FY 2017 Project for Ministry of the Environment, Japan

# FY2017
# Study of City-to-City Collaboration Project for Low Carbon Society

## Study on feasibility of a low-carbon waste treatment system and micro-grid system and promotion of activities under inter-regional collaboration in Ayeyarwady region and Sagaing region

# Project Report

March 2018

Mitsubishi Research Institute, Inc.
Fujita Corporation

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**Appendix**

## List of Abbreviations

This report uses the following standardized units and abbreviations.

**Units**

| | |
|---|---|
| T | ton |
| Kg | kilogram |
| MJ | Megajoule |
| MW | Megawatt |
| kW | Kilowatt |
| kWh | Kilowatt hour |
| GWh | Gigawatt hour |
| TWh | Terawatt hour |
| MPa | Megapascal |
| Ha | Hectare |
| Km | kilometers |
| 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 |
| JPY | Japanese Yen |

**Abbreviations**

| | |
|---|---|
| ADB | Asian Development Bank |
| CDM | Clean Development Mechanism |
| COP | International Conference of the Parties |
| EIA | Environmental Impact Assessment |
| EIAP | Environmental Impact Assessment Procedure |
| EMP | Environmental Management Plan |
| EPC | engineering, procurement, construction |
| EPGE | Electric Power Generation Enterprise |
| ESE | Electricity Supply Enterprise |
| FY | Fiscal Year |
| GHG | greenhouse gas |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| IEE | Initial Environment Examination |
| IFC | International Finance Corporation |
| IMF | International Monetary Fund |
| INDC | Intended Nationally Determined Contributions |
| JCM | Joint Crediting Mechanism |
| JICA | Japan International Cooperation Agency |
| LDC | Least Developed Country |
| MALI | Ministry of Agriculture, Livestock and Irrigation |
| MAPCO | Myanmar Agribusiness Public Corporation |
| MESC | Mandalay Electricity Supply Corporation |
| MIC | Myanmar Investment Commission |

| | |
|---|---|
| MIMU | Myanmar Information Management Unit |
| MRV | Measurement, Reporting and Verification |
| PV | Photovoltaics |
| SIDS | Small Island Developing States |
| SPC | Special Purpose Company |
| YESC | Yangon Electricity Supply Corporation |
| UMFCCI | The Republic of the Union of Myanmar Federation of Chambers of Commerce and Industry |

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# Executive Summary

## Study on feasibility of a low-carbon waste treatment system and micro-grid system and promotion of activities under inter-regional collaboration in Ayeyarwady region and Sagaing region

Under inter-regional collaboration in Ayeyarwady Region and Sagaing Region, JCM feasibility of a low-carbon waste treatment system (e.g. power plant projects using fuels such as rice husks) and micro grid system was studied. The study also assisted efforts on creation of regional waste treatment system and local distributed self-reliant power system (e.g. capacity building, and planning support for facilitating the implementation of waste treatment project) in the regions.

## 1. Background of the project

Through inter-regional collaboration between Ayeyarwady Region, Sagaing Region and Fukushima City, "Partnership for Low-Carbon Initiative (with Ayeyarwady region: starting from in 2015, and with Sagaing Region: starting from August 2017)" was established. Under the initiative, workshops were held in Monywa, Sagaing Region and Yangon, in which through discussions on policy trends, current situation and local needs of the region, activities in Fukushima City, and relevant technologies (e.g. waste treatment) were introduced. Possibility for JCM project formulation and collaboration for low-carbon development in waste treatment and renewable energy area was discussed.

**<Overview of Sagaing Region, Myanmar>**

Sagaing Region is located in the north-western part of Myanmar, with large amount of rice production. Large number of rice mills exist in Shwebo District, located in the eastern part of the region and in the north-western part of Mandalay (the second largest city after Yangon), making the district one of the most populated area of rice mills in the region. The quality of rice is higher than that of Ayeyarwady Region; rice mill business management is well done in the area, and construction of new rice mills, expansion and renewal of existing rice mills are expected in the future. The area is one of the most promising rural regions for future economic development.

**<Overview of Fukushima City>**

Fukushima City, while putting the utmost importance on the introduction of renewable energy sources through cooperation among the municipal governments, citizens and business operators, has also been engaged in various initiatives and activities such as “creation of a low-carbon, circular-type society with effective global-warming preventive measures and low burden on the environment,” “restoration from nuclear disaster,” “revitalization of local areas” and “promotion of the building of townships resistant to disasters and emergencies,” aiming at making “Fukushima” a vigorous and environmentally most advanced city, based upon well advanced local production and consumption features, as well as safe and secure energy sources, in the future.

## 2. Current Situation and Challenges for Low-Carbon Development

Through Partnership for Low Carbon Initiative, importance of developing a sustainable, low-carbon, circular-type, vigorous and environmentally advanced region, and measures for such development (roadmap) have been shared among the participants. With such shared understanding, feasibility of a rice husk power plant in a new industrial zone within the region has been considered.

Additionally, regarding waste treatment and renewable energy, experiences of Fukushima City have been shared, and current situation of policy dialogue between Ayeyarwady Region and Fukushima City (creating a masterplan, discussions on environmental education, etc.) was shared, as part of capacity building for government officials and other stakeholders (rice mill business industry).

| Item | Key activities | Outcome and future tasks |
|---|---|---|
| JCM Project Formulation | Examination of candidate sites<br><br>Basic plan was created and proposed to stakeholders | • Development plans for project formulation with stakeholders (MRF (Myanmar Rice Federation) and MAPCO (Myanmar Agribusiness Public Corporation))<br>• Specific plans for rice husk power plant project |
| Policy dialogue | Forming consideration group in the region under the leadership of Chief Minister of Sagaing Region<br><br>Building relationships with counterpart Minister of Energy<br><br>Through the workshop in the region, common understanding was obtained on the | • Shared recognition on expansion with not only the Chief Minister and the responsible minister of the region but also with other relevant parties including Minister of Agriculture, Livestock and Irrigation of the Union of Myanmar. (Securing electricity by renewable energy is an effective approach to the development of rice milling business; and controlling CO2 emissions and preventing environmental pollution caused by waste are important.)<br>• Policy dialogue was conducted on specific measures for low-carbonization concept in the developing Myaung Mya Industrial Zone (The responsible regional minister has high interest in promotion of local electrification using renewable energy. Direction of plan has |

| | | |
|---|---|---|
| | importance of rice husk power plant for restructuring of industrial zones and rice mills. | been shared and now is the phase for specific policy development). Relationship building with working-level officials will be left as future task (it is essential to acquire trust from them for JCM formulation)<br>• More policy dialogue is needed for implementation of micro-grid system and specific measures for collaboration with neighboring area development. (Such issues have been shared with the Chief Minister of the region.) |
| Business exchange and capacity building | Through the workshop in the region,<br>• Activities of companies in Fukushima City (waste treatment, etc.) were introduced to relevant business parties.<br>• Opinions were exchanged on the possibility of cooperation between companies in Myanmar and Fukushima City.<br>• Importance of dialogue to embody businesses was confirmed and recognition was shared. | • It was understood that not only policy formation but project creation in the business sector has an important role in realizing a low-carbon society.<br>• Dialogue with Chamber of Commerce and companies in Myanmar was a new attempt. They have high expectations on Japanese companies. Because of this, we share the recognition that continued exchange is important. (From business dialogue triggered by policy dialogue to the utilization of functions of the Chamber of Commerce, and further to business that will contribute to establish a low-carbon community) |

## 3. Further Project Development

### Rice Husk Power Plant Activities in Industrial Zone

**<Local needs and significance of the project>**

As with Ayeyarwady Region, for which a policy dialogue was conducted previously in an city-to-city cooperation, Sagaing Region is facing social problems to be solved such as increase in waste and power consumption (environmental pollution, access to energy, etc.,) that follow economic development. In particular, problems related to disposal of rice husks are more severe in Sagaing Region where open-air burning of husks is performed on a large scale, compared to Ayeyarwady.

The rice husk power generation project in Ayeyarwady Region (JCM subsidiary project on facilities) is an activity providing two benefits, i.e., effective use of rice husks that are disposed of (i.e., waste reduction) and power generation. Relevant parties in the region and rice milling enterprises are both interested in the project. In rice milling businesses, a challenge is to reduce production costs and enhance the quality of rice for improved competitiveness as an industry by increasing the scale of businesses and replacing facilities. To promote this activity, it is essential for rice milling enterprises to secure electricity stably. For survival of the rice milling industry in Myanmar, it has been recognized as an effective approach to use rice husks as a resource and take measures to secure electricity independently, not relying solely on power supply from the national grid.

**<Tasks for realization>**

Because the stable and long-term procurement of rice husks is indispensable to realize a rice husk power generation project, cooperation must be established among the government, business enterprises and industry groups to create a mechanism of procuring rice husks generated at rice mills. Discussion for realization will be made hereafter.

**<Establishment of a model for further development of rice husk power generation projects>**

As heat is produced in addition to electricity in rice husk power generation, it was pointed out that the heat might be used effectively. Specifically, this is an idea of producing cold energy using the heat and applying it to the cold energy demand in factories and depositories. Reduction in greenhouse effect gas emissions and increase in economic efficiency are also expected by it. We have to examine the feasibility of this idea hereafter to establish a cogeneration type rice husk power generation system through detailed discussion on its technological aspect and needs of cold/hot water, considering specific cases.

**<Power supply to neighboring regions>**

For the rice husk power generation at rice mills in this region targeted, the regional government has great expectation on not only the use of electricity in the industrial zone but also contribution to improvement in electrification rates and stability of power supply. To realize this, development of micro-grids, etc., is necessary to supply electricity to the regions surrounding the industrial zone. However, it is economically difficult for business enterprises to bear the costs of developing micro-grids. During this policy dialogue, we explained that the wheeling service of electricity, which was a mechanism to supply electricity virtually through existing power distribution networks, had been developed in Japan, and the power generation using waste was realized in Fukushima City with this mechanism. We proposed that Myanmar examined the feasibility of this mechanism. Because there is a substation at a site adjacent to the industrial zone, which is the main candidate site, wheeling service using this substation and existing distribution networks may become a solution as a power supply scheme for consumers of other regions. However, detailed technical and institutional conditions have to be examined. Discussion with relevant parties in the region should be deepened on whether or not a business model of supplying power to the regions adjacent to the industrial zone can be established with a method like wheeling service.

**<Support for policy development regarding waste treatment>**

The outcome of city-to-city collaboration between Fukushima City and Ayeyarwady Region, “promotion of new measures for waste treatment following economic development,” was shared among parties in Sagaing Region. The urban area of Sagaing Region, like in Ayeyarwady Region, faces large amount of untreated waste (e.g. plastic waste from food containers); waste treatment measures in the urban area will be essential in the future.

Based on the development plans and action plans considered in Ayeyarwady Region, measures for Sagaing Region with respect to its regional characteristics will need to be considered.

**<Capacity building (business exchange)>**

As for business exchanges between Fukushima Chamber of Commerce and Industry, its members and the local Chamber of Commerce and its members, in-depth business dialogue will be needed for possible future collaboration in specific business projects.

# 1. Purpose and Implementation Arrangement

## 1.1 Project Objective

All countries attended the 21st International Conference of the Parties (COP21) on the United Nations Framework Convention on Climate Change held in December 2015 in Paris, France. They adopted the Paris Agreement, a legal framework of equitable and effective measures against climate change from 2020 onward. The Paris Agreement demands the promotion of activities toward decarbonization, stating that the temperature rise of the earth should be less than 2 degrees C adequately compared to the preindustrial era and efforts should be made to decrease it down to less than 1.5 degrees C. COP21 also decided that the activities of non-state entities including cities must be grasped, and that the efforts of all nongovernmental entities (cities and other local public bodies) are appreciated and their scale-up must be promoted.

“Marrakech Action Proclamation for Our Climate and Sustainable Development” adopted in COP22 held in November 2016 in Marrakech, Morocco, emphasized again that the global climate was warming at an unprecedented rate and we were obliged to take urgent countermeasures. It was recognized that global actions of not only national governments but also municipalities, as well as economic turnabout, would give a positive opportunity to further prosperity and sustainable development.

