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 (Introduction of one-through boiler into food factory)

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

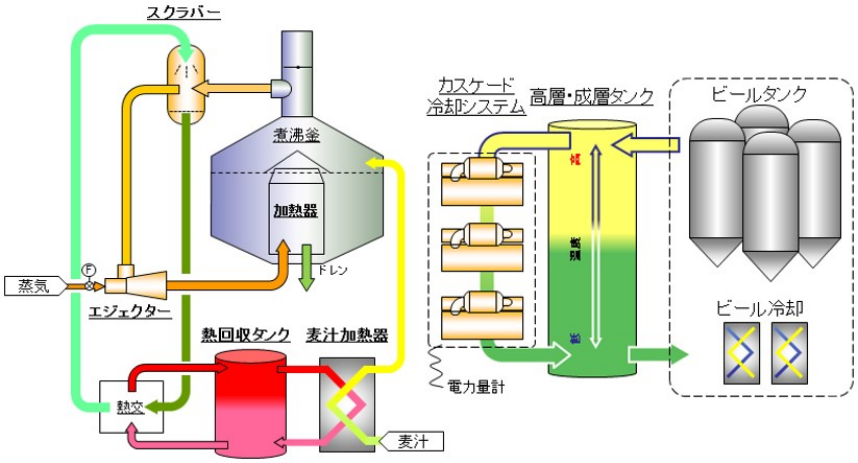
CHAPTER 1 BACKGROUND OF THE STUDY

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	 High-efficiency once-through boiler with monitoring system

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.

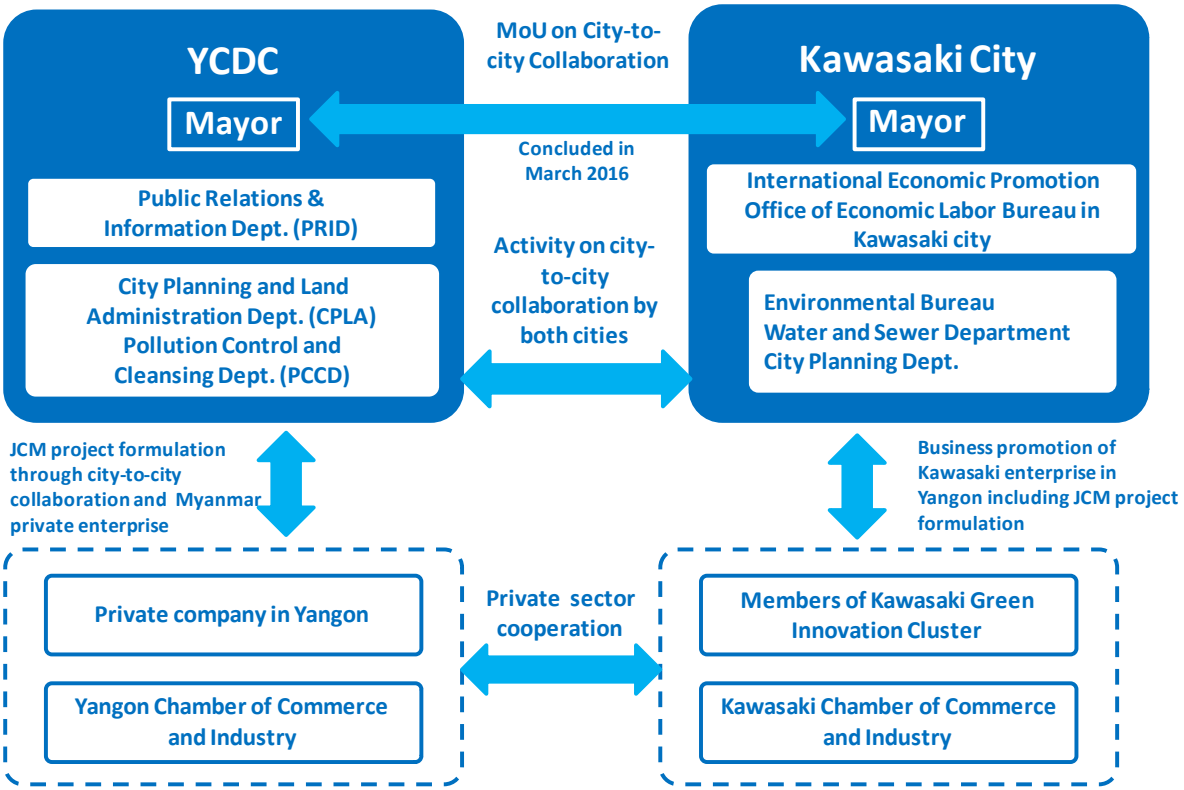


Figure 1-1 Implementation Scheme of the Project

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.

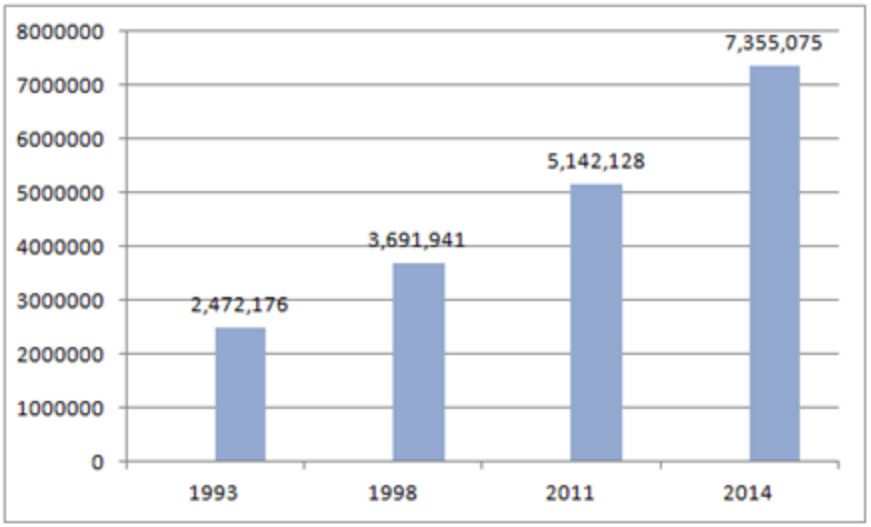
Basic information of Yangon city is indicated in the following table comparing to Kawasaki city.

