FY2016 Project for Ministry of the Environment Japan

FY2016 Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration

(JCM Feasibility Study for Low-Carbon City in Ayeyarwady Region (Study of a low-carbon waste treatment system in Pathein Industrial City))

Report

February 2017

Mitsubishi Research Institute, Inc.
Fujita Corporation

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List of Abbreviations

This report uses the following standardized units and abbreviations.

unit

t	ton
kg	kilogram
MJ	Megajoule
MW	Megawatt
kVA	Kilovolt-ampere
MVA	Megavolt-ampere
kW	Kilowatt
kWh	Kilowatt hour
GWh	Gigawatt hour
TWh	Terawatt hour
Mpa	Megapascal
ha	Hectare
m2	Square meter
m3	Cubic meter
t-CO2	Carbon dioxide emissions (t)
kg-CO2	Carbon dioxide emissions (kg)
MMK	Myanmar kyat
USD	U.S. dollar

Abbreviations

ADB	Asian Development Bank
ASEAN	Association of South - East Asian Nations
BTG	Boiler, Turbine, Generator
CDM	Clean Development Mechanism
DICA	Directorate of Investment and Company Administration
EIA	Environmental Impact Assessment
EIAP	Environmental Impact Assessment Procedure
EMP	Environmental Management Plan
EPC	engineering, procurement, construction
ESE	Electricity Supply Enterprise
FAO	Food and Agriculture Organization
FIL	Foreign Investment Law
GHG	greenhouse gas
HPGE	Hydropower Generation Enterprise
IEA	International Energy Agency
IEE	Initial Environment Examination
IFC	International Finance Corporation
IFC EHS	International Finance Corporation Environmental Health and Safety
INDC	Intended Nationally Determined Contributions
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency

MCDC	Mandalay City Development Committee
MEPE	Myanmar Electric Power Enterprise
MIC	Myanmar Investment Commission
MOST	Ministry of Science and Technology
MRV	Measurement, Reporting and Verification
NLD	National League for Democracy
O&M	operation and maintenance
PCDC	Pathein City Development Committee
PV	Photovoltaics
SIA	Social Impact Assessment
SPC	Special Purpose Company
UNFCCC	United Nations Framework Convention on Climate Change
YCDC	Yangon City Development Committee
YESB	Yangon City Electric Enterprise
3R	Reduce, Reuse, Recycle

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Executive Summary

JCM Feasibility Study for Low-Carbon City in Ayeyarwady Region
(Study of a low-carbon waste treatment system in Pathein Industrial City)

Executive Summary

1. Background of the examination

A partnership was formed between Ayeyarwady Region and Fukushima City as the platform for a new city-to-city collaboration under the collaborative scheme (framework) between the two, and discussions were conducted among stakeholders from both parties. In concrete, the status quo and the needs of Pathein City in Ayeyarwady Region were studied and comprehended, various initiatives by Fukushima City and related technologies were presented as reference, and examinations were performed concerning the possibility of collaboration between both Cities, as well as the possibility of deploying the Joint Crediting Mechanism (JCM) for realization of a low-carbon township in Ayeyarwady Region, in the fields of waste treatment and water treatment, in particular, through joint activities such as the holding of workshops in both Pathein City in Ayeyarwady Region and Fukushima City, mutual visits by members of both Cities (including on-site investigations), and exchange of opinions concerning the policy trends of both Cities.

Ayeyarwady Region, Myanmar
Ayeyarwady Region is the largest agricultural area in Myanmar, and the Region has been promoting new initiatives in recent years, including the development of new industrial parks, in order to promote the industrialization of the Region. This Region is considered to be one of the local areas in Myanmar where a rapid economic development is anticipated towards the future, and accordingly, the experience and knowhow held by Japan that experienced a rapid economic growth in the past are expected to be positively utilized in the Region.

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. Awareness of the issues, and the direction towards the realization of a low carbon partnership

All members of the "Partnership", through discussions thus far, came to share the awareness about the importance of building a sustainable, low-carbon-type, vigorous, well-advanced township in Ayeyarwady Region, and the direction (roadmap) towards the realization of such township, as stated below.

Goal Image of the Region

It is important to aim at realizing an "environmentally most advanced City of Ayeyarwady (tentative name)", a city, which is full of vigor, yet low-carbonized and environmentally friendly, with its local features well preserved, by making the most of advanced technologies and knowhow, while preventing the occurrence of various social problems (environmental pollution, natural disaster, etc.) from the increase in the volume of waste materials, increase in the environmental load including deterioration of water quality, increase in the amount of energy consumption, loss of the rich natural environment of the Region and so forth, which could occur as a result of the economic growth.
It is indispensable for the administration, citizens and business operators to work together for the preservation of the environment and for the promotion of low-carbonization, and it is important to gradually expand the sphere of deployment, by firstly proceeding with a model-type approach based on a pair of wheels of "deployment by business operators" and "deployment of institutional efforts: i.e. creation of a proper mechanism to support business deployment".
In bringing the model-type approach into practice, it is indispensable to utilize the experience and knowhow of Japan that experienced a rapid economic growth in the past, as well as the framework of the JCM, through discussions within the Partnership, which is the platform of the city-to-city collaboration.

The fields of waste treatment, recycling of resources, water treatment and energy sources, in particular, are the priority areas in the development of townships, and it is important to aim at the below-stated directions in both fields of waste treatment and water treatment (which were the discussion themes of this time).

3. Direction of deployment in individual fields

Field of waste treatment: Promotion of new treatment measures for waste materials, corresponding to the progress of the economic growth

Vision

It is important to convert our mind to technologies based on the concept of 3R (Reduce, Reuse, Recycle) and aim at creating a low-carbon, circular-type township, corresponding to the increase in the volume of waste materials associated with the economic growth.

Future Perspectives

We promote production of energy from waste materials by way of the rice-husk power generation as an appropriate treatment (effective utilization) of biomass-type waste materials such as rice husks, taking the advantage of Ayeyarwady Region being one of the

leading rice-growing areas in Myanmar (We will here utilize Japan's support systems such as the JCM).
We promote collaboration among the administration, business operators and industrial associations for creation of a proper mechanism to procure rice husks generated at rice polishing mills, as it is indispensable to stably procure rice husks on a long-term basis in order to perform stable rice-husk power generation for a long period of time.
In parallel with the advanced efforts (i.e. rice-husk power generation), a change in the awareness of people in the local community about waste materials is important, and accordingly, we proceed with the measures to change the awareness of local people. (e.g. to promulgate the habit of sorting waste materials. As the educational approach is thought to be effective here, we will utilize the place of education for that purpose.)

Development in other areas

Hereafter, it is important to bring into practice a model-type approach of "environmentally most advanced township" in Ayeyarwady Region, by also proceeding with the deployment in related fields (e.g. promotion of renewable energy sources, recycling of resources, energy efficiency, etc.) and in other regional areas (e.g. other townships in the Region, other industrial parks, etc.) in a well coordinated manner, by making good use of the approach from the city-to-city collaboration.

[Details of recognized issues, future perspectives and action plan (draft)]

~Promotion of new measures for waste treatment corresponding to the progress of economic growth~

Recognition of issues

Thus far, in Ayeyarwady Region, municipal waste has been disposed of by way of sanitary landfills, but the amount of waste materials has been increasing in urban areas, corresponding to the progress of the economic growth. As a result, there is concern about the occurrence of such problems as shortage of final disposal sites and the scattering of waste in both urban and rural areas.
In the case of municipalities in Japan that experienced a rapid economic growth in the past, they have been converting their waste disposal method from the landfill-type to the incineration-type and/or enhancing the approach of 3R (Reduce, Reuse and Recycle). In proceeding with the 3R approach, the sorting of waste materials, in particular, is considered to be one of the most important matters.
It is necessary for Ayeyarwady Region to promote proper treatment measures and effective utilization of agricultural waste materials such as rice husks (e.g. realization of biomass power generation), in light of the fact that the Region is one of the leading agricultural areas in Myanmar.

Direction of deployment for the solution of the issue

For this reason, it is necessary to proceed with the examination of an action plan for the proper treatment of biomass-type waste materials such as rice husks (effective utilization), as well as that for the sorting of waste materials.
In parallel with the advanced technological approach, it is also important to change the

awareness of people in the local community about the water preservation (As the educational approach is thought to be effective here, we will utilize the place of school education for this purpose.)

Proposed action plan (draft)

For the action plan to promote new waste treatment measures corresponding to the progress of the economic growth of Ayeyarwady Region, it is important to (1) examine the feasibility of commercialization (business operation) of proper treatment measures (effective utilization) of biomass-type waste materials such as rice husks (energy production using waste materials by way of rice husk power generation), and (2) enhance institutional measures (guidance, etc.) and enlighten the awareness of local people (in order to gain their cooperation to the environmental education approach to promulgate the habit of sorting waste materials).

(1) Commercialization of proper treatment measures (effective utilization) of biomass-type waste materials such as rice husks.
- Deployment of rice husk power generation, utilizing the JMC.
- Creation of a mechanism for the procurement of rice husks (collaboration among the administration, business operators and industrial associations).

(2) Enhancement of institutional measures and enlightenment of people's awareness.
- Clarification of the vision about the treatment of locally generated waste materials (reference: Basic Plan of Fukushima City).
- Change of people's awareness towards the compliance with regulations (Reference: Study meetings conducted by commercial and industrial groups in Japan; enlightenment activities).
- Environmental education approach to promulgate the habit of sorting waste materials (Reference: Activities on the level of elementary schools).
- Waste-sorting and recycling activities with the participation of the administration, business operators, citizens (families), schools and communities.

1 Purpose and Implementation Arrangement

1.1 Purpose

Japan proposed its INDC (Intended Nationally Determined Contributions) to UNFCCC (United Nations Framework Convention on Climate Change) in July 2015. Japan's INDC towards GHG emission reductions is at the level of a reduction of 26.0% by FY2030 compared to FY2013 (25.4% reduction compared to FY2005 (approximately 1.042 billion t-CO2 eq), ensuring consistency with its energy mix, set as a feasible reduction target. It further states that the Joint Crediting Mechanism (JCM) is not included as a basis of the bottom-up calculation of Japan's emission reduction target, but the amount of emission reductions and removals acquired by Japan under the JCM will be appropriately counted as Japan's reduction.

Furthermore, in December 2015, Paris Agreement was adopted at 21st COP21 in UNFCC held in Paris, France. Stakeholders besides national government, such as municipalities and industries are becoming more important.

This project aims to support projects that aim to achieve low-carbonization of cities, by formulating projects that can reduce CO2 emissions from energy consumptions, and acquire JCM credit in foreign cities and regions; it aims to do so through city-to-city collaboration with Japanese municipalities that possess know-how in forming low-carbon societies. JCM Feasibility study for low-carbonization of cities was conducted to formulate JCM projects in cities or regions that city-to-city relationship and to establish operation and maintenance structure for Japanese technologies and policies with Japanese research

1.2 Survey Items

The research surveyed the following items for a low-carbon waste treatment system (rice husk power generation) in the new industrial zone under construction (Pathein Industrial City) in Pathein City, Ayeyarwady Region.

