeyarwaddy Region
- Education: B.Sc(Defense Services Academy)
- History of Service
  - 1964 - 1968: Cadet (Defense Services Academy)
  - 1968 - 1997: Army Officer (Second Lt. to Brigadier General)
  - 1997 - 2003: Ministry of Energy Deputy Minister
  - 2003 - 2011: Ministry of Forestry Minister
  - 2011 - to date: Chief Minister of Ayeyarwady Region

TABLE OF CONTENT



LOCATION

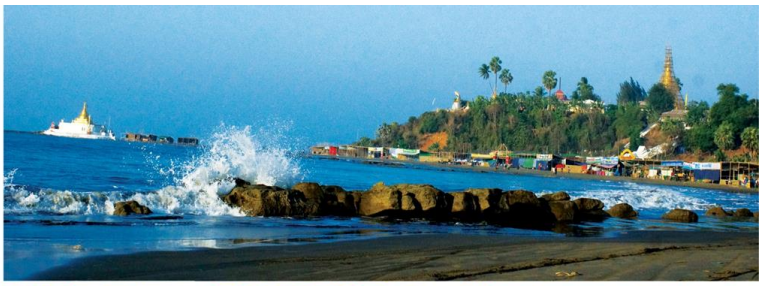
- Southernmost region of Central Myanmar.
- Land Size: 13,567 sq. miles
- Delta region of Ayeyarwady River
- Land profile:
- Plains & low-land
- Rivers & creeks

ADMINISTRATION

Number of	Units
Districts	6
Townships	26
Towns	13
Wards	273
Village Tracts	1919
Villages	11908

POPULATION

Population	Acers(2014)
People	5958197
Ethnicities	Burmar
	Karen
	Rakhine
	Chin
Density	439/sq.mile



EDUCATION

	Primary	Middle	High	University
Schools	6023	306	197	12
Teachers	28661	9240	3450	2580
Students	709640	320443	95469	28609

HEALTHCARE

	200 BEDS	200 BEDS & Above
General Hospital with Specialist Services	6	105
Private Specialist Hospitals	-	10
Health Clinics	222	
Sub-health Clinics	1132	








OIL & GAS

- Large amount of untapped reserves
- Enough to be self-sufficient and not dependant on international market and imports.



AGRICULTURE LAND USE

Crop	Acres(2015)
Monsoon Paddy	3.6 million
Summer Paddy	1.2 million
Beans/Pulses	1.1 million
Sugar cane	195
Yellow maize	24598
Rubber	33570
Pepper	6945

Oil Crop	
Groundnut	113395
Sunflower	43307
Mustard	110
Jetropha	134559

Type of Land	Acres(2015)
Cultivable Land	4.9 million
Waste Land	54976

Produces 35% of Myanmar's Rice Production

LIVESTOCK & FISHERIES

Type of Livestock	Number(2015)
Buffaloes	239861
Cattle	1256605
Goat	113014
Pig	1643668
Chicken	20079772
Duck	3799905

Fisheries	Acres(2015)
Fish pond/aquaculture	115461.89
Prawn/shrimp	57891.59

FORESTRY

Forestry	Hectare(2015)
Forest Reserve	565519.99
Natural Forest	13669.88
Teak	7122.47
Commercial Forest	18008.51
Village Use	21853.03
Industrial Use	7162.94
Watershed	180749.20
Private Teak Plantation	2998.72
Private Hardwood Plantation	1778.99

TELECOMMUNICATION

Communication	Unit
Auto Telephone Exchange	39
Auto Telephone Capacity	23713
Mobile Radio Station	189
Mobile Telephone Capacity	696107
ADSL lines	319
Microwave Station	38
Submarine Fiber Cable Station	3
Telephone Density	11.7%

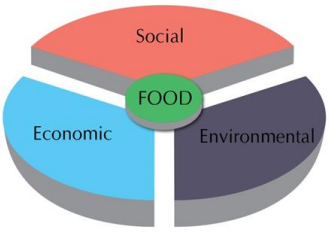
SALT

# of Productionsites	Total Production Area(ACRES)	Production (MT)
352	14360.92	130325.05


INDUSTRIAL ZONES
• Pathein Industrial Zone
- 252.8 Acres
• Hinthada Industrial Zone
- 86.2 Acres
• Myaungmya Industrial Zone
- 58.1 Acres
DIG
MANUFACTURING


TOURISM
• Two famous beaches
NgweSaung & ChaungTha Beaches
- 29 miles from Pathein Airport
- 30 minutes flight from Yangon
Mawtin Pagoda and beach are also well known
as tourist attraction.

FUTURE POTENTIAL



OPTIMIZING VAST RIVER SYSTEM

Irrigation
- 4 dams
- Manage planting and farmer income during dry season

Port
- Lower transportation cost
- Reduce bottleneck congestion
- Promote trade and export

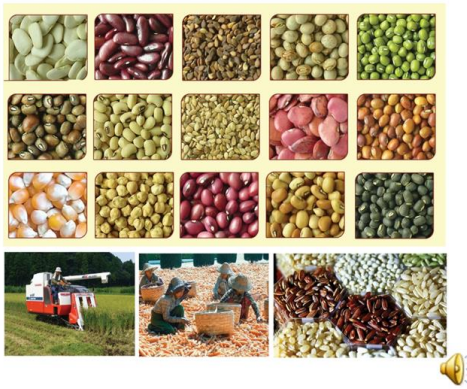
FROM RICEBOWL TO LIFEBOWL

Ayeyarwaddy is famous for food security:
- Agriculture
- Livestock
- Fisheries

Development of multi-commodity production centers.

INVESTING ACROSS THE VALUE CHAIN

Inclusive and Integrated Development



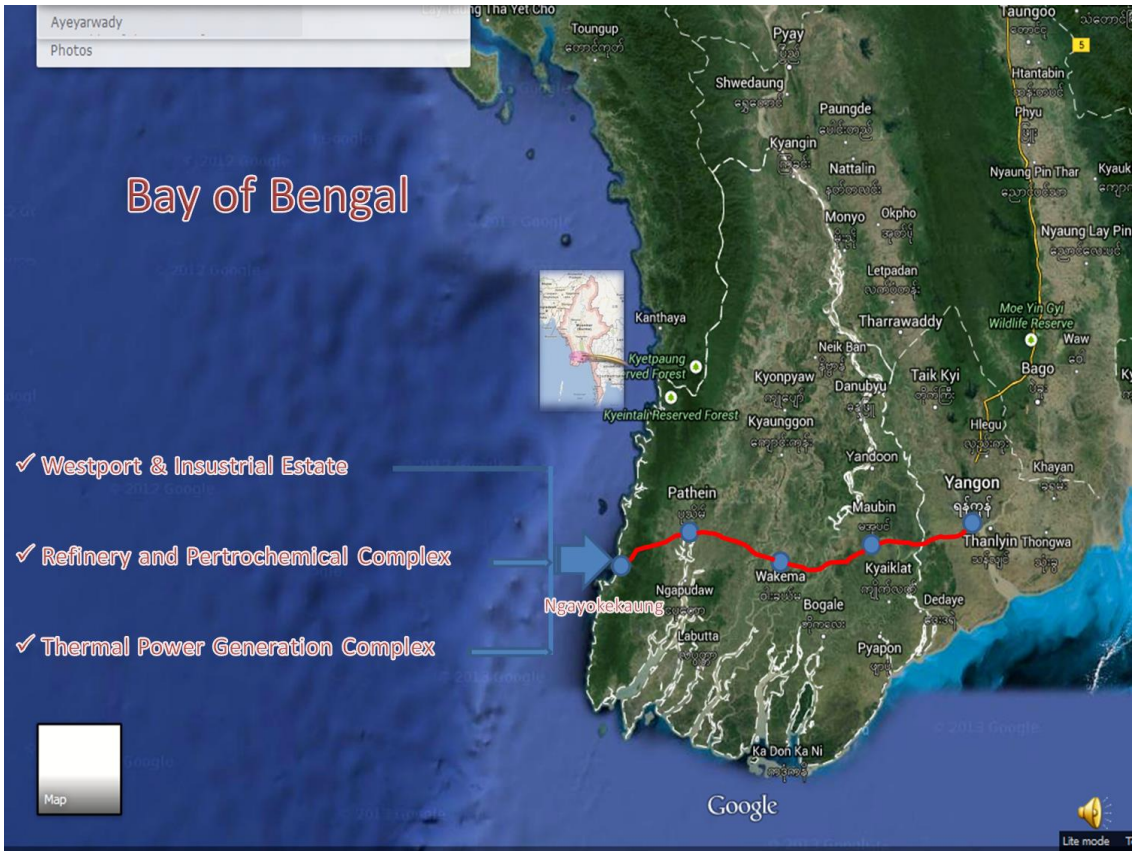
PATHEIN

- Capital of Ayeyarwaddy Region
- 300,000 people
- Established city
  - Own airport
  - Railway connectivity
  - Road network
  - Port and river way access
- To be developed into future urban city

Future Investment Plan

PROPOSE PROEJCTS

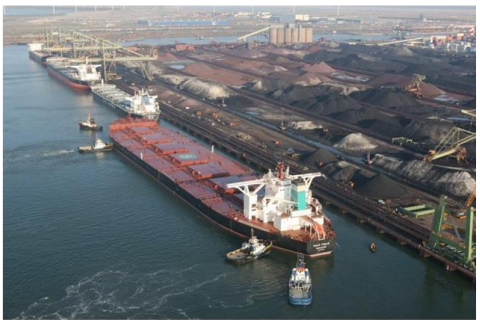
- **Westport & Industrial Estate**
- **Refinery and Petrochemical Complex**
- **Thermal Power Generation Complex**
- **Road, Rail, Transmission & Pipe Lines**
- **Telecommunications**
- **Community Development and Industrial Parks(Hubs)**