A city is the place of activities that support the development of society and economy. Many people live there. About 50% of the world population live in cities, the area of which is less than 2% of that of all lands in the world. The ratio is anticipated to increase up to 70% by 2050. As it is estimated that more than 70% of CO2 emissions in the world were from cities in 2006, the role that cities play in mitigating climate change is great. For achieving the goal of Paris Agreement, it is important to implement measures against climate change steadily in urban areas to reduce emissions of greenhouse gas.

In this project, Japanese research institutes, private companies and universities as well as Japanese municipalities having experience regarding the formation of a low-carbon society supported such formation by the cities of developing countries based on intercity cooperation. To promote the formation, capacity building in the cities of developing countries was also propelled with the support of Japanese municipalities.

## 1.2 Survey Items

Based on the aforementioned background and objective, this research surveyed the following items for a low-carbon waste treatment system and micro-grid system in a new industrial zone in progress in Sagaing Region, Myanmar.

(1) Overview of the area and local needs
(2) JCM Project Feasibility
(3) Low-carbon society development support
(4) Participation in local surveys, workshops and other meetings

## 1.3 Survey Arrangement

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 local companies and with cooperation from Sagaing Region and Ayeyarwady Region.

**<Roles of entities from Japan>**

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 measures for forming JCM projects, and supported policy dialogue between Fukushima City and the local government (Sagaing Region), in addition to its role of the overall project management.

Fujita Corporation, with its knowledge and experiences in industrial, urban, and regional development, considered possibilities for specific project formulation (rice husk power plant).

Fukushima City had policy dialogue with the officials of the local government to discuss policy-side approach for low-carbon, environmentally friendly regional development, introducing its experiences in establishing waste treatment plans, renewable promotion plans, and raising environmental consciousness (e.g. educational programs at school). Department of environment served as the main counterpart from Fukushima City.

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 from Fukushima City.

**<Roles of entities from Myanmar >**

MAPCO (Myanmar Agribusiness Public Corporation) served as the local partner company.

Various stakeholders from the Sagaing Regional government contributed, including the Minister of Sagaing Region (Minister of Electricity, Industry, Road & Transportation, Regional Government Republic of the Union of Myanmar) as the head, and other officials from the related departments.

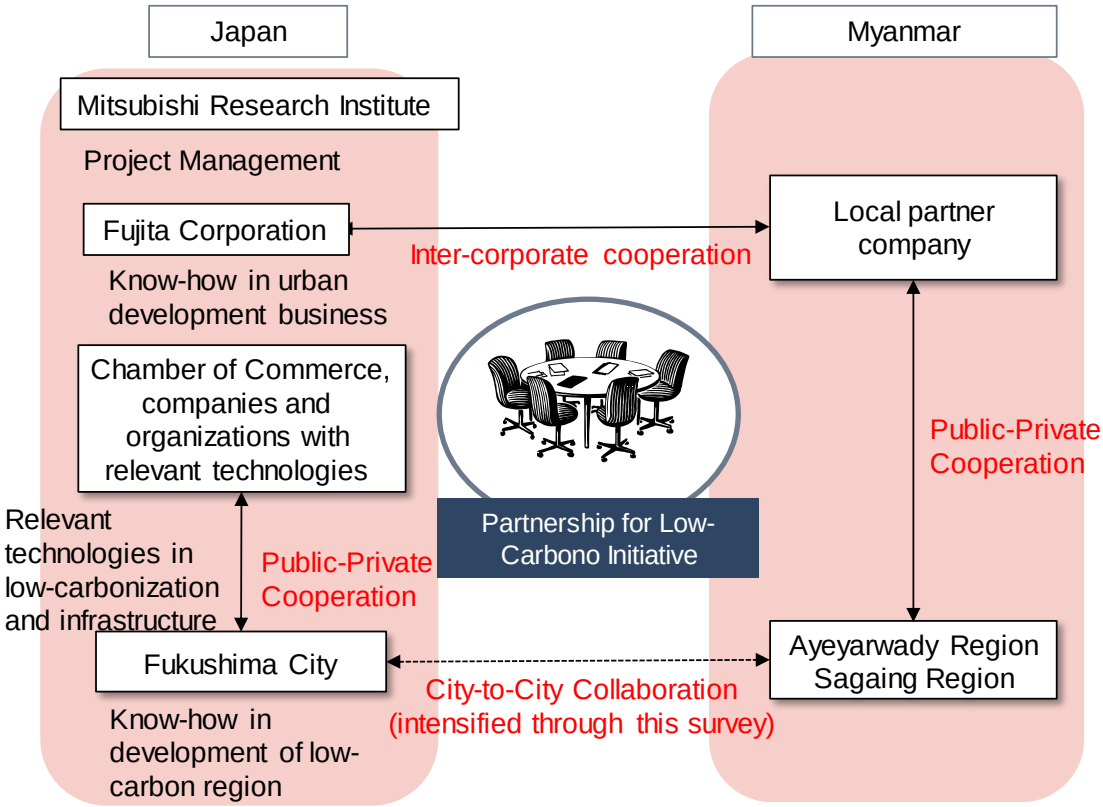


Figure 1-1 Organizational Structure

## 1.4 Overview of City-to-City Cooperation

Ayeyarwady Region, which is the main product region of rice, is concerned with work of clearing off large amounts of rice husks (in rice cropping districts, the largest amount of waste is rice husks).

As economy grows, addressing power shortages and emerging environment problems (waste, water preservation, etc.) became the most important issue in local cities in Myanmar.

Establishment of low-carbon, environmentally-friendly industrial zone is expected by applying the experiences of Japanese municipalities and companies. Additionally, such unique regional development is important for attracting businesses and promoting the industrial sector.

Myanmar has high expectations for Japanese experiences and technologies which have undergone rapid economic growth in the past. When the Chief Minister of Ayeyarwady Region visited Japan towards the end of April 2015, he learned about the activities related to energy efficiency and renewable energy in Fukushima City. Then, in June of the same year, the Chief Minister sent an official letter of intent to the Mayor of Fukushima City asking for support and cooperation in the development of Pathein Industrial City (letter asking for support and cooperation for the creation of a sustainable low-carbon city under an inter-city cooperation scheme).

In response to such a request for support and cooperation, Fukushima City, the Fukushima Chamber of Commerce and Industry, Mitsubishi Research Institute, and Fujita Corporation jointly established a partnership called the “Partnership for a Low-Carbon Initiative in Ayeyarwady” as a platform for city-to-city collaboration, and decided to perform activities for such purpose. In FY 2015, the Partnership held workshops in Pathein City in Ayeyarwady Region as well as in Fukushima City, conducted field surveys and made policy dialogues, and examined the possibilities of developing a project applicable to the subsidies under JCM Scheme. And furthermore in February 2016, when government officials of Fukushima City visited the site in Ayeyarwady Region, they handed the Chief Minister of the Region a letter from the Mayor of Fukushima City responding to the request for support and cooperation, and expressed Fukushima City’s willingness to cooperate with Ayeyarwady Region not only in the sectors of renewable energy and waste treatment but also in various important matters such as the formulation of a master plan, based on Fukushima City’s experience hitherto so as to achieve a sustainable, resilient, and low-carbon society in Pathein City.

**<Past Activities>**

| | |
|---|---|
| June 2015 | Chief Executive of Ayeyarwady Region made a request to Mayor of Fukushima City for cooperation. |
| October 2015 | Relevant parties of Ayeyarwady Region visited Fukushima City. |
| February 2016 | Relevant parties of Fukushima City (Deputy Director of Environment Division, etc.) visited Ayeyarwady and hand over a reply letter of Mayor of Fukushima City regarding the request to the responsible Minister of Ayeyarwady Region. |
| September 2016 | Workshop in Ayeyarwady (attendance of Chief Executive of the region) |
| October 2016 | Director of Urban Development Bureau of Ayeyarwady Region, etc., visited Fukushima City. |
| January 2017 | Discussion on the direction of project expansion at WS in Ayeyarwady (attendee: responsible Minister of Ayeyarwady Region, Chief of Environment Section of Fukushima City, etc.) |

With such background, central government officials, in discussions for policy development regarding local distributed power supply system, asked MAPCO to consider expanding the first JCM project in Myanmar for rice husk power plant (Myaung Mya project, by Fujita and MAPCO) in other areas from Ayeyarwady Region; Sagaing Region (Shwebo District in particular) was proposed as a specific candidate project site.

MAPCO conducted its own local survey, and Fujita Corporation conducted preparatory survey in June. Afterwards, request for constructive development support under collaboration between Sagaing Region and Ayeyarwady Region was proposed (as an official letter from the regional minister to mayor of Fukushima City). The letter consisted of following requests:

- Promoting measures for waste treatment system (including local rice husk power plant project)
- Promoting micro-grid systems utilizing local renewable energy sources

As a result of discussion between Fukushima City and Fukushima Chamber of Commerce, it was decided that activities under Partnership for Low-Carbon Initiative in Ayeyarwady would be expanded to inter-regional collaboration between Sagaing Region as well.

**<Activities conducted this year>**

| | |
|---|---|
| July 2017 | Responsible Minister of Ayeyarwady Region made a request to Mayor of Fukushima City for cooperation for development under collaboration of Sagaing and Ayeyarwady Regions. |
| September 2017 | Workshop in Sagaing Region (in Monywa City, Sagaing Region with attendance of the Chief Minister of the region) |
| February 2018 | Workshop in Ayeyarwady |
| February 2018 | Discussions in Fukushima City |
| March 2018 | Reporting of city-to-city collaboration activities (Naypyidaw) |

Part of the activities under city-to-city cooperation through the partnership for low-carbon initiative are conducted in cooperation with FY 2017 Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration (“Study on feasibility of solar power generation system and solar powered low-carbon water treatment system, and promotion of activities in Ayeyarwady Region” and FY 2017 Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration (“Study on feasibility of a low-carbon waste treatment system and micro-grid system and promotion of activities under inter-regional collaboration in Ayeyarwady region and Sagaing region”).

**<Results of policy-dialogue in February in Myanmar>**

Inter-regional workshop between Ayeyarwady Region and Sagaing Region was held in a meeting room in Yangon on February 6th from 3 pm. There were 10 participants from Japan and 18 participants from Myanmar in the workshop.

Not only government officials from Ayeyarwady Region and Sagaing Region, but also various people from relevant organizations and ministries, such as Ministry of Industry and Agricultural Department of Yangon, Myanmar Rice Federation, and MAPCO, participated in the workshop. Activities in Fukushima City, including relevant policies and local generation and consumption scheme at a waste power plant in Arakawa Clean Center, were introduced. There was particularly high interest in rice husk power plant, as there was one project under construction in Myaung Mya in Ayeyarwady Region; lively discussion was conducted regarding the topic.

During the courtesy visit to the Minister of Agriculture, Livestock and Irrigation, inter-regional collaboration activities between Ayeyarwady Region and Sagaing Region were explained; the Minister expressed that while meeting electricity demand was important, it was equally important to conduct measures for reducing CO2 emission and environmental pollution from waste, and that the rice husk power plant project would be an effective solution for such issues. He also commented that Fukushima City is a city rich with tourism resources and agricultural products, and showed appreciation towards past support through city-to-city collaboration.

The Minister showed his gratitude towards Fukushima City for its continuous support, and commented that activities for establishing rice husk power plant, which is environmentally-friendly, are meaningful for the country and should be promoted; he also showed his intent for continuous exchange with Fukushima City to build deeper relationships for food processing technologies using rice.

Table 1-1 Overview of Ayeyarwady Region and Sagaing Region

| | Myanmar | Sagaing Region | Ayeyarwady Region |
|---|---|---|---|
| Area | 680,000 km2<br>(1.8 times the area of Japan) | 94,000 km2 | 35,000 km2 |
| Population | 50 million | 5 million | 6 million |
| Overview | Consists of 7 Divisions and 7 States | Located in the northwestern part of Myanmar, next to Kachin State, Shan State, Mandalay Region, Magway Region, Chin State, and Nagaland State and Manipur State of India<br>Capital: Sagaing City | Located adjacent to Yangon; located in the delta of Ayeyarwady River<br>Capital: Pathein City |
| Economic Trends | Last frontier of Asia; many Japanese companies are advancing as well. | There is large amount of rice production in the area; quality of rice is better than that of Ayeyarwady Region. | The largest granary area in the country (rich production of rice, soy beans, corn); it is gathering attention as a new developing area. |


Figure 1-2 Local Workshop with the Chief Minister of the Region (September 2017)


Figure 1-3 Courtesy Visit to the Minister of Agriculture, Livestock and Irrigation of Myanmar (February 2018)


Figure 1-4 Local Workshop (February 2018)

# 2. Overview and Needs of the Area

## 2.1 Overview of the Area and Local Policies

In this section, the socio-economic situation of Sagaing Region and Shwebo District is described.

