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

Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration in Yangon city (Project for Introduction of Solar PV into Yangon city facility)

Final Report

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ABBREVIATION

CPLA	City Planning and Land Administration Dept.
GHG	Greenhouse Gases
INDC	Intended Nationally Determined Contributions
JCM	Joint Crediting Mechanism
MEPE	Myanmar Electric Power Enterprise
MGD	Million Gallon per day
MMK	Myanmar Kyat
MOECAF	Ministry of Environment Conservation and Forestry
MOU	Minutes of Understanding
MRV	Monitoring, Reporting and Verification
PCCD	Pollution Control and Cleansing Dept.
PCS	Power Conditioners
PV	Photovoltaics
USD	United States Dollars
YCDC	Yangon City Development Committee
WSD	Engineering Department (Water and Sanitation)

UNITS

A	–	Ampere
kWh	–	kilowatt-hour
kW	–	kilowatt
MW	–	Megawatt
V	–	Voltage

CHAPTER 1 BACKGROUND OF THE STUDY

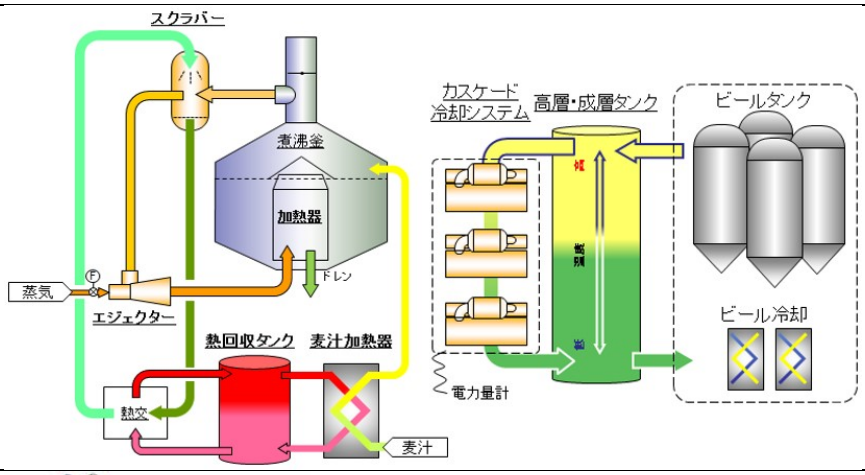
1.1 BACKGROUND

Yangon City, the former capital of the Republic of the Union of Myanmar, is one of the largest commercial cities in the country which population is over 5 million. In response to the democratization in recent years, rapid urbanization of Yangon city is on-going through the inflow of foreign capital and development by private companies. However, the city faces the difficulties such as deterioration of infrastructure due to the limited investment, technical assistance and social development from foreign countries against the military government. More specifically, there are some problems to be considered, for example, the demand far exceeds the supply of electricity power with the urban development and infrastructure development, traffic congestion is caused by the poor road condition or lack of facilities, including signal, and the lower capacity of water supply and sewerage facilities by their aging. Considering such situation in Yangon city, the necessity of saving energy and low carbon development is needed and the study for the city to city collaboration between Yangon city and Kawasaki city is implemented since last year.

Yangon city and Kawasaki city started its cooperation through city to city collaboration study even though they do not have any official communication. The outcome of the city to city collaboration study in the previous year was i) conclusion of MOU for city to city collaboration between Yangon city and Kawasaki city, ii) Discussion based on MOU, and iii) Development of two JCM model projects which were adopted by Ministry of Environment, Japan.

The 2nd year of the city to city collaboration project aims to conduct tangible projects under city to city collaboration between Yangon and Kawasaki city based on the previous results and relations of trust.

Output I Conclusion of MOU The MOU between Kawasaki city and Yangon city was concluded on the end of March 2016.	  

Output II JCM model project Introduction of saving energy system into Beer factory Estimated GHG emission reduction 2,841 tCO2/year	
Output III JCM model project Introduction of high efficiency boiler into food factory Estimated GHG emission reduction 674 tCO2/year	

1.2 OBJECTIVE OF THE STUDY

The study aims to contribute for solving issues which Yangon city has by utilizing Joint Crediting Mechanism (hereinafter as JCM) as well as considering approaches under the city to city collaboration with Kawasaki city which has rich experience and knowledge for low carbon society development.

1.3 IMPLEMENTATION FRAMEWORK

Nippon Koei Co., Ltd leaded the project in cooperation with Kawasaki city and proposed JCM projects from the view of technical and policy making to Yangon City Development Committee, hereinafter as YCDC.

The counterpart of local side is City Planning and Land Administration Department (CPLA) and Pollution control and Cleansing department (PCCD) continuously from the last year.

The main implementation body of Kawasaki city is International Economic Affairs Office and conducted support of development of low carbon action plan in cooperation with other relevant departments such as Water and Sewer Department and Environmental Bureau.

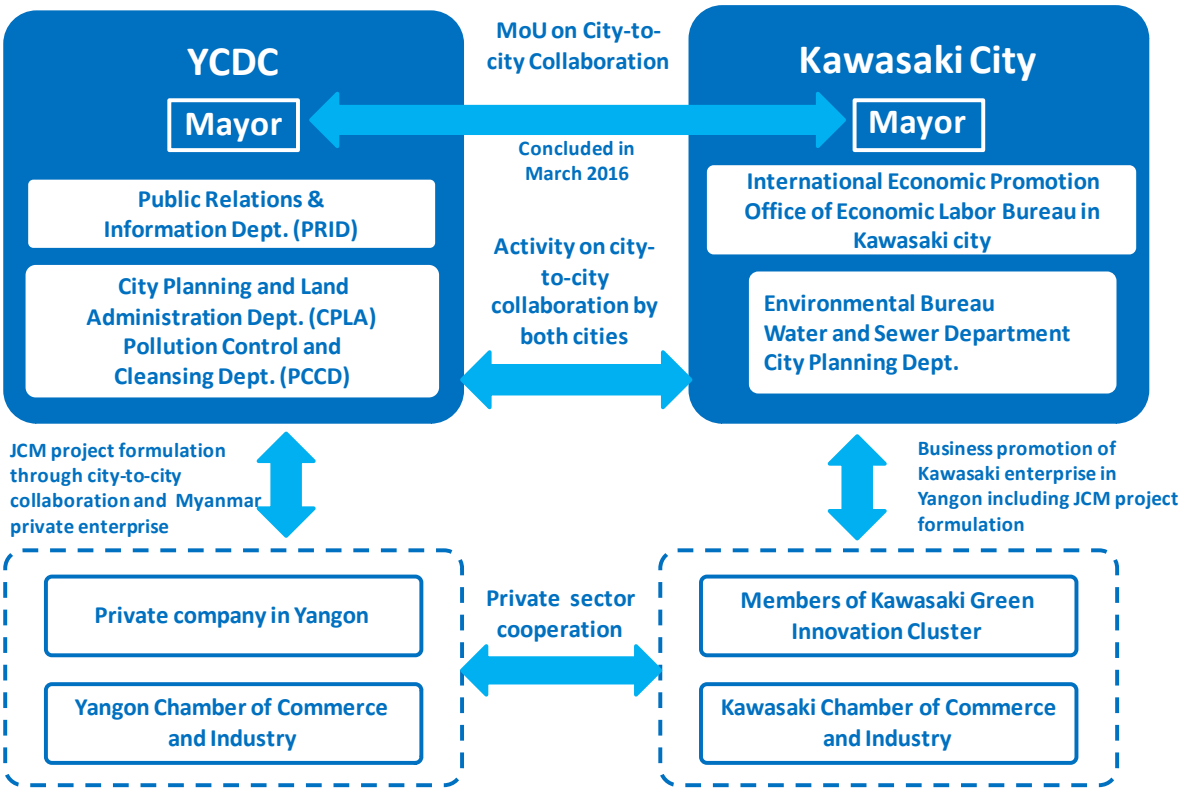


Figure 1-1 Implementation Scheme of the Project

CHAPTER 2 OVERVIEW OF YANGON CITY

2.1 OVERVIEW

2.1.1 General Information

Yangon city used to be a capital of the Republic of the Union of Myanmar so called as Rangoon until 2006. The current capital is Naypyidaw which locates in the north from Yangon.

Yangon city belongs to Yangon region as administrative area of Myanmar and has a border with Bago region in the north and east of Yangon and Ayeyarwady region in the west. The Yangon region is the most industrialized area in the country and major industry of the country concentrates in the region.

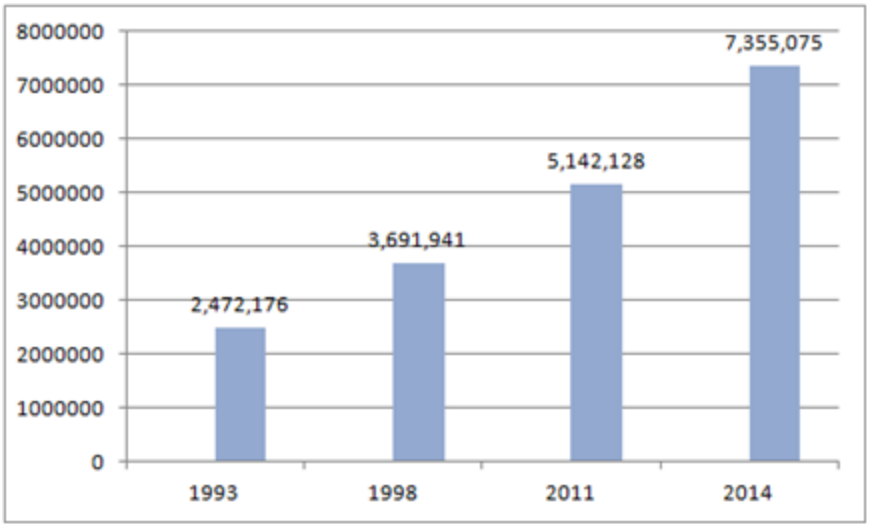
Basic information of Yangon city is indicated in the following table comparing to Kawasaki city.

Table 2-1 Overview of Yangon City

Item	Yangon city	Kawasaki city
Area [km^2]	598.8	143.0
Population [persons]	5.21 million [2014]	1.47 million [2015]
Average temperature [degree-C]	27.5	16.6

Source: The Study Team prepared based on several data

Yangon region including Yangon city increases population because of rapid urbanization at three times compared to population of 1998.