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

Table 2-2 Trend of Yangon city's Population

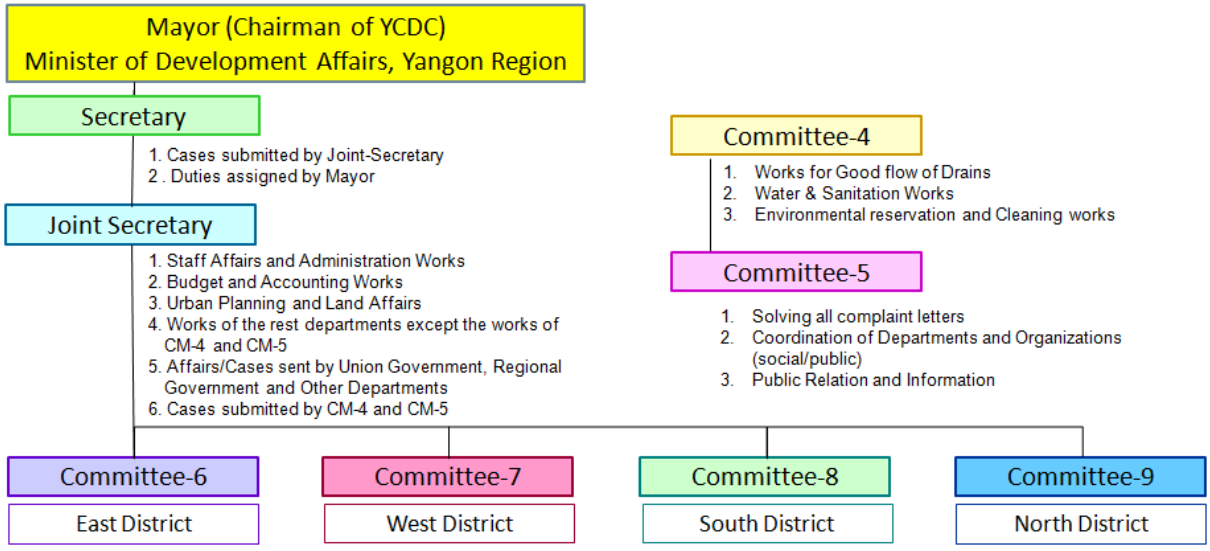
2.1.2 Yangon City Development Committee (YCDC)

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 2-1 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.

2.2.1 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 2-3 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

2.2.2 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 2-4 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 2-5 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.

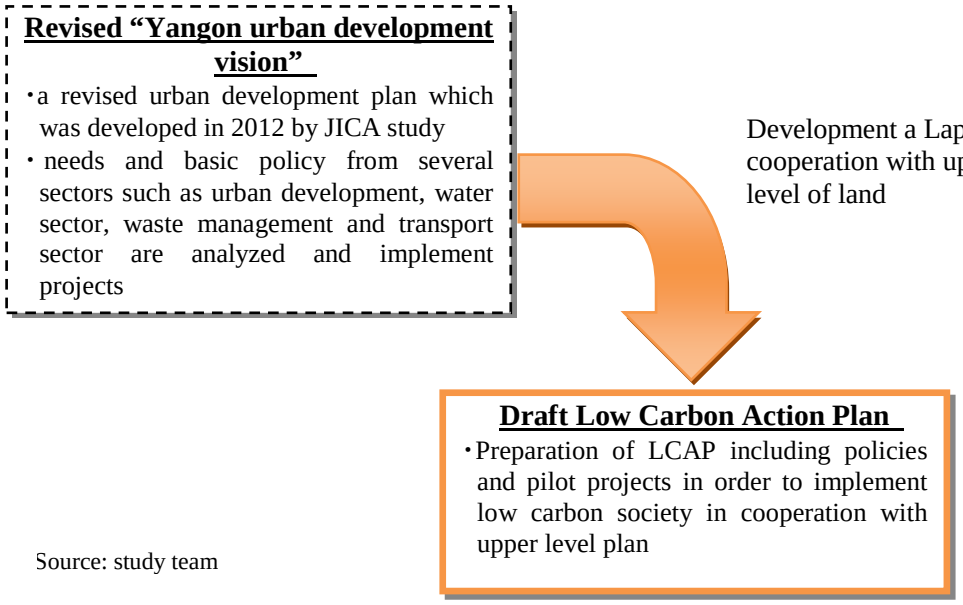
Source: The study team

3.2 PREPARATION OF LOW CARBON ACTION PLAN

3.2.1 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.

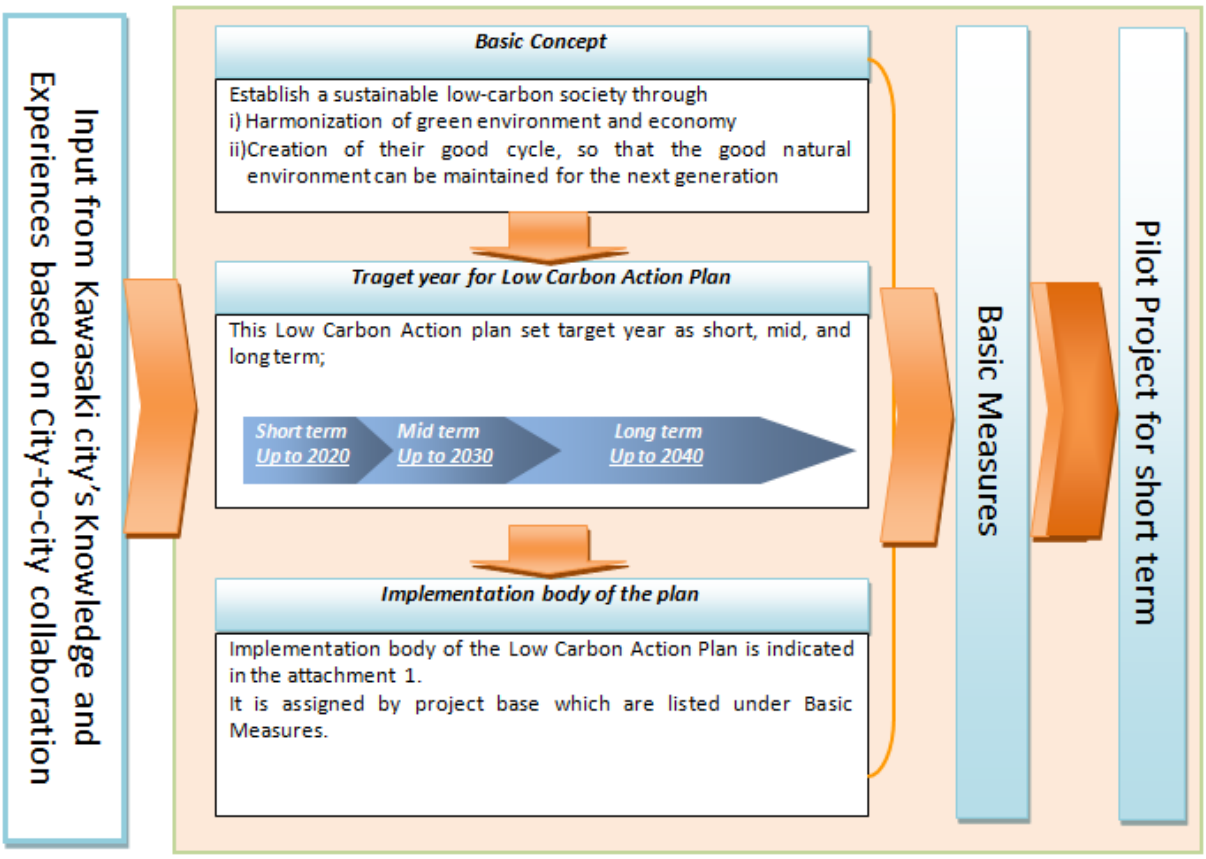


Source: study team

Figure 3-1 Setting of Low Carbon Action Plan

3.2.2 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	PP4: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.