### 2.1.1 Socio-Economic Situation of the Area

Sagaing Region is the second largest region in Myanmar (the largest is Shan). The regional capital is located along the Ayeyarwady River. The region has an area of approximately 93,000 km2, with 8 districts, 37 townships and one self-administered zone. The population is a little more than 5 million; its composition does not differ much from that of the whole country, and an increasing trend in population can be seen.

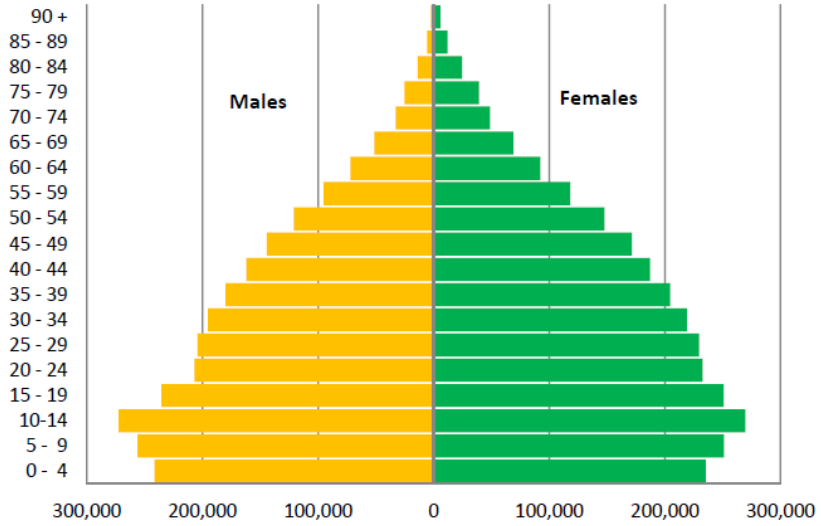


Figure 2-1 Population Pyramid in Sagaing Region

Source) Department of Population, Ministry of Immigration and Population "The 2014 Myanmar Housing and Population Census: Sagaing Region"
https://reliefweb.int/report/myanmar/2014-myanmar-population-and-housing-census-sagaing-region-census-report-volume-3-e
(Last accessed: March 6th, 2018)

As there are two main rivers in the region (Ayeyarwady River and Chindwin River), the main industry of the region is rice milling, but production of other grain products is rich as well. Aside from agriculture, the region is blessed with natural resources such as gold, coal, and oil; therefore, the living standard of the region is relatively high compared with the whole country. However, it is important to note that a large difference in living standards remains in the region; the southern part with plain field is more developed, while the mountainous northern region faces serious poverty issues.

Shwebo District, which is the candidate district for the project, is the most populated district within the region, with population of approximately 1.5 million population (refer to the table below).

Table 2-1 Sagaing Region Population by District

| State/Region/District | Population |
|---|---|
| Sagaing (Overall) | 5,350,299 |
| Sagaing | 520,399 |
| Shwebo | 1,431,450 |
| Monywa | 757,092 |
| Katha | 860,360 |
| Kalay | 508,015 |
| Tamu | 144,827 |
| Mawlaik | 163,896 |
| Hkamti | 423,283 |
| Yinmarpin | 508,015 |

Source) Department of Population, Ministry of Immigration and Population "The 2014 Myanmar Housing and Population Census: Sagaing Region"
https://reliefweb.int/report/myanmar/2014-myanmar-population-and-housing-census-sagaing-region-census-report-volume-3-e
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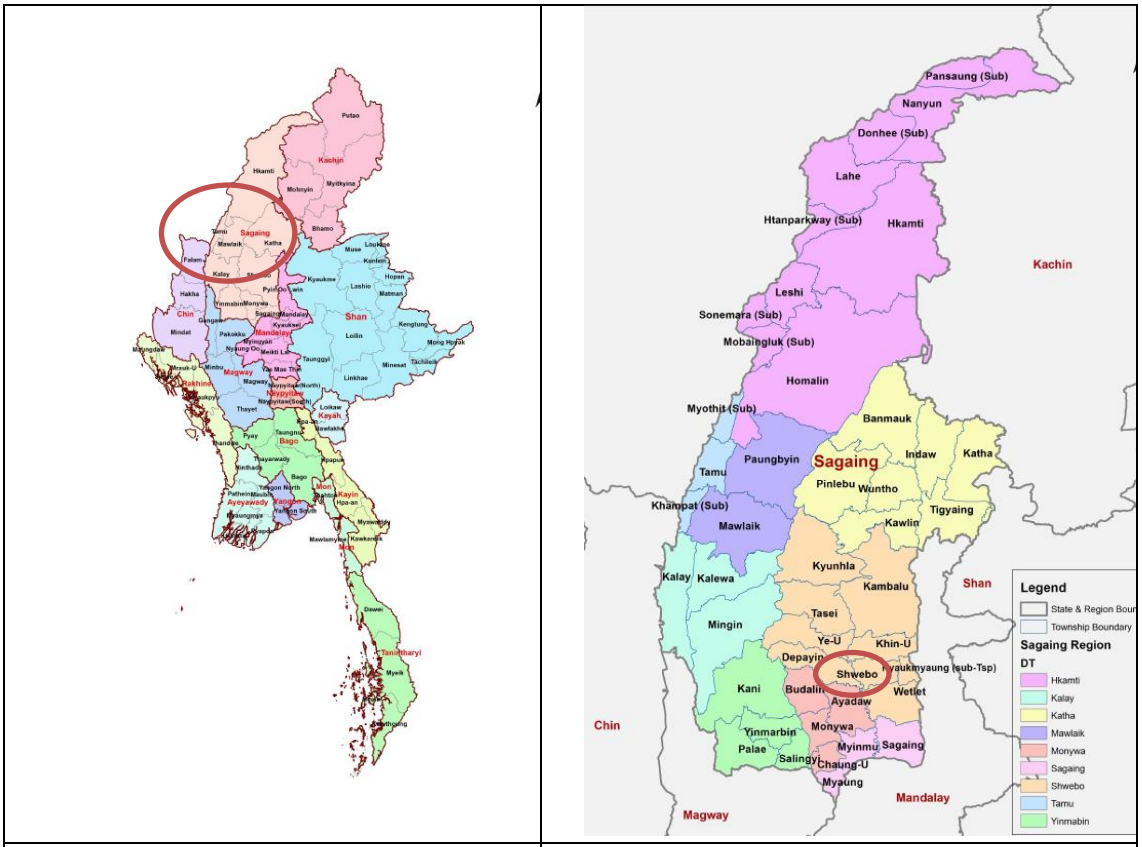


| Sagaing Region within Myanmar | Shwebo District within Sagaing Region |
|---|---|

Figure 2-2 Map of Sagaing Region and Shwebo Region

Source) Department of Population, Ministry of Immigration and Population "The 2014 Myanmar Housing and Population Census: Sagaing Region"
https://reliefweb.int/report/myanmar/2014-myanmar-population-and-housing-census-sagaing-region-census-report-volume-3-e
(Last accessed: March 6th, 2018)

Shwebo District is one of the foremost areas in Sagaing Region for rice production; agriculture with a focus on grain production is popular. The district focuses on its high-brand rice, “Shwebo Paw San,” in particular. The production of agricultural product in Shwebo is shown below.

Table 2-2 Grain Production Amount

| Crop Name | Monsoon | | Summer/Winter | | Total | |
|---|---|---|---|---|---|---|
| | Yield (Basket/acre) (ton/ha) | Production (basket) (ton) | Yield (Basket/acre) (ton/ha) | Production (basket) (ton) | Yield (Basket/acre) (ton/ha) | Production (Basket) (ton) |
| Paddy | 85 | 67,913,946 | 94 | 28,319,798 | 88 | 96,233,744 |
| | 4.39 | 1,419,401 | 4.85 | 591,884 | 4.54 | 2,011,285 |
| Black gram | 17 | 250,800 | 19 | 1,617,004 | 18 | 1,867,804 |
| | 1.37 | 8,201 | 1.54 | 52,876 | 1.45 | 61,077 |
| Green gram | 16 | 2,697,369 | 18 | 775,615 | 17 | 3,472,984 |
| | 1.29 | 88,204 | 1.45 | 25,363 | 1.37 | 113,567 |
| Sesame | 12 | 441,133 | 17 | 3,070,269 | 16 | 3,511,402 |
| | 0.73 | 10,808 | 1.03 | 75,222 | 0.97 | 86,029 |
| Groundnut | 42 | 5,560,480 | 65 | 10,482,663 | 55 | 16,043,143 |
| | 1.18 | 63,389 | 1.83 | 119,502 | 1.55 | 182,892 |

Source) JICA (2016) “Preparatory Study for Intensive Agriculture Promotion Program in the Republic of the Union of Myanmar”
http://open_jicareport.jica.go.jp/807/807/807_104_12250759.html
(Last accessed: March 6th, 2018)

Rice production in Myanmar is shown below by region. Ayeyarwady is the largest rice-producing region in delta area, while Sagaing Region is the largest rice-producing region in the dry area.

Table 2-3 Rice Production by Region

| | | 2004/05 - 2008/09 | | | 2009/10 | | | 2010/11 | | | 2011/12 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Rainy | Dry | Total | Rainy | Dry | Total | Rainy | Dry | Total | Rainy | Dry | Total |
| Delta Area | **Ayeyarwady** | **5,563** | **2,303** | **7,866** | **5,944** | **2,563** | **8,507** | **5,944** | **2,563** | **8,507** | **5,972** | **2,510** | **8,482** |
| | Bago | 4,259 | 585 | 4,844 | 4,790 | 791 | 5,581 | 4,790 | 791 | 5,581 | 4,803 | 630 | 5,433 |
| | Yangon | 1,625 | 283 | 1,908 | 1,709 | 333 | 2,042 | 1,709 | 333 | 2,042 | 1,710 | 320 | 2,030 |
| | Subtotal | 11,447 | 3,171 | 14,618 | 12,443 | 3,687 | 16,130 | 12,443 | 3,687 | 16,130 | 12,485 | 3,461 | 15,946 |
| Dry Area | Naypyidaw | NA | NA | NA | NA | NA | NA | NA | 34 | 34 | 287 | 43 | 329 |
| | Magway | 1,162 | 271 | 1,433 | 1,467 | 262 | 1,729 | 1,501 | 322 | 1,823 | 1,524 | 332 | 1,856 |
| | Mandalay | 1,401 | 435 | 1,836 | 1,298 | 346 | 1,644 | 1,307 | 369 | 1,675 | 993 | 331 | 1,324 |
| | **Sagaing** | **2,746** | **751** | **3,497** | **3,131** | **874** | **4,005** | **3,179** | **865** | **4,044** | **3,109** | **745** | **3,855** |
| | Subtotal | 5,309 | 1,457 | 6,766 | 5,896 | 1,482 | 7,378 | 5,986 | 1,590 | 7,577 | 5,913 | 1,451 | 7,364 |
| Coast Area | Mon | 1,213 | 181 | 1,394 | 1,278 | 222 | 1,500 | 1,278 | 222 | 1,500 | 1,294 | 206 | 1,500 |
| | Rakhine | 1,638 | 31 | 1,669 | 1,825 | 31 | 1,856 | 1,825 | 31 | 1,856 | 1,697 | 29 | 1,726 |
| | Tanintharyi | 534 | 43 | 577 | 544 | 24 | 568 | 544 | 24 | 568 | 510 | 25 | 535 |
| | Subtotal | 3,385 | 255 | 3,640 | 3,647 | 277 | 3,924 | 3,647 | 277 | 3,924 | 3,501 | 260 | 3,761 |
| Mountain Area | Chin | 103 | * | 103 | 120 | * | 120 | 120 | * | 120 | 127 | * | 127 |
| | Kachin | 680 | 27 | 707 | 925 | 45 | 970 | 925 | 45 | 970 | 945 | 18 | 963 |
| | Kayah | 123 | 15 | 138 | 137 | 17 | 154 | 137 | 17 | 154 | 140 | 17 | 157 |
| | Kayin | 595 | 173 | 768 | 721 | 215 | 936 | 721 | 215 | 936 | 755 | 217 | 972 |
| | Shan | 2,099 | 171 | 2,270 | 2,394 | 160 | 2,554 | 2,394 | 160 | 2,554 | 2,409 | 154 | 2,563 |
| | Subtotal | 3,600 | 386 | 3,986 | 4,297 | 437 | 4,734 | 4,297 | 437 | 4,734 | 4,374 | 407 | 4,781 |
| Total | | 23,742 | 5,269 | 29,010 | 26,283 | 5,883 | 32,166 | 26,373 | 5,991 | 32,365 | 26,273 | 5,579 | 31,852 |

Source) Myanmar: Capitalizing on rice export opportunities, The World Bank, Report number 85804 dated 28 February 2014.
http://documents.worldbank.org/curated/en/570771468323340471/Myanmar-Capitalizing-on-rice-export-opportunities
(Last accessed: March 6th, 2018)

### 2.1.2 Power Sector Situation

#### (1) Main Policies for the Power Sectors

There are three main policies related to the electricity sector in Myanmar: Myanmar Energy Master Plan, National Electricity Master Plan, and National Electrification Plan.