(1) Overview and local needs
(2) Selection of Japanese experiences, know-how, and technologies to be utilized
(3) Project feasibility
(4) Local survey, 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 the local partner (a local company developing businesses in various sectors including rice industry, urban development industry, and financial industry).

Mitsubishi Research Institute, with its rich experiences in policy implementation, planning, and JCM research for the Japanese national and municipal government, collected relevant information, managed workshops, considered formulation of JCM projects, and supported policy dialogue between Fukushima City and the local government, in addition to its role of the overall project management.
Fujita Corporation, with its knowledge and experiences in industrial, urban, and regional development, further considered the possibility of specific candidate projects.
Fukushima City had policy dialogue with the officials of the local government to discuss policy-side approach for low carbonization of the industrial zone. It also introduced policy-side aspects of “industrial city” including its whole surrounding area, by sharing Japanese experiences. It utilized its experiences and knowledge in creating renewable energy promotion plan, waste treatment plan (with a focus on approaches to recycling, development in waste power generation, waste treatment policies, approaches to low-carbonization, etc.), and in building industrial zones.
Fukushima Chamber of Commerce and Industry Companies cooperated with its member companies to introduce their technologies and know-how in businesses, and to investigate possibilities in transferring technologies of companies related to Fukushima City.

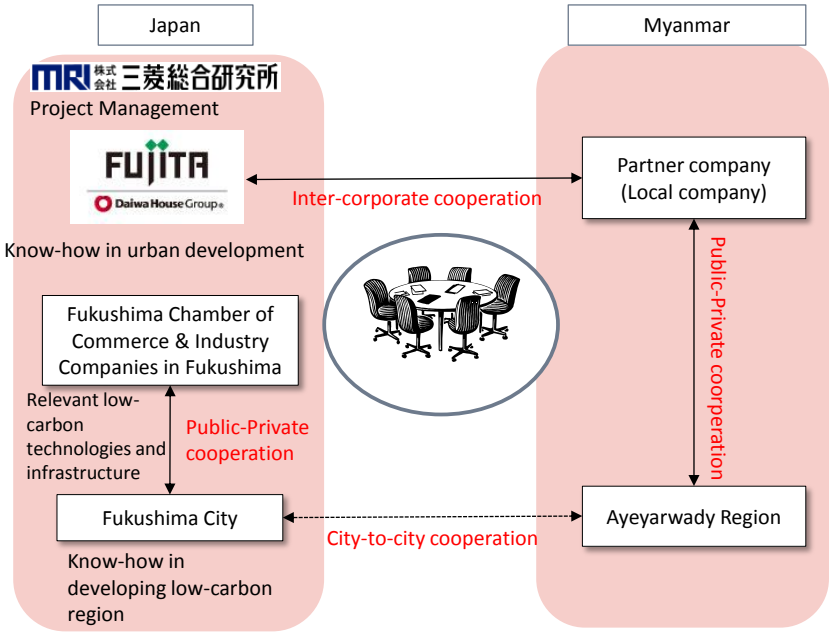


Figure 1-1 Organizational Structure

1.4 Overview of City-to-City Cooperation

In order for Pathein Industrial City, which is currently under development, to achieve a comprehensive development, there are still many issues to overcome, such as procurement of stable supply of power and installation of waste treatment facilities. We can expect a unique development of Pathein Industrial City and its surrounding areas, if we utilize the experience and knowhow of Japan's municipalities and companies for the solution of these issues. And it is also important to proceed with such regional development with certain distinctive features for the promotion of industrial clusters and industrial development. Myanmar has high expectations for the utilization of the experience and technologies of Japan which experienced a 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 & 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 inter-city cooperation, and decided to perform activities for the inter-city cooperation. 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 making the project applicable to the subsidies under JMC scheme. And furthermore in February 2016, when government officials of Fukushima City visited the site in Ayeyarwady Region, they handed to the Minister in charge of the Region a letter from the Mayor of Fukushima City responding to the request for support and cooperation, and expressed Fikushima City's willingness to cooperate with Ayeyarwady Region not only in the secctors 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.

- First workshop in Pathein City (September 2016, Pathein City)
- Workshop in Fukushima City (October 2016, Fukushima City)
- Discussions with visitors to Japan, site visits (January 2017, Tokyo)
- Second workshop in Pathein City (January 2017, Pathein City)

The initiatives of inter-city cooperation through this Partnership were studied in two feasibility studies conducted in FY 2016 to examine the feasibility of utilizing JCM scheme towards the realization of low-carbonization of Ayeyawady Region; namely, in both "Feasibility study of introducing low-carbon water and sewage treatment systems in Pathein

Industrial City" and "Feasibility study of introducing low-carbon waste treatment systems in Pathein Industrial City".

- Outline of the workshops and field surveys by Fukushima City

When government officials of Ayeyawady Region visited Fukushima City from October 20 to 22, 2016, a workshop was held in Fukushima City. They also made a survey of Fukushima City's initiatives by visiting final disposal facilities as well as water treatment facilities.

They made a courtesy visit to the Mayor of Fukushima City, and exchanged opinions on future cooperation between Ayeyawady Region and Fukusima City with persons in charge of the Fukushima Chamber of Commerce & Industry at the seminar held to welcome the visitors from Myanmar.

Courtesy visit to Fukushima City Mayor

Discussions with the Mayor

Presentation of commemorative item from Fukushima City

Presentation of commemorative item from Myanmar

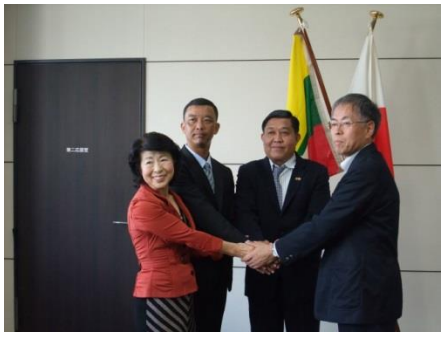


Photo with Fukushima City officials and Fukushima Chamber of Commerce and Industry member

Policy lectures from Fukushima City officials

Lecture

Photo

Networking Event by Networking Event by Partnership for a Low-Carbon Initiative in Ayeyarwady

Opening Note by Vice President

Opening Note by Mr. Aung Min Naing

In September 2016, the first on-site workshop was held in Pathein City with participation of government officials of Ayeyawady Region and of members from Japan (Mitsubishi Research Institute and Fujita), and a field survey was conducted. At the on-site workshop (held on September 20), the Chief Minister of Ayeyawady Region took the trouble of attending the first part of the workshop. In the field survey, the members from Japan paid a visit to the Development Division of the Region and conducted interviews with General Manager and persons in charge of the Division in order to gather the most up-to-date information about the current situation and future development trend. In addition, the members exchanged opinions about the situation of the new industrial zone, by visiting related facilities.

First Local Workshop (September 2016)

Discussions with the Chief Minister of Ayeyarwady Region

Discussions with the department of regional development

Second Local Workshop (January 2017)

Discussion with the minister

Discussions at the workshop

- Outline of the workshops and field surveys by Fukushima City

Following workshops and meetings were held among members from Fukushima City, Fukushima Chamber of Commerce and Industry regarding activities for Partnership for a Low-Carbon Initiative in Ayeyarwady.

- Preliminary meeting (April 2016, Fukushima City)
- Preliminary meeting (May 2016, Tokyo)
- Workshop and discussions with the Chamber of Commerce and Industry (July 2016, Fukushima City)
- Preliminary meeting (August 2016, Tokyo)
- Workshop (October 2016, Fukushima City)
- Preliminary meeting (December 2016, Tokyo)
- Workshop (December 2016, Fukushima City)
- Wrap-up meeting (February 2017, Tokyo)

2 Overview and Needs of the Project Area

2.1 Overview of Myanmar and Ayeyarwady Region

Myanmar has been undergoing a rapid economic development in recent years, and it is one of the most attention-gathering regions in Asia. It consists of seven divisions and seven states. Ayeyarwady Region is an administrative region located in the delta along the Ayeyarwady River. It is in the south of Myanmar; in its north is Bago, in its east is Yangon, in its south is the Bay of Bengal.

Table 2-1 Overview of Myanmar and Ayeyarwady Region

	Myanmar	Ayeyarwady Region
Area	676,579 km2 (1.8 times that of Japan)	35,000 km2
Climate	Most of the land belongs to tropical or sub-tropical zone with great difference of temperature and precipitation depending on the location. A year can be divided into three seasons: wet season (mid-May to October), dry season (October to February), and hot season (March to May)	Delta area located in the south of Myanmar
Population	51.48 million (as of 2015.5.29) *Source: Ministry of Labour, Immigration and Population	6.18 million
Population Density	74 people/km2	177 people/km2
Households	10.88 million households	1.49 million households
Local Administration System	Composed of seven Divisions and seven States. Divisions are mainly inhabited by Burmese, while States are mostly populated by other minority people.	Capital: Pathein City
Correnrt situation	On March 30th, 2016, Htin Kyaw was declared as the new President. On March 31st, Htin administration by NLD (National League for Democracy) was established. Responsibilities of the ministers were approved. New administration by NLD has been initiated with high expectation from the citizens.	New Chief Minister,and Ministers were appointed.

Source: Ministry of Foreign Affairs, JETRO

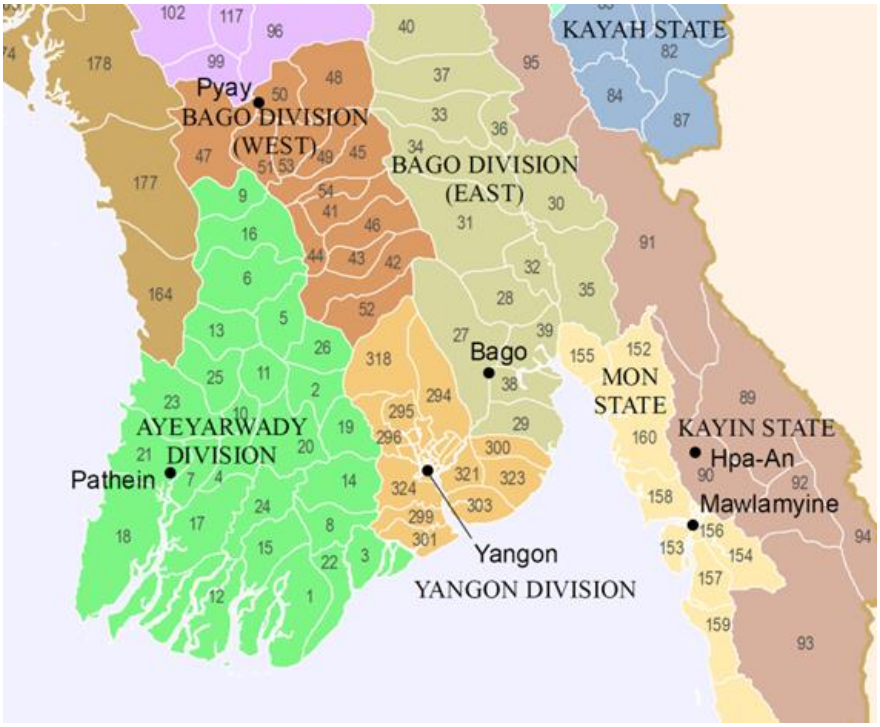


Figure 2-1 Location of Ayeyarwady Region and Pathein City

Source: Myanmar Information Management Unit

2.2 Overview of Pathein City and Pathein Industrial City

This survey focuses on Pathein City, the capital of Ayeyarwady Region; its population is approximately 0.3 million and 0.14 million live in the central part of the city. The size of the city is approximately 25.8 square miles and the altitude is 11.53 feet. The city is situated at the bank of Pathein River, which is a tributary of the Ayeyarwady River. It is the second largest port city in Myanmar after Yangon. It is attracting increased attention as the base for new development area; development of deep-sea port which is accessible by large ships is planned in the future, and construction of access road and rails from Yangon is underway. Pathein City has established its vision towards 2040; within the vision, it aims to achieve three pillars for development. It aims to establish itself as the hub for tourism, logistics, and green agriculture. The overview of Pathein City is shown below.