Source: JICA ”the Preparatory Study for Urban Development Programmed in the Greater Yangon in 2011” and population census in 2014

Figure 2-1 Trend of Yangon city’s Population

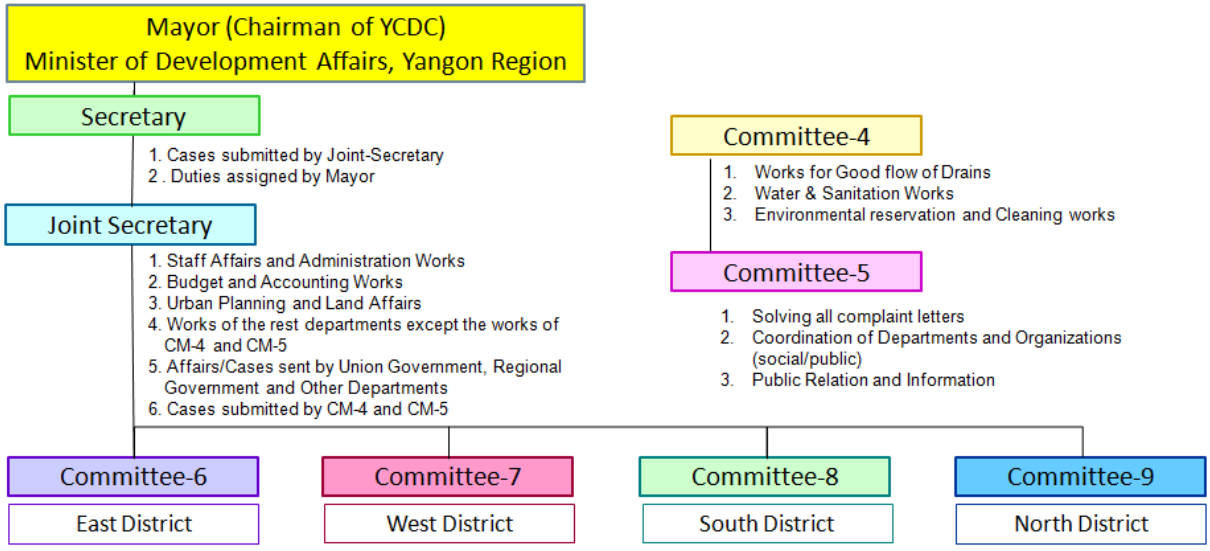
2.1.2 Yangon City Development Committee (YCDC)

Myanmar consists of seven regions, seven states, five autonomous areas and one autonomous region which are regulated by constitution. Also, under these areas, there are district and township as administrative unit.

Yangon City Development Committee (YCDC) which administrates Yangon city and provides government services is a development committee based on Yangon city development law.

In 2016 April, new government was established and the YCDC's framework was drastically changed as indicated in the following figure. The major points of change are Join Secretary was established under Secretary and City planning and land administration department which used to be independently set became a part of Joint Secretary. Also, Water & sanitation works and Pollution control and cleansing department were integrated into Committee-4. Four new Committees such as Committee-6 to Committee-9 were established to administrate four districts of Yangon city.

Main counterparts for the study are continuously City Planning and Land Administration Department (CPLA) and Pollution Control and Cleaning Department (PCCD) from the first year's project. Also, as for solar PV project, Water and Sanitary Department (WSD) is in charge of the project formulation.



Source: YCDC

Figure 2-2 YCDC's Administrative Framework

2.2 CLIMATE CHANGE POLICY IN MYANMAR

The study focus on Yangon city but climate change policy is handled by national government, so the climate change policy of Myanmar is summarized in the following as national policy including Yangon city.

2.1.3 Current situation of GHG emission

Myanmar submitted the first national report in 2012. According to the national report, the origin of GHG emission are dominated by land use and forest sector same as other Asian agricultural countries at 36.5%, agriculture at 17.1%, and waste materials at 4%. Also, regarding origin of emission and carbon sink, land use and forest sector are major share.

Table 2-2 Amount of GHG emission in Myanmar (2000)

Sector	CO_2 [Gg CO_2-eq]		
	Carbon sink	GHG Emission	Total amount of GHG emission
Energy	0	786	786
Industry	0	463	463
Agriculture	0	22,843	22,843
Land use and forest sector	142,221	40,405	-101,816
Waste materials	0	2,826	2,826
Total	142,221	67,323	-74,898

Source: The 11th Workshop on GHG Inventories in Asia

2.1.4 Implementation body and National policy on global warming

Myanmar ratified UNFCCC in November 25th 1994 and Kyoto protocol in August 13th 2003. The national policy on global warming is summarized in the following table. In 2016, Myanmar Climate Change Strategy and Action Plan (MCCSAP) 2016-2030 were formulated in order to precede action plan for global warming.

Table 2-1 National Action for Global Warming

Action	Year	Summary
National Environment Policy in Myanmar	1994	- Environmental protection and prevention of deterioration - Promotion of economic development - Achievement of sustainable development in priority of environmental protection - Harmony between environment and development
Myanmar・Agenda21	1997	- Use of natural resource for sustainable development - Development of society, economy, and institution
National Sustainable Development Strategy (NSDS)	2009	- Strategy for sustainable development in three sectors such as society, economy and environment
Environment Protection Law	2012	- Management of natural resource - Promotion of social awareness - Cooperation to environmental program
National Adaptation Plan for Action (NAPA)	2012	- Selection of 32 priority actions from 8 sectors - Implementation of adaptation action for global warming
Participation to Joint Crediting Mechanism	2015	- Conclusion of JCM
Myanmar Climate Change Strategy and Action Plan (MCCSAP) 2016-2030	2016	- Target year is 2030 and plans to implement 6 priority projects for global warming policy

Source: prepared by the Study Team based on 11th Workshop on GHG inventories in Asia and the published Information by the UN prepared by the JICA Study Team

In the following, the Myanmar Climate Change Strategy and Action Plan 2016-2030 is summarized.

Table 2-3 Summary of Myanmar Climate Change Strategy and Action Plan (MCCSAP)

- Vision	The action plan aims to implement low carbon development in order to pursue sustainable development of Myanmar
- Goal	Goal of the plan is low carbon development and adptation of climate change with the target year of 2030
- Priority Action Area	Basic action plan a) Conter masure for climate change is reflected into development plan b) Development of organization and institution for cilmage change strategy c) Preparation of budget for climage change strategy d) Consideration of techniqhes for climate change strategy e) Developmetn of knowledge and organization for cliamge change f) Promotion of cooperation with several organizations for project investment Priority action plan are selected from the following sectors. 1)Agriculture and Fishery, 2) Environment, 3) Energy, Transportation and industry, 4) Urban city, 5) Welfare, 6) Education

Source: Myanmar Climate Change Strategy and Action Plan 2016

CHAPTER 3 PROMOTION OF CITY TO CITY COLLABORATION FOR LOW CARBON DEVELOPMENT

3.1 SUMARRY OF CITY TO CITY COLLABORATION

Regarding basic policy for city to city collaboration between Yangon city and Kawasaki city, it is planned for three year term as indicated in the following table. In the first year of the plan in 2015, MOU was concluded by city mayors between Yangon city and Kawasaki city based on study and discussion for current condition and needs for city to city collaboration and basic policy.

In this year as the second year of the study, it prepared draft low carbon action plan and selection of pilot project based on the basic policy discussed in the first year.

In the final year of the study, it is planned to formulate the low carbon action plan authorized by YCDC and support for implementation of action plan.

The summary of menu for city to city collaboration through three years is indicated in the following table.

Table 3-1 City to city Collaboration Implementation Menu

Fiscal year	Topics	Summary
FY2015	1) To grasp and share the current situation for city-to-city collaboration	It was focused to build the deeper understanding of each other through the understanding of the current situation and information sharing by having several consultation meetings in Myanmar and Japan.
	2) To examine the menu for city-to-city collaboration	It was examined the menu for city-to-city collaboration by having the consultation of the issues and needs of Yangon city and possible supports to be offered from Kawasaki city.
	3) To examine the draft MOU	It was examined and prepared the draft MOU based on the above discussion for future city-to-city collaboration
FY2016	1) To prepare the low-carbon development action plan	To prepare low-carbon development action plan from middle and long term point of view based on the low-carbon development vision stated in Master Plan of the development of Yangon metropolitan area prepared in 2013
	2) To conduct regular WG meetings (including the meetings in Japan)	To implement regular WG meetings to promote the preparation of low-carbon action plan and implementation of the city-to-city collaboration. WG will be hold in Myanmar and Japan.
	3) To prepare the draft menu for technical training	To prepare the technical training menu based on the possible support from Kawasaki city toward the technical assistance requested by Yangon city
	4) To prepare the draft pilot project	To select the sites for pilot projects which are feasible in the short term and prepare implementation plans in lo-carbon development action plan.

FY2017	1) To implement the pilot project based on the low-carbon development action plan	To support pilot project implementation based on the pilot project implementation plan prepared in 2016 fiscal year.
	2) To implement the technical training (including training in Japan)	To implement the technical training in Myanmar and Japan based on the technical training menu prepared in 2016 fiscal year.
	3) To implement regular WG meeting (including meeting in Japan)	To attempt close cooperation through the implementation of regular WG meetings.

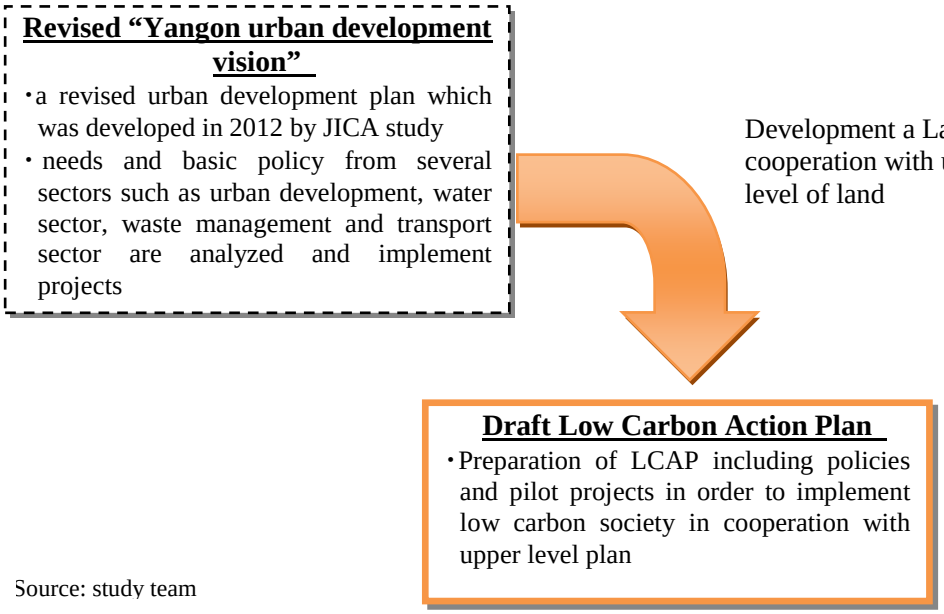
Source: The study team

3.1 PREPARATION OF LOW CARBON ACTION PLAN

3.1.1 Low Carbon Action Plan

Draft Low Carbon Action Plan (LCAP) was prepared in cooperation with Kawasaki city which has knowledge and experiences for low carbon plan's development and the basic policy. The implementation schedule of the plan is from 2017 up to 2040 and the scheme of the plan is set as three terms such as short, middle and long terms in order to conduct pilot projects for achieving low carbon society.

Also, the upper level plan of the LCAP is a revised "Yangon urban development vision" which is prepared by JICA study in 2016 to 2017. The LCAP aims to coordinate with basic policy and implementation schedule of the Yangon urban development plan.