Myanmar Energy Master Plan was formulated under the support of ADB (Asian Development Bank). It analyzed the effective use and the optimum energy composition of various primary energy resources toward 2030. A trial calculation of energy demand by sector (residential, commercial, industrial and agricultural) was made in the plan.

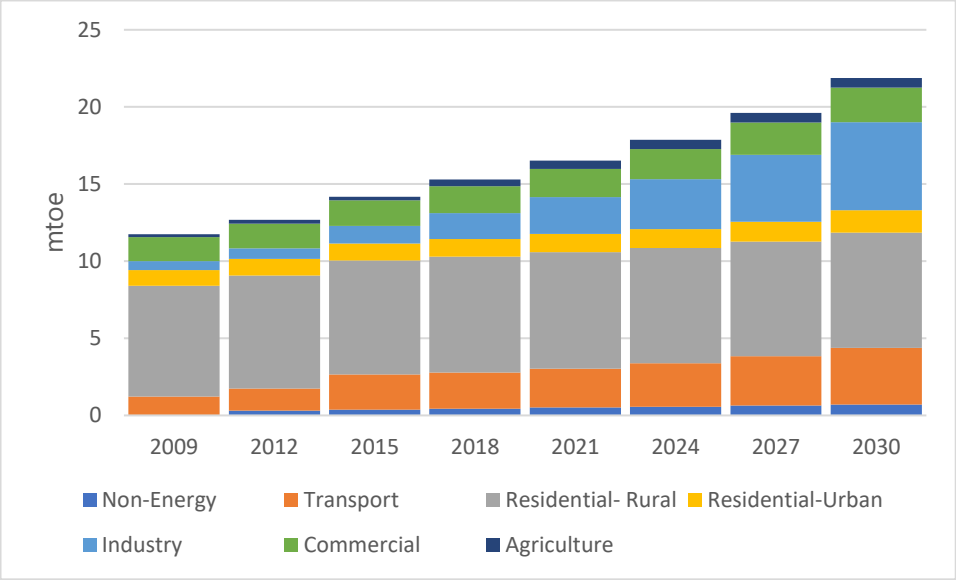


Figure 2-3 Energy Demand by Sector in 2030 (middle scenario, mtoe)

Source) Myanmar National Energy Master Plan

http://www.burmalibrary.org/docs22/2015-12-Myanmar_Energy_Master_Plan.pdf

(Last accessed: March 6th, 2018)

As known from the above prospect, significant increase in energy demand following economic development is anticipated. In particular, increase in the industrial sector is large. Final energy consumption by energy carrier is shown below.

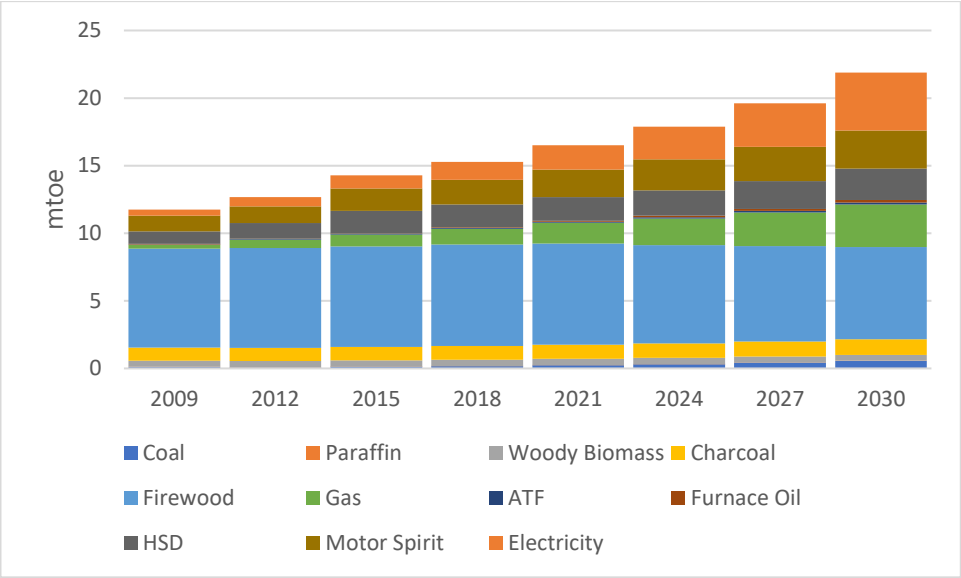


Figure 2-4 Final Energy Consumption by Energy Carrier (middle scenario, mtoe)

Source) Myanmar National Energy Master Plan

http://www.burmalibrary.org/docs22/2015-12-Myanmar_Energy_Master_Plan.pdf

(Last accessed: March 6th, 2018)

Electricity demand is shown in orange at the top of the bar chart. It is seen that increase of the demand toward 2030 is larger compared to other energy carriers.

National Electricity Master Plan was formulated under the support of JICA (Japan International Cooperation Agency). It examined the prospect of electricity supply and the ideal energy composition toward 2030. Power source composition toward 2030 is shown below.

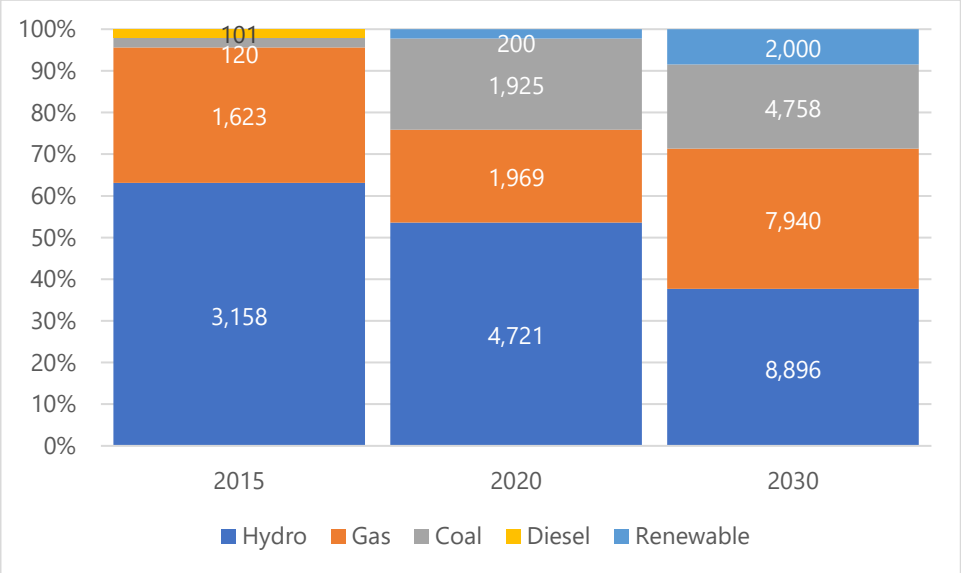


Figure 2-5 Installed Capacity for 2030 (GW)

Source) Power Development Opportunities in Myanmar

http://www.myanmarinvestmentforum2017.com/themes/demo/assets/download/Power%20Development%20Oppourtunites%20in%20Myanmar.pdf

(Last accessed: March 6th, 2018)

Myanmar is rich in water resources. In 2015, hydropower generation occupied more than 60% of the nation's installed capacity, while gas-fired power occupied a little over 30%, coal-fired power and diesel power being the remainder. A problem of this power source composition is the difference in the production of electricity between rainy season and dry season. A policy of decreasing the dependence on hydropower was expressed in the prospect toward 2030. Anticipated power source composition in 2030 is: hydropower 8,896 MW (38%), coal-fired power 7,940 MW (33%), gas-fired power 4,758 MW (20%), and others including renewable energy 2,000 MW (9%).

The supply and demand projection of electricity and master plans were established in Myanmar. However, its average electrification rate is thirty odd percent, the rate being lower in some regions. Based on this situation, Myanmar Government, setting the goal of achieving 100% electrification rate in 2030, showed a roadmap in National Electrification Plan formulated under the support of World Bank.

The plan assumed that 99% of the households were electrified by power transmission from the central grid while the regions located at the fringe of the grid were electrified by off-grid (use of mini-grid and household-use photovoltaic power generation) to promote electrification more rapidly. The responsible ministry of realizing the electricity supply from the central grid is Ministry of Electricity and Energy, while the one of realizing the mini-grid projects is Ministry of Agriculture, Livestock and Irrigation. Overseas organizations (World Bank, ADB, GIZ of Germany) are now providing technical support on mini-grid, the specification and level being formulated.

Minigrid projects funded by ADB (80% of project cost covered) are shown below. Vendors must own the responsibility of maintenance and management for three years, and renew battery system installed with the system after three years.

Table 2-4 Mini-Grid Projects with ADB Support

| Township | Households | Population | PV Capacity | Battery kWh | Cost Total USD | Type |
|---|---|---|---|---|---|---|
| Magway Region | | | | | | |
| Thayet | 197 | 931 | 7.2 | 57.6 | 73,350 | Stand-alone |
| Sinbaungwe | 270 | 2,170 | 8.7 | 63.3 | 82,368 | Stand-alone |
| Minbu | 89 | 336 | 4.9 | 57.6 | 44,100 | Diesel hybrid |
| Yenangyaung | 330 | 1,654 | 130 | 92.2 | 102,300 | Stand-alone |
| Salin | 143 | 625 | 6.5 | 38.4 | 50.832 | Stand-alone |
| Pauk | 157 | 836 | 6.0 | 46.1 | 50.856 | Stand-alone |
| Mandalay Region | | | | | | |
| Kyaukse | 317 | 925 | 10.8 | 86.4 | 98,580 | Grid ready |
| Nyaung-U | 200 | 977 | 9.8 | 115.2 | 75,000 | Stand-alone |
| Kyaukpadaung | 103 | 484 | 4.9 | 57.6 | 87,980 | Stand-alone |
| Taungtha | 110 | 654 | 4.9 | 57.6 | | Stand-alone |
| Sagaing Region | | | | | | |
| Sagaing | 170 | 569 | 6.0 | 46.1 | 102,770 | Stand-alone |
| Khin-U | 165 | 668 | 7.0 | 61.4 | | Stand-alone |

Source) ADB “Developing Renewable Energy Mini-Grids in Myanmar: A Guidebook”
https://www.adb.org/documents/developing-renewable-mini-grids-myanmar-guidebook
(Last accessed: March 6th, 2018)

Note) “Stand-alone” refers to an off-grid system, “Diesel hybrid” refers to a hybrid system of diesel and solar, “Grid Ready” refers to a system that can be connected to the grid

### (2) Financial Situation of the Power Sector

As described above, considerable new investments in facilities are anticipated in the electricity sector in Myanmar hereafter. From a financial point of view, however, serious deficit situations continue in the electricity sector in Myanmar. Power generation projects in Myanmar are implemented by private power generation enterprises and publicly-owned Electric Power Generation Enterprise (EPGE). First, energy produced is bought by EPGE temporarily (if supplied to the grid), and then bought by transmission and distribution enterprises (Electric Supply Enterprise (ESE), Yangon Electricity Supply Corporation (YESC), or Mandalay Electricity Supply Corporation (MESC) depending on

regions) and supplied to consumers. Electricity charges are determined based on the living standards of consumers for improved electricity access (see the table below). However, as this is not the level of electricity charges sufficient to recover the costs of power generation, procurement, transmission and distribution, the electricity sector in Myanmar is in serious deficit situations (anticipated deficit in fiscal 2017 is about 37.7 billion kyat). The government subsidizes the operation (anticipated to be Ks.22.66/unit in fiscal 2017) to cover the deficit. The subsidy is as much as the value that occupies a little under 10% of the budget of Ministry of Electricity and Energy.