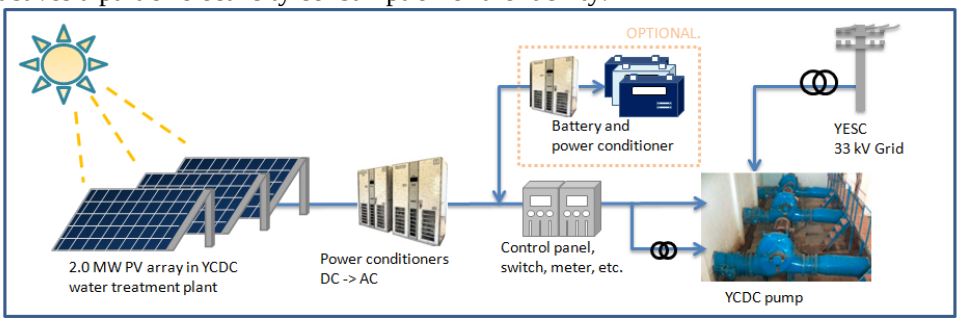
Source: study team

3.2.3 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

Project	**PP3:Introduction of high efficiency pumps into existing pumping station**	**FY2017 FS, planned to implement after 2018**
Target	Existing pumping station	
Implementation body	YCDC Water and Sanitation Department	
Project Summary	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

Item	Value
Location	Hlawga
Current Pump efficiency	80? % (tentative)
Pump efficiency	90?% (tentative)
Electricity consumption	11,038MWh/yr
Pump load	2.0-2.1 MW
Current monthly tariff	96mil MMK/m
Annual saving	128 mil MMK/yr
CO2 Reduction	ton/year

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

3.2.4 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.

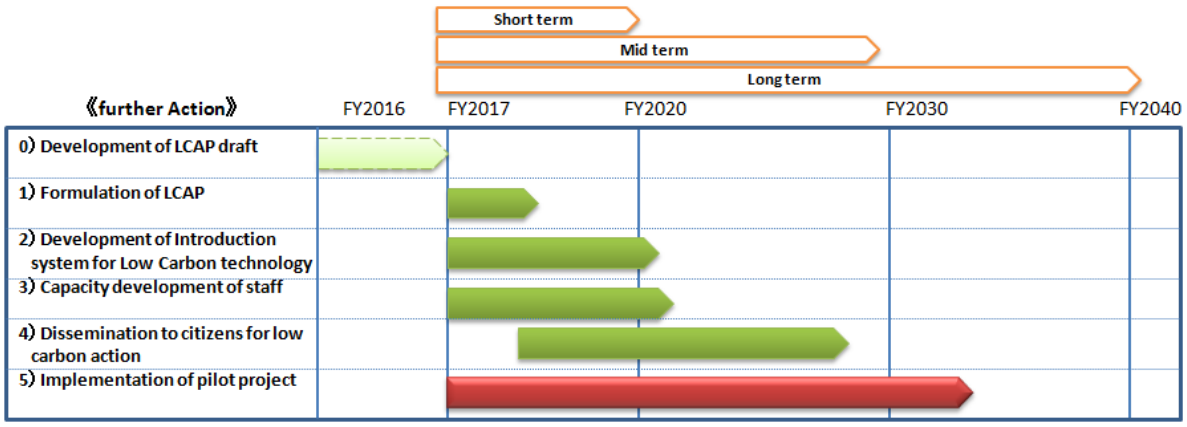


Figure 3-3 Schedule for Further Action

3.3 STUDY RESULT FOR CITY TO CITY COORPORATION

3.3.1 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

Content	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	・Meeting with YCDC（PCCD、CPLA、WSD）for low carbon action plan ・Conducting Boiler market survey
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 boiler suppliers ・Meeting with boiler project owner
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 factory which introduce boilers for collecting reference data ・Visiting JFE Waste incilation power plant
JCM workshop at Tokyo	January 22nd to 24th 2017	・Participation to JCM workshop at Tokyo

Source: study team

3.3.2 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 fi eld study, MOU revision was discussed among the both cities.

Kick off meeting between YCDC and Kawasaki city

Discussion at YCDC

3.3.3 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

3.3.4 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.

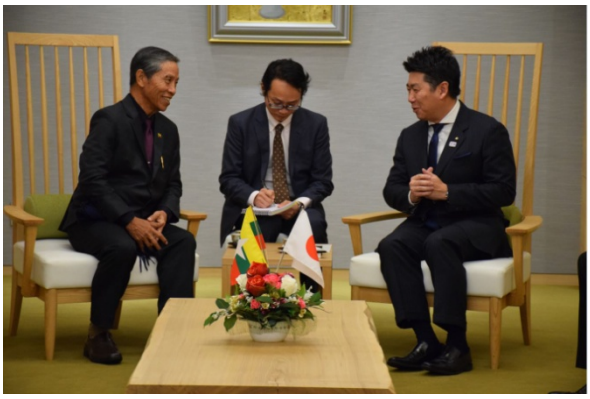
Presentation by Kawasaki city

Japan Pavilion

3.3.5 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 cooperation Kawasaki factory which has recycling technology of scrap cars and Takeei corperation 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

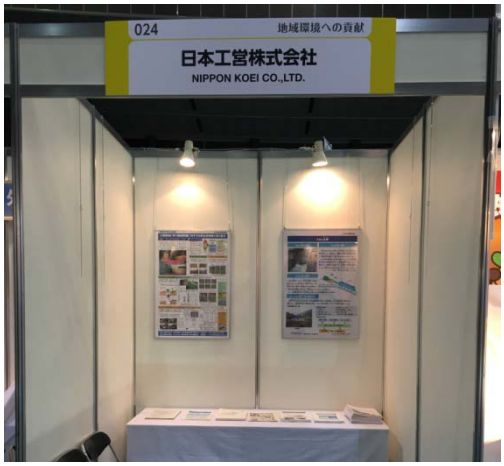
3.3.6 JCM seminar at Tokyo

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.

3.3.7 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 OUTLINES

JCM project formulation study was conducted in accordance with the city-to-city collaboration. Planning of JCM Model Project was conducted together with Japanese company who has interested in application of JCM Model Project scheme.

The project "Introduction of High-efficiency Once-through Boiler in Food Factory" was proposed for the JCM Model Project FY2016. The project aims for GHG emission reduction by introduction of high-efficiency once-through boiler in a food company newly established near Yangon in Myanmar.