Table 2-2 Overview of Pathein City

Area	10,898 km2
Population	1,636,716
Population Density	150/km2
Labor population rate	61.9%
Unemployment rate	3.8%
Literacy rate	93.8%
Main agricultural products	Rice, beans, etc.
Main manufacturing products	Textile

Source: http://www.patheinic.com/dev/

In addition to Pathein Industrial Park (approximately 250 acres) Hinthada Industrial Zone (approximately 86 acres), and Myaungmya Industrial Zone (approximately 58 acres), construction plan for new industrial zone called Pathein Industrial City is proceeding with the leadership of the Minister of Ayeyarwady Region, to achieve further industrial development. The milestone of Pathein Industrial City is shown in the figure below. The support from the region was determined in November 2012, and a feasibility study begun within the same month. In March 2014, land acquisition started to take place, and a report for design of the industrial park was proposed in November. In April 2015, reports for EIA (Environmental Impact Assessment) and SIA (Social Impact Assessment) were turned in, and with the completion of these reports, MIC application was proposed in November 2015. Completion of phase 1 is planned in March 2019.

Figure 2-2 Milestone of Pathein Industrial City

Note: Recent material shows that the phase completion will be in March 2019
Source: Pathein Industrial City http://www.patheinic.com/dev/

Pathein Industrial City is an industrial zone with an area of approximately 1,000 ha, placed three hours away from Yangon by car and five minutes from Pathein by car. It is expected that the industrial city would serve as the center for economic development in Ayeyarwady Region, due to its high accessibility from Yangon and construction plan for large port. Basic information of Pathein Industrial City is shown in the table below.

Table 2-3 Overview of Pathein Industrial City

Area	1770 acre
Power supply	106.5 MW (by 2017)
Water supply	24,000m3/day (by 2018)
Wastewater	22,000m3/day (by 2019)
Access to main road	21km (Papawaddy Main Road)
Access to port	4km (Pathein Port)
Access to rail station	5km (Pathein Station)
Access to airport	10.9km (Pathein airport)

Source: http://www.patheinic.com/dev/

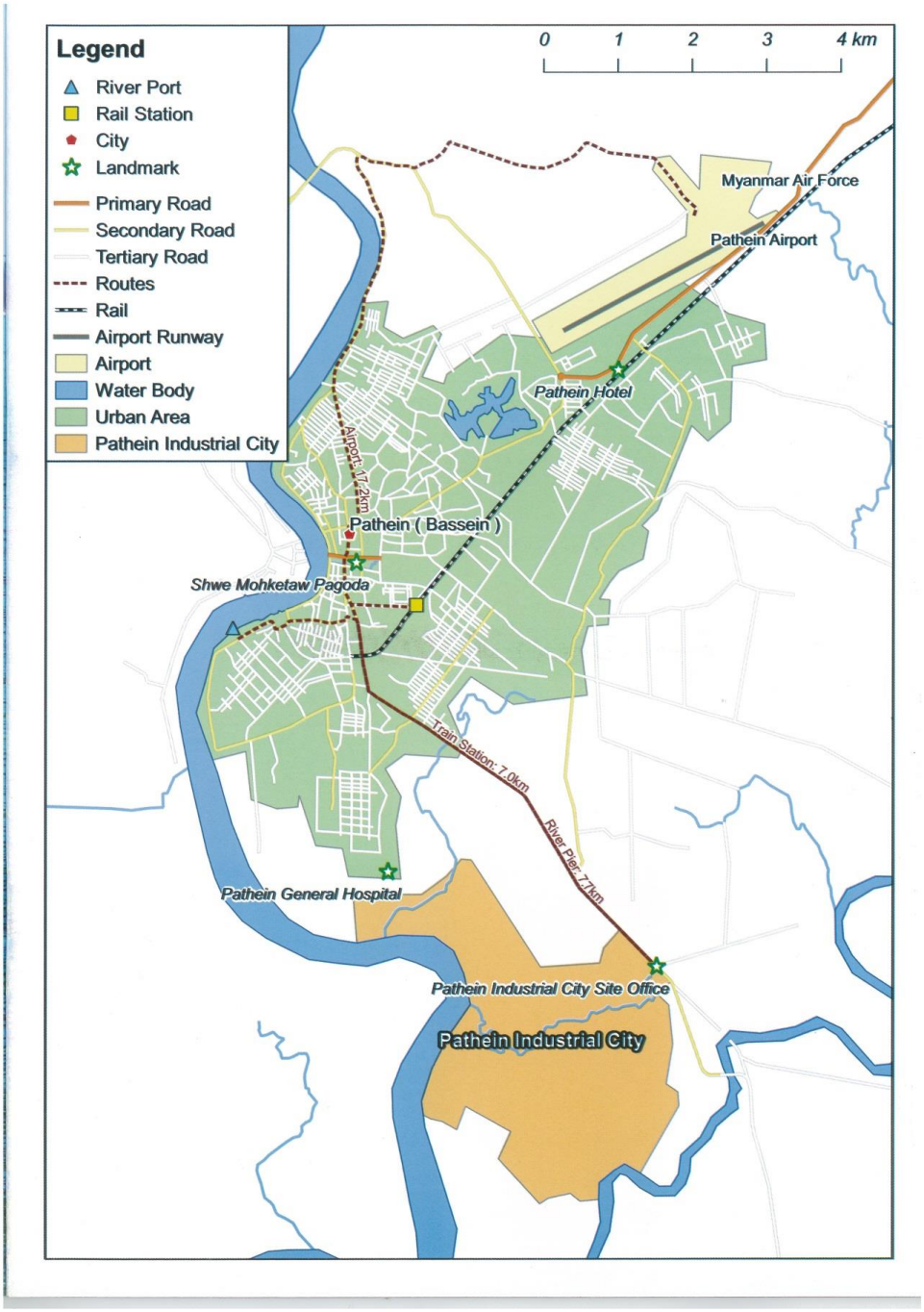


Figure 2-3 Map of Pathein Industrial City

Source: Pathein Industrial City

With the industrial zone at the center, Pathein Industrial City is to comprehensively develop related infrastructure such as housings, large commercial facilities, hotels and leisure facilities, and to develop the area as an export base. Various social and economic impacts in the area, including industrial accumulation, employment, development of regional economy, and decreased poverty, are expected with the development of Pathein Industrial City.

2.3 Overview of Waste Treatment in Myanmar

2.3.1 Policies and Regulations for Waste Treatment

In Myanmar, National Environmental Conservation Committee is in charge of environmental conservation measures. In 1994, National Environmental Policy was enforced, and importance of environmental conservation was stated. In 2012, the Environmental Conservation Law was established, which is the basis of environmental conservation policies in Myanmar. The law establishes environmental conservation committee, defines the obligations and rights of the ministry, environmental standards, monitoring of municipal environment, conservation of natural resources and cultural heritages, prior permission for projects, insurance, prohibitions, and penalties.
Relating to solid waste treatment, the law states that the government has the right to set environmental quality standard (Chapter 6 Article 10), to install monitoring system when conducting waste treatment with toxic substances (Chapter 7 Article 13), and responsibility of a person or organization operating business (Chapter 7 Article 16). Such obligation is posed upon both domestic project owners and international project owners.

Table 2-4 Articles related to Waste Treatment in Environmental Conservation Law (excerpt)

Chapter 6 Article 10	The Ministry may, with the approval of the Union Government and the Committee, stipulate the following environmental quality standards: … (h) solid wastes standards
Chapter 7 Article 13	The Ministry shall, under the guidance of the Committee, maintain comprehensive monitoring system and implement by itself or in co-ordination with relevant Government departments and organizations in the following matters: … (d) transport, storage, use, treatment and disposal of pollutants and hazardous substances in industries
Chapter 7 Article 16	A person or organization operating business in the industrial estate or business isn the special exonomix zone or category of business stipulated by the Ministry: (a) is responsible to carry out by contributing the stipulated cash or kind in the relevant combined scheme for the environmental conservation including the management and treatment of waste

Source: Environmental Conservation Law

However, no compulsory environmental quality standard exists at the national level in Myanmar. National Environmental Quality (Emission) Guideline was established in 2015, but the standard only serves as a reference. The guideline was established with reference

EHS (Environmental Health and Safety) guideline provided by IFC (International Finance Corporation).
Following the Environmental Conservation Law, Environmental Conservation Rules were established in 2014. The rules state that the government must identify project categories that generate waste with toxic substances (Chapter 9 Article 41), and that the government must implement and advise measures for improving treatment, storage, and transportation process (Chapter 9 Article 43).

Table 2-5 Articles related to Waste Treatment in Environmental Conservation Rules (excerpt)

Chapter 9 Article 41	The Ministry shall specify categories and classes of hazardous wastes generated from the production and use of chemicals or other hazardous substances in carrying out industry, agriculture, mineral production, livestock and fisheries, waste disposal and other activities in coordination with the relevant Government department and Government organization.
Chalter 9 Article 42	The Ministry, to enable to promote the establishment of necessary facilities or centers for the treatment of solid waste, liquid waste and gas emissions which contain poisonous and hazardous substances, shall cooperate with the relevant Government departments, Government organizations and experts: (a) May cause certain categories of business which release solid waste, liquid waste and gas emission containing prescribed amount of poisonous and hazardous substances to carry out treatment by establishing its own waste treatment factory or waste treatment station, or combined waste treatment factory or waste treatment station … (c) May assign duty to the Department to inspect and report whether the business concerned comply with the waste treatment under sub-section (a).
Chapter 9 Article 43	The Ministry: … (c) May adopt necessary measures for improvement of destruction, storage, placement and transportation of solid waste in coordination with the relevant Government departments and Government organizations;

Source: Environmental Conservation Rules

2.3.2 Key Issues for Waste Treatment

In the workshops held in Pathein City and Fukushima City, challenges from the hardware-aspect (e.g. construction of a treatment facility) and from the software-aspect (e.g. establishing regulations and carrying them out) were discussed.

The amount of waste generated in Pathein City is approximately 68 tons per day, of which 58% is collected using 9 vehicles. The collected waste is accumulated in the final treatment site of Nan Thar Kone, with an area of about 5.4 acres. While residential waste is collected every day, industrial and commerciall waste is only collected on a on-call basis. It is expected that the capacity of Nan Thar Kone final treatment site will be full in the near future. While additional 20 acreas of final treatment site is planned, need for a better means of processing waste is recognized. The vehicles used for collection are old; in some cases, broken trucks are left in the final treatment site as well.