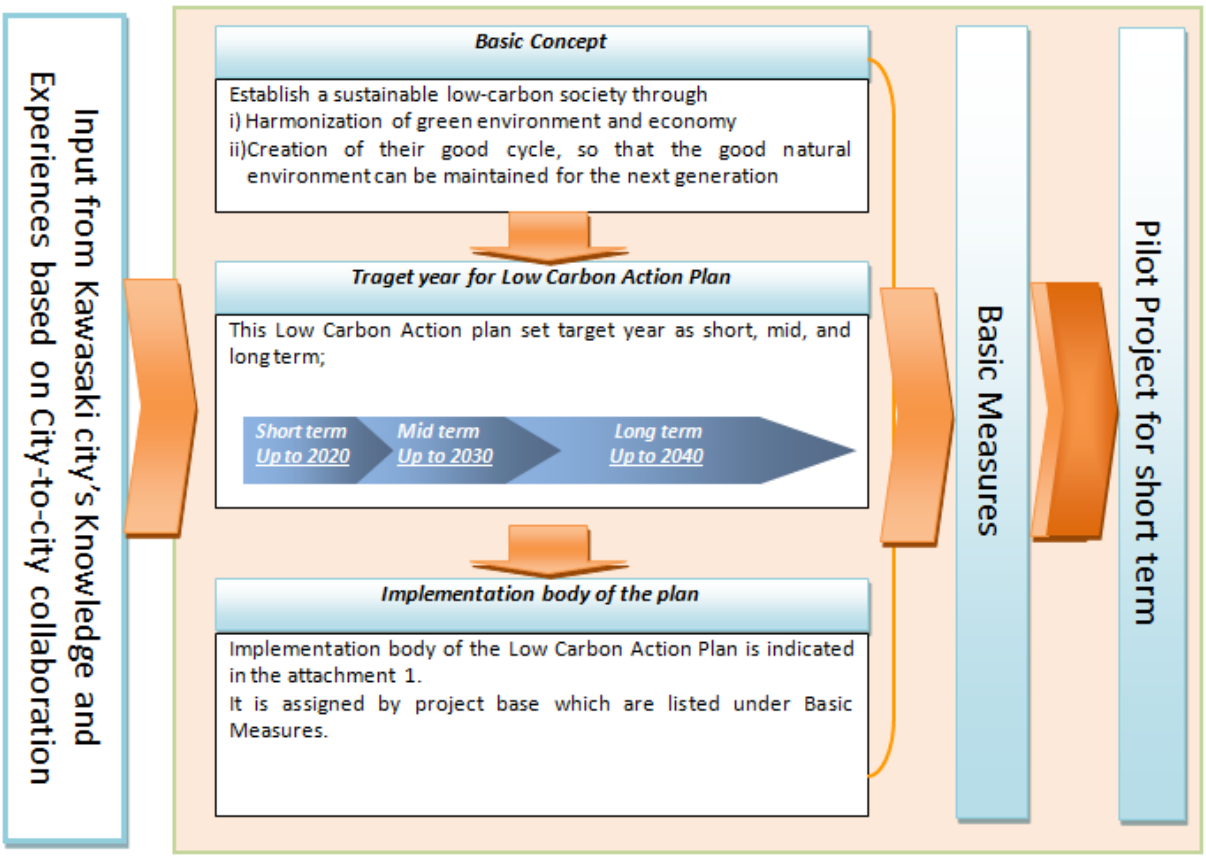


Source: study team

Figure 3-1 Setting of Low Carbon Action Plan

3.1.2 Framework of Low Carbon Action Plan

Framework of Low Carbon Action Plan is indicated in the following figure which includes basic concept, implementation schedule, implementation body, basic policy by sectors and pilot projects.



Source: study team

Figure 3-2 Framework for Low Carbon Action Plan

【Basic Concept】

The Low Carbon Action Plan aims to contribute for development of sustainable and low carbon society of Yangon city based on i) harmonization of green environment and economy and ii) creation of their good cycle, so that the good natural environment can be maintained for the next generation.

【Implementation Schedule】

The implementation schedule is set as from FY2017 to FY2040 and divided into three parts such as short, middle and long term. The basic policy and implementation of pilot project are planned by each three parts.

The implementation schedule is set as the same with SUDP, Sustainable Urban Development Plan which is upper level of plan to the LCAP.

【Basic Policy】

Basic policy of the plan was developed by sector considering needs of urban development of YCDC, on-going projects, and future development plan. The basic policy is indicated in the following table.

Table 3-2 Needs and basic policy of Low Carbon Action Plan

Sector	Needs and Basic policy
Industry	Yangon city has existing industrial parks and a plan of development of industrial parks in the city. Existing industrial parks have issues on renewal of aged facilities.
Energy	Population growth and development of industry cause increase of demand of electricity and frequent electric outage. It is important to provide stable electric supply.
Urban City	Urban development in the city center is increased because of private investment from domestic and international entities. It is expected that such commercial development will be more promoted since government also actively call for investment.
Transportation	Traffic congestion is one of issues to be solved in the city. It is necessary to consider counter measure for traffic congestion.
Waste Management	The main issue of waste management is increase of cost for garbage collection, needs for incineration facility and recycling system because of increase of waste materials. The total amount of wastes is exceeding 2000t per day and it is necessary to consider counter measure to the issue.
Education	It is necessary to improve understanding of citizens about recycling system and saving energy in order to archive low carbon society.
International Cooperation	Regarding low carbon and sustainable development, needs for introduction of leading technology from domestic and international courtiers is necessary.
MRV(Monitoring, reporting and verification)	It is important to introduce monitoring system for air pollution, and water contamination, and promotion of saving energy project.

Source: study team

Based on the needs derived from issues, basic policy of LCAP was established as in the following table.

Table 3-3 Basic Policy for Low Carbon Action Plan

Sector	Basic policy
Industry	***I. Reduction of greenhouse gas emission from industrial activities*** 1. Establishment of a business model towards "low-carbon Yangon City" 2. Fostering eco-friendly industries 3. Creation of eco-friendly model for industrial complexes
Energy	***II. Utilization of renewable energy resources*** 1. Promotion of Solar-city Project 2. Creation of a system for making an effective use of energy 3. Making a wider use of renewable energy resources, considering the regional characteristics
Urban City	***III. Creation of low-carbon city*** 1. Encourage construction of highly energy efficient buildings 2. Introduction of energy efficient technology into public sector 3. Promotion of energy efficient technology to private sector
Transportation	***VI. Introduction of Low carbon technique in the transportation Sector*** 1. Establishment of eco-friendly transportation network 2. Enhance convenience of public transportation 3. Promotion of measures for greenhouse gas emitted from automobiles
Waste Management	***V. Creation of recycling-oriented society*** 1. Promotion of 3R activities of non-industrial wastes and industrial wastes 2. Introduction of low-carbon waste incineration facility Reduction of greenhouse gas emission from collection and transportation of wastes

Sector	Basic policy
Education	***VI. Environmental education and study on global environmental issues*** 1. Promotion of environmental education and study 2. Promotion of human resource development
International Cooperation	***VII. Introduction of international technology through city to city cooperation*** 1. Contribution to reduction of global greenhouse gas emission by introducing international technology through city to city cooperation 2. Supporting and cooperating international environmental conservation activities
MRV(Monitoring, reporting and verification)	***VIII. Research and development of environmental technologies*** 1. Research and development of environmental technologies, and promotion of scientific measures 2. Conducting MRV in order to promote introduction of saving energy technology

Source: study team

【Pilot project】

Based on basic policy which was set in above, several pilot projects which pursue to implement from short term to midterm in order to promote low carbon society were selected as in the following table.

Table 3-4 List of Pilot Projects

Sector	Proposed Pilot projects	Schedule
Industry	PP1: Introduction of high efficiency boilers into factory	Short term
Energy	PP2:Introduction of solar PV system into existing water pumping station	Short term
Urban City	PP3: Introduction of high efficiency pumps in to existing pumping station	Short term
Waste management	PP5:Intoduction of IoTsystem into waste collection system	Short term

Source: study team

【Implementation body】

Implementation body in YCDC and its role were summarized in the following table. The implementation body is assigned by sector including its major roles. In the case the sector stride several implementation bodies such as education and dissemination to citizens for low carbon society, it is necessary to discuss which should be major body and how to coordinate among several bodies.

Table 3-5 Major implementation body by basic policy

Sector	Basic policy	Major implementation body
Industry	・Promotion of saving energy technology to private sector ・Plan and development of eco-friendly industrial park	⇒CPLA ⇒CPLA
Energy	・Promotion of saving energy project >>In case the public facility, management body inYCDC is major implementation body ・Promotion of renewable energy project >>In case the public facility, management body inYCDC is major implementation body	⇒relevant body ⇒relevant body

Sector	Basic policy	Major implementation body
Urban City	・Low carbon urban development >>In case the public facility, management body inYCDC is major implementation body >>In case private facility, edification of low carbon development is conducted by CPLA	⇒CPLA
Transportation	・Promotion of low carbon public transport ・Promotion of low carbon transport in pirate sector	⇒CPLA
Waste Management	・Promotion of 3R ・Promotion of low carbon development for waste management facility	⇒PCCD
Education	・Edification of recycling system to city staff and citizens ・Promotion of introduction of renewable energy into private sector	⇒PCCD
International Cooperation	・Promotion of introduction of international high efficiency technology under city to city collaboration	⇒Public relations
MRV	・Promotion of introduction of monitoring system for GHG emission reduction	⇒PCCD、CPLA

Note: CPLA (City Planning and Land Administration Dept,), PCCD (Pollution Control and Cleansing Dept.),
Source: study team

The issues which need to be discussed continuously are summarized in the following table.

Table 3-6 Issues to be discussed and policy for counter measure

Issues	Policy
1)Proportion and dissemination of low carbon techniques to private sector	It is necessary to introduce low carbon technology to private sector for future development such as industrial park, commercial facility, hospitals and transport sector. It is difficult to handle by one unit of YCDC, so it is recommended that several units or new unit for the task shall take in part of the sector.
2)Edification of YCDC staff and citizens for low carbon development	As for low carbon technology, staffs of YCDC has gap in understanding. In order to implement low carbon society in the future, it is necessary to expand the understanding among YCDC. Also, for recycling activities, it is necessary to have cooperation with citizens and disseminate information.
3)Preparation of institution for low carbon development	As for implementation of low carbon and sustainable society, development of institution and system is needed to develop as well as implementation of pilot projects.

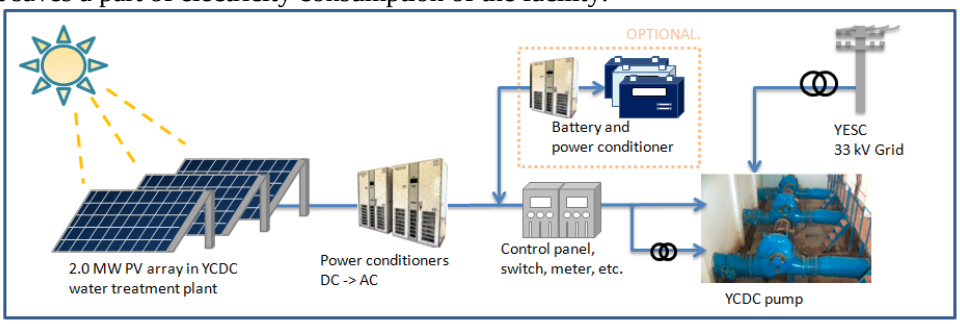
Source: study team

3.1.3 Summary of Proposed Pilot Projects

Summary of proposed pilot projects are indicated in the following table.

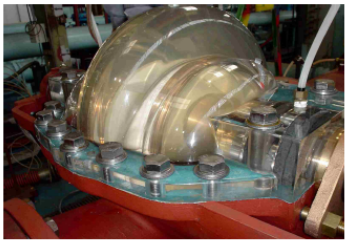
Project	PP1: Introduction of high efficiency boiler into factory	FY2017 FS, Planned to implement after 2018
Target	New or existing factory	
Implementation body	Private sector	
Project Summary	It aims to reduce GHG emission and fuel consumption by introduction of high efficiency boilers into factory. 	