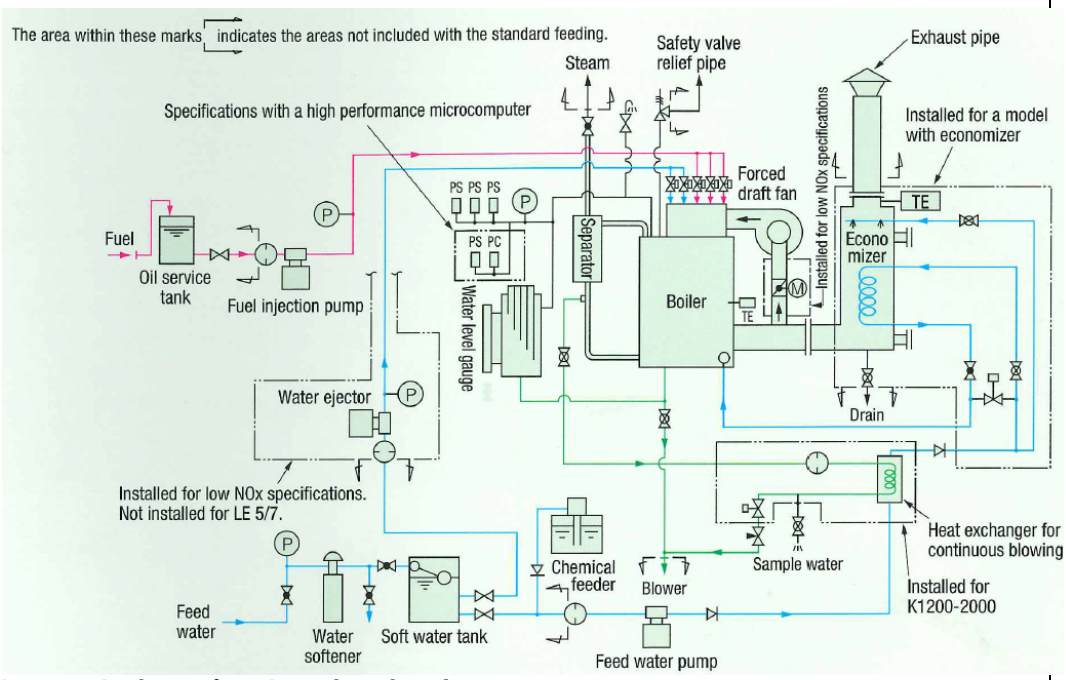
Rapid growth of energy demand in Myanmar is the background of the proposed project which applies low-carbon technique. IEA estimates the energy supply in Myanmar in 2010 was 14 MTOE (of which, fossil fuel was 2.8 MTOE). The energy demand will be increased to 35.2 MTPE in 2030 (of which, 22 MTOE is from fossil fuel). On the other hand, the production of natural gas, the main fossil fuel source in Myanmar, is decreasing due to depletion trend after peak out. Ministry of Energy recognizes that there is possibility of the energy crisis in around 2020, unless proper development is conducted.

Although energy import such as LNG and heavy oil is planned, those will be a significant burden on national budget by the outflow of foreign currency in the future. Accordingly, energy saving is the urgent issue in Myanmar. Energy Policy formulated in 2014 includes energy saving promotion as one of the main policy in Myanmar, and it encourages energy saving industrial technology such as boiler, kiln, and heat exchanger.

The introduction of high-efficiency once-through boiler is meaningful not only as the practical method for fuel saving but also as the model project for the dissemination of energy saving technology.

The outline of the proposed project is as shown in the table at next page.

Table 4-1 Outline of Proposed JCM Model Project

Project owner	Private food processing company
Project site	Food processing factory established in Thilawa Special Economic Zone (SEZ) in Myanmar
Outline of technology	The project owner has been constructing food factory in Thilawa SEZ near Yangon. The food factory will start its operation in 2017. By own investment, the factory will install high-efficiency once-through boilers and will achieve fuel reduction, energy saving, and reduction of GHG and air pollutant emission.
	 High-efficiency once-through boiler with monitoring system  Source: Catalogue of IHI Once Through Boilers **High-efficiency Once-through Boiler to be introduced in the Project**
Project Output	The high-efficiency once-through boiler installed in this project reduces GHG emission at 674ton-CO2/year. The proposed project would be applicable to similar industry such as food, paper and pulp, construction material, and cement factory, and would be the model of energy saving project in industry sector.

Source: The Study Team

4.2 METHOD FOR THE PROJECT FORMULATION

The formulation of JCM Model Project was conducted based on the following study method. Results of the study are also summarized in the same table.

Table 4-2 Study Method and Result of JCM Model Project Formulation

	Item	Study Method	Study Results
1	Confirmation of design and monitoring plan for the introduction of once-through boiler	- To confirm equipment specification and design, and to estimate of CO2 emission reduction - Study for equipment specification and monitoring system	- Specification of once-through boiler was determined and CO2 emission reduction amount was estimated based on efficiency difference from assumed reference boilers. - Type and requirement of monitoring equipment was studied and the project owner introduced flow meter, thermometer, steam pressure meter, and fuel meter.
2	Confirmation of necessary approval and license	- To confirm item and procedure of acquisition of necessary approval and license by referring with experience project	- Necessary approval and licenses were confirmed and obtained.
3	Modification of Initial Environmental Examination (IEE)	- To apply IEE modification about boiler type change to Thilawa SEZ Management Committee (TSEZMC).	- The project owner prepared application document about boiler type change under condition with JCM Model Project, which was submitted to TSEZMC. The change was approved.
4	Coordination of conditions for application of JCM Model Project	- To coordinate and prepare agreement necessary in JCM Model Project and to confirm guidelines for implementation of JCM Model Project	- Agreement on International Consortium was concluded and JCM Model Project was adopted.
5	Study for dissemination of once-through boiler	- To study project possibility in industrial zones in Yangon To study structure for the JCM Model project formulation	- Possibility of dissemination of once-through boiler in Myanmar was studied.
6	Study for technology of increase efficiency of once-through boiler	- To study technique to increase boiler energy saving such as fuel combustion efficiency improvement	- The applicability of nano-emulsion fuel technique to improve boiler fuel combustion efficiency was studied.
7	Promotion of once-through boiler in Myanmar and in Yangon	- Study for dissemination of energy saving technique in Low Carbon Action Plan - Support of YCDC for formulation of Low Carbon Action Plan	- Promotion of energy saving in industrial estate and pilot project for energy saving was incorporated in Low Carbon Action Plan

Source: The Study Team

4.3 STUDY RESULT

4.3.1 Applied Technology

In this JCM Model Project, once-through boiler which has high-efficiency and compact body is introduced in Myanmar. Boiler types are mainly categorized as water tube boiler and fire tube boiler. Once-through boiler is a type of the water tube boiler. The characteristics of each type of boiler is as follows:

(1) Water tube boiler

Water tube boiler consists of steam drum, water drum, and a number of water tubes. Water tube boiler is a type of boiler of which water circulates in water tubes. Fuel is burned inside the furnace, and combustion gases are heated, which heats water in the steam-generating tubes trough walls of the tubes. There are boilers from small capacity to large capacity in water tube boilers.

(2) Fire tube boiler

Fire tube boiler consists of furnace and a number of smoke tubes. Combustion gases heated by fire pass through tubes running through a sealed container of water. The heat of the combustion gases is transferred through the walls of the tubes to the water, and steam is generated from the water. Fire tube boiler applies from small capacity to middle capacity.

(3) Once-through boiler

Once-through boiler is a kind of water tube boiler in which water flows, without recirculation, sequentially through the economizer, and evaporating and heating tubes. The capacity is rather small, up to 6 ton/h. The boiler has high efficiency and requires high-level control.