Waste generated in Pathein City is transported to a certain block within the city, and it is left in a pile. Construction of facilities to appropriately process this would be necessary. Additionally, policy requirements on citizens and business owners for appropriate waste treatment would be necessary as well. Furthermore, considerations for thoroughly carrying the formulated policies would be vital as well. In the workshops held in Pathein City and Fukushima City, the aforementioned concerns were shown by the government officials of Myanmar. It would be important to thoroughly explain and educate the citizens about the policies, and to motivate them to act accordingly

2.4 Overview of the Electricity Sector

Policies on electricity and energy are managed by Ministry of Electricity and Energy, The departments under the ministry are roughly categorized into two; one overseeing the electricity sector and the other overseeing the energy sector.
The departments in the electricity sector originally belonged to the Ministry of Electric Power under the former government. Department of Electric Power Planning is in charge of electricity policies and plans. Department of Electric Power Transmission and System Control is in charge of various projects related to transmission and grid control. Plans for new power plants are overseen by the Department of Hydropower. Electric Power Generation oversees power generation. Distribution is conducted by Electricity Supply Enterprise. Electricity distribution in Yangon City and Mandalay are conducted by Yangon City Electricity Corporation and Mandalay City Electricity Corporation.
Myanmar Oil and Gas Enterprise, Myanmar Petrochemical Enterprise, Myanmar Petroleum Products Enterprise are in charge of various projects in the energy sector.
The organizational structure of the Ministry of Electricity and Energy is shown below.

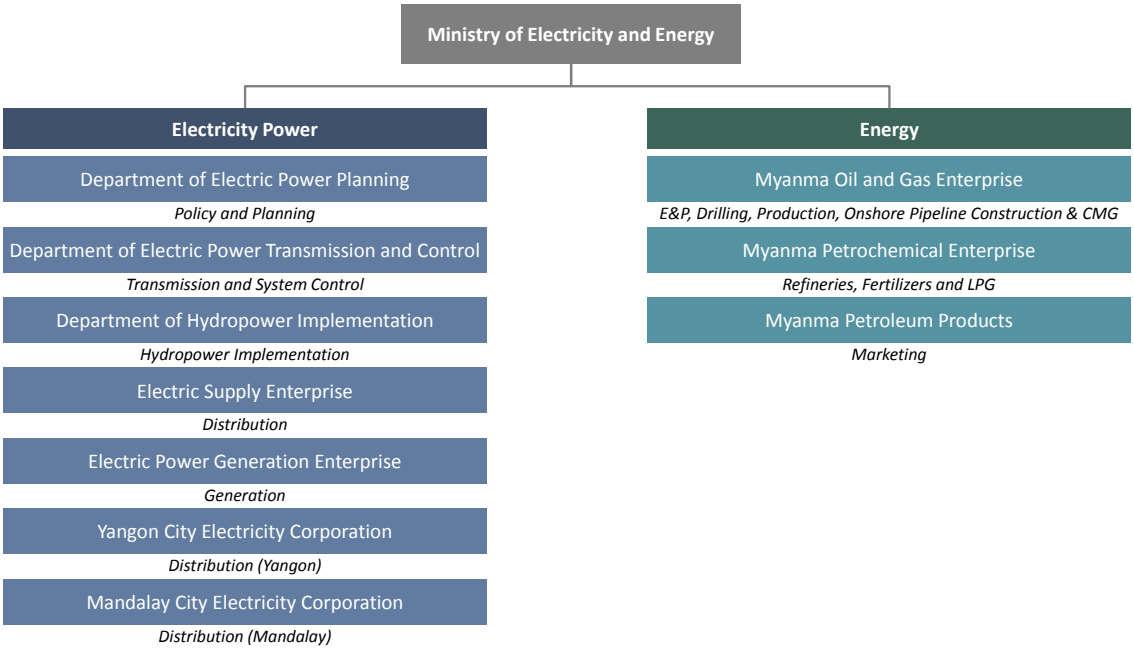


Figure 2-4 Organizational Structure of the Ministry of Electricity and Energyin Myanmar
Source: Current Status & Opportunities for Myanmar Electricity and Energy Sector

2.4.1 Electricity Tariff in Myanmar

Electricity tariff in Myanmar was raised in April 2014, in order to save the power sector from its financial deficit, although there were oppositions from the citizens during the former government. It was the first tariff rise in two years since January 2012. The current government raised residential tariff by 15% and industrial tariff by 40%. The current tariff is shown below.

Table 2-6 Electricity Tariff in Myanmar

	Consumption kWh/month			Tariff MMK/kWh
Residential	1	~	100	35
	101	~	200	40
	201	~		50
Industrial	1	~	500	75
	5,001	~	10,000	100
	10,001	~	50,000	125
	50,001	~	200,000	150
	200,001	~	300,000	125
	300,001	~		100

Source: Information from local government

According to the current electricity tariff table, rate for households with the least amount of electricity consumption (1~100 kWh/month) is set at 2.8 JPY/kWh (0.08 MMK/JPY), which amounts to monthly bill of approximately 140~280 JPY. Households with such consumption, less than 3 kWh/day, would be of a low income class.

Compared to Japan, of which average household daily consumption is approximately 20 kWh, consumption standard in Myanmar is less than sixth of that in Japan. Furthermore, rate for high-income households in Myanmar (possessing a living environment of one air-conditioner per room) is as little as 4 JPY/kWh. Considering that the Japanese tariff is 13~20 JPY/kWh, the electricity tariff of Myanmar is set at a very low level.

While large industrial customers have a lower tariff rate in Japan, they bear a larger burden for electricity in Myanmar. Small rice millers (monthly consumption of 288,000 kWh) in Ayeyarwady Region, for example, must pay the second highest rate of 10 JPY/kWh (125 MMK/kWh), and smaller millers must pay the highest rate of 12 JPY/kWh (150 MMK/kWh). Under such circumstances, there is a large possibility for these smaller rice millers to be screened out by larger businesses.

It is not certain whether the financial deficit of the power sector has been cleared with the aforementioned tariff raise, as no official comments have been made by the government. Nevertheless, to accomplish sustainable economic growth win accordance with the increasing electricity demand, electricity tariff in Myanmar inevitably needs to be raised again, or restructured.

2.4.2 Electrification Policy in Myanmar

Electricity generation in Myanmar for the past few years is shown in the figure below. The amount has been increasing annually; generated amount of 8,625 GWh in FY2010 increases to 14,156 GWh in FY2014.

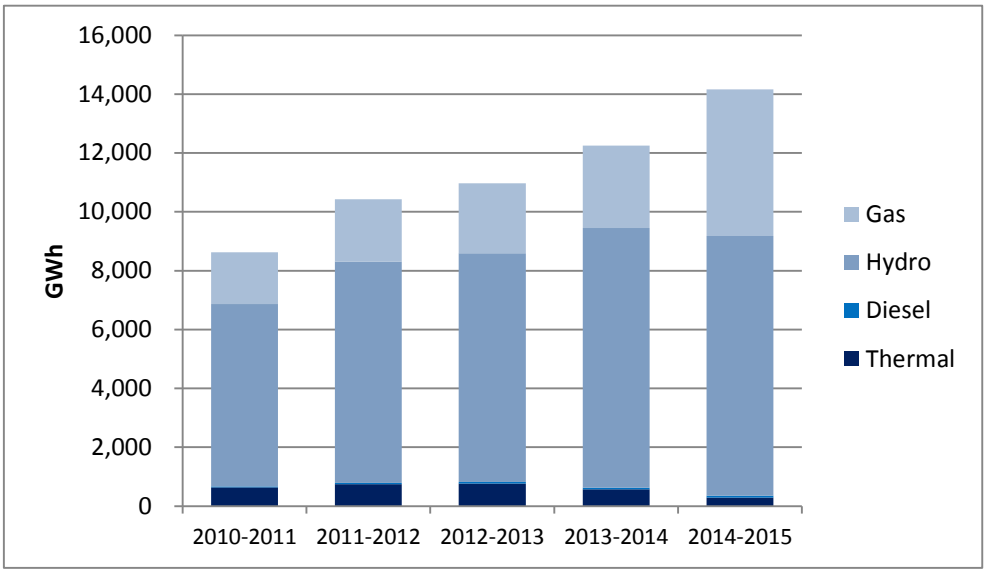


Figure 2-5 Electricity Generation in Myanmar

Source: Central Statistical Organization

While electricity generation from hydropower plants holds a large portion of the total generation, the share is annually decreasing. While these plants can cover the peak demand during the rainy season, power demand from the commercial and industrial sector must be curtailed as hydropower generation decreases in the dry season.

In accordance with the economic development in Myanmar, its power demand is expected to grow rapidly. To achieve sustainable economic growth, it is vital for power supply to be able to meet such increase in demand. Projection of energy consumption is shown in the figure below.

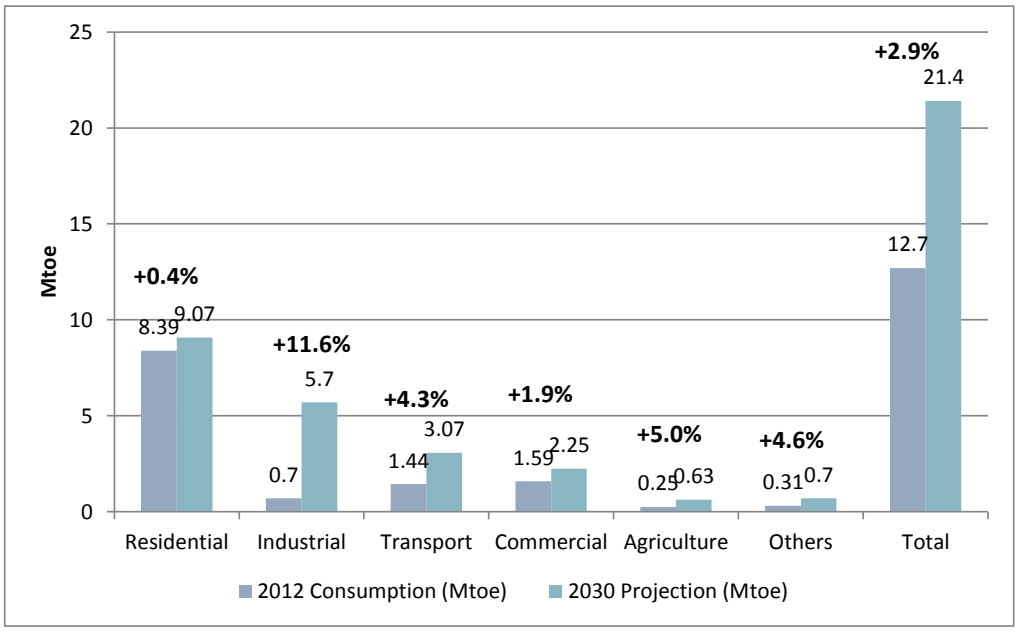


Figure 2-6 Projection of Energy Consumption by Sector

Source: Central Statistical Organization

Although rise in power demand is expected, electrification rate in Myanmar is significantly lower than the other South Asian countries. Electrification in the rural area in particular is recognized as an issue in Myanmar. With the support of international organizations such as the World Bank, a National Electrification Plan was formulated in Myanmar, which aims to accomplish 100% electrification rate by 2030.