Refinery and Petrochemical Complex

Thermal Power Generation Complex

Coal Plantation



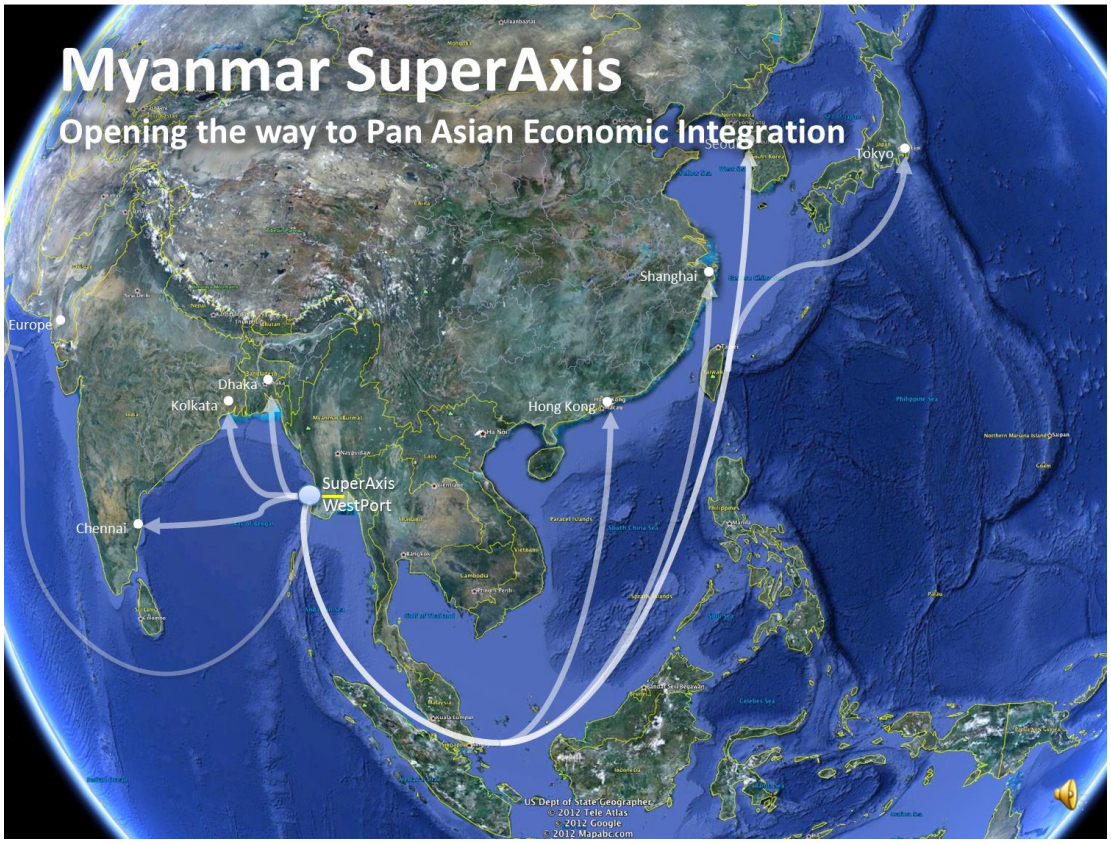
Power Plant:

- Initially coal fired, but with the option to convert to gas in later phase
- Primary for port and (heavy) industry
- Secondary for SuperAxis hinterland

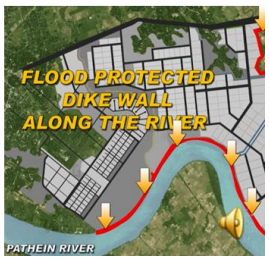
Capacity development:

- Phase 1: 700 MW
- Phase 2: 700 MW additional
- Phase 3+: 2 x 700 MW additional

Note: an additional 100 MW will be produced by co-generation gas turbine, located at the refinery or gas plant.



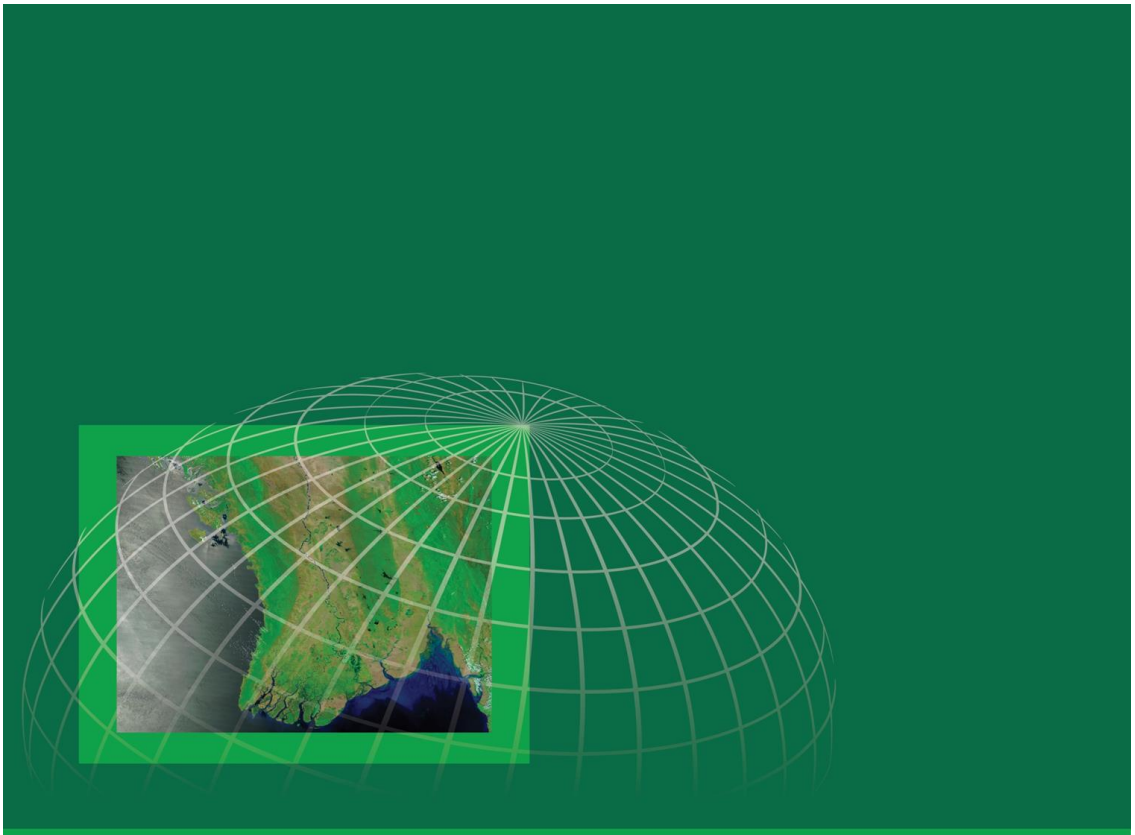
AYEYARWADDY DEVELOPMENT Co.,Ltd



AYEYARWADDY DEVELOPMENT Co.,Ltd

Other Facilities

- Residential Estate
- 18 Holes Golf Course
- Pathein Industrial Stadium
- River Side Park
- Green Area Outdoor Canteens
- Shopping Center and Supermarket



Ayeyarwady Regional Government Office

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Fax : +95-42-25275
Email : awyregion.gov.mm@gmail.com
Website : www.ayeyarwady.gov.mm

New Pathein Port And Industrial Estate

AYEYARWADDY DEVELOPMENT Co.,Ltd

For Reference: TEAM GROUP IBS

Introduction

Ayeyarwaddy Region and its naturally irrigated soil provide fertile grounds for abundant agriculture and fresh produce to prosper.

The Ayeyarwaddy Region, otherwise known as the "Rice Bowl of Myanmar," accounts for producing roughly 35% of the country's rice.

In addition to rice, other crops include maize, sesame, groundnut, sunflower, beans, pulses, and jute.

Fishery is also important; producing fish, prawn, fish-paste, dry fish, dry prawn, and fish sauce.

Mission

Alleviate the poverty rate of the region with Economic development and activities.

Increase influx of foreign currency / local income by promoting export.

Enhance the living standards and job opportunities in the region.

Create international standard business opportunities in Industrial and Trade sectors.

Site Location

- Distance from YGN to Pathein : 188 km
- Types of Businesses
  - Rice Mill and Rice Processing Factories
  - Downstream rice production Factories
  - Bean, Corn, and Sesame Processing Factories
  - Fishery cold storage and Processing Factories
  - Garment Factories
  - Forestry products and Processing Factories
  - Agricultural and Farming Machinery Production Factory
  - Electronic and Consumer products Factories
  - Storage and Logistic Service Businesses

Hinterland of Pathein Port

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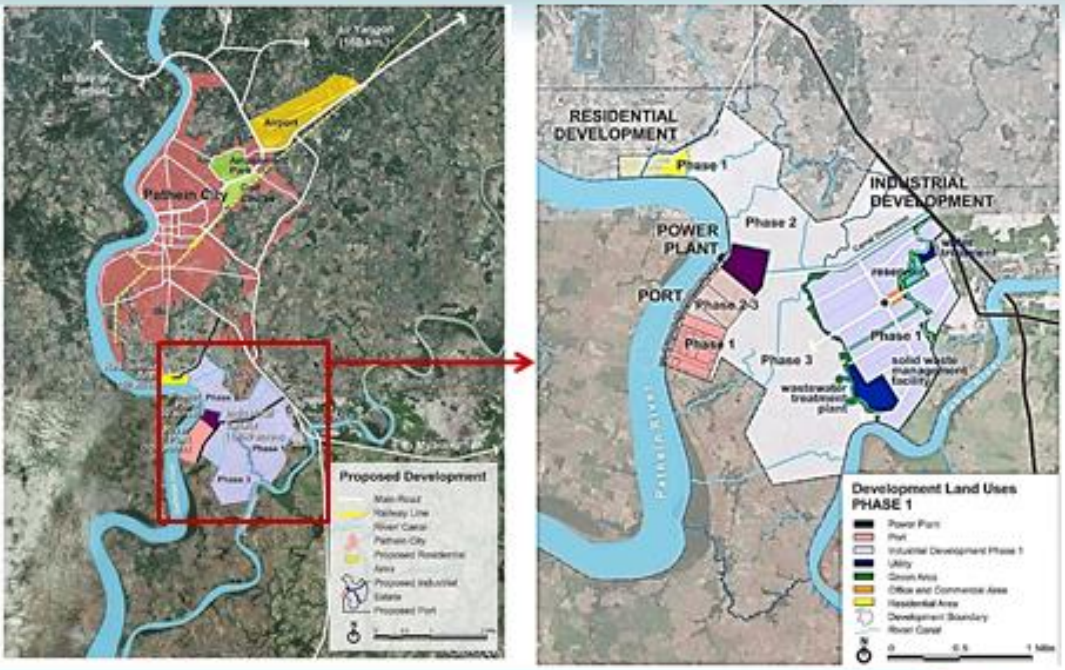
Proposed Development Site