Table 2-5 Electricity Tariff in Myanmar

| Residential | | Industrial | |
|---|---|---|---|
| ~100 kWh | 35 Kyat/kWh (USD 0.03) | ~500 kWh | 75 Kyat/kWh (USD 0.06) |
| 101~200 kWh | 40 Kyat/kWh (USD 0.03) | 501~10,000 kWh | 100 Kyat/kWh (USD 0.07) |
| 200 kWh~ | 50 Kyat/kWh (USD 0.04) | 10,001~50,000 | 125 Kyat/kWh (USD 0.09) |
| | | 50,001~300,000 kWh | 150 Kyat/kWh (USD 0.11) |
| | | 300,001~ kWh | 100 Kyat/kWh (USD 0.07) |

Source) Lincoln Legal Services (Myanmar) "Legal and Tax Considerations when Investing in Myanmar's Renewable Energy Sector with a Focus on Electricity Tariffs"
https://www.lincolnmyanmar.com/wp-content/uploads/2017/08/Green-Energy-Summit-Lincoln-Myanmar.pdf
(Last accessed: March 6th, 2018)

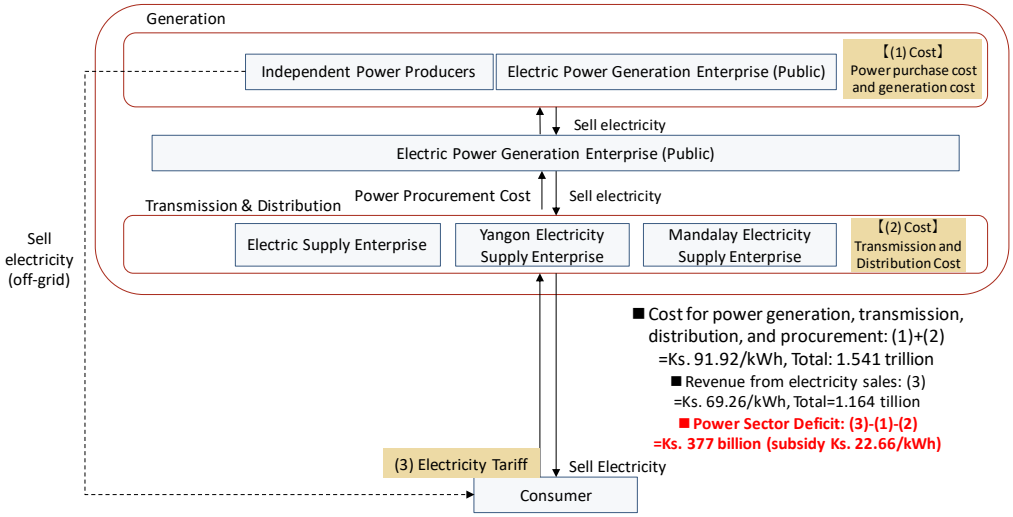


Figure 2-6 Actors Involved in Power Supply in Myanmar

Source) Lincoln Legal Services (Myanmar) "Legal and Tax Considerations when Investing in Myanmar's Renewable Energy Sector with a Focus on Electricity Tariffs"
https://www.lincolnmyanmar.com/wp-content/uploads/2017/08/Green-Energy-Summit-Lincoln-Myanmar.pdf
(Last accessed: March 6th, 2018)

In addition to construction of large-scale power plants and expansion of the national grid, power supply using distributed energy resources is being considered in Sagaing Region. As already explained, there is a large amount of rice production in the region, which generates a large amount of waste, rice husks; such rice husks are high potential for biomass power in the area.

## 2.2 Local Needs

As with Ayeyarwady Region, for which a policy dialogue was conducted previously in an city-to-city collaboration with Fukushima City, Sagaing Region is facing social problems to be solved such as increase in waste and power consumption (environmental pollution, access to energy, etc.,) that follow economic development. In particular, problems related to disposal of rice husks are more severe in Sagaing Region where open-air burning of husks is performed on a large scale, compared to Ayeyarwady.

**<Problems with rice husk waste>**

There is large amount of rice husk waste generated in the area, and most is thrown away.


Figure 2-7 Local Situation of Rice Husk Waste (Piled Up)

Source) Provided by MAPCO


Figure 2-8 Situation of Local Waste Treatment (Burnt off the field of former airport site)
Source) Provided by MAPCO

**<Needs for Power Supply>**

To achieve 100% electrification in 2030, Myanmar is considering power supply through grid expansion and off grid. However, even in areas that already receive power supply from the national grid, power supply is not stable, particularly in areas located towards the end of the grid. Diesel generators are often installed in these areas. There is increasing interest in local generation and consumption of electricity utilizing micro-grid to improve quality of power supply. However, there remain some challenges to promote micro-grids in Myanmar.

While power supply through micro-grids and minigrids are mentioned in the national electrification plan with provision of subsidies, there is no standard or specification for micro-grids and minigrids. Interconnection rules with the national grid are not established. These regulations and rules must be established in parallel with promotion of micro-grids and minigrids.

Aside from policy challenges, challenges remain from business feasibility perspective. Distributed energy resources including renewable energy (e.g. solar and biomass) are promising generation technologies for middle to small scale micro-grids, but standard power purchase price in Myanmar for large scale power plants would not be sufficient to make a business case for renewable energy projects. Power sector in Myanmar is in a serious financial deficit due to subsidies provided for retail electricity tariff, and providing additional subsidies for renewable power plants would worsen the situation. Based on such circumstances, it can be concluded that micro-grids that sell electricity to the grid would not be a realistic business model at this moment. Private power lines can be

constructed especially for the micro-grids to supply power only within the micro-grid, in which case power purchase price can be set freely even under the current regulations. However, constructing private power lines can be extremely costly, and it would also mean double investing in social infrastructure, which would pose additional social costs; therefore, micro-grids with private power lines would not be a realistic business model.

Another option for a micro-grid business model is supplying power to consumers within the micro-grid using existing power line infrastructure. Generally in developed countries, cost for using the existing power lines would be collected in a form of “wheeling charge,” but no regulation exists for such concept in Myanmar currently, and therefore no price is set. In order for this business model to be realized, negotiations with the local government would be necessary.

Financing is another challenge for conducting renewable energy projects in Myanmar. Local banks do not have experiences in providing loans for renewable energy projects, making it difficult for them to assess various risks associated with renewable energy projects. Even when using foreign banks, negotiations with the local banks would still be needed, and higher interest rate is expected.

# 3. JCM Project Feasibility Study

## 3.1 JCM Project Formulation

Promising technology for low-carbon waste treatment system would be rice husk power generation technology. As already mentioned, Shwebo District in Sagaing Region is an agricultural area, with rich generation of rice husks. In fact, the largest waste generated in Shwebo District is rice husks, and their inappropriate treatment is leading to environmental pollution, raising needs for their utilization. Even compared with Ayeyarwady Region, rice husks are burnt open-air on a large scale, posing more serious problems in Sagaing Region in particular.

Feasible JCM project for low-carbon waste treatment system (rice husk power plant) in Shwebo District, Sagaing Region, along with its candidate site and applied technology, is considered.

### 3.1.1 Project Overview

As a power plant to be installed in the industrial zone and rice mills in Shwebo District, Sagaing Region, achievement of an early operation of a 3 MW scale biomass power plant using rice husks under the SPC established between Japanese and Myanmar local companies is aimed (application for JCM subsidy between latter half of fiscal year 2018 and first half of fiscal year 2019, starting operation in 2021).

### 3.1.2 Project Site

The following locations in Shwebo District were considered as candidate sites for the project: area within an industrial zone, and area adjacent to a large scale rice mill.

There are 120 rice mills in Shwebo, so it is possible to collect enough rice husk. Particularly in the Shwebo Industrial Zone, there are as many as 100 rice mills. If the average amount is 20 t, the total amount is 2,000 t and the amount of rice husk is 400 t. 100 t is required for 3 MW and 200 t for 6MW. It is readily possible to procure the required amount of rice husk.

In particular, industrial zone with many rice mills and large-scale rice mill (Wetlet District), two most promising sites for the project, are compared.

- Industrial Zone in Shwebo District
  Of the 357 sections in the industrial zone, 80% are already occupied with factories, of which half are rice mills (rice mills accumulation area). There is a large amount of unused rice husks generated in the area. Power is supplied from the grid, but in times of shortage, diesel generators are used; stable supply of power is an important issue.
- Large Scale Rice Mill in Wetlet District
  Currently, the district it has a rice milling facility which handles 150 tons of rice per day, producing 30 tons of rice husk per day. In this fiscal year, another rice milling

facility, which handles 100 tons of rice per day, will be added. Thus, this mill will produce 50 tons of rice husk per day. At present, although the power demand is almost satisfied, there is a little uncertainty because of the economic development around the area. Because there is no usage of rice husk, it is being burned in a large vacant lot.

Based on the comparison, from the aspect of stable rice husk supply, a large-scale rice mill operated by a single rice miller would be more feasible, while the region's intent was to prioritize installation within the industrial zone that would benefit multiple rice millers.

Therefore, implementation in the industrial zone would be prioritized, and in the later development stage, project expansion in larger scale industrial zones would be considered. Regarding development in large-scale industrial zone, further considerations would be needed for explaining the project benefit.

### 3.1.3 Applied Technology

Technology to be applied in the proposed project is considered from the following perspectives to sustainably operate the project: (1) collectable amount of rice husks, (2) generation system, and (3) rice husk supply.

#### (1) Collectable Amount of Rice Husks

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.

From such perspectives, potential amount of rice husks was considered as follows:

- Total amount of generated rice husks
  Industrial Zone in Shwebo: estimated amount from rice production is 85,700 ton/year (357 sections*80%*50%*20t/day*50%*20%*300days/year=85,700t/y)
- Amount of rice husks that can be utilized
  Unlike in Ayeyarwady Region, rice mills using gasification power plant as self-power supply facility are limited in Shwebo District.
  Assuming that 50% of the rice millers participate in the project, 42,900 ton of rice husks can be collected each year, which is enough for a power plant larger than 4 MW.

### (2) Electricity Demand and Current Power Supply

Of the 357 sections in Shwebo Industrial Zone, 80% are already occupied with factories, of which half are rice mills (rice mill accumulation zone). There is a substation nearby, and power is supplied from the grid, but in times of power shortage, diesel generators are utilized. There is a large amount of unused rice husks. Stable power supply and burning off of unused rice husks on the field are serious issues of the area.

### (3) Power Generation System

Considering the characteristics of rice husks, possible choices of power generation systems are gasification type and direct burning type (Boiler Turbine Generator: BTG). 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.

The study proposes to utilize the turbine technology, which serves as the core technology in the system, of a Japanese company with high efficiency even at a small scale. As for the boiler technology, partner company will be selected with regards to conformity with the conditions of the turbine technology. The overview of the generation system is shown below.