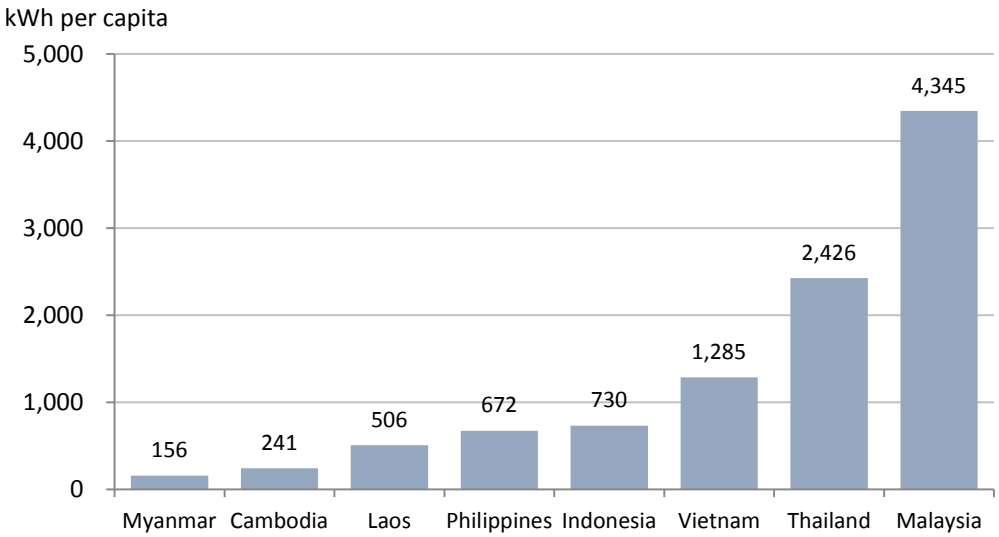


Figure 2-7 Electricity Consumption per Capita in ASEAN Countries

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

While the main grid is planned for a large scale rollout, in the short term, rural areas are planned to be supplied from off-grid, as stated in the National Electrification Plan. Generation in off-grid is mainly from diesel generators and small-scale hydropower, but solar systems are planned to be utilized as well in the plan.

	Installed Capacity (MW)	Generation (GWh)
Diesel Generator	78.999	50.743
Small Hydropower	33.33	44.114

Table 2-7 Power Generation of Off-Grid (2012-2013)

Source: National Energy Policy (2014)

3 Utilizing Japanese Experiences, Know-How, and Technologies

In this chapter, policy-making experiences, cases, and promising technologies for waste treatment in Japan are identified.

3.1 Policies

3.1.1 Plans for Waste Treatment

Fukushima City establishes “Fukushima City Non-industrial Waste Treatment Basic Plan” under the “Fukushima City Environmental Basic Plan.” The former plan aims to accomplish appropriate treatment of non-industrial waste and reduction in its amount. There are three basic policies within this plan: (1) Formation of a circular economy through promotion of the 3R activities based on the reduction, reuse, and recycling of waste, (2) Assurance of safe and comfortable living environment through promotion of appropriate waste treatment, and (3) Environmental conservation through cooperation between the citizens, business owners, and the municipality.
In addition to the basic plan, in order to further promote reduction in waste generation from 2014 to 2020, the city establishes its quantitative goals for waste generation. The numbers are shown below.

Table 3-1 Goals for Waste Generation in Fukushima City

	2010	2020
Waste generation (g/capita,day)	1,109	890
Total waste generation (t)	117,971	91,600
Recycling rate (%)	16.1	more than 26.0
Final treatment amount (t)	12,983	9,000

Source) Fukushima City Non-industrial Waste Treatment Basic Plan

3.1.2 Activities for Enforcing Waste Treatment

Not only setting these goals but also to accomplish them, Fukushima City has been conducting educational activities and informing companies.

(1) Education on Environment
Fukushima City conducts education regarding environmental topics, using its original textbook called “Our Fukushima.” The educational activity is not only limited to lectures, but also involves various hands-on program; the findings of such activities are presented at events.

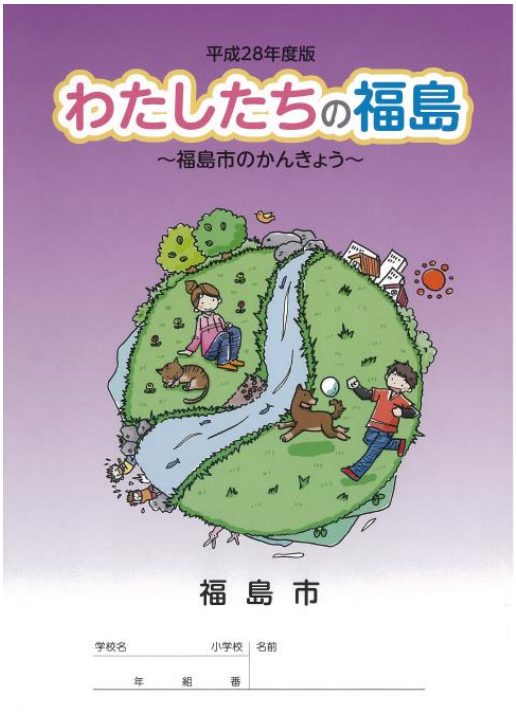


Figure 3-1 Textbook “Our Fukushima”

Source) Textbook “Our Fukushima” by Fukushima City

For instance, elementary schools and middle schools in Fukushima City provide educational activities relating to categorization of waste and its reduction. As part of environmental education, students visit waste treatment facilities and learn about the treatment process. They learn about challenges in waste treatment, and present their own ideas about how to appropriately throw waste away and to reduce the amount of waste. Additionally, some schools provide educational programs relating to collection of recyclables through collection of milk cartons. In 2015, there were 40 schools that conducted such activities, and the amount of collected carton was 5,264 kg.

(2) Informing the private companies and the local area

Various activities to improve the awarenesss of the private companies and the local residents for waste treatment are conducted.

Additionally, as a means of promoting citizen-to-citizen beautification awareness, certain citizens are entitled as a “Patrol member for the environmental health of Fukushima City,” where these members are to appropriately clean places that need to be cleaned and to supervise those who conduct activities that deteriorate the environment .

“Adopt Program” is a collaborative program by the city and the citizens. It is a concept to treat citizens as “foster parents” and environment (e.g. roads, parks, rivers, etc.) as “foster children.” The citizens, as foster parents, conduct beautification (cleaning) activities for their environment, their children, with love and responsibility. The city supports groups that conduct such activities (at least three times a year, for a continuous period of more than a year) by offering “adopt signs,” promoting them on the website, and providing them with

insurance services during their activities. There are 273 groups registered as of 2016. In this way, Fukushima City has been conducting activities to support the citizen-based beautification and cleaning activities. The overview of the program is provided below.

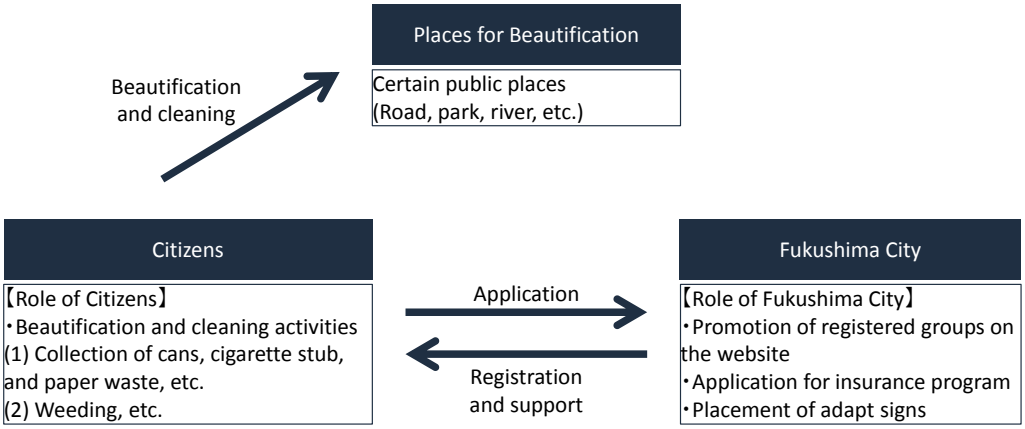


Figure 3-2 Overview of the “Adopt Program”

Source: Fukushima City website

When there are changes to legislation and regulations, Fukushima Chamber of Commerce and Industry holds meetings for sharing and exchanging information to learn about such change and to discuss about measures to be taken.

3.2 Cases

In order to utilize generated waste, there is a biomass power plant in Fukushima City that uses waste treatment process. At Arakawa Clean Center, which is the waste treatment facility in Fukushima City, there is a biomass power plant that utilizes heat generated from the waste treatment process. The construction was completed in 2008; its maximum output is 5,100 kW, and its annual electricity generation is 28,599,000 kWh. Generated electricity is not only utilized in the incinerator and the recycling plant at the facility, but the surplus is also supplied to neighboring schools. Generated heat, not only electricity, is utilized for heating at neighboring welfare facilities.

In addition to the power plant at waste treatment facility, biomass power plant is constructed at a food factory. A food factory in Fukushima City utilizes effluent generated in processing soy sauce and miso with oxygen, generates methane gas, and uses the gas to operate turbine engine. The plant started its operation in September 2014; the output is 25 kW and annual electricity generation is 144,000 kWh.

3.3 Promising Technologies

Effective technology for low-carbon waste treatment system to be utilized in Pathein City, Ayeyarwady Region is described in this section.

Based on the findings from this study, one promising technology for low-carbon waste treatment system is rice husk power plant technology. As already stated, Ayeyarwady Region is an agricultural region with a large amount of rice husks. The largest waste generated in Pathein City is rice husks; environmental problems arising from their inappropriate treatment and the need for their utilization are recognized.

While there is a need for collecting and sorting waste in Pathein City, the need is not recognized widely among the residents; it is difficult at the moment to conduct such collection scheme at a large scale.

By collecting plastic waste at certain sites and co-firing with rice husks, the generated rice husks can appropriately be processed and the collecting/sorting scheme can be initiated at the same time. Schools and temples are currently considered as sites for collecting plastic waste, from the viewpoint of collectability. When conducting plastic waste collection at schools, knowledge and experiences of Fukushima City can be utilized for environmental education.

In this way, JCM project of rice husk power plant which mixes plastic waste as its fuel is highly beneficial, as project can be established in relatively short amount of time and that it woulf lead to future projects which require collecting/sorting of waste.

4 JCM Project Formulation and its Feasibility Study

4.1 JCM Project Formulation

4.1.1 Project Overview

Rice husk biomass power plant of 3 MW scale under an SPC of Japanese and Myanmar companies within Pathein Industrial Park to be prepared in prior to the move-in of factories is proposed in this study.