Source: study team

Project	PP2:Introduction of Solar PV system into existing pumping station	FY2016-17 FS, Planned to implement after 2017
Target	Nyaung Hnit Pin pumping station	
Implementation body	YCDC Water and Sanitation Department	
Project Summary	By introduction solar PV system into existing pumping station which is managed by YCDC, it saves a part of electricity consumption of the facility.  • Solar PV generation system reduces electric energy usage in pumps in YCDC water supply facility • Solar power for internal supply  Solar PV Installation Area  800 kW Booster Pumps	

Item	Value
Location	Nyaung Hnit Pin
Average tariff	105 MMK/kWh
PV system efficiency	77%
Solar Irradiation (Average)	4.69 kWh/m2/d
Planned capacity (Tentative)	2,000 kWp
Annual generation energy	2.85 GWh (8-10 % of consumption)
Annual saving	299 mil MMK
CO2 Reduction	1015 ton/year

Source: study team

<table>
<tr><td>Project</td><td>PP3:Introduction of high efficiency pumps into existing pumping station</td><td>FY2017 FS, planned to implement after 2018</td></tr>
<tr><td>Target</td><td colspan="2">Existing pumping station</td></tr>
<tr><td>Implementation body</td><td colspan="2">YCDC Water and Sanitation Department</td></tr>
<tr><td>Project Summary</td><td colspan="2">By introduction of high efficiency pumps into existing pumping station, electricity consumption and GHG emission shall be reduced.
 
Old Pump system (image)
 
New high-efficiency pumps (example)
• Hlawga water treatment plant installed pump in total 2 MW capacity in 1980
• Old, low efficiency pumps are to be replaced with new, high-efficiency pumps
• Efficiency improvement of pumps reduces electric energy consumption and reduce CO2 emission
<table><tr><th>Item</th><th>Value</th></tr><tr><td>Location</td><td>Hlawga</td></tr><tr><td>Current Pump efficiency</td><td>80? % (tentative)</td></tr><tr><td>Pump efficiency</td><td>90?% (tentative)</td></tr><tr><td>Electricity consumption</td><td>11,038MWh/yr</td></tr><tr><td>Pump load</td><td>2.0-2.1 MW</td></tr><tr><td>Current monthly tariff</td><td>96mil MMK/m</td></tr><tr><td>Annual saving</td><td>128 mil MMK/yr</td></tr><tr><td>CO2 Reduction</td><td>ton/year</td></tr></table></td></tr>
</table>

Source: study team

Project	PP4:Introduction of IoT system into wastes collection	FY 2017年FS, planned to implement after 2018
Target	Pilot area in Yangon city	
Implementation body	YCDC Pollution control and cleansing department	
Project Summary	By introduction of IoT system into existing waste collection facility, it achieve efficient collection route and saving cost for waste collection.	

Source: study team

3.1.4 Further Action

This year's objective for Low Carbon Action Plan was to develop draft of LCAP and select of pilot projects. As for further action of LCAP, it is planned to formulate the LCAP and implement pilot projects. In the following, the basic policy for next fiscal year is summarized.

1) Formulation of LCAP

LCAP needs to be understood by YCDC and prepare for formulation. Internal discussion in YCDC shall be conducted for implementation the LCAP.

2) Preparation of system for introduction of low carbon technology

It is necessary to prepare standards for introduction of saving energy and incentive system. Aiming for implementation by FY2020, it is discussed and prepared for development of such systems.

3) Capacity development of YCDC staff

In order to precede low carbon society, it is necessary to conduct capacity development of YCDC for understanding and knowledge of low carbon technology. It promotes capacity development of YCDC staff from the midterm wise.

4) Dissemination activities to citizens

It is necessary to have citizen's cooperation for achievement of low carbon society. It promotes dissemination activities to citizens on low carbon technology and recycling activities.

5) Implementation of pilot projects

Pilot projects are listed in this study. As for implementation pilot projects, feasibility study is conducted from next fiscal year. The list of pilot project shall be updated based on needs and situation at time.

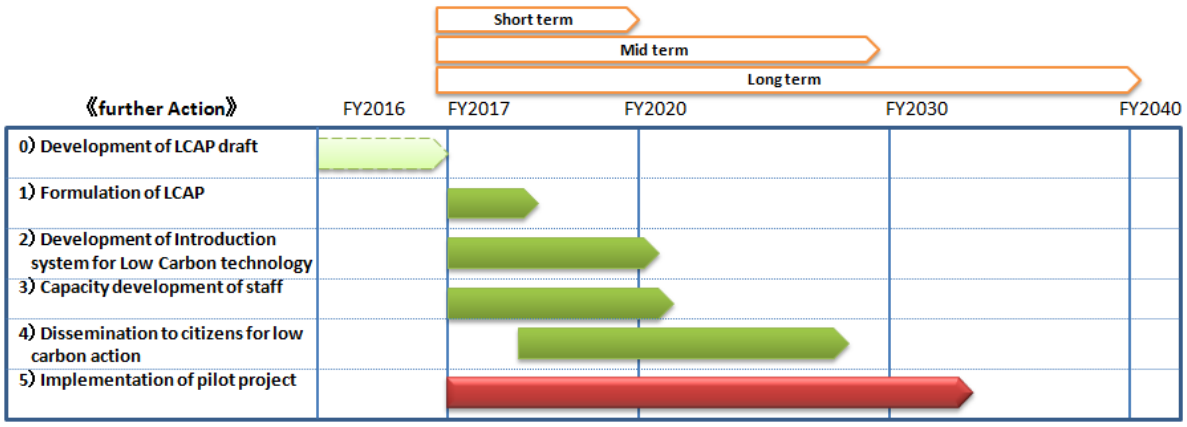


Figure 3-3 Schedule for Further Action

3.2 STUDY RESULT FOR CITY TO CITY COORPORATION

3.2.1 Summary

In the study, it was discussed between Kawasaki city and YCDC about issues and counteraction for implementation of low carbon society. Also, a relationship of both cities was connected strongly through the study by sharing Kawasaki city's experience and knowledge for environmental technology and development of low carbon society which comes with regeneration from pollution issues.

In the following, the study results for city to city cooperation are summarized.

Table 3-7 Study results for city to city cooperation

Contents	Schedule	Summary
Kick-off meeting at Tokyo	May 20th 2016 13PM~15PM	・Explanation of proposed scheme and schedule ・Issues and policy of counteraction
The 1st field study	June 13th to 19th 2016	・Meeting with YCDC（PCCD、CPLA）, JICAexpert, JICA ・Confirmation on electricity tariff ・Preparation of questionnaire on YCDC solar PV site and current situation
The 2nd field study	August 28th 2016	・ Conducting solar PV site survey and site selection
	September 12th to 17th 2016	・Meeting with YCDC（PCCD、CPLA、WSD）for low carbon action plan ・Conducting site survey for collecting data and plans ・Meeting with YESC as for connecting with solar4 PV facility and net metering
JCM workshop at Kitakyusyu and Kawasaki	October 16th to 22nd 2016	・Conduct JCM workshop at Kawasaki city and Kitakyusyu city and invite two officials from YCDC
The 3rd field study	November 7th to 11tj 2016	・Meeting with CPLA and JICA expert about Low Carbon Action Plan ・Meeting with PCCD and WSD about solar PV project ・Meeting with YCDC on dual net metering system for solar PV project
Participation of COP22	November 7th to 11th 2016	・Kawasaki city official participated at COP22 which was held at Morocco and presented Yangon and Kawasaki city to city cooperation project
Visiting at Kawasaki Myanmar Planning and Finance deputy minister	December 8th 2016	・As a part of project by Japan Asean center, Myanmar Planning and Finance deputy minister was invited to Kawasaki city and visited eco-town in Kawasaki city.
The 4th field study	December 26th to 28th 2016	・Meeting with CPLA and PCCD about Low Carbon Action Plan and MOU revision ・Visiting Hlaingthaya waste management site as alternative candidate for solar power project ・Visiting Hlawga solar power project site
JCM workshop at Tokyo	January 22nd to 24th 2017	・Participation to JCM workshop at Tokyo

Source: study team

3.2.2 Discussion between Kawasaki city and YCDC

At the first field study, Kawasaki city and YCDC had a kick-off meeting for summary of the last year's study result and city to city cooperation framework, and introduction of ukichima solar PV at Kawasaki city as well as this year's schedule.

Also, at 4th field study, MOU revision was discussed among the both cities.

Kick off meeting between YCDC and Kawasaki city

Discussion at YCDC

3.2.3 JCM workshop at Kitakyusyu city and Kawasaki city

Two officials from YCDC participated JCM workshop from October 17th to 21nd in Kitakyusyu which was provided by Ministry of Environment, Japan and visited low carbon facilities in Kawasaki city such as solar PV facility introduced in water purification plant.

＜Visiting Nagasawa water purification plan＞

Water purification plant

Solar panel introduced on the cover of plant

Monitoring panel for showing generated electricity

Power conditioner


Explanation of solar PV project


Inside of plant

＜JCM workshop at Kitakyusyu city＞


Presentation by YCDC


Presentation by Kawasaki city

＜Visiting low carbon facility at Kitakyusyu＞


Wind power facility

Solar PV facility

3.2.4 Participation of COP22

Kawasaki city official participated COP22 which was held at Morocco from November 8th to 18th. Yangon city to city cooperation study was introduced at Japan pavilion on 8th of November.

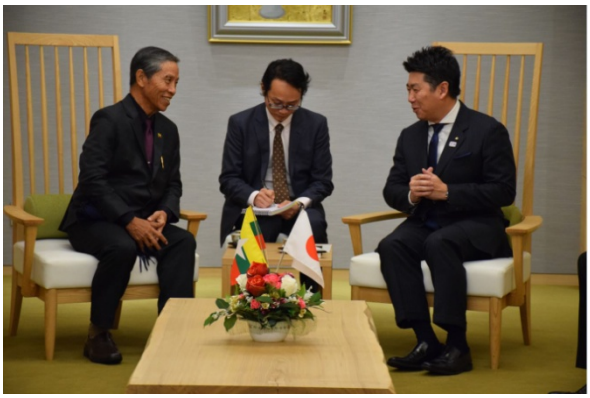
Presentation by Kawasaki city

Japan Pavilion

3.2.5 Myanmar Planning and Finance Deputy Minister invited to Kawasaki

As a part of Japan Asean Center's project, Myanmar Planning and Finance Deputy minister was invited to Kawasaki city and visited low carbon facilities in the city.

Based on the request from Myanmar side, Yamanaka corperation Kawasaki factory which has recycling technology of scrap cars and Takeei cooperation Kawasaki factory which is a recycling company, and ukichima mega solar power plant were selected for visiting.


Fukuda mayor of Kawasaki city and Myanmar Planning and Finance Deputy Minister


Visiting Kawasaki city

Visiting scrap factory

Visiting Ukichima mega solar facility

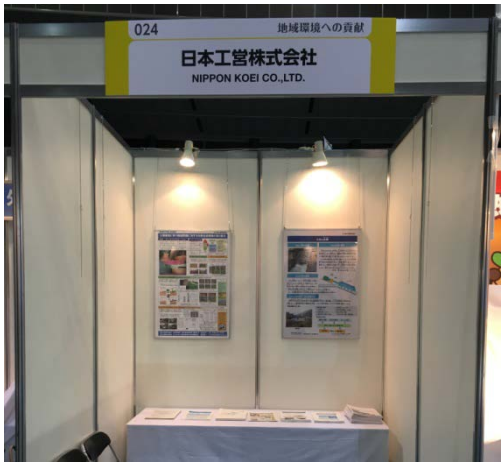
3.2.6 JCM seminar at Tokyo

JCM seminar at Tokyo was conducted on 23rd and 24th of January. In the seminar, the study result was presented and Kawasaki official participated in the panel discussion on the role of city government of the study.