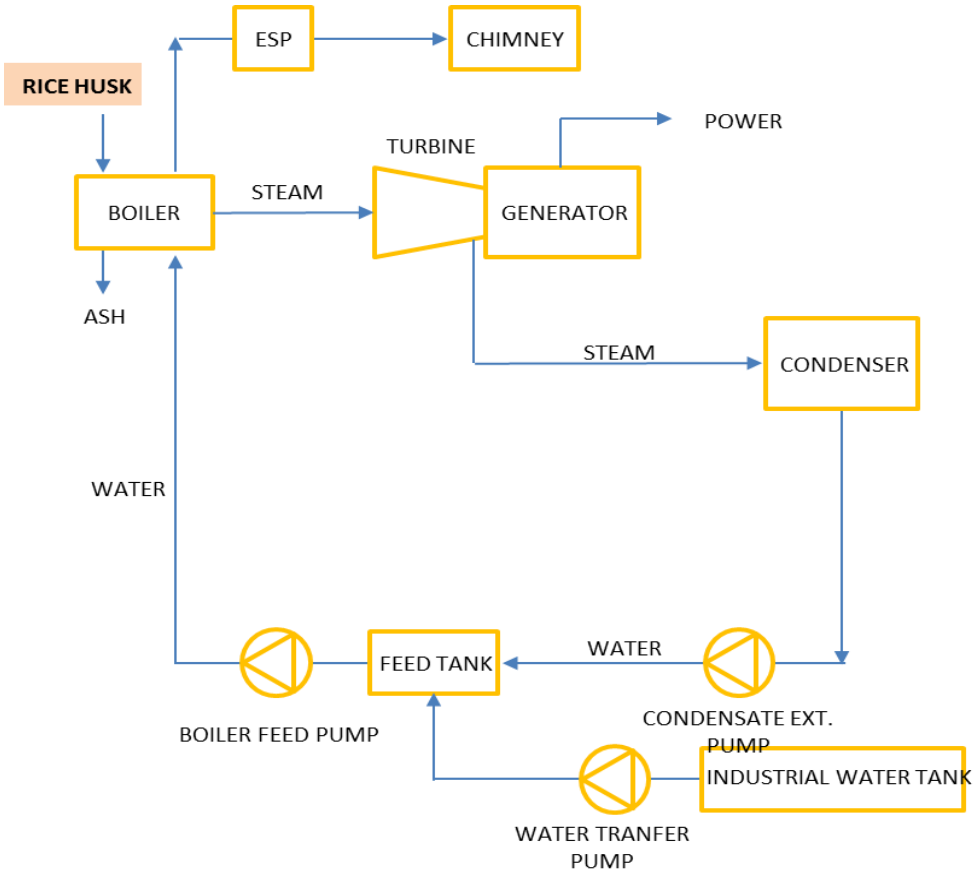


Figure 3-1 Boiler Turbine Generator (BTG) Power Generation Flow

The aforementioned system is used in the first JCM project by Fujita Corporation and MAPCO in Myaung Mya District in Ayeyarwady Region. This system will be used as a base with some modifications to construct an optimized system for the region.

Based on the experiences in the first JCM project, the optimal system will be created (from the aspects of equipment cost and generation efficiency).

Differences between the first JCM project in Myaung Mya District in Ayeyarwady Region are shown below:

**<Common Features>**

- Both project sites do not have large rivers nearby; pumping up underground water can negatively affect rice cultivation. Returning of underground water will be conducted after careful discussions with the stakeholders of the local agricultural department, but changing the steam cooling method to air-cooling method will be considered as well.
- After re-examination of equipment from the first project, measures for reducing initial cost will be considered.
- Ground foundation is expected to be better than that of the first project; increase in construction cost is expected to be eliminated.
- Consideration of surplus power supply

**<Candidate Site: Shwebo District>**

- To assure stable procurement of necessary rice husks, formation of a rice husk power supply organization, consisting of small and middle scale rice millers, is necessary.
- Benefits of participating in the project need to be clarified.

## 3.2 GHG Emission Reduction

### 3.2.1 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 will fulfill electricity demand. The industrial city is connected to the grid; therefore, reference value will be assumed as power supply from the grid. There is no official emission factor provided by the government of Myanmar, and it is difficult to acquire data on power plants connected to the grid; therefore, emission factor was calculated based on IEA data according to the CDM method. The result is shown below.

Table 3-1 Grid Emission Factor based on IEA Data (t-CO2/MWh)

| | Coal | Oil | Gas | 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 | 0.218 |
| 2013 | 0.956 | 0.825 | 0.729 | 0.195 |
| 2014 | 0.969 | 0.848 | 0.729 | 0.280 |
| 2015 | 0.973 | 0.825 | 0.729 | 0.304 |
| Emission factor (2009～2013) | - | - | - | 0.214 |
| Emission factor (2010～2014) | - | - | - | 0.230 |
| Emission factor (2011～2015) | - | - | - | 0.238 |

Furthermore, installation of gas power plant is under discussion in Myanmar; in the future such thermal power plants will hold a higher share in Myanmar's generation mix from hydropower plants. Therefore, reduction from the proposed project is likely to increase as well. Therefore, estimation of grid emission factor will be treated as ex post.

It is important to keep in mind that monitoring point must be established which can appropriately monitor the amount of electricity sold to the grid, not including the electricity consumed within the plant. In addition, when conducting heat supply as well, it is assumed that boiler with the highest energy efficiency at the thermal supply site or in Myanmar is to be altered. On the other hand, when altering conventional rice husk drying process under the sun, the amount of emission reduction will not be accounted for.

### (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.

Based on the idea of the materiality (The threshold of materiality for verification is set at five (5) percent of emission reductions. etc.), small amount of emission resource will not be considered.

### (3) Other Sources of Emission

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.

### (4) Emission Reductions

Assuming the above, emission reduction is calculated as follows.

Table 3-2 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 | 0.238 | kg-CO2/kWh |
| Reference emission | 5,141 | t-CO2/year |
| Fuel transport | 30,900 | t/year |
| Project emission | 0 * | t-CO2/year |
| Emission reductions (planned) | 5,141 | t-CO2/year |

Note) Regarding project emissions, about half of rice hulls are procured from adjacent rice mills and the remaining half are contracts to procure from nearby rice mills, which are considered small amount of emissions resource and are not taken into consideration in calculating reductions.

## 3.3 Business and Policy Proposals

Business scheme (technology specifications, funding, and organizational structure), and measures for JCM project formulation are considered. In addition, possible environmental impact and social impact and measures are considered with reference to local legislations.

### 3.3.1 Business Scheme

The business scheme of the project is shown below.

Table 3-3 Project Scheme

| | |
|---|---|
| Implementation Site | Industrial Zone in Shwebo District, Sagaing Region |
| Size | 3 MW Scale |
| Fuel | Rice Husk |
| Applied Technology | Boiler Turbine (Biomass Power Generation) |
| Power Supply | Generated power will be used within the rice mill, and surplus will be sold to the neighboring community and other factories in the industrial zone (distribution via micro-grid) |
| Project Scheme | Establishment of SPC assumer (e.g. Japanese company and local partner)<br>Utilization of JCM Subsidy |

#### (1) Technology Specifications

Considering the amount of rice husk supply and power demand in the industrial city, this study proposes the following system.

Table 3-4 Specifications of the Rice Husk Power Plant

| | | |
|---|---|---|
| Installed capacity | 3,360 | kW |
| Self-consumption | 360 | kW |
| Sold electricity | 3,000 | kW |
| Availability | 24 | hrs/day |
| | 300 | days/year |
| Generated electricity | 72,000 | kWh/day |
| | 21,600,000 | kWh/year |
| Rice husk | 4 | t/h |
| | 103 | t/day |
| | 30,900 | t/year |
| (Reference)<br>Plastic waste to be co-fired | 0.011 | t/h |
| | 0.264 | t/d |
| | 79.2 | t/year |

### (2) Project Investment

Equipment cost (estimate) excluding civil engineering works is 689 million JPY (gross generation capacity of 3.3 MW). Project investment cost will be distributed according to SPC investment.

### (3) Project Organizational Structure

**<Project Implementation in Industrial Zone>**

The facility is considered as part of the infrastructure prepared by MAPCO; therefore, operational organization should be MAPCO. However, considering the past development experiences in Myanmar local companies, establishment of a joint venture with experienced company would be best. Therefore, with possibility of utilizing JCM scheme, establishment of an SPC between a Japanese and Myanmar local company is being considered. The international consortium structure is shown below:

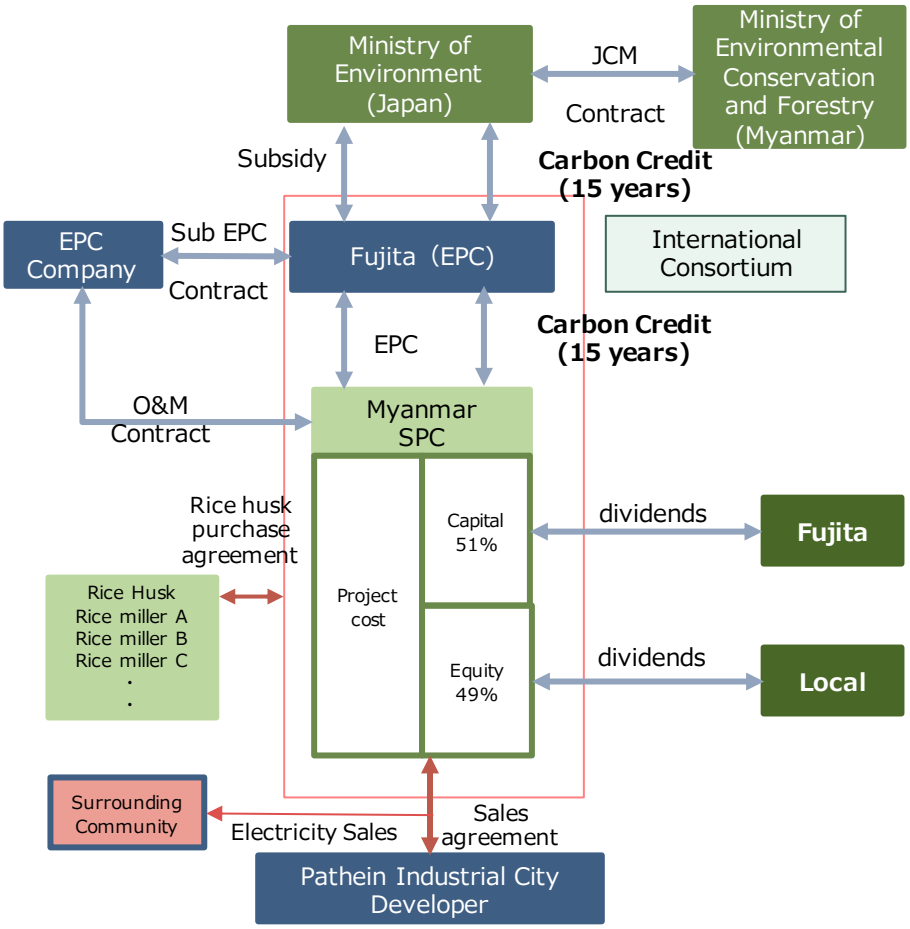


Figure 3-2 Project Organizational Structure (Proposal)

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

#### (4) Sales of Generated Power

All of the generated power will be sold to MAPCO. The power will be supplied to MAPCO facilities and neighboring factories. The power will be sold off-grid.

#### (5) Identification of Participating Entities in the Project

Local company from Myanmar assumed to be participating in the project is MAPCO, which has purchased the land for industrial zone and planning construction of rice mills.

To roll out similar projects in other areas, investment rate of Japanese companies should be gradually lowered; however, at the current economical standard in Myanmar, the project scale is too large for a single entity to participate. Therefore, it is assumed that about three companies will be participating in the project.

### 3.3.2 Environmental and Social Impacts

Possibility of environmental impact (e.g. air and water contamination) from the rice husk power plant project and necessary measures, procedures for environmental impact assessment, possibility of social impact and measures are discussed.

Foreign investment must undergo investment approval procedures at MIC (Myanmar Investment Committee) under Foreign Investment Law and Foreign Investment Rules.

In order to acquire approvals for foreign investment, project categories identified under the EIAP (Environmental Impact Assessment Procedures) must conduct EIA (Environmental Impact Assessment) or IEE (Initial Environmental Examination), or prepare an EMP (Environmental Management Plan).

EIAP identifies the following project categories to conduct IEE or EIA: 1) Project in which investment is decided by the Parliament or the government cabinet or the President, 2) energy sector development, 3) agriculture, livestock and forestry development, 4) manufacturing (food and beverage manufacturing, garments, textiles and leather products, wood manufacturing, chemicals manufacturing, manufacture of glass and ceramics, manufacture of construction materials, metal, machinery and electronics), 5) waste management, 6) water supply, 7) infrastructure and service development, 8) transportation, and 9) mining.