4.1.2 Project Site

The study proposes that the aforementioned project be situated to an area next to the power generation facility planned by the developer of Pathein Industrial City.
Numerous manufacturing facilities are to be located in the large Pathein Industrial City, with a large amount of power demand expected. Power supply in Myanmar is mainly from the hydro power in the northern mountainous region, but Ayeyarwady Region is situated in the very southern part of Myanmar, at the end of the national grid.
In addition, Ayeyarwady is a delta region with many paddy fields, with relatively lower electrification rate; it is unlikely that electricity demand in Pathein Industrial City will be met solely with the power supply from the national grid. Therefore, the developer of the industrial city is planning to construct a power plant of its own. The power plant is likely to be located near river ports, as its fuel is going to be transported with ships.
To conduct a rice husk power plant in the industrial city, rice husks must be procured from different rice mills, as there are no plans for rice mills to move in to the industrial city. Many rice mills are located along the river, as rice were mainly transported with ships in the old days; in the same way, rice husks are likely to be transported with ships. Therefore, suitable location of a rice husk power plant would be along the river.
With the aforementioned reasons and plans for grid rollout, the best construction site for rice husk power plant would be the area located next to power plant planned by the industrial city developer.

4.1.3 Applied Technology

Technology to be installed in the proposed project is considered from the following perspectives to sustainably operate the project: (1) Collectability of rice husks, (2) power demand in Pathein Industrial City, (3) generation system, and (4) the amount of plastic bottles to be co-fired.

(1) Collectability 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. First, the amount of rice husks in the area was investigated.
Total amount of rice husks generated in Pathein district, estimated from the amount of rice produced, is 112,400t/year. Not all of this amount can be utilized. 90% of the rice husks generated during rice polish process in Pathein district are utilized as fuels for boiler and diesel generator. When utilizing them as boiler fuels, they are either used for acquiring heat or steam. Heat is for drying rice. Steam is used either for producing parboil rice, or for dynamo power generation by changing piston movement into rotating movement with steam engine. There is little change expected in rice husk demand for drying and producing parboil rice, but demand for dynamo power, as its electricity efficiency is low, is expected to decline in the future.
In this way, rice husks may continue to be utilized as boiler fuels in rice mills. However, if 25% of small, self-manufactured gasification plants are expected to be changed into national grid use (due to environmental regulations and low efficiency), there will be rice husk surplus, which amounts toabout 25,300t/year of rice husks available for use. This assumption is agreed to be realistic by the local stakeholders as well. The amount above enables 3.5MW of power generation.

(2) Power Demand in Pathein Industrial City

As for electricity demand in Pathein Industrial City, its primary source of power will be supplied from the national grid and the power plant planned by the developer of Pathein Industrial City. During the operation phase of the factories, power will be supplied from these primary sources, but not all of the electricity demand will be supplied in the early stages of development, from the viewpoint of investment efficiency and national grid construction priorities. Insufficient power supply during construction phase is even more likely.
In general, factories have steel-frames, which require large amount of electricity for construction. Even in countries like Japan that have stable power supply, private power generators are often utilized during construction phase. The need for such source of power would be stronger in Myanmar. For construction companies, acquiring stable source of power and fuels for generators is critical. Therefore, electricity demand for Pathein Industrial City construction, considering its schedule, was estimated. Considering various conditions, if 3MW of electricity can be supplied, more than 50% of peak demand can be met. It is necessary to acquire places for supplying electricity when there is electricity surplus after supplying for construction demand; discussion for transmitting electricity to the local government and neighboring villages has therefore begun.

(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.
Rice husks are the primary fuel for this power plant; amount of plastic waste that can be collected is very limited. Thus, the system will prioritize efficiency for rice husk power generation.
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 comformity with the conditions of the turbine technology. The overview of the generation system is shown below.

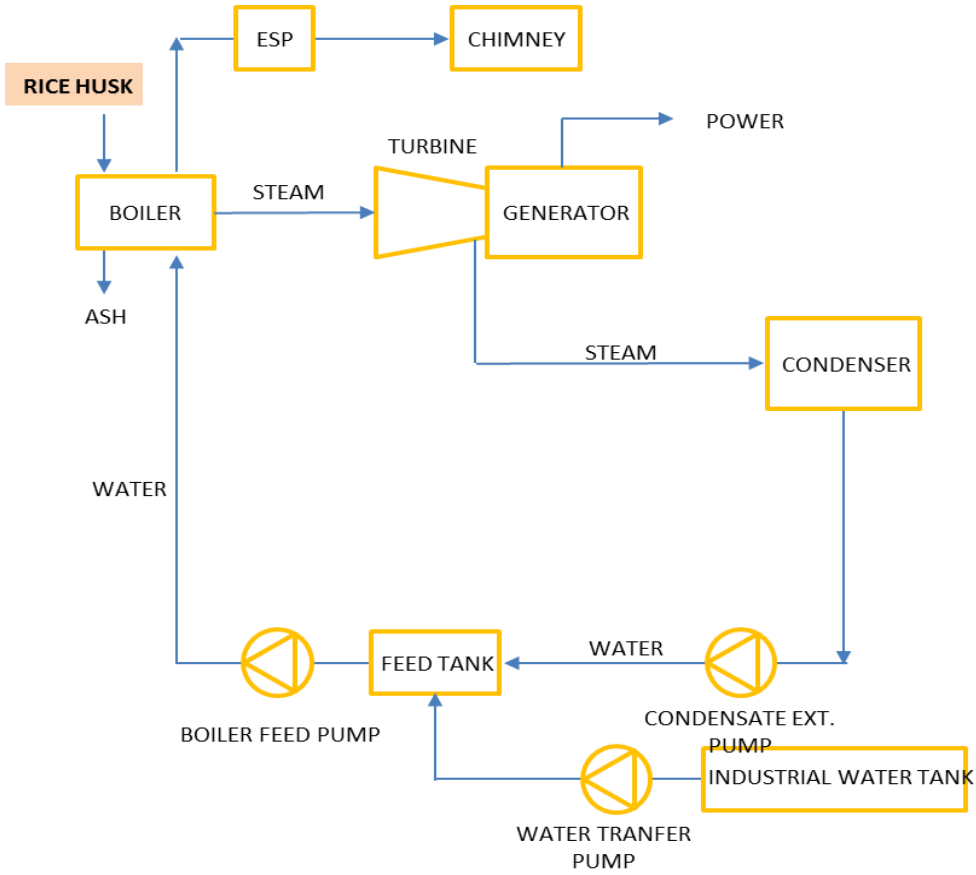


Figure 4-1 Boiler Turbine Generator (BTG) Power Generation Flow

Such power plant project can be expected to be promoted horizontally to other rice-producing areas in Ayeyarwady Region, Myanmar, and other regions in Asia.

(4) Amount of Plastic Bottles to be Co-Fired

Since the primary fuel of the power plant is rice husks, increase in construction cost and maintenance/operation cost due to co-firing fuels with different compositions and physical characteristics should be kept minimal.

Although there is local scheme for recycling 1L PET bottles (for reuse after cleaning), amount that can actually be collected in Pathein, with no official sorting rules or recycling schemes, can be estimated according to population and number of households. Population in Pathein is approximately 360,000, with 76,000 households; approximately 4.7 people per household. When each household collects and brings one PET bottle per week, 10,200 PET bottles can be collected per day. There are 1,481 elementary schools in Pathein district, with 493,650 students. If each student participates in the collection scheme by bringing one PET bottle a month, approximately 16,000 PET bottles can be collected per day in the district.

According to these estimates, it was decided that 10,600 PET bottles (500mL) per day would be crushed and co-fired in the power plant. Co-firing rate (weight base) would be 0.5%, which would not affect change in plans for equipment such as boiler. However, it should be noted that crushed PET bottles would be around 7~10mm, while rice husks are around 4mm in size; therefore, co-firing method would need to be further considered.

4.2 GHG Emission Reduction

4.2.1 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 fullfill electricity demand in Pathein Industrial City. 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 4-1 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	0.219
2013	0.956	0.825	0.729	0.195
2014	0.969	0.848	0.729	0.280
Emission factor (2009～2013)	-	-	-	0.215
Emission factor (2010～2014)	-	-	-	0.230

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. ect), small amaount of emission will not be considerd.

(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 4-2 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	0.230	kg-CO2/kWh
Reference emission	4,968	t-CO2/year
Fuel transport	30,900	t/year
Co-fired plastic waste transport	79	t/year
Project emission	0	t-CO2/year
Emission reductions (planned)	4,968	t-CO2/year

4.2.2 Project impacts besides emission reductions

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

(1) Economic benefits

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

(2) Social benefits

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

4.3 Business and Policy Proposals

4.3.1 Environmental and Social Assessment

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 tro 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.

<u>Environmental protection of power plant</u>
<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)

4.3.2 Project Scheme

The proposed scheme for the project is described below.

Table 4-3 Project Scheme

Project site	Within industrial city (Rice mill factory site or area next to the power plant)
Scale	Middle scale (2-3 MW, to be determined after the consideration of rice husk procurement)
Fuel	Rice husk + plastic waste (collected at schools and temples) *Site collection of plastic waste will be conducted utilizing the knowledge of Fukushima City.
Technology	Boiler turbine (biomass power generation)
Generated electricity	(For now) supplied for construction at the industrial city, surplus sold to the grid (In the future) Off grid supply within the industrial city
Project scheme	SPC (e.g. Japanese company and local partner company) is expected. JCM subsidy will be utilized.

(1) Project Specifications

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

Table 4-4 Specifications of the Rice Husk Power Plant

Installed capacity	3,333	kW
Self consumption	333	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
	96	t/day
	28,800	t/year
Plastic waste to be co-fired	0.011	t/h
	0.264	t/d
	79.2	t/year

(2) Project Investment

Cost of equipment (approximate estimate, only ineligible parts for subsidies) is 670 million JPY.

Project investment will be according to the SPC investment.

(3) Project Organizational Structure

The proposed project is part of the infrastructure for the Pathein Industrial City; therefore, the developer of the industrial city should conduct the project as well. However, considering the development of private companies in Myanmar in the past, it is desirable that the proposed project be conducted with experienced company. Taking into account that JCM scheme will be utilized, this study proposes that an SPC is established with Japanese and Myanmar companies. The international consortium structure is shown below.