3.2.7 Kawasaki International Eco-tech Fair

From 16th to 17th of February, Kawasaki International Eco-tech Fair 2017 was held in Kawasaki city. In the fair, Yangon and Kawasaki city cooperation study was introduced as well as activity of Kawasaki Green Innovation Cluster.

Presentation of Yangon Project



Nippon Koei booth

CHAPTER 4 JCM PROJECT FORMULATION

4.1 OUTLINE

Study for JCM model project formulation was conducted under the city-to-city collaboration between Kawasaki and Yangon city.

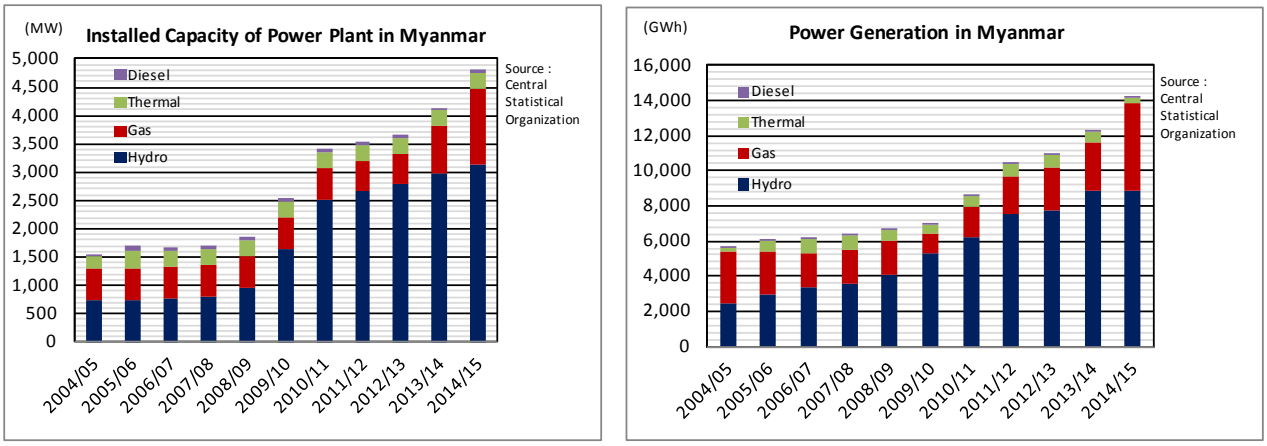
In this project, JCM model project was formulated together with Japanese companies who are interested in expanding their business in Yangon by utilizing JCM scheme. The study asked participation and cooperation from companies who are the members of Kawasaki Green Innovation Cluster, managed by Kawasaki City. This Cluster is the group of organization aiming at industrial promotion, environmental conservation and international contribution under industry-government-academia network. The Cluster supports and promotes business incubation utilizing environmental technology and know-how accumulated in Kawasaki city.

Power demand is rapidly increasing, and power shortage is the pressing issue in Myanmar. From the past, Myanmar has been depending on hydro power. To cope with demand increase and power shortage, the country is constructing and expanding thermal power stations and has been trying to achieve stable power supply. However, demand and supply imbalance has not been improved yet.

The electric energy consumption in Myanmar was increased from 6,964 GWh in 2009 to 14,181 GWh in 2015. The average growth rate of electric energy is 15.3%. The installation capacity has been insufficient. The peak demand in Myanmar in 2015 was 2,072 MW, of which 1,082 MW was demand in Yangon. The total installed capacity is 4,819 MW, of which 70% is hydropower. In dry season, the power output is decreased to less than 2,000 MW.

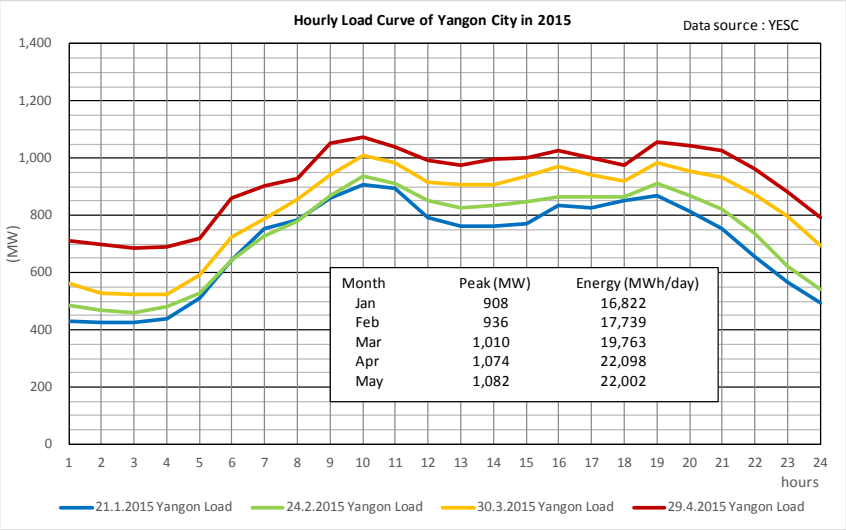
Meanwhile, national gas is depleting, and Ministry of Electricity and Energy recognizes that Myanmar may have energy crisis in 2020. Import of LNG and coal will be significant burden for national budget. Thus, introduction of renewable energy is the urgent issue for Myanmar.

National Energy Management Committee has set the target of introduction of 2,000 MW renewable energy (9% of total grid installation capacity) by 2030 in Energy Policy 2014. In addition, the new government of Myanmar which commenced in April 2016 clarified the promotion of renewable energy in the power development policy.



Source: Study on Gas Application in Myanmar, METI (February 2016)

Figure 4-1 Installed Capacity and Generated Energy in Myanmar



Source: YESC

Figure 4-2 Load Curve and Peak Demand in Yangon

There are mega-solar projects planned in local region in Myanmar, however, there is no example of installed large-scale grid-connected solar PV generation plant in Myanmar. Utilization of solar PV technology

Yangon is the largest demand center of Myanmar. Utilization of solar generation technology in Yangon is meaningful and effective as model project and actual fossil fuel saving and CO2 emission reduction project. Accordingly, mega-solar project was formulated in the public facility in Yangon.

The outline of the proposed JCM project is summarized as follows.

Table 4-1 Outline of Proposed JCM Project

Project Owner	YCDC
Project Site	Candidate sites proposed from YCDC facility such as existing water supply facility
Outline of technology	About 2.0 MW grid-connected solar PV generation system (consists of PV module, power conditioners, transformer, and distribution boards) is proposed to be installed in a water treatment facility managed and owned by YCDC. A part of electricity currently provided from YESC is planned to be supplied from solar PV generation system to be installed in the premise of water treatment plant.
Output	Approx. 10% of electric energy used in the water supply facility is supplied from solar PV system, and reduce about 1100 ton CO2 emission.

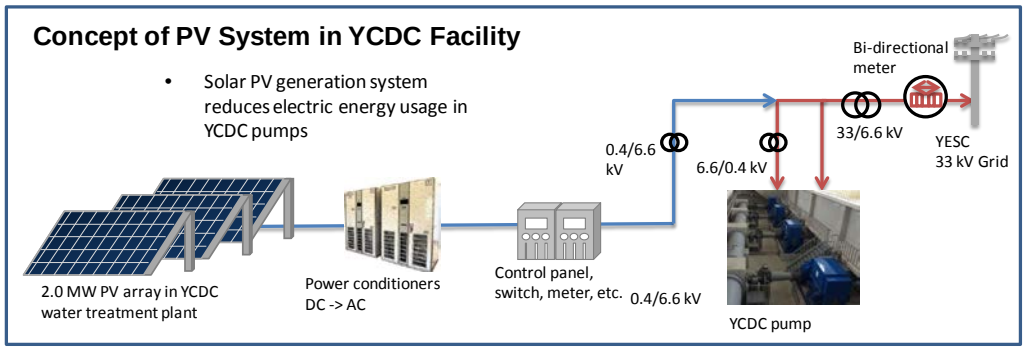


Figure 4-3 Outline of Solar PV System proposed for YCDC Water Supply Facility

Source: The Study Team

4.2 METHOD AND RESULT OF PROJECT FORMULATION

JCM project formulation study was conducted based on the proposed method as shown in the table below. The result of the formulation study is also summarized in the same table.

Table 4-2 Method and Result of JCM Project Formulation

	Item	Proposed Method	Result
1	Project site selection from sites proposed by YCDC considering existing YESC[*1] grid capacity	- Obtaining grid information from YESC for the concerned site - Selection of optimum site from YCDC candidate sites considering connection point, possibility of reverse-flow, and local grid capacity	- 33 kV distribution line and substation condition around the site was confirmed with YESC. - Based on the above, optimum site that has no problem in grid capacity for reverse-flow was selected
2	Study for preparation of specification of solar PV generation system	- To prepare system details for selected project site (such as power conditioners, connection boxes, junction boxes, transformers, distribution boards) - To prepare project schedule, cost estimation, design, and calculation of GHG reduction amount	- Specification of solar PV system, PV module, PCS, transformer was determined. Downsizing PCS is applied and the system will apply no connection box and junction box. - Project schedule, cost estimation, and estimation of GHG reduction amount were conducted.
3	Budget preparation in YCDC for proposed JCM project	- To confirm the procedure of YCDC budget FY 2018/2019 for implementation of JMC Model Project	- Flow of YCDC budgeting and schedule was confirmed.