There is no compulsory environmental standard referenced in EIA. National Environmental Quality (Emission) Guideline was established in 2015 with reference to Environmental Health and Safety Guideline established by IFC (International Finance Corporation), but this standard is only a reference standard. Therefore, currently, EIA must be conducted with regards to international standards (e.g. JICA, IFC, ADB, etc.).

The 3 MW scale rice husk power plant project would fall under the project category “Power Plants from Waste Products” in EIAP. Under this category, projects over 50 MW need to undergo IEE, and projects designated by the government need to undergo EIA. Therefore, it is expected that the proposed project does not need to undertake IEE nor

EIA.

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)

Currently, there are no regulations for landfill of burnt ash generated from rice husk power plant, but necessary measures for reducing environmental impact will be taken under discussions with the regional stakeholders.

### 3.3.3 Project Effects

#### (1) Economic Impact

- Utilization of rice husk waste and economic benefits
  There are strong needs for utilization of rice husks; their utilization will generate economic benefits for rice millers
  .
- Power supply in industrial zone
  The industrial zone can supply power for construction electricity needs. Stable production in the industrial zone is expected.

- Green power supply to the industrial zone and securing disaster-resilient independent distributed power
  Rural areas in Myanmar experience large-scale floods during the rainy season, requiring measures for disaster resiliency. Self-reliant distributed energy

resources can supply power during disasters, contributing to increased resiliency in the region.

- New business opportunities
  While rural industrialization becomes a challenge in economic development, growth of new industries (e.g. processed rice products, agricultural processed products, distribution of marine products, etc.) is an important issue. The proposed project of rice husk power plant can supply not only electricity but also heat. Heat can be utilized for drying rice, or other products; it may create new opportunities for businesses.

### (2) Contribution to the Local Society

- Improving electricity access in the local community
  Challenges associated with energy access and waste treatment are one of the most serious issues Myanmar is facing. Rice husk power plant is one solution that can be expanded in other areas in Myanmar. The central government is transitioning into policy development utilizing distributed power system (renewable energy, micro-grids, etc.) to fundamentally improve electricity supply. The proposed project can be an embodiment of a business model for such policy.

## 3.4 Project Planning and Capacity Building

### (1) Policy Development Support

In local workshop held in Sagaing Region (September 2017 in Monywa), as a support for policy development in the waste treatment field through city-to-city cooperation , activities for waste treatment in Fukushima City were introduced; in Fukushima City, “Fukushima City Fundamental Plan for General Waste Treatment” is established to promote appropriate treatment and reduction of waste. In the plan, the following three fundamental policies are proposed:

- Promotion of 3R activities (reducing, reusing, and recycling of waste) and establishment of a circular-type society
- Promotion of appropriate waste treatment and securing safe and comfortable living environment
- Environmental conservation through collaboration between citizens, businesses, and the government

In local workshop held in Yangon (February 2018), policies in Fukushima City regarding renewable energy promotion were introduced, and discussions were held on energy policies related to low-carbon waste treatment system in Myanmar (rice husk power plant) and PV system implementation. Myanmar is in power supply shortage, but utilizing environmentally-friendly renewable energy resources is meaningful for the country, and it was concluded that further considerations would be conducted under public-private cooperation based on city-to-city collaboration.

The following policies in Fukushima City were introduced:

- Fukushima City Renewable Energy Promotion Plan
- Future Visions of Fukushima City
- Arakawa Clean Center (Local generation and consumption of waste power plant)
- Deployment of Renewable Energy Power Plant
- PV System Installment Subsidy
- Programs for Interest Subsidy for Renewable Energy Related Facilities

Additionally, there was a courtesy visit for the Ministry of Agriculture, Livestock and Irrigation of the Union of Myanmar. The activities in Ayeyarwady Region and Sagaing Region under city-to-city cooperation, along with features of Fukushima City (tourism, agriculture, food processed products such as bread utilizing rice flour and Japanese sake) were introduced. The Minister showed appreciation for continued support by Fukushima City, and expressed his intent to provide further support for low-carbon waste treatment system (rice husk power plant).

Through the workshop, a shared understanding for the importance of utilizing renewable energy in industrial zones and rice mills development was formed. The understanding was shared not only with the government officials, but also with the union officials such as the Minister for the Ministry of Agriculture, Livestock and Irrigation of the Union of Myanmar (power supply with renewable energy for development of rice mill

industry)

- Overview of Joint City-to-City Collaboration Workshop with Ayeyarwady Region and Sagaing Region

| | |
|---|---|
| Date | February 6th (Tue) 15:00~17:00 |
| Venue | Meeting Room in Yangon |
| Participants (28 in total) | ・Japanese side: 10 participants (including: Fukushima City officers, Fukushima Chamber of Commerce and Industry board directors, Mitsubishi Research Institute, Fujita Corporation (including Yangon Branch staffs, etc.)<br>・Myanmar Side: 18 participants (including: Engineers from Sagaing Region and Ayeyarwady Region, officers from Yangon, Myanmar Rice Federation, MAPCO, etc.) |
| Overview | ・Renewable energy promotion plan in Fukushima City was introduced, and energy policies related to PV system installation and low-carbon waste treatment system (rice husk power plant) in Myanmar were discussed.<br>・Myanmar is in shortage of power supply, but additional electricity would need to utilize environmentally friendly renewable energy, and it was agreed that specific measures would be considered with the public and private sector under the city-to-city collaboration. |

- Overview of Courtesy Visit to the Minister of Agriculture, Livestock and Irrigation

| | |
|---|---|
| Date | February 7th (Wed) 13:30~14:00 |
| Venue | The Republic of the Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI) Meeting Room |
| Participants (15 in total) | ・Japanese side: 10 participants (including: Fukushima City officers, Fukushima Chamber of Commerce and Industry board directors, Mitsubishi Research Institute, Fujita Corporation (including Yangon Branch Staffs))<br>・Myanmar side: 5 participants (including Minister of Agriculture, Livestock and Irrigation, UMFCCI, Myanmar Rice Federation) |
| Overview | ・There was a courtesy visit to the Minister of Agriculture, Livestock and Irrigation, and the activities in Ayeyarwady Region and Sagaing Region under city-to-city cooperation, along with features of Fukushima City (tourism, agriculture, processed products such as bread utilizing rice flour and Japanese sake) were introduced.<br>・The Minister showed appreciation towards the past support by Fukushima City, and expressed his intent to provide further support for low-carbon waste treatment system (rice husk power plant). |

### (2) Business Exchange

On invitation to Fukushima City in July, there was a networking event with the member companies of Fukushima Chamber of Commerce and Industry. The officers shared current situation and trends in investment law and discussed about the possibility for Fukushima companies to do business in Myanmar.

During the networking event in February in Yangon with the local business stakeholders, companies from Fukushima were introduced, including those engaged in waste paper recycling, biogas power plant from waste water, and unique products for environmental conservation and industry promotion.

Discussions were held on the possibility for collaboration between Myanmar companies and Fukushima City companies; a shared understanding was formed that business dialogues are important for embodiment of collaborations. To achieve a low-carbon society, project formulation in the business sector, along with policy development, is important. The related stakeholders recognized such low-carbon society concept as a business opportunity as well (through the shared experiences of Fukushima City companies).

This was the first attempt to conduct business-side dialogue between the local chamber of commerce, and it was understood that there were high expectations for Japanese government, and continued exchange would be important (e.g. collaborations with MAPCO; MAPCO is a large company engaged in agricultural businesses in Myanmar).

- Overview of Discussions with Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI) and other Business Stakeholders

| | |
|---|---|
| Date | February 7th (Thu) 14:00~16:00 |
| Venue | Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI) Meeting Room |
| Content | ・During the networking event, activities of Fukushima City were shared from the Chamber of Commerce and Industry, and discussion was held on possibility for collaboration between Myanmar local companies and Fukushima City companies. The importance of business dialogue for establishing specific plans was understood among the participants. |
| Participants (26 in total) | ・Japan side: 10 participants (Fukushima Chamber of Commerce and Industry, local companies, Fukushima City officials, Mitsubishi Research Institute, Fujita Corporation)<br>・Myanmar side: 16 participants (Union of Myanmar Federation of Chambers of Commerce and Industry, Myanmar Rice Federation, MAPCO, local companies) |

### (3) Capacity Building

During the local workshop (February 2018, Yangon), as an outcome of city-to-city collaboration between Fukushima City and Ayeyarwady Region, concept of “Promotion of new waste treatment in correspondence with economic development” (sharing understanding on challenges, measures for resolving challenges, action plan for city-to-city collaboration), was shared with related parties in Sagaing Region.

Waste treatment: measures for waste treatment promotion in correspondence with economic development is explained below.

**<Vision>**

In correspondence with increasing waste due to economic development, transition into 3R model (reduce, reuse, recycle) and achieving low-carbon, circular-type urban development is important.

**<Development Plan>**

- Utilizing the fact that the area is one of the foremost rice producing area in Myanmar, energy utilization of waste through rice husk power plant will be promoted (using Japanese supporting scheme including JCM), as a means of biomass waste treatment. For long-term sustainable rice husk power plant operation, long-term stable supply of rice husk is essential; collaboration between the government, businesses, and industry groups will be promoted for procuring rice husks generated in rice mills.
- Along with advanced projects (rice husk power plant), raising awareness for waste in the local society is important, and activities for this purpose will be promoted (e.g. environmental education is effective for establishing waste sorting scheme, and school education can be a place for such education).
- Development in other area:
  In the future, based on city-to-city collaboration activities, activities in other areas (e.g. promotion of renewable energy, resource circulation, energy conservation, etc.) and in other regions (other cities in the region and other industrial zones) will be conducted.

**<u>Understanding of challenges, future development, and action plans (proposal)</u>**

**Waste treatment area ~ Promotion of new waste treatment in correspondence with economic development ~**

**<Understanding of challenges>**

- Even in rural areas, municipal waste is treated by landfill; in urban area, waste is increasing due to economic development, and dispersed waste in the agricultural area and limited final treatment site are foreseen as future challenges.
- Japanese municipalities, which have experienced rapid economic development, activities for transition from landfill treatment to incineration treatment,

strengthening of 3R (reduce, reuse, recycle) activities are undertaken. In particular, sorting waste is one of the most important activities in 3R.

- In Sagaing Region, one of leading regions for agriculture in Myanmar, agricultural waste treatment and utilization (e.g. biomass power plant) is necessary.

**<Development Plans for Solving Issues>**

- Therefore, based on the current local situation and Japanese experiences, appropriate treatment of biomass waste such as rice husks (and their utilization), and considerations of action plan for waste sorting activities, are necessary.
- Along with advanced projects, it is important to raise awareness for waste in the local society; to establish waste sorting scheme, it is effective to implement environmental education activities (utilizing school education, etc.)