The applied technology of the project is once-through boiler, which has not yet generally disseminated in Myanmar. Once-through boiler is mainly manufactured in Japan.

As the reference scenario to calculate CO2 emission reduction, the efficiency of conventional fire tube boiler and water tube boiler generally supplied in Myanmar will be referred in the methodology.

The advanced performance of small once-through boiler is summarized in the table below. The technique is one of the leading energy saving measure in Japan. The equipment is compact and occupies only small areas. By quantity control system, high-efficiency operation is possible even at low load range.

The small once-through boiler has low-pollution aspect. It has not only high energy saving aspect but also low emission of air pollutant such as NOx, which is accounted as co-benefit. It is meaningful to conduct the project as co-benefit model project in Yangon, where air pollution is concerned.

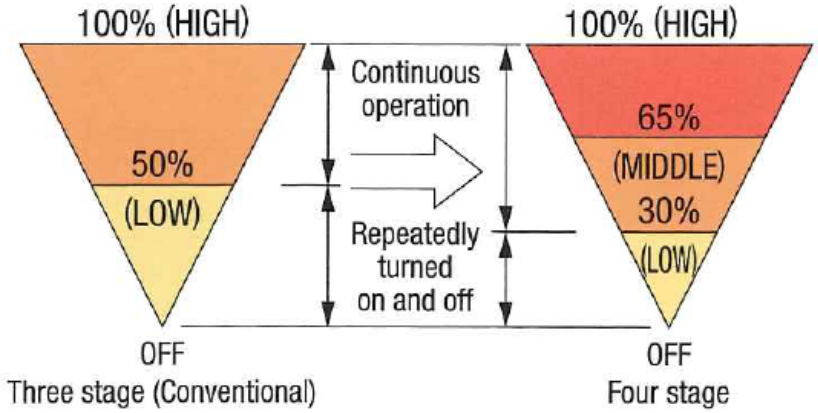
The introduction of small once-through boiler will contribute to the fossil fuel reduction, CO2 emission reduction, and mitigation of air pollution.

Table 4-3 Technical Advantages of the Project Boiler

Technical Advantages	Description
Rapid starting, high response to load variation, and high-level control	With steam generation in a tube, rapid starting is possible and the system is high load responsive. High-level control is conducted to provide stable steam amount and steam temperature.
Prevention of heat loss at the time of low load and starting and stop, by a four stage control and high-efficiency operation at low load	The four stage control enables to response to the load variation (100%, 60%, 25%、0% load). High efficiency operation is possible at wide r heat load ranges. Low-pollution and high-efficiency is achieved and the efficiency is as high as 94%.
Recovery of exhausted combustion gas by economizer	The remaining heat of exhaust combustion gas is recovered by Economizer, which provides heat to pressured water by the residual heat. This economizer system improves the boiler energy efficiency.
Low NOx Emission	Low NOx emission burner, which has low-pollution aspect

Source: The Study Team

The rated efficiency of the project boiler is high as much as 94%, which is the most important characteristics of the JCM project. In addition to this, energy- efficiency operation by four stage control enables further efficiency improvement in wide load ranges.

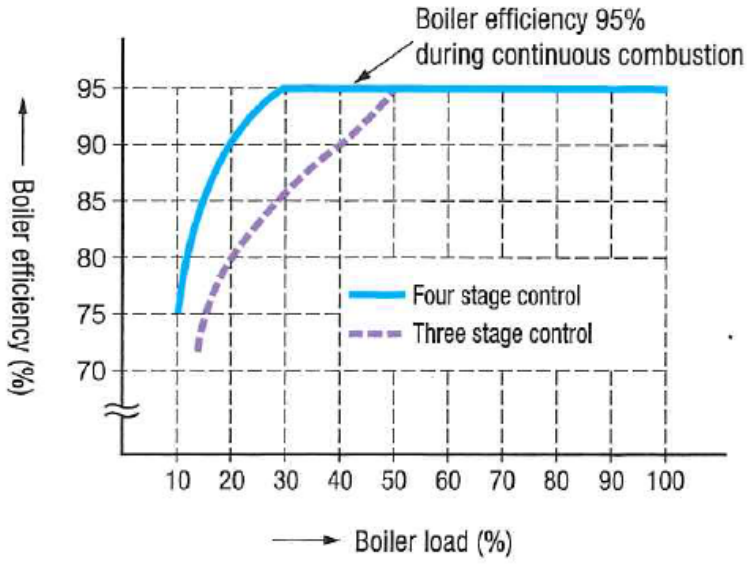


Source: Catalogue of IHI Once Through Boilers

Figure 4-1 Concept of Four Stage Control

Compared to conventional three stage control, new four stage control has advantage especially keeping high efficiency even at the low load rage (25-50%) operation, as shown in the figure above. In addition, the boiler system with this four stage control has following additional advantages:

- Small noise
- Stable and safe operation
- Long boiler life



Boiler efficiency for each load
(When equipped with economizer)

Source: Brochure of IHI Once Through Boilers

Figure 4-2 Comparison of Conventional Three Stage Control and New Four Stage Control

The mail specification items of the boiler to be installed in JCM Model Project are as shown in the table below.

Table 4-4 Main Specification Items of Boiler

Item	Specification
Type	Multi-tube small once-through boiler
Thermal Output	1,254 kW
Equivalent evaporation	2,000 kg/h ×6 units
Max. pressure	1.57 MPaG
Working pressure	0.9-1.4 MPaG
Control method	Electrical four stages control, electrical On-Off
Facility power	9 kW/unit
Fuel	Diesel oil
Boiler efficiency	94% (steam pressure 1.2 MPaG, feed water temperature 15 degree-C, feed air temperature degree-C)

Source: Prepared by the Study Team referring to IHI Catalogue

4.3.2 Monitoring Plan

For the estimation of CO2 emission reduction amount, it is necessary to measure fuel consumption and efficiency of the project boiler in the monitoring.

Monitoring equipment which compiles international/regional standard was selected for conducting monitoring in the project. Following measuring tools were selected in the project for monitoring.

- Flow meter for feed water
- Thermometer for feed water

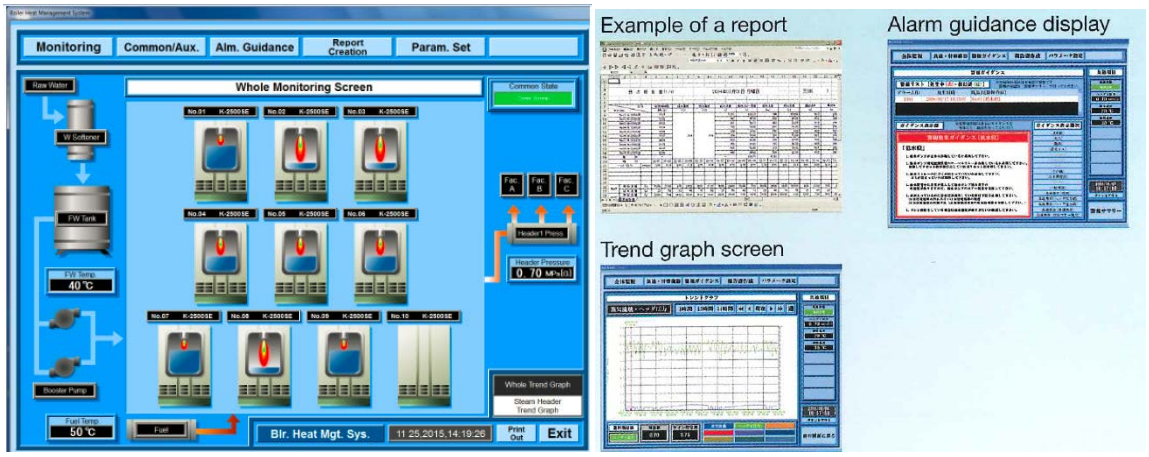
- Steam pressure meter
- Fuel meter

Considering methodology to be prepared in the future, requirement of the measuring equipment was proposed to be as follows.