	Item	Proposed Method	Result
4	Specifying YCDC load, power consumption, power tariff, and study for financial feasibility	- To conduct site visit to confirm location of YCDC facility load and power tariff by local consultants - Financial feasibility study based on saving electricity by solar PV system	- YCDC water supply facility such as water treatment plant, pumping station, and reservoir was studied with confirmation of pump load, electric energy usage, and power tariff - Financial analysis was conducted. FIRR and recover years were calculated.
5	Confirmation of necessity of power wheeling in YESC grid and required approval matters about net-metering, as necessary	- Confirmation and discussion with YESC about application and approval of wheeling charges of YESC distribution lines and net-metering as necessary	- All PV generated energy is planned to be consumed inside the YCDC facility and power wheeling will not be necessary. Bi-directional meter will be applied for net-metering
6	Implementation structure, project plan, and schedule for JCM Model Project	- Discussion and coordination among Participants of International Consortium	- Project implementation structure was discussed and prepared for International Consortium to apply JCM Model Project with possible representative participant

*1:YESC Yangon Electricity Supply Cooperation
Source: The Study Team

4.3 STUDY METHOD

4.3.1 Study Method of Solar Power Generation Project

JCM Project Formulation Study for PV generation project for YCDC Facility was conducted with following process:

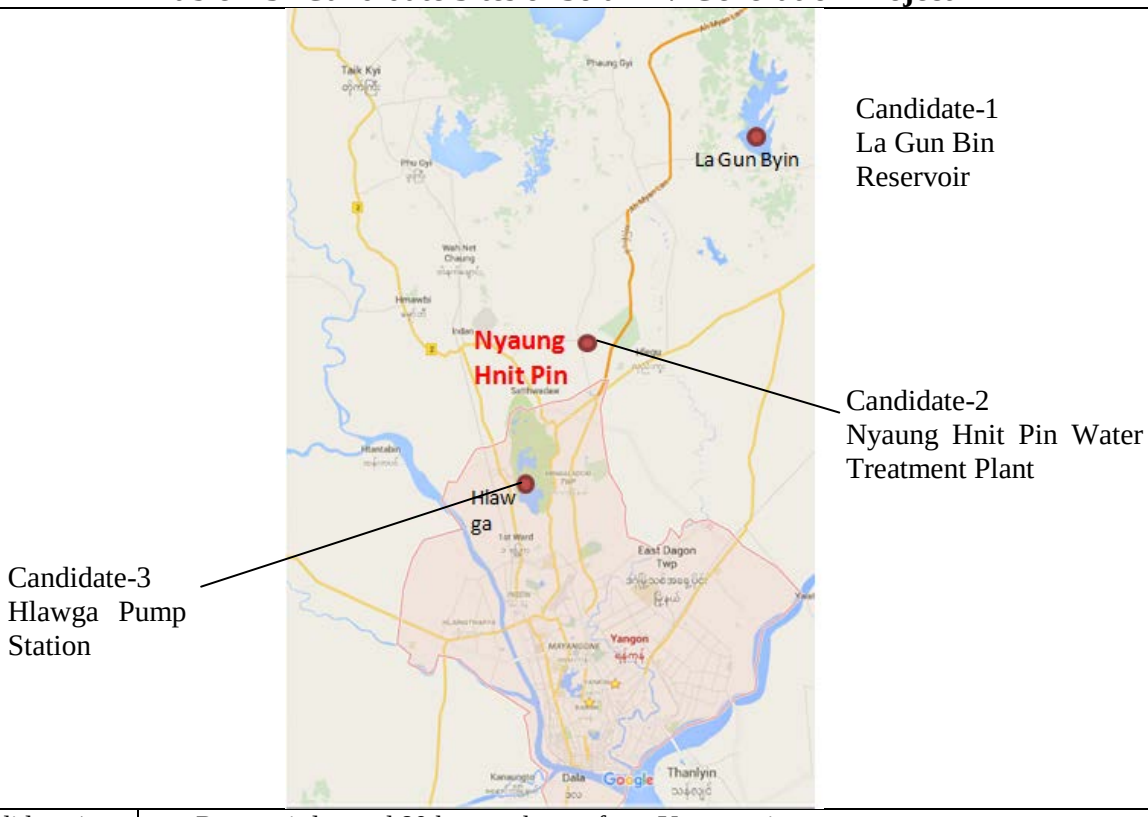
1) List up of candidate sites from YCDC
2) Interview at candidate sites using questionnaire
3) Study for system outline, scale, confirmation of possible land area for PV system, and site screening
4) Site survey
5) Study for solar PV generation amount and system specification
6) Study for grid connection of solar PV system
7) Confirmation of power tariff and estimation of recovery years
8) Financial analysis
9) Preparation of project implementation structure and schedule
10) Financing plan

4.3.2 Issue and Result

(1) Method and result of project site

As the candidate sites for JCM Model Project, YCDC proposed three existing water facilities. The outlines of the candidate facility areas are summarized in the following table.

Table 4-3 Candidate Sites of Solar PV Generation Project

<table>
<tr><td colspan="2"> 
</td></tr>
<tr><td>Candidate-1
La Gun Bin Reservoir</td><td>- Reservoir located 80 km north-east from Yangon city centre
- Centrifugal pump and induction motor: 132 kW x 6 units, 25kW x 6 units, and 30 kW x 4 units
- All pumps are manufactured by KBS
- Pumps were installed in 2016.
- Annual electric energy consumption is 288 MWh.</td></tr>
<tr><td rowspan="2">Candidate-2
Nyaung Hnit Pin Water Treatment Plant</td><td> 
Proposed site for PV Module Installation</td><td> 
Nyaung Hnit Pin 800 kW Pump</td></tr>
<tr><td colspan="2">Outline:
- Water treatment plant located 44 km north from Yangon city centre
- Existing distribution pump: 560 kW x 6unit + 800 kW x 4 unit, and other pumps such as filtration pumps, back-wash pumps
- 1st Phase: 205 m^3/d (45 MGD) , 2nd Phase: 205 m^3/d (45 MGD)</td></tr>
</table>

Candidate-3 Hlawga Pump Station	 Intake Pond	 1000 kW Motors
	Outline: - Pump station is located 28 km north from Yangon city centre - Existing distribution pumps: 1000 kW x 4 units, 236 mil m^3/d (52 MGD) - Annual electric energy usage: 19.9 GWh	

Source: The Study Team

Interview survey was conducted in the above three candidate sites using the questionnaire. Possible areas for PV module installations and site conditions were confirmed and the optimum target site was selected.

(2) La Gun Bin

The peak load of pumps in La Gun Bin water reservoir is approx. 450 kW in total. This is smaller than planned the solar PV capacity, and when PV generation is conducted, reverse flow goes into YESC grid. This condition requires negotiation with YESC about power wheeling.

The location is relatively far away from Yangon, which is 80 km from the city centre. Road condition is not favourable to approach the site. It would not be convenient as model project site considering visitors.

(3) Nyaung Hnit Pin Water Treatment Plant

Nyaung Hnit Pin water treatment plant has pumps with total installation capacity 7.8 MW, of which normal operation load is 5.8 MW. When PV generation capacity is 2 MW, a part of pump power is to be supplied from solar PV. In this case, no reverse flow to YESC grid will be generated, and all PV generated energy will be consumed in the water treatment facility. There is no affect on YESC grid and investigation about grid capacity and discussion for reverse-flow will not be necessary.

The site is located 44 km away from Yangon city centre. This site is relatively convenient as model project. This site is considered to be the most preferable as the JCM Model Project.

(4) Hlawga Pump Station

The installed pump capacity of Hlawga is in total 4 MW, of which normal operation load is 2 MW. The pump station is located in Hlawga national park, and most convenient and appropriate as model project.

Meanwhile, the manufactured year of distribution pumps is 1980 and the installation year is 1989. Renewal of pump is considered to be necessary due to aging. In addition, replacement of distribution board is on-going. Connection of solar PV system to the

existing facility will be depending on the replacement work, and affect on JCM model project schedule is concerned. Accordingly, the priority of this site as the JCM model project is considered to be the second.

JCM Feasibility Study for City to City Collaboration Project in FY2016
PV generation project for YCDC Facility

Questionnaire Form for Planning PV Generation System

Name:_____ Date: _____

Please kindly provide following information. If the answer is not clear, please put "not known".

1 General

1 Name of facility		
Location and address		
Coordinate	Latitude:	Longitude:
Name and title of responsible officer		, title:
Contact phone number		
Geological condition		

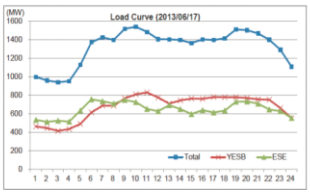
2 Area for solar PV

Available land area for solar PV	+ + +	m2, total _____ m2
Current status of land for solar PV (Please explain usage, flatness or tilt (degree), needs of clearing, etc.)		
Distance from PV site to nearest vehicle road		m
Availability of soil bearing test	Yes/ No	if available, N value or t/m2 :

3 Load of Facility

Electric energy consumption in the facility		kWh/mon or		kWh/year
Peak time of the day, peak load	:	hr,		kW
Off-peak time of the day	:	hr,		kW
Type of main load (pump, motor, etc.)				
Specification of pump and other load (kVA or kW, nos, manufacturer)		kVA or kW x		units
		kVA or kW x		units
		kVA or kW x		units
Voltage, phase, power factor of main load		V		ϕ, cos θ
Installed year of main equipment				

Please provide daily load curve of the facility
(figure in the right is an example)



4 Map and plans

Please provide **facility general layout**
Please provide **single line diagram**
Please provide **copy of electricity bill**
Please provide geological information of site (such as soil penetration test, if any)

Thank you very much for your kind co

Figure 4-4 Questionnaire for Selection of Solar PV Project Site

Outline and selection result of three candidate sites are summarized in the table below.

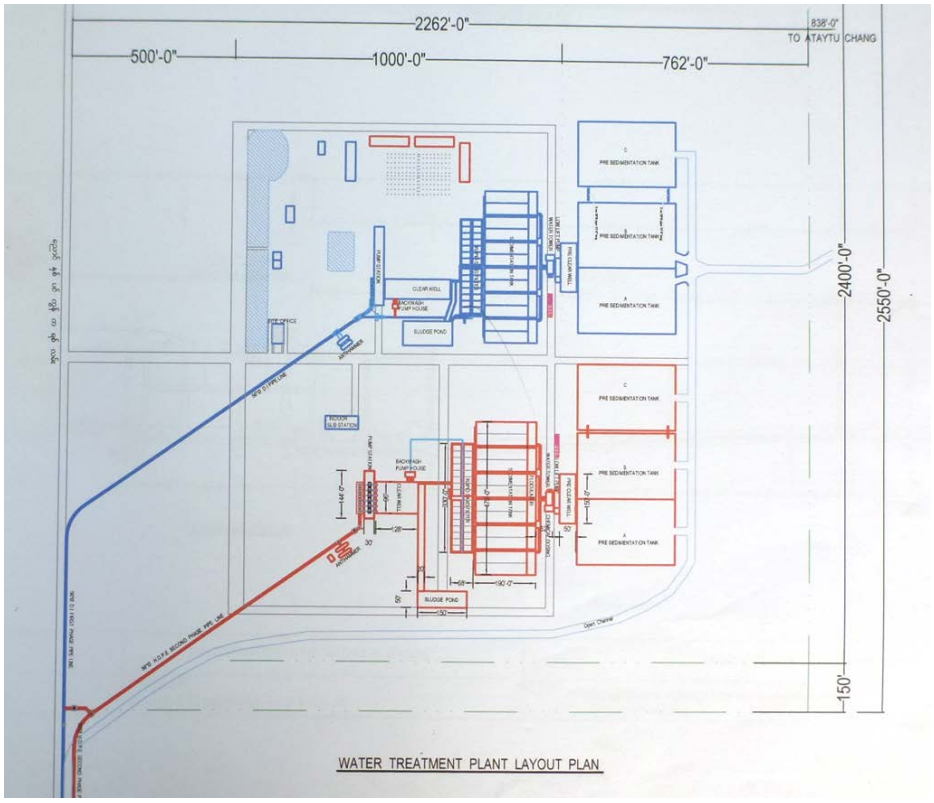
Table 4-4 Result of Site Selection

Candidate Site	Pump outline	Daily Average Load	Selection Result
La Gun Bin Reservoir	- 132kWx6+25 kWx6 + 30 kWx4, 400V - Peak 450 kW, off-peak 350 kW	- Approx. 450 kW in total	Too small, remote
Nyaung Hnit Pin Water Treatment Plant	- Peak 7MW, off-peak 6.8 New, 24 hr operation - 1st phase 2014, 2nd phase 2015	- Installed capacity: 7.8MW: - 440 kW (LV) + 3.2MW+3.4 MW (HV) - Operating load: 5.8 MW	- 1st priority: PV possible to supply with 400/6.6 kV transformer
Hlawga pumping Station	- 24hr, fixed demand - 1MW x 2nos, 6.6 kV - Pump installation in 2008	- Installed capacity: 1000 kW x 4 units = 4MW - Operating load: 2MW	- 2nd priority: Under partial update (new electric board has mismatch of interface). →It will take time until PV connection study becomes possible.