**<Action Plan Based on City-to-City Collaboration (Proposal)>**

As an action plan for promotion of new waste treatment in correspondence with economic development in Sagaing Region, the following are important: 1) appropriate treatment (utilization) of biomass waste such as rice husks (energy use of waste through rice husk power plant), 2) strengthening measures from policy perspective (policy guidance, etc.) and raising awareness (support for environmental education activities for establishing waste sorting scheme)

(1) Business on biomass waste treatment (utilization) such as rice husks

- Development of rice husk power plant business using JCM Scheme
- Building structure for rice husk procurement (collaboration between the government, business entities, and business association)

(2) Strengthening measures from the policy side and raising awareness

- Clarification of vision for waste treatment in the local area (reference: fundamental plan in Fukushima City)
- Raising awareness for adhering to regulations (reference: study meetings in Japanese Chamber of Commerce and Industry, awareness raising activities)
- Environmental education activities for establishing waste sorting scheme (reference: educational program in elementary school)
- Sorting and recycling activities with participation from the government, business, citizens (households), school and the community

## 4. Future Project Development

Based on this year's survey results, plans for future project development were considered.

| Challenges | Results | Future Plans |
|---|---|---|
| Examination of business feasibility | Discussion with three Japanese companies regarding equipment procurement and O&M<br><br>Confirmation of power plant size<br><br>Examination of development plan<br>(It is expected that the first phase will be 3 MW scale power plant in an industrial zone in Shwebo District) | Of the relevant stakeholders, MRF and MAPCO agree on conducting project of 3 MW scale or larger; further discussions will be held for specific measures |
| Negotiations with urban development | Planning of measures for policy guidance<br>Confirmation of power plant size<br><br>Discussions were held on policy guidance during inter-regional collaboration workshop<br><Direction of policy guidance><br>-Policy guidance for appropriate treatment of rice husk waste<br>-Using waste as energy (local generation and consumption)<br>-Contribution to electrification of neighboring regions<br>-Ideas for roll out of micro-grid | Embodiment of development plans for not only industrial zone but also neighboring area (rice mill business is the core industry of agricultural area, and co-existence with the local development is important.) |
| Negotiations for electricity sales | -Sharing understanding with the Regional Minister of Electricity<br>-Discussions with MRF and MAPCO<br>-Discussions with relevant governmental departments<br>-Shared understanding was established that power supply using renewable energy is an effective means for CO2 emission reduction and prevention of environmental contamination due to waste, and that rice husk power plant is one promising solution.<br>-Discussions for possibility for | Negotiations need to be made with the central government, regarding grid interconnection and micro-grid; specific advantages and disadvantages will be clarified (leading to specific discussions for policy development and technology implementation) |

| Challenges | Results | Future Plans |
|---|---|---|
| | implementing micro-grid system (the discussion has just initiated) | |
| Negotiations with entities to participate in business | -Considerations will be made with the regional government<br>-Discussion will be conducted, focusing on two sites (Shwebo and Wetlet, prioritizing Shwebo)<br>-Discussions for business planning with MAPCO<br>-Forming organization for rice husk supply, consisting of individual rice millers of local (Shwebo) area | Forming of an organization of small to middle scale rice millers will be discussed in March. |
| Negotiations on construction site | -Considerations will be made with the regional government<br>-Discussion will be conducted, focusing on two sites (Shwebo and Wetlet)<br>-Considerations will be aligned with MAPCO business plan (Shwebo)<br>-Confirmation of individual business owner's plan in Wetlet | Specific discussions to be conducted in project formation phase |
| Approval and permission process | -Basic process for approval and permission is the same as that of in Ayeyarwady Region<br>-Detailed processes will be checked with local relevant departments | -Specific discussions to be conducted in project formation phase<br>-It is essential to build relationships with stakeholders of the region (Minister and officers) |
| Specific supporting measures through city-to-city collaboration | -During the local workshop in Sagaing Region held in September, understanding on the project and basic plans was acquired from the Chief Minister of the region and relevant stakeholders.<br>-Ministers of relevant departments in Sagaing Region were to participate in Fukushima City workshop in January, with courtesy visit, workshop and network event planned, but VISA could not be issued due to complications in Myanmar.<br>-During the local workshop in February, relevant stakeholders from | -It is essential to build strong relationships with the relevant departments and officers (to be continued as a future task)<br>-Establishment of low-carbonization model in an existing industrial zone with accumulation of rice mills, which is considered as one of the most promising candidate sites for the project (The first project in Ayeyarwady Region is a new industrial zone, while |

| Challenges | Results | Future Plans |
|---|---|---|
| | Ayeyarwady Region and Sagaing Region participated, sharing their experiences and leading to collaboration between the two regions.<br>-Policy dialogue between regions with JCM experiences would be an effective approach.<br>-Regarding micro-grids and their development, wheeling system in Japan was introduced. | this survey examined the possibility of a project in existing industrial zone)<br>-Further measures for growth into low-carbon urban development model with regards to neighboring areas (regarding policy aspect and technical aspect of micro-grid, wheeling scheme, etc.)<br>-The central government has high expectations for such activities as well. |

**Activities regarding rice husk power generation in industrial zones**

**Local needs and significance of the project**

As with Ayeyarwady Region, for which a policy dialogue was conducted previously in an intercity cooperation, Sagaing Region is facing social problems to be solved such as increase in waste and power consumption (environmental pollution, access to energy, etc.,) that follow economic development. In particular, problems related to disposal of rice husks are more severe in Sagaing Region where open-air burning of husks is performed on a large scale, compared to Ayeyarwady.

The rice husk power generation project in Ayeyarwady Region (JCM subsidiary project on facilities) is an activity providing two benefits, i.e., effective use of rice husks that are disposed of (i.e., waste reduction) and power generation. Relevant parties in the region and rice milling enterprises are both interested in the project. In rice milling businesses, a challenge is to reduce production costs and enhance the quality of rice for improved competitiveness as an industry by increasing the scale of businesses and replacing facilities. To promote this activity, it is essential for rice milling enterprises to secure electricity stably. For survival of the rice milling industry in Myanmar, it has been recognized as an effective approach to use rice husks as a resource and take measures to secure electricity independently, not relying on power supply from the national grid only.

**<Specific Measures (proposal)>**

- Considerations for a business model from the aspect of increasing competitiveness of rice millers (production of rice-processed food using renewable energy)
- Establishment of a business model in which rice husk, which is waste resource, contributes to power supply, leading to new businesses using such power

**Tasks for realization**

Because the stable and long-term procurement of rice husks is indispensable to realize a rice husk power generation project, cooperation must be established among the government, business enterprises and industry groups to create a mechanism of procuring rice husks generated at rice mills. Discussion for realization will be made hereafter.

**<Specific Measures (proposal)>**

- Considerations for forming an organization through MRF
- Policy guidance from the government

**Establishment of a model for further development of rice husk power generation projects**

As heat is produced in addition to electricity in rice husk power generation, it was pointed out that the heat might be used effectively. Specifically, this is an idea of producing cold energy using the heat and applying it to the cold energy demand in factories and depositories. Reduction in greenhouse effect gas emissions and increase in economic efficiency are also expected by it. We have to examine the feasibility of this idea hereafter to establish a cogeneration type rice husk power generation system through detailed discussion on its technological aspect and needs of cold/hot water, considering specific cases.

**<Specific Measures (proposal)>**

- Examining heat demand in rice husk power plant area
- Consideration for a system using both power and heat (detailed study on economic and technical feasibility)

**Power Supply to Neighboring Area**

For the rice husk power generation at rice mills in this region targeted, the regional government has great expectation on not only the use of electricity in the industrial complex but also contribution to improvement in electrification rates and stability of power supply. To realize this, development of micro-grids, etc., are necessary to supply electricity to the regions surrounding the industrial complex. However, it is economically difficult for business enterprises to bear the costs of developing micro-grids. During this policy dialogue, we explained that the wheeling service of electricity, which was a mechanism to supply electricity virtually through existing power distribution networks, had been developed in Japan, and the power generation using waste was realized in Fukushima City with this mechanism. We proposed that Myanmar examined the feasibility of this mechanism. Because there is a substation at a site adjacent to the industrial complex, which is the main candidate site, wheeling service using this substation and existing distribution networks may become a solution as a power supply scheme for consumers of other regions. However, detailed technical and institutional conditions have to be examined. Discussion with relevant parties in the region should be deepened on whether or not a business model of supplying power to the regions adjacent

to the industrial complex can be established with a method like wheeling service.

**<Specific Measures (Proposal)>**

- Consideration of possibility for power supply using electricity wheeling service (policy dialogue with stakeholders from the electricity-related sectors of the regional government)
- Grasping the construction situation of distribution grid around the industrial zone
- Specific measures for local electrification

**Supporting Policy Development for Waste Treatment**

The outcome of city-to-city collaboration between Fukushima City and Ayeyarwady Region, "promotion of new measures for waste treatment in correspondence with economic development," was shared with the Sagaing Region stakeholders. In the urban area of Sagaing Region, like Ayeyarwady Region, faces large amount of abandoned waste (e.g. plastic waste from food containers), and waste treatment measures in the urban area will be essential in the future.

Based on the development plans and action plans considered in Ayeyarwady Region, measures for Sagaing Region with respect to its regional characteristics will need to be considered.

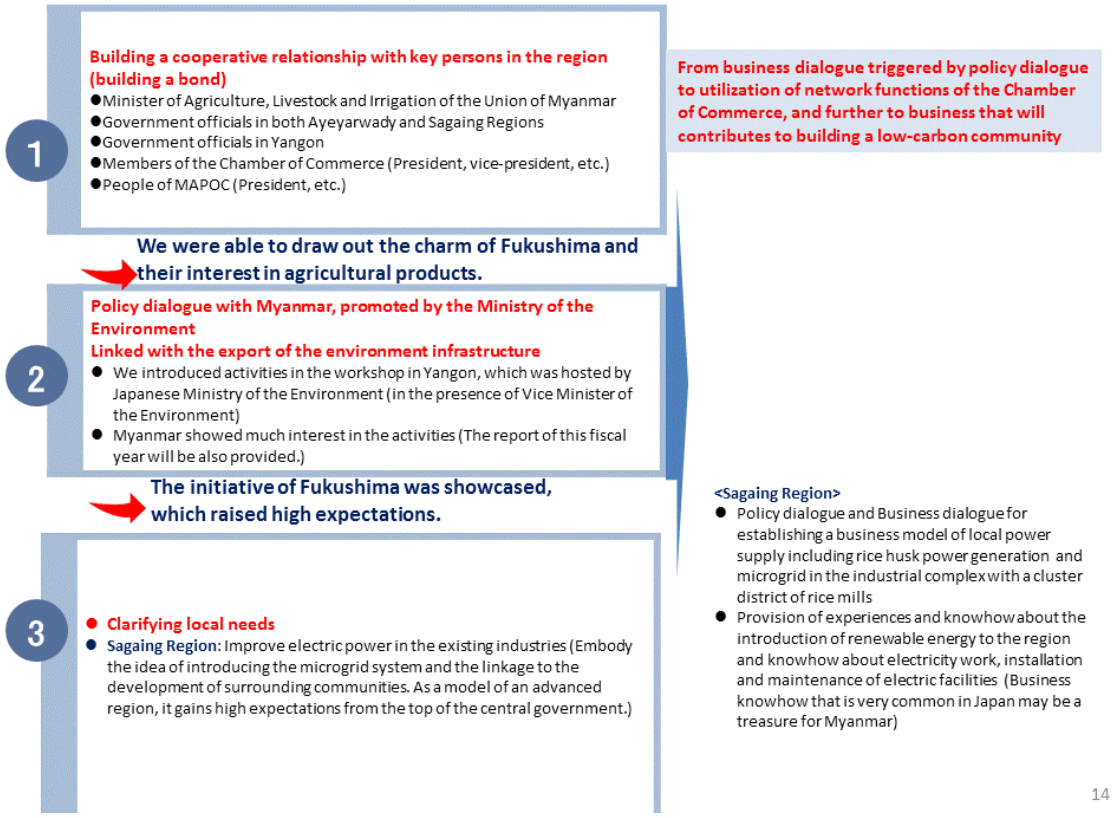


Figure 4-1 Key Points and Future Plans

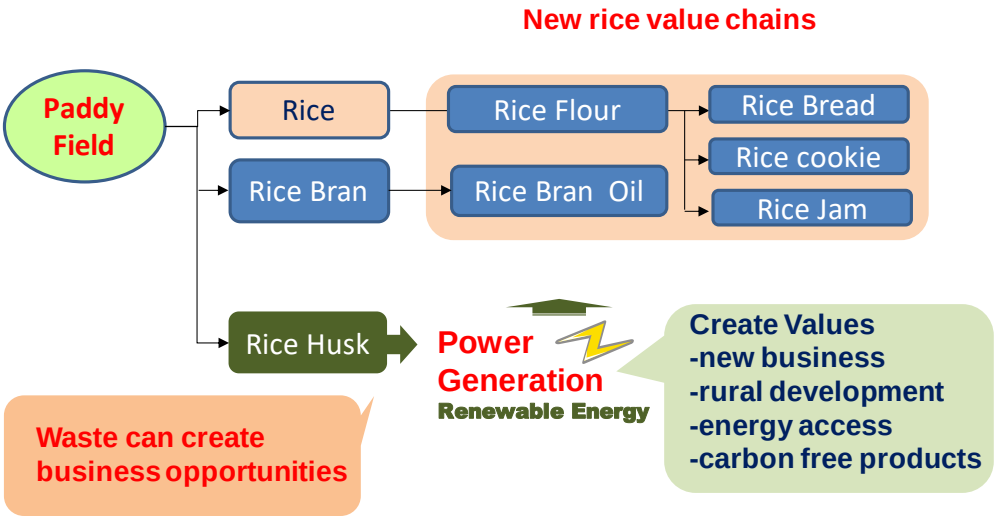


Figure 4-2 Creation of New Values by Rice husk power generation