- Meter is certified in compliance with national / regional / international standards
- Measured data is automatically sent to a server where data is recorded and stored.
- Recorded data is checked its integrity once a month by responsible staff.
- In case a calibration certificate issued by an entity accredited under national/international standards is not provided, such measuring equipment is required to be calibrated, or guarantee certificate is issued by the manufacturer

Boiler management system will be installed together with once-through boiler to assist monitoring. With the data obtained in the measuring tools, steam amount and boiler efficiency will be calculated in the boiler management system. The boiler management system has following function.

- Quantity control
- Calculation of data for heat management (Efficiency, load, fuel amount, feed water amount, steam amount, etc.)
- Management of maintenance data and fault recording
- Energy saving operation at low load range

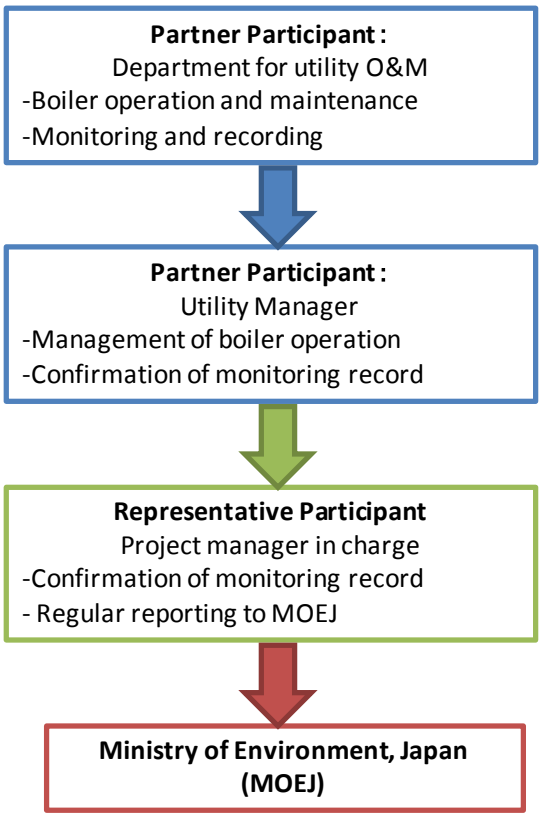


Source: IHI

Figure 4-3 Example of Display of Boiler Management System

The monitoring will be conducted by the partner participant as the daily operation works. A local company assinged by the boiler manufacturer will support monitoring as necessary.

The monitoring implemenation structure is as shown in the figure below. The recorded data in the boiler operation and maintenance will be sent from Partner Participant to Representative Participant and will be used for reporting to Ministry of Environment, Japan.



Source: Prepared by the Study Team

Figure 4-4 Monitoring Structure

4.3.3 Confirmation of Necessary Approvals and IEE Update

It is necessary for adoption of JCM Model Project applicant to clear necessary approval matters in Myanmar. The required approval items and environmental clearance for the Project are as summarized in the table below.

Table 4-5 Required Approval Matters and Study Result

Items	Result of Study
Approval for investment and construction	The factory is constructed in Thilawa Special Economic Zone (SEZ). The One-stop Service Centre of Thilawa SEZ Management Committee (TSEZMC) consolidates the management of necessary approvals. Necessary approvals for the investment and construction of the factory were obtained at the One-stop Service Centre.
Application of boiler type change in the existing IEE approval	The approved IEE for construction of factory was conducted based on coal boiler installation. IEE modification for boiler fuel type from coal boiler to once-through boiler using diesel oil was applied and approved in August 2016.
Inspection for boiler installation	For safety confirmation, inspection by Ministry of Industry is necessary for boiler installation. At the time of boiler installation, the Project is planned to obtain approval from Ministry of Industry.

Source: The Study Team

(1) Necessary approval for factory construction

The project facility is installed in a food factory in Special Economic Zone (SEZ). The one-stop service centre integrates the management of necessary approval matter. The approvals required in the factory construction are as follows.

- Reservation Agreement, Sub-lease Agreement
- Investment Approval
- Design Approval of Building Construction
- Fire Safety Certificate
- Building Certificate
- Environmental Conservation and Prevention Plan (ECPP), Initial Environmental Examination (IEE)

Flow for necessary approval matter is shown in the figure below.

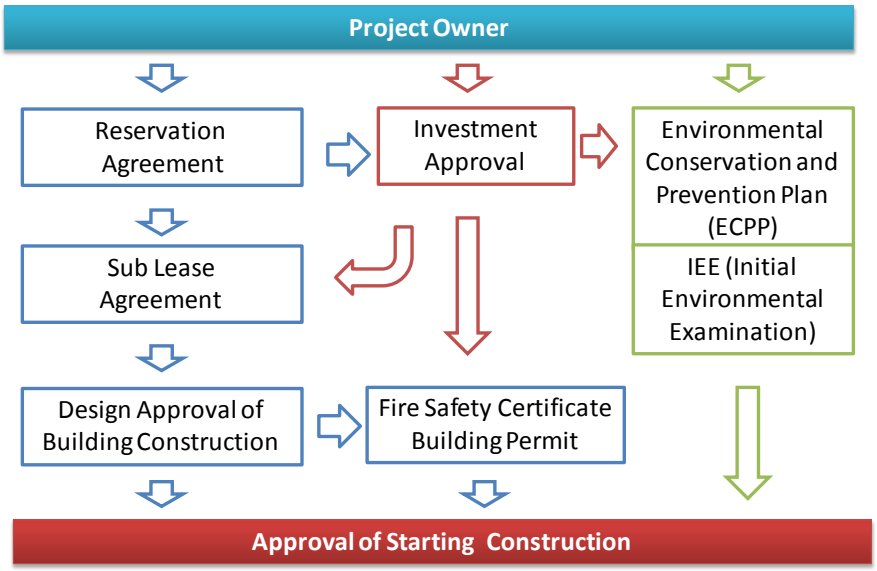


Figure 4-5 Approval Flow of Factory Construction

The representative participant conducted above approval procedure and obtained necessary approvals for construction.