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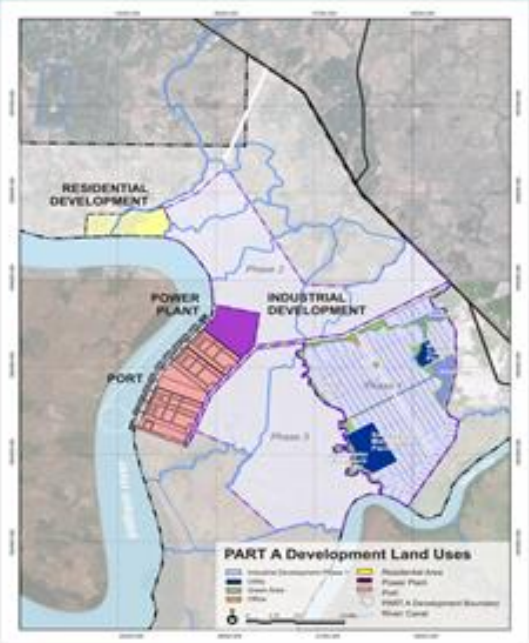
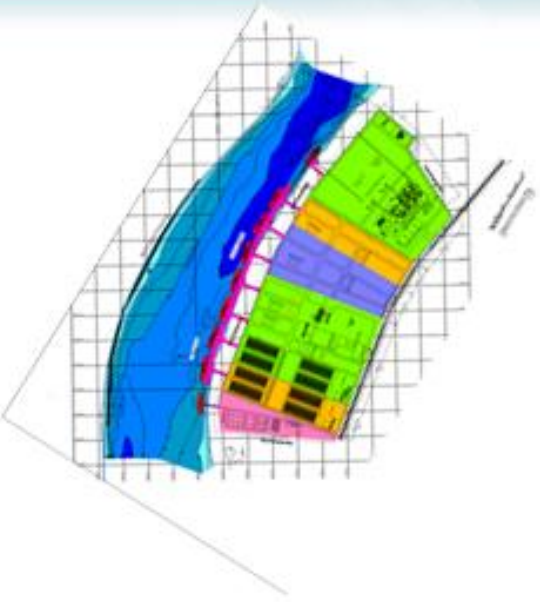
Port Terminal Plan





Power Plant & Coal Port

Self-sustaining City

- To build reliable and sufficient power supply to support the International requirements of the Estate's Industrial Operators.

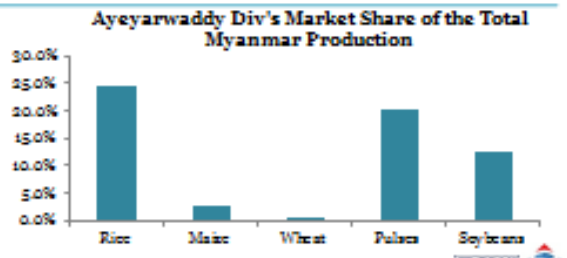
Phased Planning

- To build 15MGW Electric Power Plant for Phase-1 and continue to expand 3 units based on operator requirements.

Resource – Based View Analysis : Agriculture

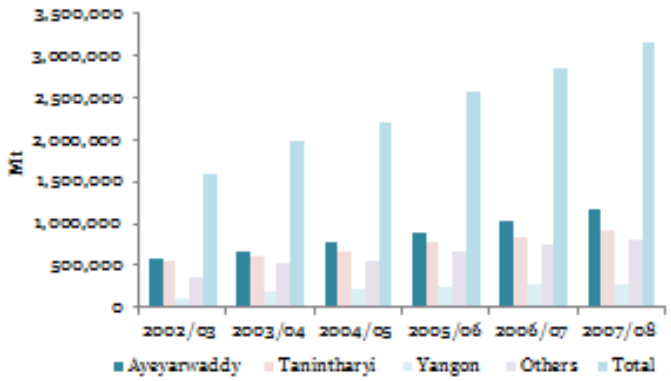
State/Division	Rice (Mt)	Maize (Mt)	Wheat (Mt)	Pulses (Mt)	Soybeans (Mt)
Ayeyarwaddy	**7,509,711**	**29,512**	**898**	**1,025,760**	**27,534**
Sagaing	3,778,532	230,312	83,280	1,143,775	14,302
Bago(East)	3,075,475	3,915	-	531,424	416
Mandalay	2,151,758	54,632	23,843	580,280	12,546
Bago(West)	2,235,943	664	-	369,854	19,197
Magwe	1,513,135	80,661	871	771,567	4,896
Others	10,261,565	714,725	38,145	609,461	138,122
Total Myanamr Production	30,526,119	1,114,421	147,037	5,032,121	217,013

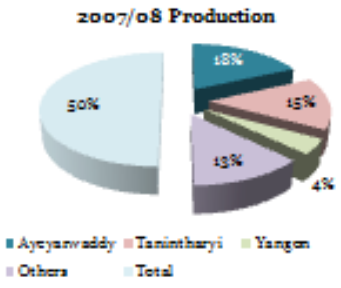
Products	Ayeyarwaddy Div's Production Ranking (Out of 17 Div)
Rice	1st
Pulses	2nd
Soybeans	3rd
Wheat	5th
Maize	10th



Source: Based on FAO data, 2009

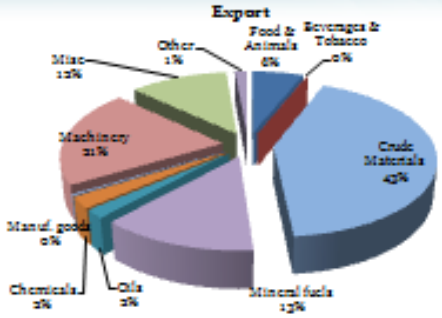
Resource – Based View Analysis : Fisheries

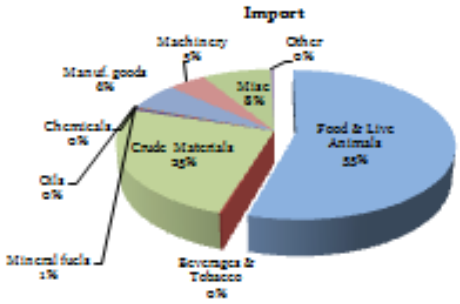




Source: Based on FAO data, 2009

General Cargo Forecast



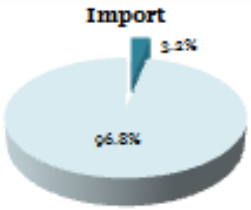


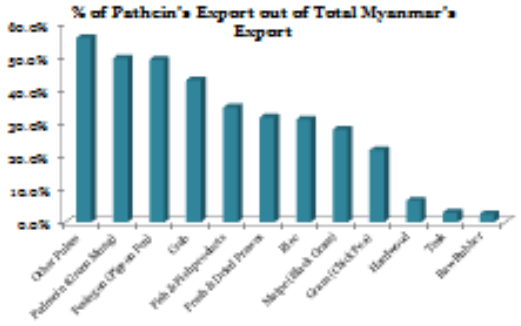
Export : Food & liveanimals (55%), and 25% is crude materials

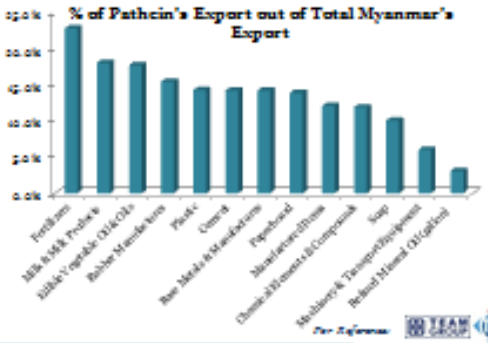
Import : Crude materials (43%), and Machinery (21%)

Source: Based on FAO data, 2009

Pathein Port – Most Likely Case







Source: Based on FAO data, 2009

3 Major Districts Near Pathein Port

	Rice		Seasonal Crops	
District	Rain Crop	Summer Crop	Wheat	Potato
Pathein	68,731	4,651	381	105
Myang Mya	80,854	5,067		
Labutta	55,132	2,811		
Total	204,717	12,529	381	105

	Seasonal Crops			
District	Onion	Peanut	Sesame	Maize
Pathein	8,392	99	38	89,699
Myang Mya				1,948
Labutta				28,009
Total				119,656

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Infrastructure

30% of the total Project Area to be used as Green Area and Buffer Zone

Efficient and well planed water reservoir, water supply and drainage systems

Special emphasis to prevent air, water and sound pollution effectively, and waste water treatment

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Project Overview

Logistics Advantage
(Cost, time, Availability)

Natural Resources
Labor Supply and competitive cost

Port
- Phase 1 : 4 million tons
- Phase 2 : 2 million tons
- Phase 3 : 2 million tons

25 – 50 million USD

Industrial Estate
- Phase 1 : 590 Acre, Saleable 400 acre
  Construction Cost 20 - 48 million USD (3 alternatives)
- Phase 2 : 550 Acre, Saleable 400 acre
- Phase 3 : 550 Acre, Saleable 400 acre

Utilities
- Water Treatment Plant
- Waster Water Treatment Plant
- Solid Waste Management System

Power Plant Reliability, Reasonable Price
- Unit 1 : 125MW
- Unit 2 : 125MW
- Unit 3 : 125MW
- Unit 4 : 125MW

Construction Cost 40 – 80 million USD

Competitors
- Yangon/Thilawa SEZ
- Dawei
- Myawaddy

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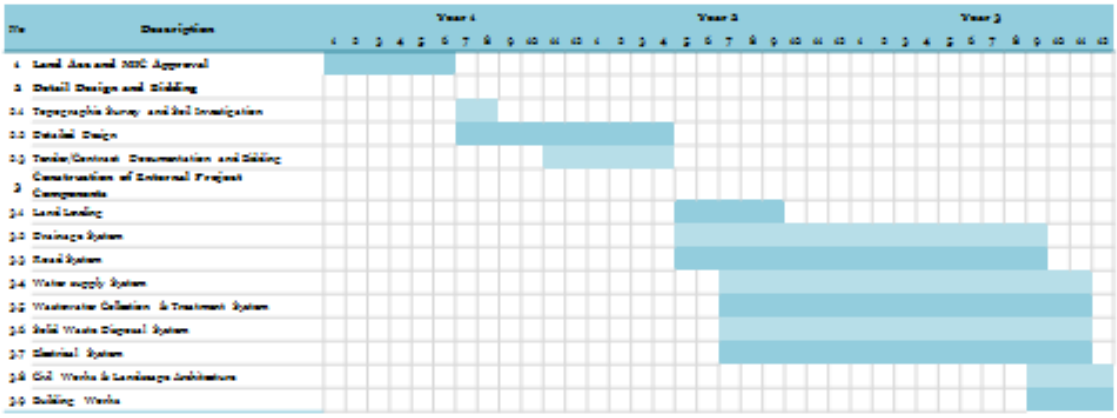
Project Construction Plan for Industrial Estate Phase-1



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Current Progress/Achievement

Received mandate from Ayeyarwaddy regional Government for project development (21 Sept. 2012)

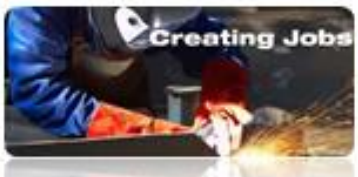
Submitted application for processing by MIC

Conducting Feasibility Study, EIA, and SIA with TEAM Consulting Group from Thailand (currently in finalizing stage)

Benefits

Increase business profits by reducing transportation cost:

- Exporting local products directly from Pathein Port to other foreign countries.