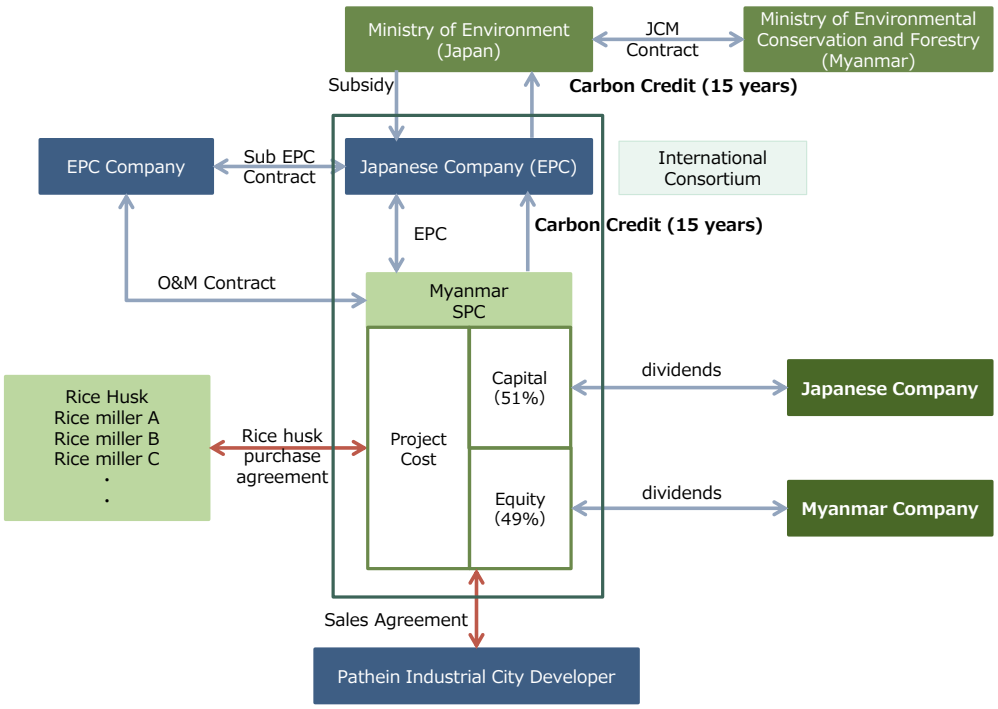


Figure 4-2 Project Organizational Structure

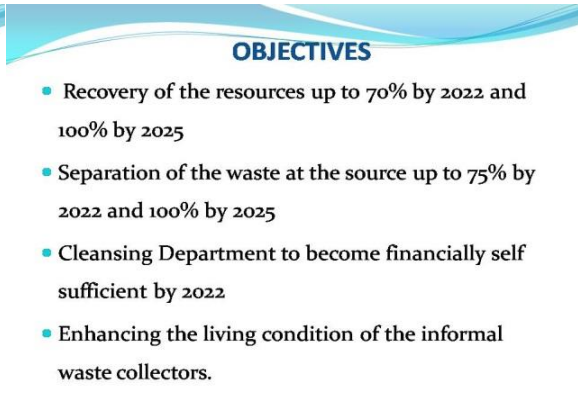
The installed technology requires specific knowledge and experiences. Consigning the whole operation and maintenance process to an EPC company is planned.

4.3.3 Necessary Measures for Project Establishment

In achieving a low carbon, resilient and sustainable regional development in Pathein City and Ayeyarwady Region, realization of individual project (JCM project) and development through policies with regard to past experiences in Fukushima City through city to city collaboration is important (development through business and development through policies). In particular, to proceed with individual projects utilizing schemes including JCM, cooperation between public and private sectors (administration, companies and residents) is essential. In Japan, there is an established framework to first prepare a comprehensive regional development plan at the national and municipal level (“fundamental plan” or “master plan”), and to create individual action plans based on the basic strategy. Conducting individual projects under such framework (grand design for regional development) enables promotion of various programs from long-term perspective, which accelerates implementation of advanced activities.

Pathein City has been discussing its goal image of the region (vision), and it has been promoting “Vision for Pathein in 2022” as its regional development vision; goals such as “to become ‘the Clean City’ and “no waste, more resources” are proposed under this vision. Activities for realizing this vision are to be discussed in detail at this point in time.

Vision in Pathein City



Proposed Objectives

Source) Presentation materials by Ayeyarwady Region

Through policy dialogues at the local workshop and in Fukushima City (discussions under Inititative for Low Carbon Ayeyarwady Partnership), future perspectives of cooperation for formulation of low-carbon city establishment in Ayeyarwady Region have been summarized and common understanding has been achieved.

Proposed Direction of Collaboration in the Building of a Low-carbon Township in Ayeyarwady Region through City-to-City Collaboration

1. Background of the examination

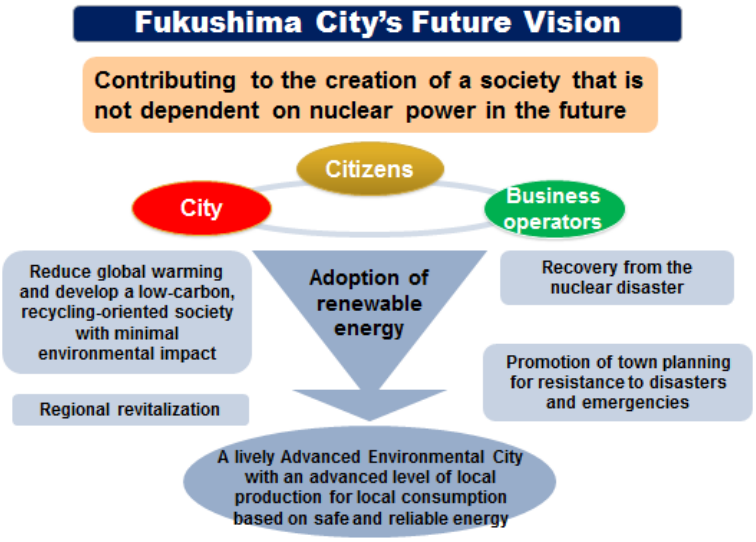
A partnership was formed between Ayeyarwady Region and Fukushima City as the platform for a new city-to-city collaboration under the collaborative scheme (framework) between the two, and discussions were conducted among stakeholders from both parties. In concrete, the status quo and the needs of Pathein City in Ayeyarwady Region were studied and comprehended, various initiatives by Fukushima City and related technologies were presented as reference, and examinations were performed concerning the possibility of collaboration between both Cities, as well as the possibility of deploying the Joint Crediting Mechanism (JCM) for realization of a low-carbon township in Ayeyarwady Region, in the fields of waste treatment and water treatment, in particular, through joint activities such as the holding of workshops in both Pathein City in Ayeyarwady Region and Fukushima City, mutual visits by members of both Cities (including on-site investigations), and exchange of opinions concerning the policy trends of both Cities.

Ayeyarwady Region, Myanmar

Ayeyarwady Region is the largest agricultural area in Myanmar, and the Region has been promoting new initiatives in recent years, including the development of new industrial parks, in order to promote the industrialization of the Region. This Region is considered to be one of the local areas in Myanmar where a rapid economic development is anticipated towards the future, and accordingly, the experience and knowhow held by Japan that experienced a rapid economic growth in the past are expected to be positively utilized in the Region.

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.



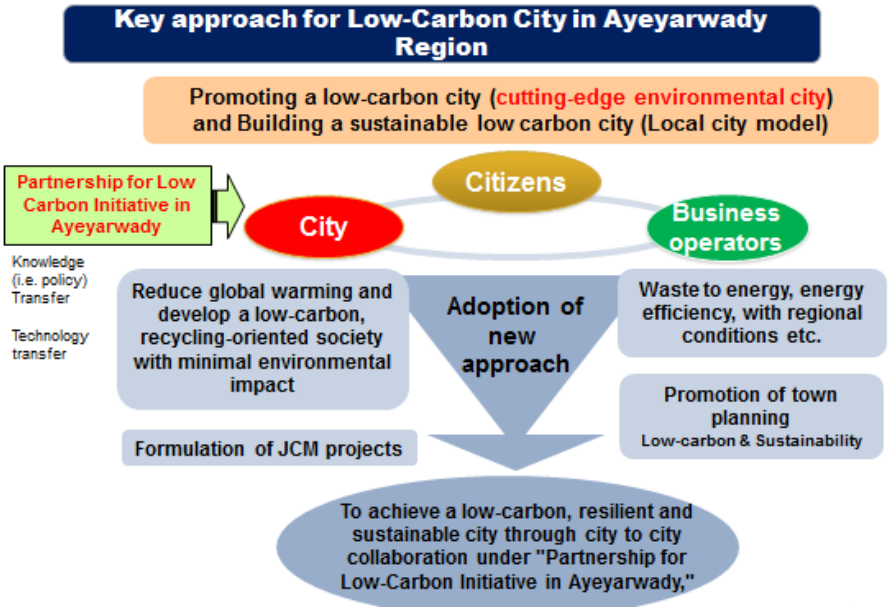
2. Awareness of the issues, and the direction towards the realization of a low carbon partnership

All members of the "Partnership", through discussions thus far, came to share the awareness about the importance of building a sustainable, low-carbon-type, vigorous, well-advanced township in Ayeyarwady Region, and the direction (roadmap) towards the realization of such township, as stated below.

Goal Image of the Region

It is important to aim at realizing an "environmentally most advanced City of Ayeyarwady (tentative name)", a city, which is full of vigor, yet low-carbonized and environmentally friendly, with its local features well preserved, by making the most of advanced technologies and knowhow, while preventing the occurrence of various social problems (environmental pollution, natural disaster, etc.) from the increase in the volume of waste materials, increase in the environmental load including deterioration of water quality, increase in the amount of energy consumption, loss of the rich natural environment of the Region and so forth, which could occur as a result of the economic growth.

It is indispensable for the administration, citizens and business operators to work together for the preservation of the environment and for the promotion of low-carbonization, and it is important to gradually expand the sphere of deployment, by firstly proceeding with a model-type approach based on a pair of wheels of "deployment by business operators" and "deployment of institutional efforts: i.e. creation of a proper mechanism to support business deployment".



In bringing the model-type approach into practice, it is indispensable to utilize the experience and knowhow of Japan that experienced a rapid economic growth in the past, as well as the framework of the JCM, through discussions within the Partnership, which is the platform of the city-to-city collaboration.

The fields of waste treatment, recycling of resources, water treatment and energy sources, in particular, are the priority areas in the development of townships, and it is important to aim at the below-stated directions in both fields of waste treatment and water treatment (which were the discussion themes of this time).

3. Direction of deployment in individual fields

Field of waste treatment: Promotion of new treatment measures for waste materials, corresponding to the progress of the economic growth

Vision

It is important to convert our mind to technologies based on the concept of 3R (Reduce, Reuse, Recycle) and aim at creating a low-carbon, circular-type township, corresponding to the increase in the volume of waste materials associated with the economic growth.

Future Perspectives

We promote production of energy from waste materials by way of the rice-husk power generation as an appropriate treatment (effective utilization) of biomass-type waste materials such as rice husks, taking the advantage of Ayeyarwady Region being one of the leading rice-growing areas in Myanmar (We will here utilize Japan's support systems such as the JCM).

We promote collaboration among the administration, business operators and industrial associations for creation of a proper mechanism to procure rice husks generated at rice

polishing mills, as it is indispensable to stably procure rice husks on a long-term basis in order to perform stable rice-husk power generation for a long period of time.
In parallel with the advanced efforts (i.e. rice-husk power generation), a change in the awareness of people in the local community about waste materials is important, and accordingly, we proceed with the measures to change the awareness of local people. (e.g. to promulgate the habit of sorting waste materials. As the educational approach is thought to be effective here, we will utilize the place of education for that purpose.)

Development in other areas

Hereafter, it is important to bring into practice a model-type approach of "environmentally most advanced township" in Ayeyarwady Region, by also proceeding with the deployment in related fields (e.g. promotion of renewable energy sources, recycling of resources, energy efficiency, etc.) and in other regional areas (e.g. other townships in the Region, other industrial parks, etc.) in a well coordinated manner, by making good use of the approach from the city-to-city collaboration.