(2) Environmental Clearance

The Initial Environmental Examination (IEE) was necessary to establish new factory in which the JCM project is implemented. IEE clearance was obtained at the time of construction planning of new factory. Meanwhile, the IEE was applied with assuming the condition that coal boiler would be installed. Under the JCM Model Project, the coal boiler plan was changed to install once-through boiler with oil. Thus, modification of IEE was necessary.

The application about changing boiler type to once-through boiler with oil was submitted in August 2016. The application was approved without any issue since the JCM project boiler will have smaller environmental affect than original coal boiler.

(3) Approval of boiler installation

For the installation of boiler, inspection of Ministry of Industry is necessary for checking safety condition. The project owner is required to submit specification sheet and catalogue of installed boiler. It requires 2-3 weeks for boiler license registration after the inspection. In this project too, it is necessary to obtain approval from Ministry of Industry.

In addition, the installed boilers are necessary to have checked every year by Ministry of Industry. It is possible to include the annual inspection of Ministry of Industry in a regular maintenance contract of the boiler maintenance company.

4.3.4 Coordination for International Consortium for Application of JCM Model Project

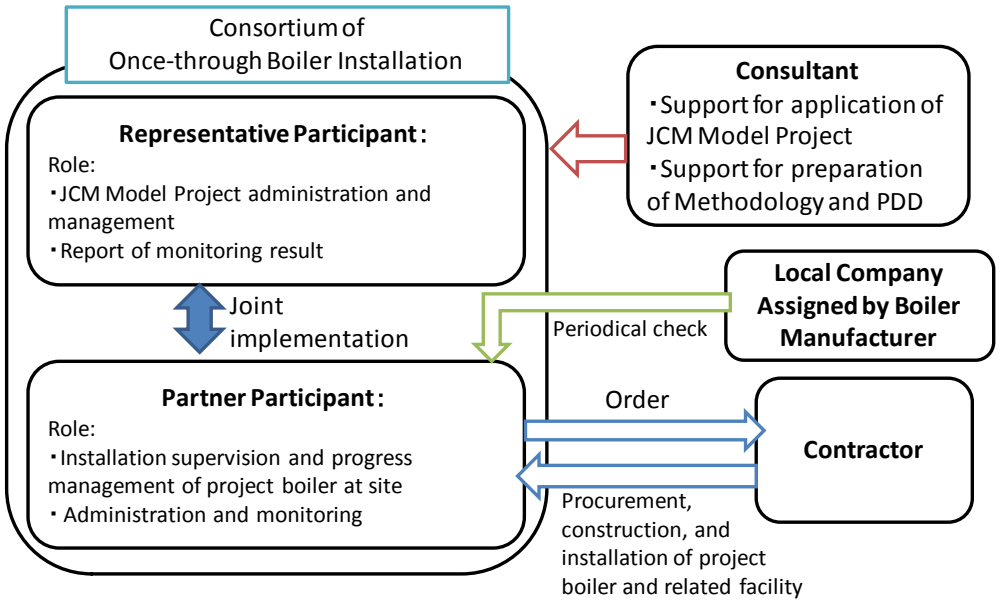
It is necessary to establish International Consortium for application of JCM Model Project. The outline of International Consortium is as shown in the table below.

Table 4-6 Study Items for Project Implementation Structure

Item	Description
Selection of representative participant of International consortium	Representative Participant is necessary to select for the application of JCM Model Project. Japanese company who invested the factory construction became the Representative Participant
Selection of local contractor	Myanmar local construction company does not have experience for equipment installation. Meanwhile, selection of the contractor is one of the key for successful project implementation. The contructor with plenty of equipment procurement and installation experiences was selected.

Source: The Study Team

Based on the items above, the project implementation structure is as shown in the figure below. The application of JCM Model Project was successfully adapted in September 2016.



Source: The Study Team

Figure 4-6 JCM Model Project Implementation Structure

As the project implementation structure, Representative Participant is the Japanese company who invest the establishment of the factory. The Partner Participant is the local company established at the site. The equipment procurement is conducted at site by the experienced contractor.

The roles and responsibilities are summarized in the table below.

Table 4-7 Party and Roles and Responsibility

Party	Roles and Responsibility
Representative Participant Japanese food company	- Planning of introduction of once-through boiler (Applied technology, cost estimation, and design) - Application for JCM Model Project - Supervision and management of the JCM Model Project
Local Participant Local food factory	- Project implementation - Management and monitoring of the Project
Contractor Japanese construction company	- Boiler equipment procurement and delivery - Equipment installation

Source: The Study Team

The implementation schedule of JCM Model Project is as shown in the table below.

The Project was adapted in September in 2016. The construction of boiler house was started. The boiler body will be installed in February 2017, after the inspection of Ministry of Industry.

Table 4-8 Schedule of JCM Model Project Implementation (Plan)

Item	2016								2017												2018		
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
JCM Model Project		★un-official adoption			★Adoption				Completion ★														
Civil works																							
Boiler house construction																							
Auxiliary facility installation																							
Equipment manufacture and transportation																							
Equipment installation																							
Boiler body																							
Pipe works																							
Electrical works																							
Commissioning test																							
Operation and maintenance																							
IEE modification																							
MRV																							
Methodology preparation															★								
Validation and project registration																			★				
Verification and credit issue																						★	
Delivery of credit to Government of Japan																							★

Source: The Study Team

4.3.5 Study for Dissemination of Once-through Boiler

New boilers are not manufacture red in Myanmar. The market condition of boiler in Myanmar is as follows.

- Boilers are imported from abroad such as India, Thailand, China, and Taiwan
- Most of the boiler type introduced in Myanmar is fire tube. Some are water tube boilers. Second hand once-through boilers are also sold.
- There are approximately 10 boiler suppliers in Myanmar. Most of the supplier sales out imported second-hand boiler without after service. According to main supplier, about file supplier can cover maintenance contract.
- Efficiency of boiler is not highly counted in Myanmar. Meanwhile, initial investment cost is considered to be the most significant.
- According to boiler supplier, about 600 boilers are estimated to be installed in Myanmar. Annual sales of boilers are considered to be 40-50 units, which will be different year by year.
- Expect biomass, the main fuel of boiler is coal. Local company will select coal due to its low cost. Meanwhile, in Yangon and city areas, there are oppositions for coal fuel in terms of environmental affect, and diesel oil is mainly selected as fuel. Small number of LPG boiler is also applied in downtown area where available land area is quite limited. Boilers using natural gas are hardly installed in Myanmar since distribution of natural gas to industry sector is quite limited and natural gas can only be used in government enterprise.
- It is roughly assumed that approximately 60% of boilers use coal, and remaining 40% applies diesel oil. There are only few number of gas boilers.

As in the information above, users have little understanding about benefit of energy saving, and high initial investment is the apparent hurdle for installation of high-efficiency equipment. Especially, under the condition that the interest rate in banks is expensive, lower investment cost is highly desired in Myanmar. In this boiler market situation, subsidy of JCM Model Project would be effective to support introduction of high-efficiency large-investment equipment.

The possibility of dissemination of once-through boiler installation as JCM Model Project was studied. As the result, two projects of once-through boiler installation were found near Yangon. However, those projects have smaller scale than the project adopted in FY2016, and it is considered not meeting with JCM Model Project.