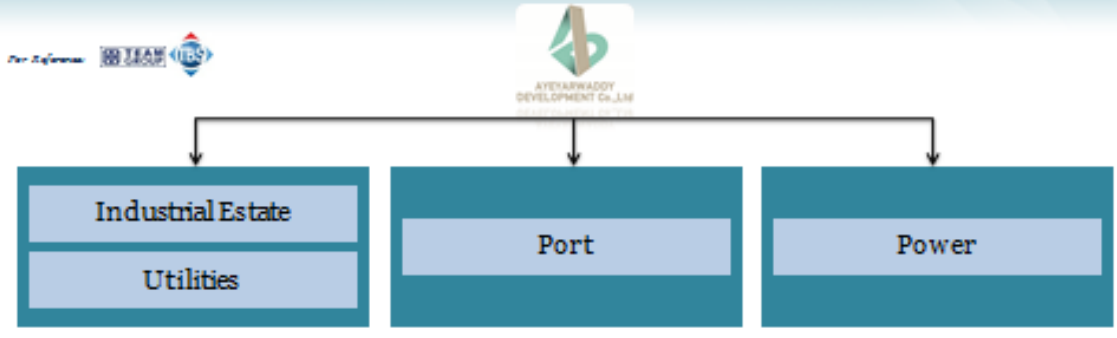
Create jobs and business opportunities for the local community:

- Generate more income and upgrade their living standard.

Development of the environment and Technology Know-How:

- Efficient water, power, and waste management,
- Improvement of sea and land transportation.

Financial Investment and Return for Phase 1 (500 Acres net)



	Initial Investment Cost (million USD)	Total Phase I Investment Cost (million USD)	FIRR
Land & Resettlement	8.48	8.48	12.20%
Industrial Estate	30.11	30.11	
Port	24.70	24.70	18.1%
Power	28.50	100.5	14.53%
Total	83.31	163.8	

* Industrial Estate Medium Standard
Power Plant 150 Kyats/Kwh

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Conclusion

This Industrial Estate and Port Project represents a good foundation for the region to develop; Not only for the local advancement of surrounding communities, but also to create national income for the Country.

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Thank you

Appendix 15: Workshop in Pathein City (2016.2)

Study for building a sustainable low carbon city
around the industrial zone in Pathein city,
Ayeyarwady Division, Myanmar

Workshop of Partnership for Low Carbon Initiative in Ayeyarwady

Date February 9, 2016. 13:30~17:00

Place Meeting room of Pathein Hotel, Pathein district.

Program

Opening remark

13:30 - 13:35 (5min) Opening & Greeting (Japanese side)

13:35 - 13:40 (5min) Greeting & Speech (Myanmar side)

Presentations

13:45 - 14:00 (15min) Key finding of visiting Japan (from Myanmar)

14:00 - 14:20 (20min) Key finding and proposal of JCM projects (from Mitsubishi Research Institute)

14:20 - 14:40 (20min) Idea of JCM projects (from Fujita)

14:40 - 15:00 (20min) Lessons from Fukushima city (Fukushima city)

15:00 - 15:15 Coffee Break

Discussion and Closing

Current situation and future prospects (from Myanmar)

Especially new industrial zone and around this area

15:15 - 15:30 (15min) Waste management in Pathein City

15:30 - 15:45 (15min) Electricity supply in Pathein City

<Photos of Local Survey Sites>

Visit to the Minister of the Ayeyarwady Region

	
Delivery of Letter of Intent from Mayor of Fukushima City to the Minister of the Ayeyarwady Region	Exchanging opinions between regional government officials and other stakeholders

The Second Workshop in Pathein City (February, 2016)

	
Workshop held for stakeholders in Ayeyarwady Region	

Development Situation in Industrial Zone Project Site (February, 2016)

	
Management office in industrial zone	Management office in industrial zone

	
Road construction in industrial zone project site	

Industrial Zone Construction Site (February, 2016)

	
Electricity line for management office	Electricity receiving transformers

	
Central part of Pathein City	Residential area in Pathein City

	
Residential building in Pathein City	Nearby area of waste collection site in Pathein City
	
School entrance	Morning meeting at a school;
	
Classroom for school (bottles and PET bottles are used as decoration)	Truck loaded with waste (Photo taken in front of a landfill site)

<Proposed JCM Project Ideas at the Workshop>

Details of JCM Project Candidates

1. Proposal in waste management: waste power plant in industrial city

- Biomass power plant using rice husks is under consideration (utilization of rice husks was pointed out as a local need)
- Separation and disposal of garbage (topic of government interest): as a first step, possibility of co-firing plastic waste, etc. collected at sites will be considered.

* Part of the power plant will be constructed before factories come in.

<Project Plans (draft)>

- Installation of a biomass power plant using rice husks aside power plant construction site in Industrial City
- Size: medium (2~3MW, considering the amount of rice husk procured)
- Fuel: Rice husks and plastic waste (collected at schools and temples; Experiences in Fukushima will be utilized)
- Power: (for now) Supplied for industrial city construction, leftover sold to the grid
  (in the future): Supplied off-grid within industrial city
- Project Owner: SPC (ex. Fujita and local partner) (under consideration)
- JCM equipment subsidy will be utilized.

2. Proposal in renewable energy: mega solar at water treatment plant

- Mega solar power plant will be installed as an independent distributed power for water treatment facility to be constructed

<Project Plans (draft)>

- Installation of PV at water treatment plant
- Size: around 1MW (considering electricity demand at water treatment plant)
- Power: (for now) Supplied for industrial city construction, leftover sold to the grid
  (in the future) Supplied for water treatment plant
- Project Owner: SPC (ex. Fujita and local partner) (under consideration)
- JCM equipment subsidy will be utilized.

<Presentations for the Workshop>

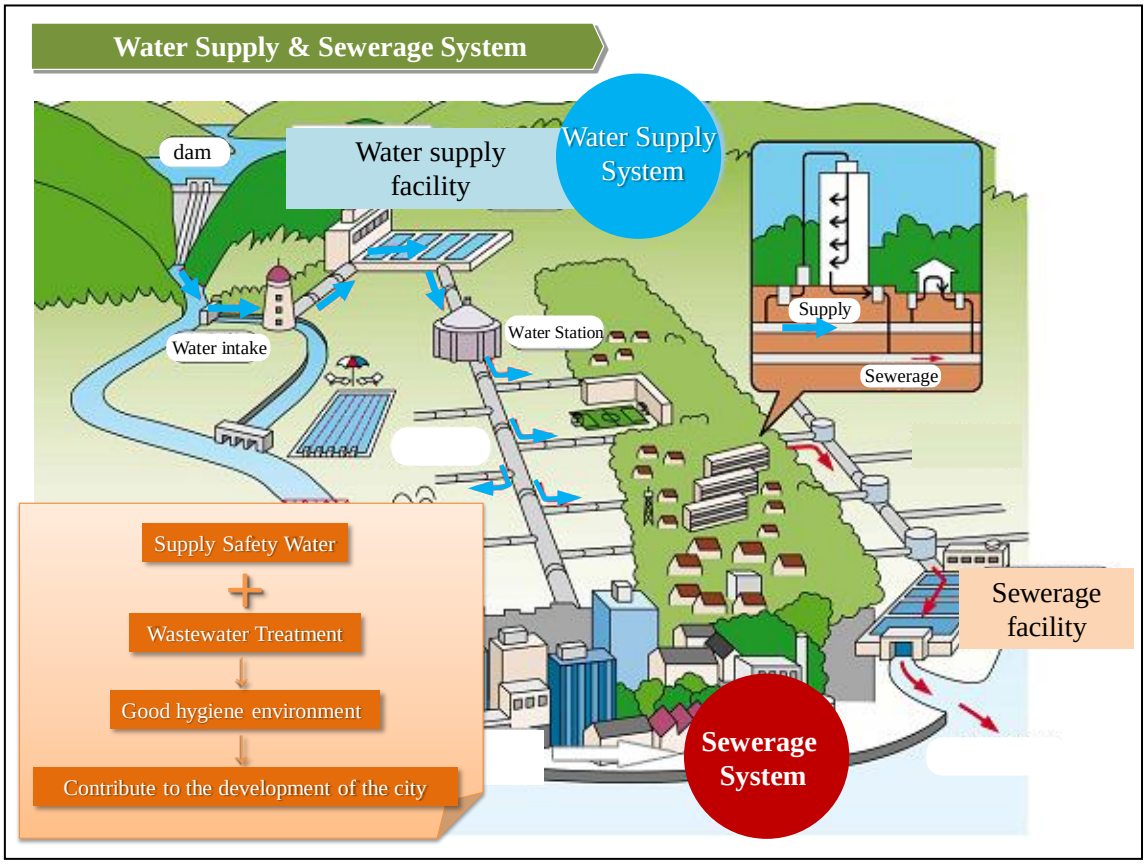
FY2015 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

Study for building a sustainable low carbon city around the industrial zone in Pathein city, Ayeyarwady Division, Myanmar

Workshop of Partnership for Low Carbon Initiative In Ayeyarwady

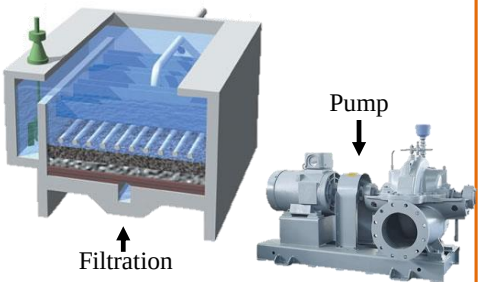
Idea of JCM Projects
☐ **Renewable Energy**
☐ **Waste Treatment**