[Details of recognized issues, future perspectives and action plan (draft)]

~Promotion of new measures for waste treatment corresponding to the progress of economic growth~

Recognition of issues

Thus far, in Ayeyarwady Region, municipal waste has been disposed of by way of sanitary landfills, but the amount of waste materials has been increasing in urban areas, corresponding to the progress of the economic growth. As a result, there is concern about the occurrence of such problems as shortage of final disposal sites and the scattering of waste in both urban and rural areas.
In the case of municipalities in Japan that experienced a rapid economic growth in the past, they have been converting their waste disposal method from the landfill-type to the incineration-type and/or enhancing the approach of 3R (Reduce, Reuse and Recycle). In proceeding with the 3R approach, the sorting of waste materials, in particular, is considered to be one of the most important matters.
It is necessary for Ayeyarwady Region to promote proper treatment measures and effective utilization of agricultural waste materials such as rice husks (e.g. realization of biomass power generation), in light of the fact that the Region is one of the leading agricultural areas in Myanmar.

(Reference) Waste treatment site in Pathein City

Waste is treated by landfill in Pathein City, but awareness for sorting and separating scheme for waste treatment has improved among the officials. Currently, heavy machines are sorting out plastic bottles, bottles, cans, and cardboards from the waste treatment site.

Waste Treatment Site

Sorting process at the final treatment site

(Reference) Experiences in Japan: history of waste management in Japan

Transition of Waste Treatment Policy in Fukushima City

History of Public Cleansing Service

Year	Efforts by Fukushima City	Social Targets
1950～	・Started to build waste incineration sites	Public health improvement
1970～	・Removed waste containers ・Installed plastic buckets and introduced a waste collection system on a fixed-day schedule ・Started a separate collection of combustible and non-combustible waste	Pollution problems and living environment protection
1990～	・Introduced a reward system for group resource recovery ・Introduced a fee-based collection of general business waste ・Implemented a subsidy program for the purchase of composting containers ・Started resource recovery by separate collection ・Started to operate the Fukushima City Recycling Plaza	Establishment of a sound material-cycle society
2000～	・Resource recovery by separate collection (currently 12 items and 9 categories) ・Promulgated the Act of Fukushima City Environmental Fund ・Implemented measures accompanied by the enactment of recycling-related laws.	

(source: Cleansing service overview in Fukushima City, 2016 edition)

<u>Direction of deployment for the solution of the issue</u>

For this reason, it is necessary to proceed with the examination of an action plan for the proper treatment of biomass-type waste materials such as rice husks (effective utilization), as well as that for the sorting of waste materials.

In parallel with the advanced technological approach, it is also important to change the awareness of people in the local community about the water preservation (As the educational approach is thought to be effective here, we will utilize the place of school education for this purpose.)

(Reference) Japanese experiences: Cooperation amon administration, citizens, and private companies in Fukushima City

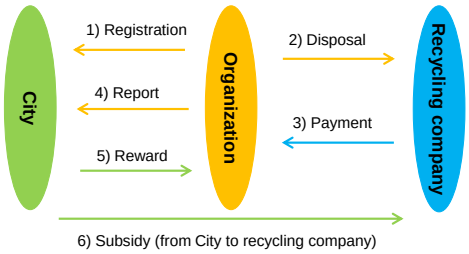
Effective Waste Utilization in Fukushima City

Reward System for Group Resource Recovery

A large truck is filled with newspapers, books and aluminum cans

Cooperation among administration – citizens – private companies

Reward is offered to PTAs and neighborhood associations which voluntarily collect resources such as waste papers, clothes and bins to promote resource recovery and achieve reuse of resources and reduction of waste.
(Number of registered organizations in 2015 : 315)



Source: Fukushima City

(Reference) Japanese experiences: Example of environmental education in Fukushima City

Recycling of milk cartons

Learning about separate waste collection

(Elementary School in Fukushima)

Action Plans (draft) based on City to City Collaboration (proposal)

For the action plan to promote new waste treatment measures corresponding to the progress of the economic growth of Ayeyarwady Region, it is important to (1) examine the feasibility of commercialization (business operation) of proper treatment measures (effective utilization) of biomass-type waste materials such as rice husks (energy production using waste materials by way of rice husk power generation), and (2) enhance institutional measures (guidance, etc.) and enlighten the awareness of local people (in order to gain their cooperation to the environmental education approach to promulgate the habit of sorting waste materials).

(1) Commercialization of proper treatment measures (effective utilization) of biomass-type waste materials such as rice husks.
- Deployment of rice husk power generation, utilizing the JMC.
- Creation of a mechanism for the procurement of rice husks (collaboration among the administration, business operators and industrial associations).

(2) Enhancement of institutional measures and enlightenment of people's awareness.
- Clarification of the vision about the treatment of locally generated waste materials (reference: Basic Plan of Fukushima City).
- Change of people's awareness towards the compliance with regulations (Reference: Study meetings conducted by commercial and industrial groups in Japan; enlightenment activities).
- Environmental education approach to promulgate the habit of sorting waste materials (Reference: Activities on the level of elementary schools).
- Waste-sorting and recycling activities with the participation of the administration, business operators, citizens (families), schools and communities.

(Reference) Visit to and discussions with elementary school in Pathein City (January)
The project members introduced examples of environmental education at public elementary schools in Fukushima City. Interest was shown from the elementary school on environmental education and waste separation/sorting scheme.


Local elementary school


Materials for environmental education at the local elementary school

Waste treatment in the backyard of the elementary school

Explanation of environmental education in Fukushima City

5 Summary and Future Perspectives

Individual (JCM) project proposal and future perspectives for city to city collaboration are summarized below.

Correspondance with Pathein City Vision

Under cooperation with local stakeholders, possible JCM projects under Pathein Industrial City will be investigated. On consideration, correspondence with “vision for Pathein in 2022” (including contents such as to become “the Clean City” and “no waste, more resources”), and development through business and development through policies will be aimed.

Low carbonization of the whole region through city to city collaboration between Fukushima City and Ayeyarwady Region

Low carbonization of the whole region in various fields will be aimed, by utilizing the city to city collaboration in Pathein Industrial City, and conducting activities in relevant sectors (e.g. promotion of renewable energy, resource circulation, energy conservation) and other areas (e.g. other cities in the region or other industrial cities). In particular, the Partnership for a Low-Carbon Initiative in Ayeyarwady will aim to be a model for low carbon regional development with regional characteristics of a regional hub city (e.g. economical development, improvement in standard of living, measures against climate change, well-balanced development model for environmental measures).

Project development using JCM

~Approach through public-private cooperation~

In realization of individual projects, JCM scheme is an extremely effective scheme in terms of economic feasibility improvement (subsidy support), cooperation between Japanese and local companies, and utilization of Japanese technologies and know-how. In September 2015, agreement towards establishing JCM was made between Myanmar and Japan for low carbon development

This study identified the following project as promising JCM project within Pathein Industrial City, and considered measures for project establishment.

<Possible JCM project in the waste treatment sector>

Biomass power plant such as rice husk power plant (3 MW scale): develop a biomass power plant utilizing rice husks for fuel, as a preliminary power plant facility within Pathein Industrial City.

Importance of the framework of inter-city cooperation at the stages of industrialization and operation of JCM projects

It is necessary to enhance policies to promote new environment preservation measures corresponding to the economic growth of Ayeyarwady Region, and here, enhancement of measures on the policy aspect (e.g. administrative guidance) and public awareness are considered to be priority issues. It is essential to actively promote the measures through mutual cooperation among the municipal government, citizens and business operators as a

unified body in order to succeed in the approaches adopted by business operators taking advantage of JCM scheme and to further promulgate such approaches. It is important to proceed with the deployment by the two wheels of “initiatives by business operators” and “deployment by the administrative policy”, by utilizing the framework of inter-city cooperation and also taking advantage of policy experience and knowhow of municipalities in Japan.

- Enhancement of measures (e.g. administrative guidance)
  As regards environmental measures, it is important to enhance administrative guidance towards compliance with regulations and to induce business operators to adopt necessary approaches (initiatives). As the measures to induce business operators, transfer of experience and knowhow of Japan’s enhancement effort of environmental measures such as administrative guidance measures and public awareness activities through related associations seems to be quite effective, and it is important to realize the measures through policy dialogues.

- Coordination with public awareness activities
  In parallel with advanced initiatives, a change in the awareness of local communities (including business operators and residents) concerning the environment preservation (e.g. proper treatment and effective utilization of waste, and treatment of wastewater) is important, and the environmental education (utilizing the place of school education) is also an effective way of promoting the change in the awareness.

<u>Realization of JCM projects and proposed action plan (draft) for the promotion of policies in related areas</u>

<u>Candidates for JCM projects in the field of waste treatment</u>
Power generation projects utilizing waste such as rice husks (estimated generating capacity of 3MW) : To deploy biomass power generation projects using rice husks as raw materials in Pathein Industrial City, as power generation facilities to develop ahead of others.

< Local needs as the background for industrialization >
As regards the rice mills in the neighboring area, development of infrastructure for power supplies from the national grid has also been considered, and the needs for effectively utilizing rice husks for power generation in rice mills are high. Governmental officials of the Region stated that the securing of necessary power was the top priority issue amid the situation where the demand for power was increasing, and expressed their high expectations for the project to generate power from rice husks. Rice husks are a type of agricultural waste materials. The Region is examining its future vision of building a clean city, and enhanced countermeasures against waste materials are one of their important administrative issues.

< Basic concept for industrialization >

- To make the waste power generation a project meeting the local needs in both aspects of (i) proper treatment and effective utilization of rice husk waste, and (ii) securing power supply in the industrial zone.
- To implement trial collection of waste plastics (e.g. PET bottles) at certain pre-determined sites like schools as a model case in order to determine the feasibility of municipal waste separation, looking into the future deployment of municipal waste treatment (e.g. promotion of 3R: reduce, reuse, and recycle), and to make schools as the place for environmental education concerning the separation of waste.

< Outline of business plan >

- Place of installation: In the industrial zone (more in concrete, in planned rice mills, or adjacent to the power plant area).
- Size: Medium (2 ~ 3 MW) The size will be determined after considering the amount of rice husks.
- Raw materials: Rice husks + waste plastics (to be collected from pre-determined collection sites like schools in the neighboring area). Environmental education through collection of waste plastics at pre-determined collection sites and activities to collect waste plastics. The knowhow accumulated by Fukushima City can be used here.
- Installed technology: Boiler-turbine (Biomass power generation)
- Power supply:
  <For a certain period> Power will be supplied to meet electricity demand for construction in the industrial zone. The surplus will be sold to the grid.
  <In the future> Power will be supplied in the industrial zone, on an off-grid basis.
- Business scheme: SPC (special purpose company) is assumed (e.g. Japanese company + local partner). Use of equipment subsidy under JCM is planned.

< Direction of policy coordination >

- Coordination with such activities as regulatory guidance is pursued in order to proceed with appropriate waste treatment at rice mills. In parallel with such regulatory enhancement activities, a proper mechanism to procure rice husks needs to be established (through cooperation among the municipal government, business operators, and industrial associations) so as to induce initiatives by rice mill operators.
- As the change in awareness in local communities about waste is important, trial implementation of collecting waste plastics such as waste plastic containers in certain pre-determined collection sites, and environmental education through such waste collection activities is to be promoted, utilizing the place of school education.
- In realizing the concept of industrialization, coordination with activities contemplated in the future vision worked out by the Region aiming at a clean city is pursued.