Source: The Study Team

PV generation site screening was conducted from above result. Accordingly, Nyaung Hnit Pin water treatment plant was selected as the JCM project site.

Following figure shows the layout of Nyaung Hnit Pin water treatment plant.



Source: WSD, YCDC

Figure 4-5 Layout of Nyaung Hnit Pin Water Treatment Plant

(5) Study for Solar PV Generation Energy and Facility

Following figure shows the facility layout, pump locations, and proposed PV module locations in Nyaung Hnit Pin water treatment plant.

Source: Prepared by the Study Team using Google Earth

Figure 4-6 Nyaung Hnit Pin and Proposed PV Module Location

Nyaung Hnit Pin water supply plant consumes electricity about 3GWh/month in average, which is corresponding to 36 GWh annually. Most of the power is consumed by various types of pumps including distribution pumps. PV generation system is planned to be installed inside the premise of Nyaung Hnit Pin water treatment plant to cover partial electricity consumption in the facility.

The pumps installed in Nyaung Hnit Pin, which is the target of PV power supply, is as shown in the following table.

Table 4-5 Pump Load in Nyaung Hnit Pin

Phase		Phase-1				Phase-2				Total	
Voltage	Start-up	kW	Manuf acturer	Installed unit	Operated unit	kW	Manufac turer	Installed unit	Operated unit	Installed kW	Operated kW
6.6 kV	Reduce-vo ltage	800	Torishi ma	4	3	560	KSB	6	4	6,560	4,640
400 V	Y-delta	110	China	4	3	110	China	4	3	880	660
		90	KSB	2	2	90	KSB	3	2	375	300
		75	KSB	1	1	75	KSB	1	1	150	150
TOTAL	---	---		11	9	---		14	10	7,965	5,750

* 90 kW and 75 kW pump is operated 12 hours/day. Other pumps are operated 24 hours/day.
Source: Water and Sanitation Department, YCDC
Source: Prepared by the Study Team, based on YCDC data

Condition of location, power output, design coefficient, and power tariff rate in the solar PV generation plan is summarized in the following table.

Table 4-6 Basic Conditions of Solar PV Generation Plan

Item	Value	Unit	Remarks
Latitude	N17.09916	degree	measured
Longitude	E96.16278	degree	measured
PV output	2,054	kW	Manufacture's design
Mobule output	265	pm (W)	Manufacture's design
Nos of module	7750	nos	Manufacture's design
Design coeff.	0.869		Manufacture's design
Temp. correc.	0.97		Manufacture's design
Total design coeff.	0.842		Manufacture's design
Electricity tariff	105	MMW/kWh	from WSD

Source: The Study Team

Based on the conditions above, electric energy generation amount and benefit was estimated as shown in the table below. The benefit comes from saving of electricity charges by solar PV generation.

Table 4-7 Generated Energy by Solar PV and Benefit Estimation

Month	Solar irradiation* ($kWh/m^2/d$)	PV System efficiency	Nos of day	Generation (kWh/mon)	Saving (MMK)
Jan	4.92	0.842	31	263,746	27,693,367
Feb	5.77	0.842	28	279,379	29,334,778
Mar	6.04	0.842	31	323,786	33,997,548
Apr	6.40	0.842	30	332,017	34,861,831
May	4.92	0.842	31	263,746	27,693,367
Jun	3.70	0.842	30	191,948	20,154,496
Jul	3.41	0.842	31	182,800	19,193,980
Aug	3.50	0.842	31	187,624	19,700,566
Sep	4.05	0.842	30	210,105	22,061,003
Oct	4.63	0.842	31	248,200	26,061,035
Nov	4.52	0.842	30	234,487	24,621,168
Dec	4.47	0.842	31	239,623	25,160,437
Average	4.69	0.84	30.42	246,455	25,877,798
Total				**2,957,463**	**310,533,577**

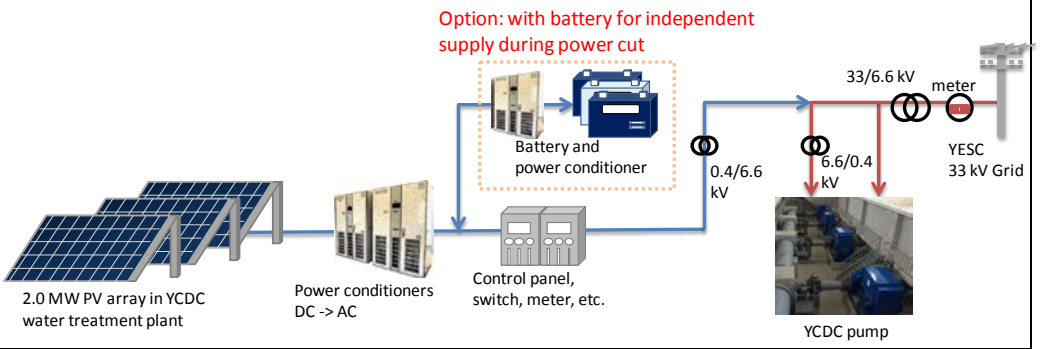
*Source: International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol:2, No:6, 2008

Source: The Study Team

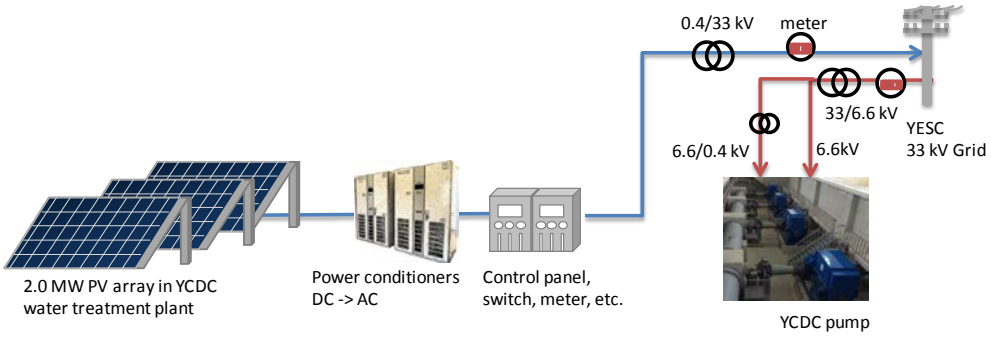
(6) Study for grid connection of solar PV system

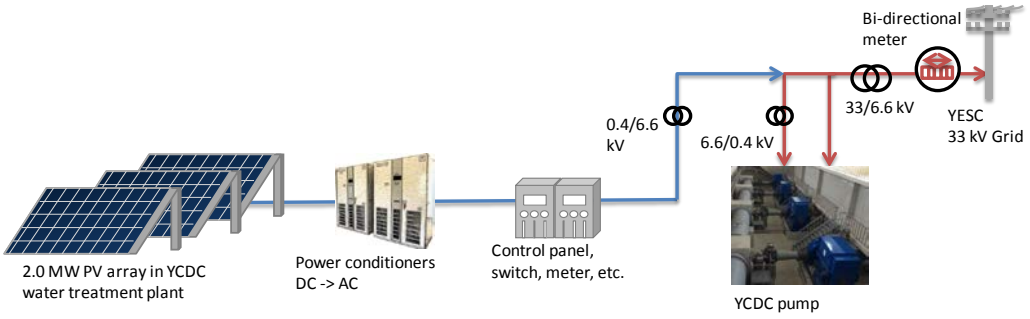
Following options were studied for the grid connection of solar PV system.

Table 4-8 Options for Grid Connection of Solar PV System

Option1: Internal connection	<Outline> - Solar PV generation system will be connected with internal 6.6 kV lines through power conditioners, distribution boards, and transformers. - All power will be consumed in the facility. There is no reverse flow to 33 kV YESC grid. - Battery is the option. Energy charged in daytime will be provided in the night time, however, the cost will be much higher. 
	<Result> - There is no reverse power flow to YESC grid. The PV system is regarded as independent power supply, and power purchase agreement is not necessary. - Cost for battery is expensive. In case battery is introduced, financial feasibility cannot be justified.

<table>
<tr><td rowspan="2">Option 2:

YESC Grid connection</td><td><Outline>
- Solar PV generation system is connected with 33 kV YESC grid through power conditioner, distribution board, and transformer.
- All the power generated by the solar PV system will flow into YESC grid.
- YCDC will pay power tariff to YESC. The amount of solar PV generated energy is deducted from the electricity amount used by YCDC pumps (Net metering). Otherwise, power purchase agreement is necessary.
 
</td></tr>
<tr><td><Result>
- Physically, it is considered to be possible for YESC grid to have reverse flow of 2 MW of solar system since transformer capacity of YESC grid of the particular substation is 20MVA, and considered to be enough.
- In case power purchase agreement need to be prepared, it is highly possible that power sales rate from YCDC to YESC is set lower than YCDC's tariff rate currently paid to YESC, considering past example. When net-metering is applied, the power sales rate will be the same as YCDC's tariff rate currently paid to YESC.
- There is no standard or regulation about grid connection of PV system at present. Discussion with YESC about standard and regulation for PV system grid connection is necessary.</td></tr>
<tr><td rowspan="2">Option3:

Connection with Bi-directional meter</td><td><Outline>
- When there is no pump load, generated energy by PV system will flow into YESC 33 kV grid.
- By the introduction of bi-directional meter, amount of PV generated energy sent to YESC grid will be deducted from general YCDC power consumption supplied from YESC. This system is equivalent to net-metering.
 
</td></tr>
<tr><td><Result>
- Solar PV energy will be utilized effectively even in case there is no pump load.
- The system is most simple since it can conduct under conventional regulation and there is no need to conclude new contract between YESC and YCDC.</td></tr>
</table>

Source: The Study Team

According to the above study and result of discussion with YESC, it was concluded to apply the bi-directional meter as in Option-3 in the above.

(7) Confirmation of power tariff and estimation of recovery years

The power tariff system in Myanmar is as shown in the table below. Tariff rate is different depending on purpose and range. For domestic use, 35 MMK/kWh is applied when monthly usage is below 100 kWh. Highest rate at 150 MMK/kWh is applied in case of industrial use, 50 MWh to 200 MWh range.

Table 4-9 Power Tariff

Purpose	Range (kWh)	Power Tariff (MMK/kWh)
Domestic use	1 - 100	35
	101 – 200	40
	> 201	50
Industrial use	1 - 500	75
	501 – 10,000	100
	10,001 – 50,000	125
	50,001 – 200,000	150
	200,001 – 300,000	125
	> 300,001	100

Source: MEPE

According to MEPE, the average sales of unit electricity were 74.2 MMK/kWh in 2015. This low rate has caused the deficit of power enterprise, however, it is difficult to increase the tariff rate since it is a part of political issue.

Meanwhile, the average tariff rate in Nyaung Hnit is 105 Kyat/kWh. This is because main load pump falls into industrial use range, and higher tariff rate than domestic rate has been applied. This rate at Nyaung Hnit Pin is applied in the benefit estimation of financial analysis.