February 9, 2016



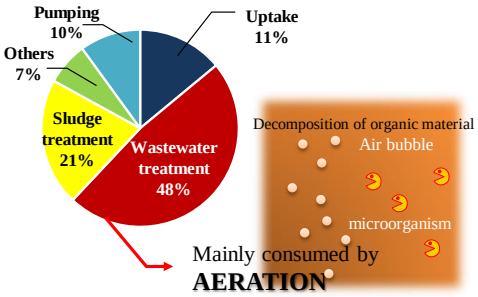
Electricity Demand for Water Facility

Water supply system



Treatment: 6,000 m^3/day
Total demand:1,367 kW/day

Sewerage System

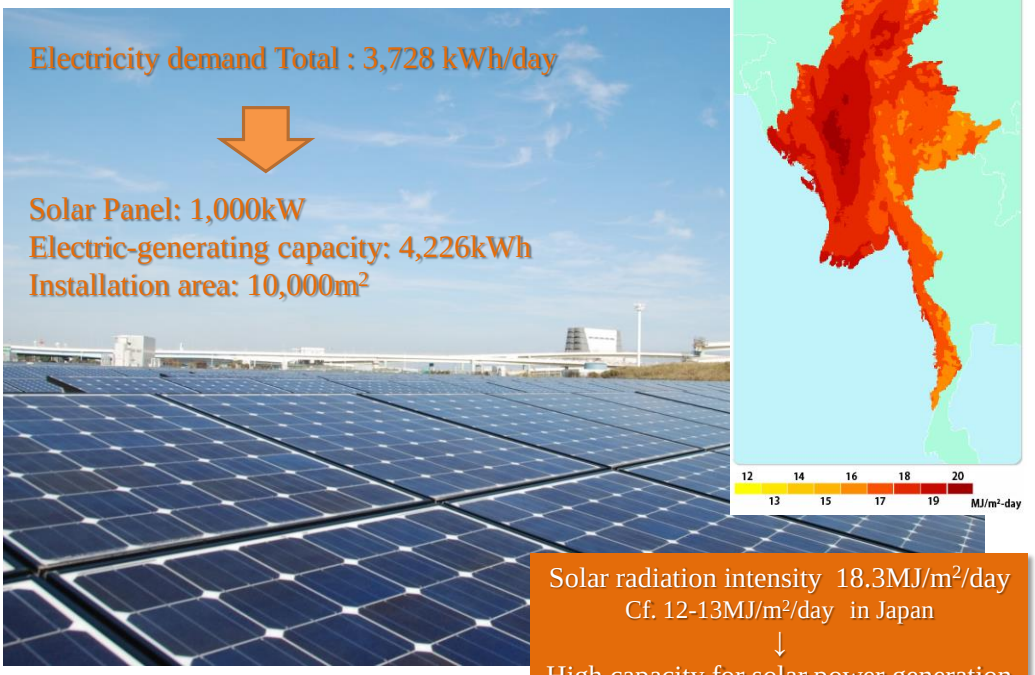


Treatment : 4,800m^3/day
Total demand :2,361kW/day

Electricity demand Total : 3,728 kWh/day

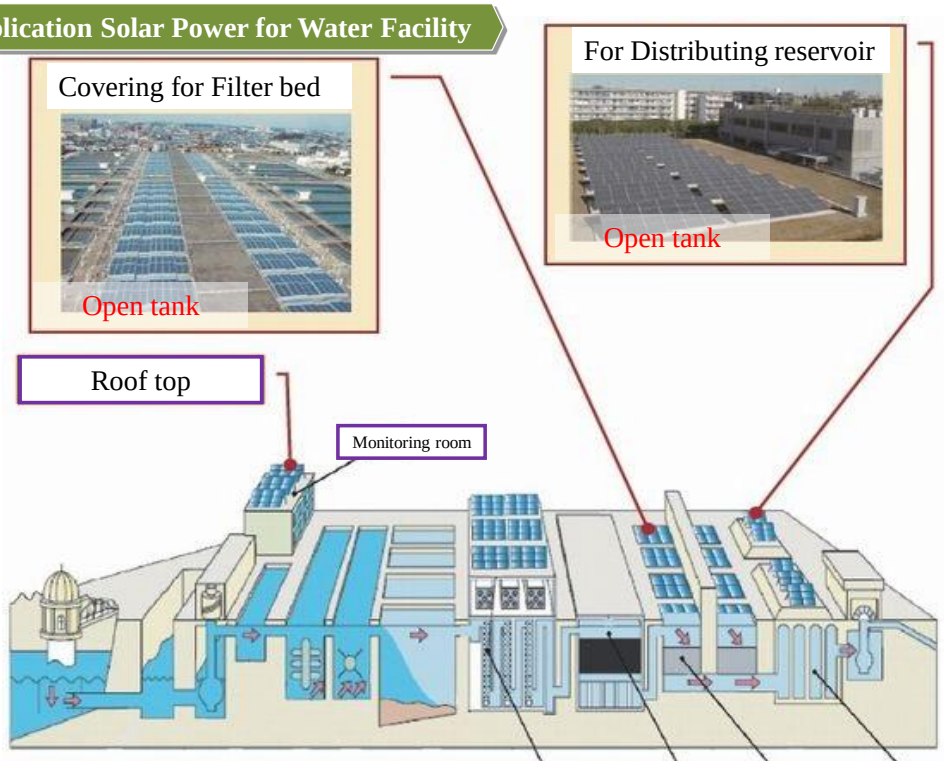
Consider the application of renewable energy

Solar Power Generation (image)



Solar radiation intensity 18.3MJ/m^2/day
Cf. 12-13MJ/m^2/day in Japan
↓
High capacity for solar power generation

Application Solar Power for Water Facility

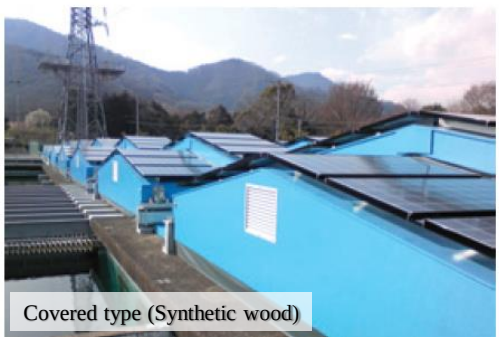


Solar Power can adopted not only "Roof top", but also "Open tank"

Application Solar Power for "Open tank"


Covered type (Aluminum)


Float Type


Covered type (Synthetic wood)

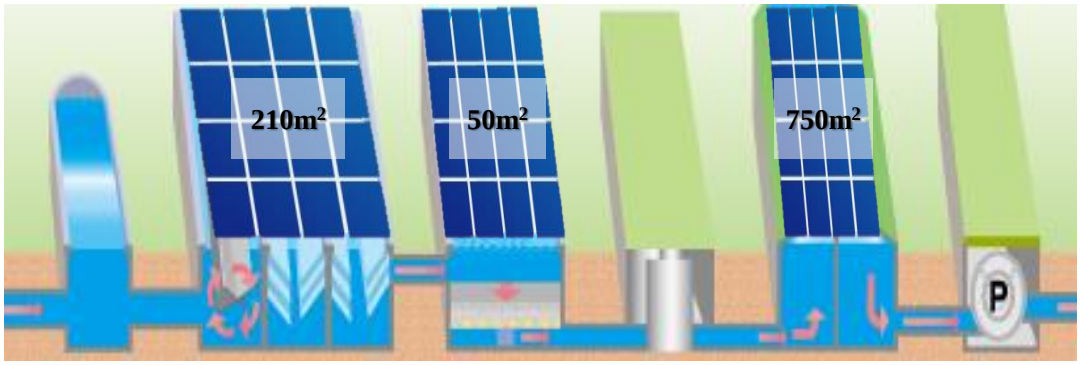

Covered type (FRP)

Application for Water Supply Facility

Assumed specification
Water supply : 6,000m^3/day

Total applicable area:1,010m^2

Sedimentation	Rapid filtration	Distributing reservoir
210m^2	50m^2	750m^2
(20mm/min)	(120m/day)	(HRT12hr)



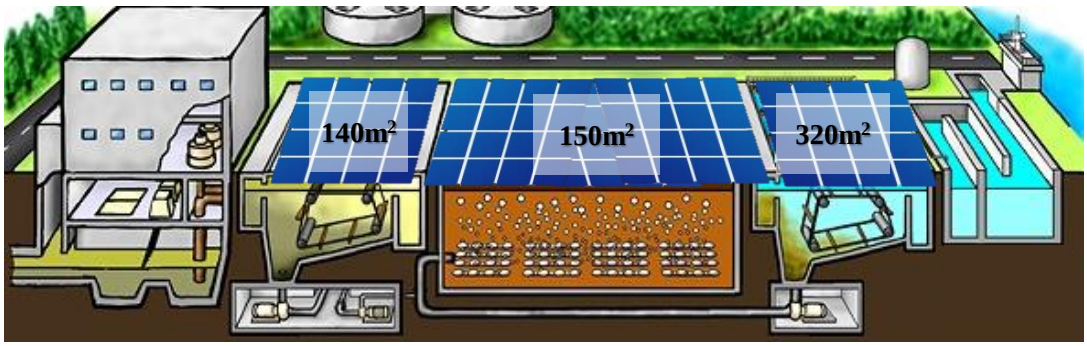
Receiving well | Sedimentation | Filtration | Sterilization | Distributing reservoir | Pumping

Application for Sewerage System Facility

Assumed specification
Sewerage System : 6,000m^3/day

Total applicable area :610m^2

Primary Sedimentation	Aeration tank	Secondary Sedimentation
140m^2	150m^2	320m^2
(35m^3/m^2/day)	(HRT8hr)	(15m^3/m^2/day)



Settling tank | Primary Sedimentation | Aeration tank | Secondary Sedimentation

Idea for Application of Solar Power

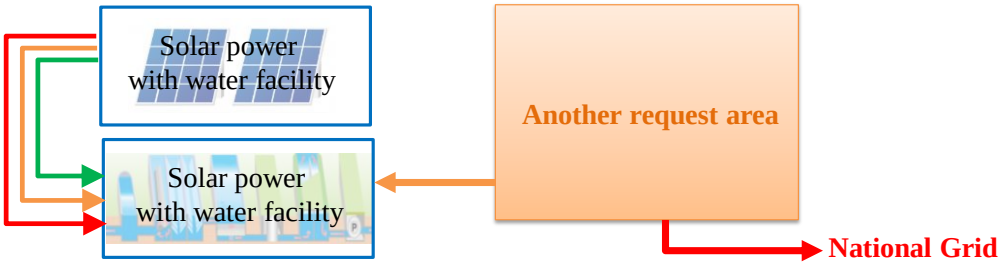
Request Area for introduce solar power: 10,000m^2

Water supply facility: 1,010m^2
Sewerage System facility: 610m^2

+

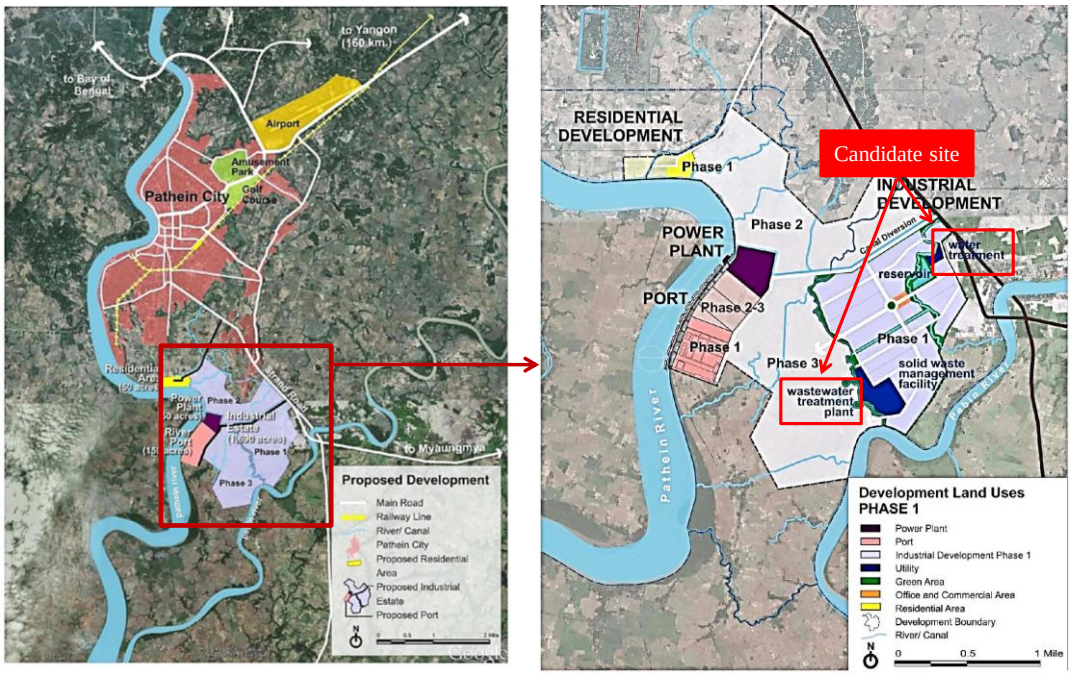
Another request area: 8,380m^2
(10,000m^2-1620m^2)

~~Application idea for "stable power supply for water treatment"~~

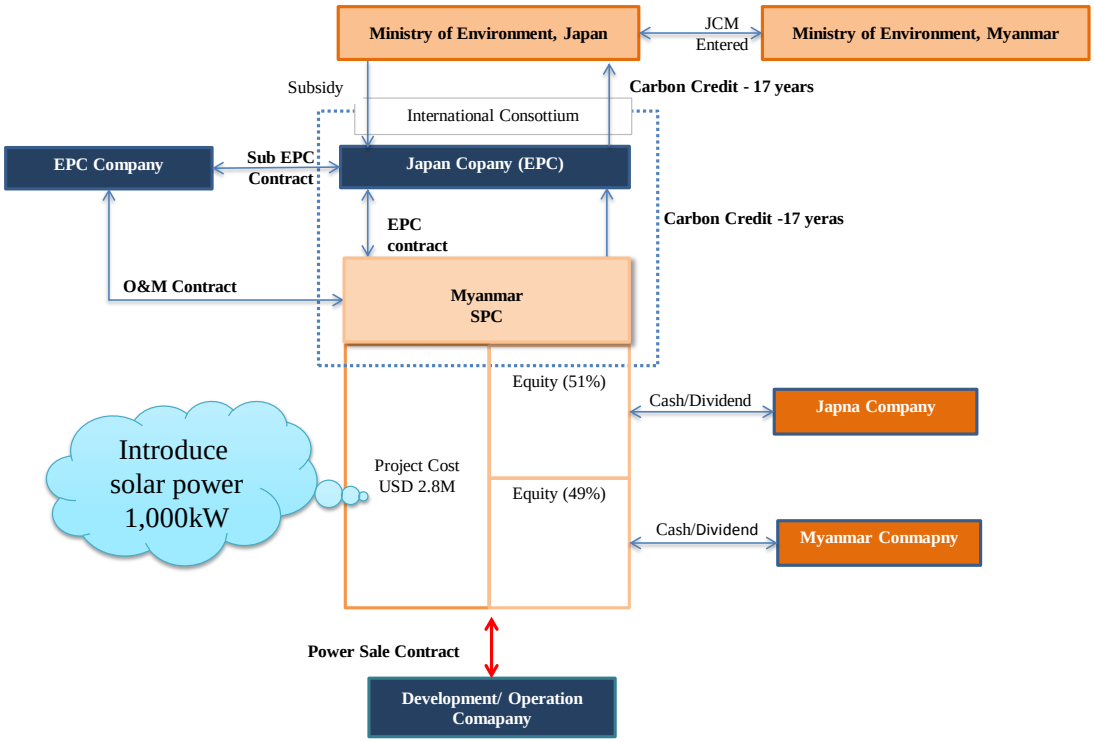


1. Use solar power as "peak-cut power generating"
2. Generate all demand for water facility for stale water treatment
3. Use solar power as "peak-cut power generating" , sell extra power to National Grid

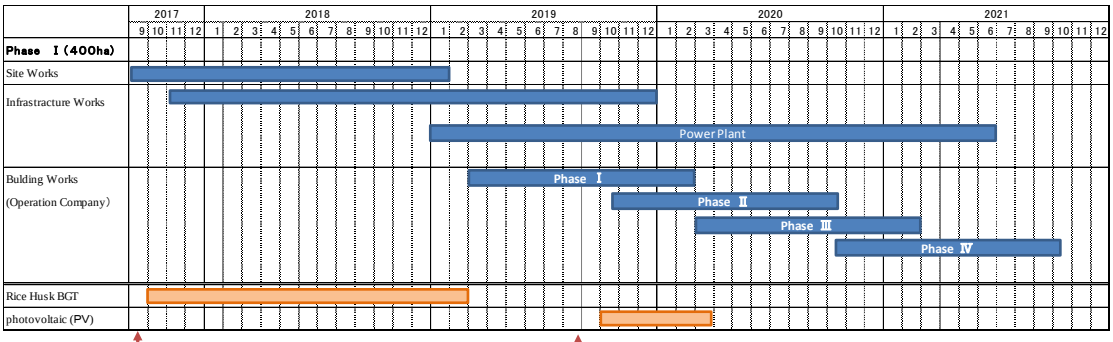
Planning Area (Assumption)



Business Scheme



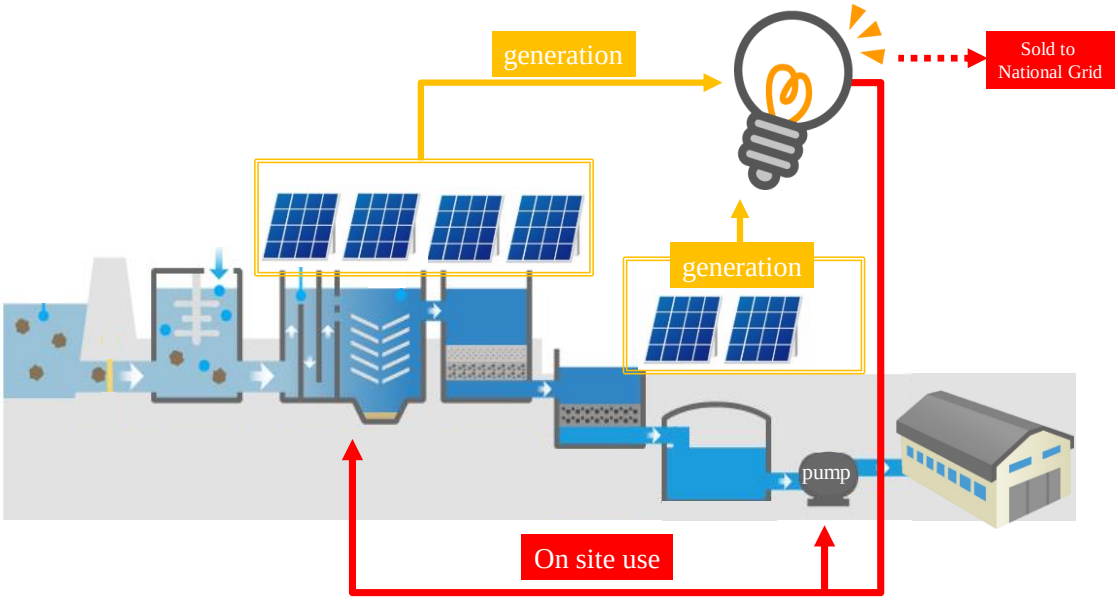
Business Schedule (Assumption)



JCM grant application

JCM grant application

Electricity usage around water facility

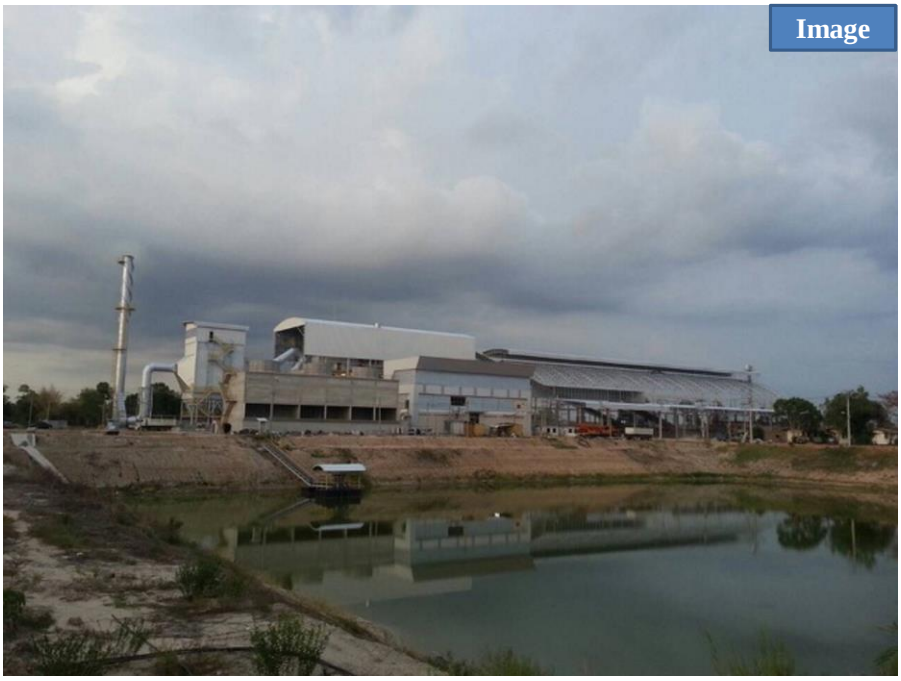


Contribute to stale power supply for water facility,
Contribute to provide good hygiene environment