Based on the estimation above, the result of financial analysis assuming subsidy amount 50% is summarized as follows.

- PV Generated Energy: 2.56 GWh/year
- Financial Benefit: 311 million MMK/year
- Discount Rate: 8.75%
- FIRR: 3.99%
- Recovery Years: 10.6 year

(8) Implementation structure and schedule

Following table summarises issues for the project implementation.

Table 4-10 Issues on Implementation Structure

Item	Description
1) Selection of Representative Participant of International Consortium	Representative Participant is necessary to select for the application of JCM Model Project. The Representative Participant was selected from a member company of Green Innovation Cluster promoted by Kawasaki city, since the project was formulated through Yangon-Kawasaki city-to-city collaboration.
2) Department in charge in YCDC for planning and implementation	The candidate solar PV project is planned in the existing water treatment facility. Engineering Department (Water and Sanitation) will be responsible for the operation of solar PV system to be installed in water treatment plant. It is necessary to provide explanation about JCM scheme in for further understanding.
3) Selection of Contractor	Myanmar local EPC company does not have experience for mega-solar. Meanwhile, selection of EPC is one of the key for successful project implementation. EPC contractor with plenty of equipment procurement and construction experiences should be selected.

Source: The Study Team

Project implementation structure was studied considering above items.

International Consortium will be formed for the application and implementation of JCM model project. A member company of Kawasaki Green Innovation Cluster will take a role of the Representative Participant for JCM Model Project, and Engineering Department (Water and Sanitation) of YCDC is proposed to be the participant of the International consortium to implement the project and to take a responsibility for operation and maintenance.

Equipment procurement is planned to be conducted by local company of representative participant, and participate to the project as the EPC contractor.

The proposed roles and responsibilities are summarized in the following table.

Table 4-11 Implementation Structure and Responsibility

Party	Responsible for
Representative Participant of international Consortium Member company of Kawasaki Green Inovation Cluster	・Planning and design of solar PV project (System design, specification preparation, cost estimation, scheduling) ・Application of JCM Model Project ・Management, supervision, and reporting of project
Partner Participant Engineering Department (Water and Sanitation), YCDC	・Implementation of solar PV project ・Land leveling ・Operation, maintenance and monitoring of solar PV system during project life period (for legal durable years)
EPC Contractor Local company	・Equipment procurement and delivery ・Equipment installation ・Support of monitoring

Source: The Study Team

Project Implementation Structure is shown in the figure below.

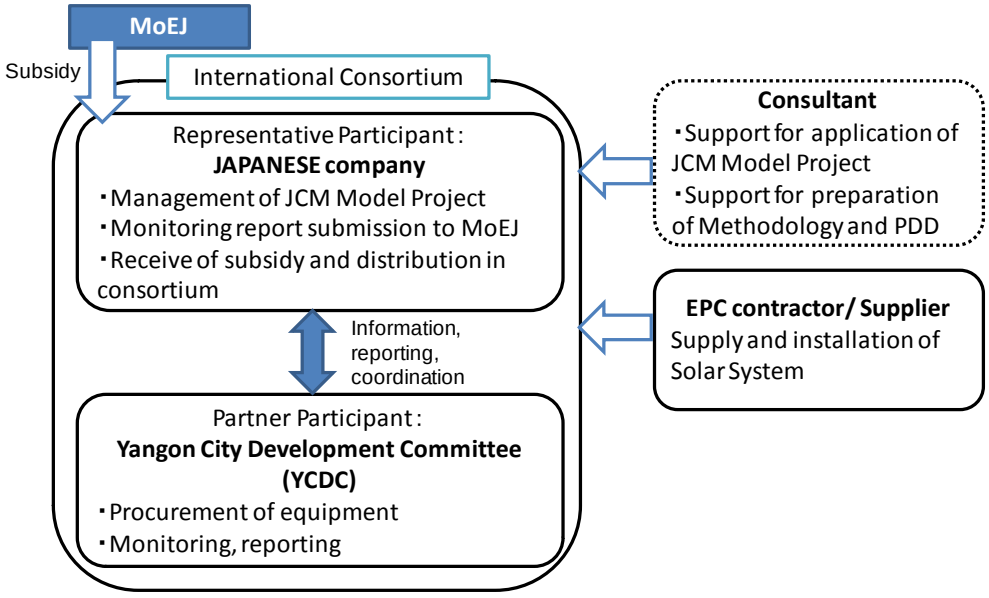


Figure 4-7 Project Implementation Structure

The project schedule includes design, procurement, delivery, installation, commissioning test, and training, which will take approx. two years for the commencement of operation.

It is necessary for the PV module installation site to increase elevation and land leveling, which is necessary to be conducted by YCDC. Thus, preparatory period is necessary about half years with avoiding rainy season.

Project implementation schedule is as shown in the table below.

Table 4-12 Project Implementation Schedule

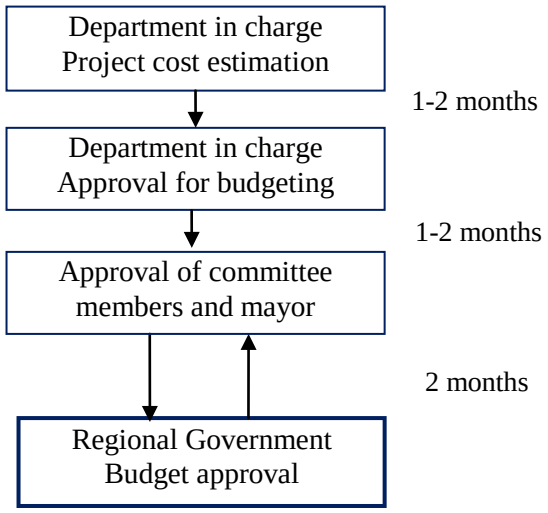
Item	FY2016						FY2017												FY2018												FY2019											
	Ja	F	Mc	Ap	My	Jn	Jl	Au	S	O	N	D	Ja	F	Mc	Ap	My	Jn	Jl	Au	S	O	N	D	Ja	F	Mc	Ap	My	Jn	Jl	Au	S	O	N	D	Ja	F	Mc
Feasibility Study																																								
JCM Model Project proposal																																								
JCM Model Project selection																																								
Detailed design																																								
Site Preparation																																								
Contract with supplier																																								
Procurement of equipment																																								
Manufacturing of supporting structure																																								
Shipment / Custom Clearance																																								
Site delivery and installation work																																								
Commissioning and training																																								
Handover																																								
Monitoring and data collection																																								
Methodology preparation																																								
PDD preparation and validation																																								
Monitoring report and verification																																								

Key player: All YCDC Contractor

(9) Financial Plan

The project will install solar PV system in the public site owned by YCDC, and provide electric energy for a part of the load of water treatment facility.

Subsidy from JCM Model Project will cover a part of project cost. Application of JCM Model Project is planned to be conducted on assumption that the remaining cost is to be covered by YCDC by securing budget in FY2018/19. To secure project budget, it is necessary to take process of budget estimation and internal approval in YCDC. In parallel with the project cost estimation, process flow of budgeting in YCDC was confirmed, as follows.



Source: Prepared by the Study Team based on information from YCDC

Figure 4-8 Flow of Budgeting in YCDC

In addition to the figure above, Yangon Regional Government will submit the budget proposal to Central Government, and Central Government will make a comment. For this, budgeting procedure will take more than half years. In parallel with project cost estimation, discussion was held with YCDC for their budget preparation to prepare JCM Model Project application in FY2017.

4.3.3 Reference of Solar PV Generation Project in Kawasaki

As the reference of solar PV generation project in Yangon, YCDC officers have visited mega-solar PV system installed in Nagasawa water treatment plant in Kawasaki city. There is no example of installed mega-solar system in Myanmar. Accordingly, the Kawasaki experience is useful and highly applicable for providing images of the planning of solar PV generation project in Yangon. At site, the engineer of water treatment plant explained about project management structure, benefit, issues, and active discussions were held.

The outline of Nagasawa water treatment plant is summarized as follows.

Overview of Water Treatment Plant

PV Module Installation

Installation of Power Conditioners

PV Modules installed on Water Treatment Facility

Figure 4-9 Site Visit of Solar PV System in Nagasawa Water Treatment Plant

Table 4-13 Outline of Solar PV System in Nagasawa Water Treatment Plant

Item	Description
Total solar PV capacity	1157 kW (266 kW on filtration pond + 612 kW on distributing reservoir, and 279 kW on regulation pond)
Total solar PV area	9,400 m2
Battery capacity	242 kWh x 2 = 484 kWh (Li-ion Battery)
Main objective	-To support minimum power at the time of digester - To enable interconnection with independent gas turbine and independent generation
Annual generation energy	1.13 GWh/year (20% of total electric energy in Nagasawa)
Annual saving	0.28 mil USD/yr (100 JPY/USD, 25 JPY/kWh)

Source: Prepared by the Study Team based on the material provided from Nagasawa Water Treatment Plant

CHAPTER 5 ISSUES AND FURTHER ACTION

5.1 ISSUES AND FURTHER ACTIONS

Issues and further actions for the study is summarized in the following.

(1) Low Carbon Action Plan

1) Formulation of LCAP
LCAP needs to be understood by YCDC and prepare for formulation. Internal discussion in YCDC shall be conducted for implementation the LCAP.

2) Preparation of system for introduction of low carbon technology
It is necessary to prepare standards for introduction of saving energy and incentive system. Aiming for implementation by FY2020, it is discussed and prepared for development of such systems.

3) Capacity development of YCDC staff
In order to precede low carbon society, it is necessary to conduct capacity development of YCDC for understanding and knowledge of low carbon technology. It promotes capacity development of YCDC staff from the midterm wise.

4) Dissemination activities to citizens
It is necessary to have citizen's cooperation for achievement of low carbon society. It promotes dissemination activities to citizens on low carbon technology and recycling activities.

5) Implementation of pilot projects
Pilot projects are listed in this study. As for implementation pilot projects, feasibility study is conducted from next fiscal year. The list of pilot project shall be updated based on needs and situation at time.

(2) Implementation of low carbon project

1) Low setting of electricity tariff
Electricity tariff in Myanmar is set as 74.2MMK per kWh at average rate which is one forth of Japanese electricity tariff. It is necessary to negotiate on the tariff for selling electricity by each project but the tariff of solar power is low since it is compared with other low cost electricity such as hydropower based IPP. It causes barrier of introducing renewable energy. It is necessary to prepare financial plan considering future increase in price of electricity and promote introduction of renewable energy.

2) Undeveloped regulation for grid connection
Myanmar does not have any case to connect between renewable energy at mega wat class and grid so far. There is no developed regulation for grid connection. Also, it is not fully studied impact on grid connection in case the renewable energy power changes at times. It is necessary to prepare regulation for grid connection in order to promote renewable energy in Myanmar.

(3) Proposed low carbon project for next fiscal year

1) Solar PV project in Htein Bin waste disposal site
Through the study of solar PV project, another potential site for solar PV project except the current project site of water pumping station was proposed at waste disposal site

managed by PCCD. As for the waste disposal site, it will consider to conduct feasibility study for solar PV site.

2) Introduction of high efficiency pump into Hlawga pumping station

Hlawga pumping station where was one of candidate sites for solar PV project has old pumps produced in 1980. It is necessary to renew the facility at near future.

YCDC's high priority is on renovation of pumps as much as early timing and it will consider conducting feasibility study for introduction of high efficiency pumps in the pumping station.