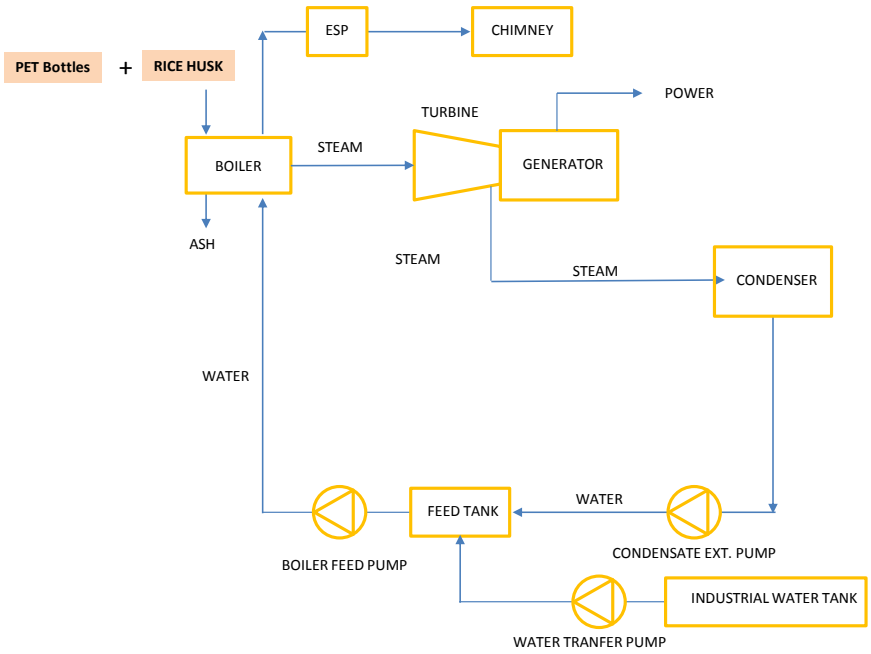
Waste Treatment

Boiler Turbine Generation System Using Rice Husk and PET Bottles

Image



Boiler Turbine Generation System

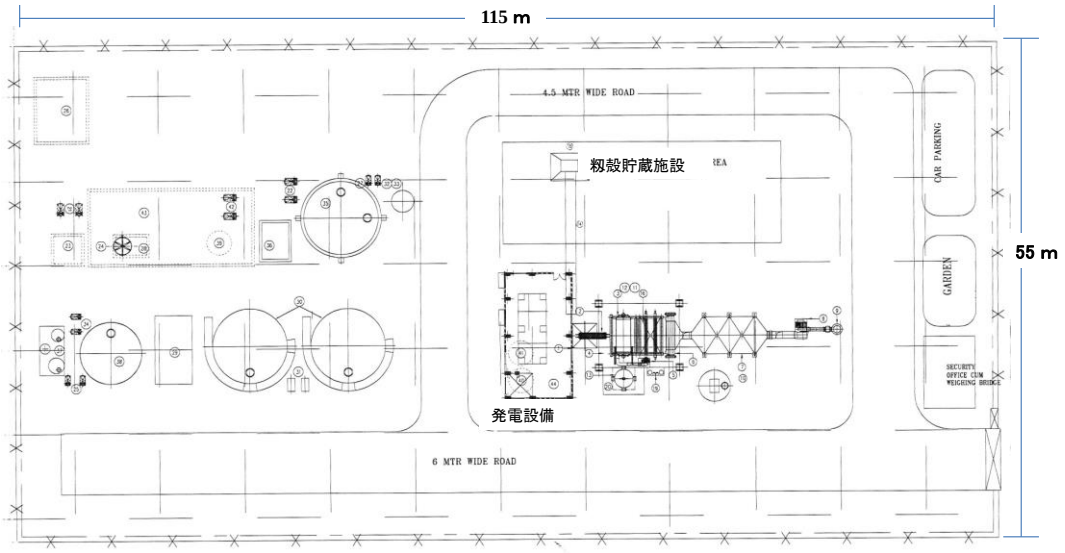


Specification of BTG system

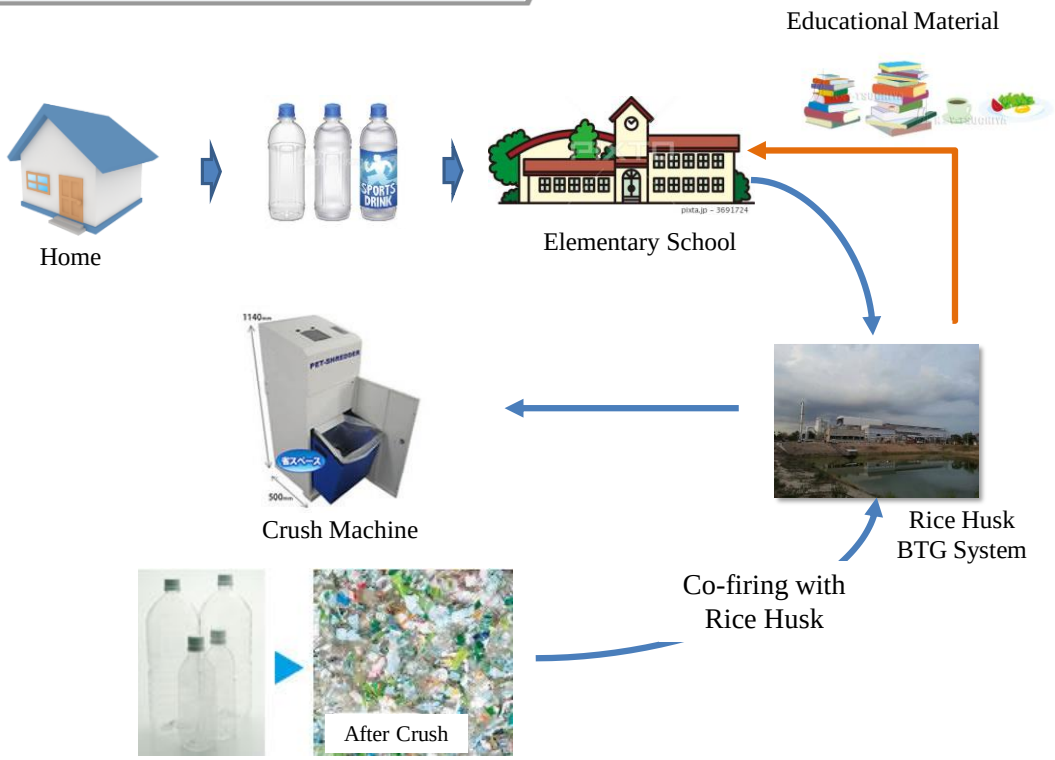
Site area	6,400m2
Power system	BTG:: Boiler Turbine Generator
Fuel	Rice husk 100% + PET botle
Heating volume	Rice Husk： 14.2MJ/kg、PET botles：23.0MJ/kg
Power generation capacity	3.3 Mw（Gross capacity）,**3.0 Mw**（Net capacity）
Power efficiency	20%
Fuel consumption	3.75 ton/hour
	90 ton/day
PET bottles consumption	0.011 ton/hour
	0.24 ton/day (10,600 bottles-500ml)
Capital costs	6.5 million USD (including Opening & development costs）
Operation hour	24 hours/day
Operation day	300 day/year
Operation hour	7,200 hours//year
Power requirements for rice mill	21,600MWh/year
Annual sale power	21,600MWh/year
Annual rice husk	27,00 ton/year
Annual PET bottles	79.2 ton/year
Project period	15 years

Layout of Rice Husk BGT System (3MW)

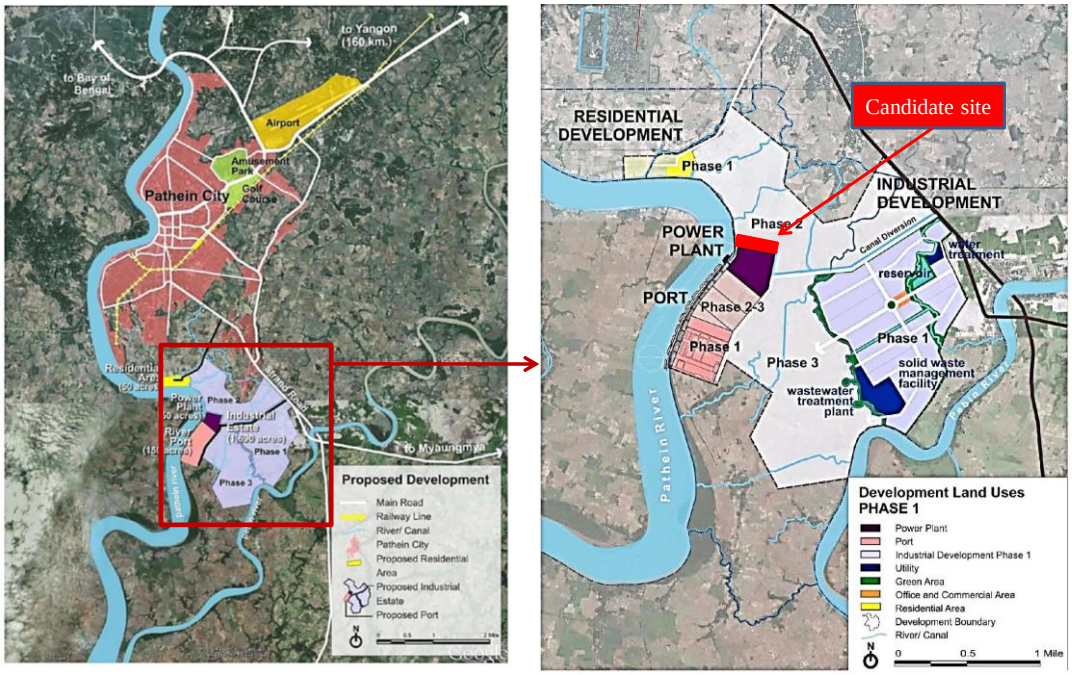
Area : 6,325m2



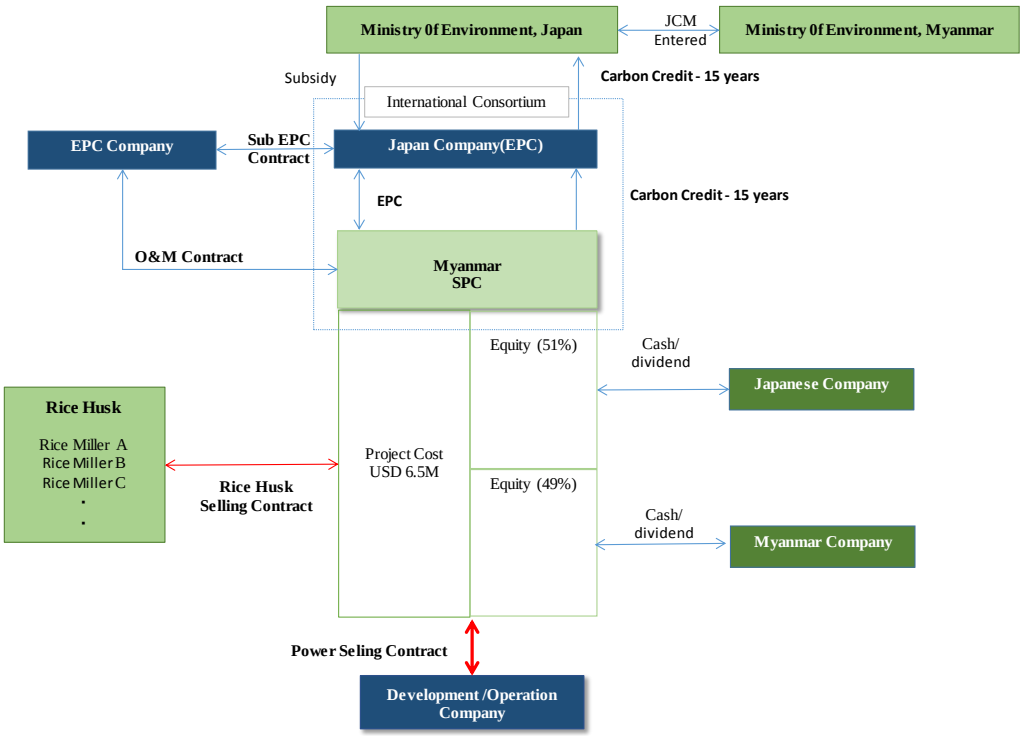
PET Bottle Recycle System



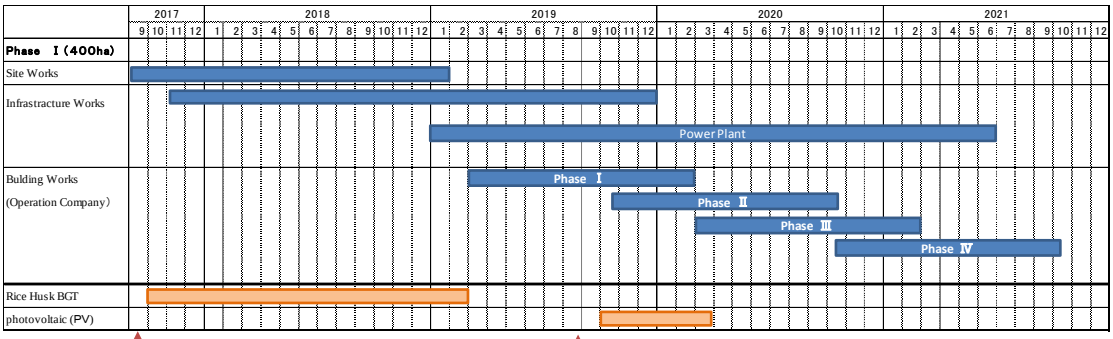
Planning area (Assumption)



Business Scheme



Business Schedule (Assumption)

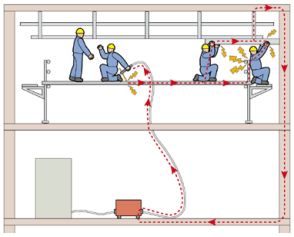


JCM grant application

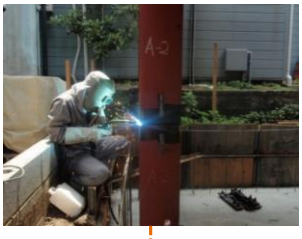
JCM grant application

Power Transmission
(The early stages of development)

Steel-frame work



Welding work

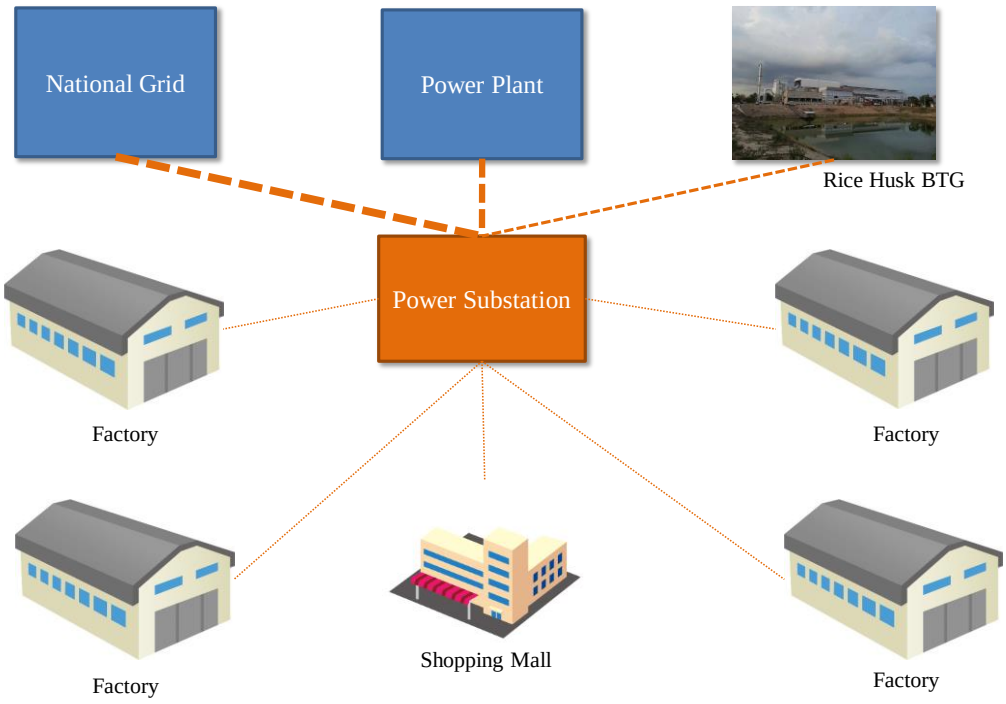


Diesel generator

welding machine

Rice Husk BTG

Power Transmission
(The late stages of development)



Topics for Further Development

Project Development Using JCM Scheme

~Through Private Cooperation~

- Possible project for waste management

Waste power plant in industrial city

- Biomass power plant using rice husks is under consideration. (*Need for utilization of rice husks from many rice mills in the local area)
- Separation and disposal of garbage is a topic of government interest: as a first step, possibility of co-firing plastic waste, etc. collected at sites will be considered.

*Some parts of power plant will be constructed before factories come in.

- Possible project for renewable energy

Mega solar at water treatment plant in industrial city

- Mega solar power plant will be installed as an independent distributed power for water treatment facility to be constructed in industrial city.

Framework Covering Individual Projects

~Through Policy Dialogue~

- **Advanced development with local aspects**
- Utilization of advanced technologies will raise the area into an advanced low-carbon city in Asia at a bound: promoting new development model in Myanmar
- Great opportunity to promote "Low-carbon city (cutting-edge environmental city" in Pathein
  =Differentiation from other industrial zones; effective means of promoting the industrial city
- **Need for Comprehensive Approach**
- From Japanese experiences, a comprehensive framework for individual projects is necessary for developing renewable energy and waste management projects.

<Areas for Japanese experiences application>
"Comprehensive Regional Plan," "Renewable Energy Promotion Plan," "Waste Management Plan," etc.

*Yearly plans towards establishing "Low-carbon city (leading environmental city)" in Pathein
FY2015: Understanding the objective and benefit of the scheme
FY2016: Setting city vision and development plans (considering local aspects)
FY2017: City planning through inter-city cooperation utilizing various tools etc.

What is a “master plan” for urban development?

A master plan sets the vision/goal of the area, and it describes specific plans and projects to achieve the goal.

Step 1: Analyze the current situation

What is the current situation of the area? Are there any issues/challenges or room for improvement?
Ex) Environment, economy, poverty, infrastructure(electricity, water…), population…

Step 2: Set the development vision

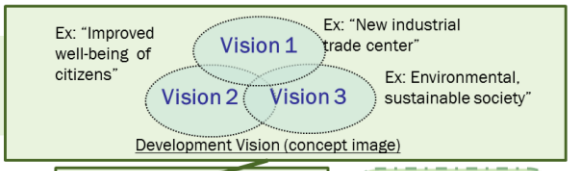
Development visions are ideal future images of a city to be realized based on the citizens’ needs and foresight of the stakeholders and experts.

Step 3: Develop an urban structure plan

Urban structure plan (land use plan) is developed. Which area is for factories? Where are offices located? Where do the residents live?

Step 4: Make infrastructure development plans

After the big picture is drawn in development vision and urban structure plan, specific infrastructure projects are designed.
Ex) Electricity, water treatment, waste, transport, greenery, etc.



Development Vision (concept image)


Land Use Plan (image)

***Other industrial zones in Myanmar also have master plans.
・Thilawa SEZ: Master plan by the Japanese government
・Dawei SEZ: Master plan support by Japan

Expected outcome:
- Attraction of factories to the industrial zone and accelerated foreign investment
- Regional development and increased higher standard of living

FY2015 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia- Study for building a sustainable low carbon city around the industrial zone in Pathein City, Ayeyarwady Region, Myanmar-

March 2016

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