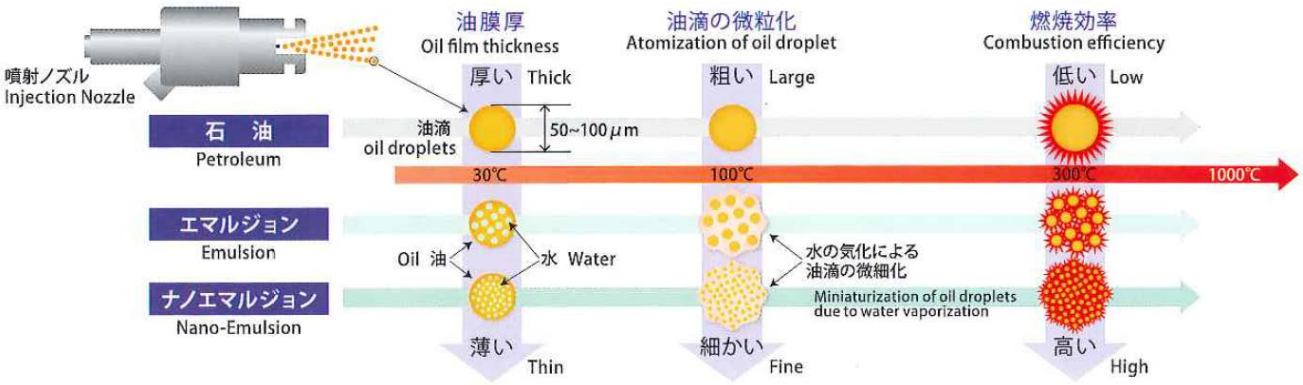
Table 4-9 Possible Dissemination of JCM Model Projects

Item	Outlines	Result
Introduction of once-through boiler in beverage factory	The project plans to install high-efficiency once-through boiler in a new beverage factory to be established in SEZ near Yangon. The equivalent evaporation is 6 ton/h.	When required average equivalent evaporation is 4.0 ton/h, the annual emission reduction amount is calculated to be as follows: - In case 24 hours/day, 296 days/year operation, the annual emission reduction will be 632 tCO2/year. - In case 12 hours/day, 296 days/year operation, the annual emission reduction will be 316 tCO2/year.
Introduction of once-through boiler in food and beverage factory	This project plans to install 2 units of 2 ton/h once-through boiler in food and beverage factory in Shwe-Pyi-Thar industrial estate near Yangon	Assuming average equivalent evaporation is 3.0 ton/h and 8 hours/day operation, the annual emission reduction amount is estimated to be 158 tCO2/year. This scale was found to be too small to apply JCM Model Project.

Source: The Study Team

4.3.6 Study for technology of increase efficiency of once-through boiler

Nanofuel Co., Ltd., one of the member companies of Kawasaki Green Innovation Cluster, has the technique of equipment for fuel combustion efficiency improvement. The technique changes the fuel to nano-particle and forms nano-size emulsion, which improves combustion efficiency of the fuel.
The water particles are homogeneously dispersed in oil droplets, and enlarge surface areas of oil drops. By this, the combustion efficiency is increased. In addition, air pollution is reduced since the combustion is conducted more perfectly and the less pollutant due to imperfect combustion will be produced.



Source: Catalogue of Nanofuel Co., Ltd.

Figure 4-7 Combustion Mechanism of Nano-Emulsion Fuel and its Advantages

Research and development for fuel condition improvement by emulsion fuel has been conducted from the past. The advantages of conventional emulsion fuel is considered to be small since (i) combustion becomes unstable due to insufficient and heterogeneous microparticulation of oil drops and (ii) large amount of additives are necessary, which increases cost.

Meanwhile, the above nano-emulsion fuel has advantages in fuel stability. In addition, the cost is lower than conventional emulsion fuel due to small requirement of additives (only 1/10 additives is required compared with conventional system) and high fuel saving effect. Furthermore, the equipment does not require boiler replacement. Large initial investment is not necessary.

Approx 40% of the diesel oil demand is from the industrial sector in Myanmar. All of the boilers installed in factories and commercial facilities in Myanmar can be the target of planning of this fuel saving technique.

In Japan, the technology was installed in approximately ten demonstration and commercial projects for application in boilers and kiln burners. Not only boilers, application to diesel engine for ships and generation has also been studied, and six manufactures in Japan and other countries have been conducting demonstrations, including in isolated island and large ocean vessel.
In the experiences above, the fuel efficiency improvements, which are equivalent to the amount of fuel reduction, were 5.4%-18%, which is varied by equipment condition and function.

When this technique is applied to the adopted JCM Model Project, additional CO2 emission reduction amount is 318 tCO2/year (original emission reduction is 674 tCO2/year), with assuming 5% of fuel reduction, which is the most conservative value.

Meanwhile, the fuel reduction effect is depending on equipment condition. It requires sorting out the reference condition with long-term with/without test for quantifying the affect of fuel reduction. Accordingly, this technique was not applied the JCM Model Project.

4.3.7 Promotion of Once-through Boiler in Myanmar and in Yangon

Compact once-through boiler is one of Japanese particular technology. Fire tube boilers and water tube boilers, of which efficiency is 80-89%, are sold in Myanmar. However, there is few example of installation of high-efficiency compact once-through boiler in Myanmar. Thus, this project will be a model of installation of high-efficiency energy-saving once-through boiler.

In Thilawa SEZ, Japanese ODA developed 400 ha of the area, which will be expanded to be 2,400 ha. The number of Japanese and other companies developed the business in the SEZ has been more than 50, and it is expected to be more than 100 companies in next five years.

In addition, there are 20 industrial estates in Yangon.

As the promotion method of once-through boiler, YCDC Low Carbon Action Plan settled the energy-saving equipment installation as its pilot project. The energy saving measurement by the installation of once-through boiler is introduced in the Action Plan to disseminate the technique ain other companies in Thilawa SEZ and 20 industrial estates in Yangon. It is considered that the dissemination of high-efficiency technique is effective in SEZ and industrial estate by sharing the experiences and information.

As described in Chapter 3.2, the high-efficiency once-through boiler project is incorporated as the pilot project in the YCDC Low Carbon Action Plan, as shown in the figure below. It promotes application of energy saving technique such as once-through boiler and high-efficiency chillier system in private factory and commercial facility.

Pilot Project for Short Term for Low Carbon Action Plan of YCDC

PP-04: Promotion of High Efficiency Equipment for Industrial Sector in Yangon

High-efficiency compressor for refrigerator

- Cascade system of high-efficiency reciprocating refrigerators can reduce electricity consumption and CO2 emission
- 28% electricity reduction

Item	Value
Location	Industrial estate, factory, etc.
Efficiency	COP4.3, compressor 95%
Capacity	Compressor 1401+1039kW Condenser 1650 kW x 2
Annual saving	1.8-3.2 GWh/year (0.18-0.32 mil US$/yr)
CO2 Reduction	1029 ton/year

High-efficiency once-through boiler with monitoring system

- High-efficiency once-through oil boiler reduce fossil fuel and CO2 emission
- Co-benefit of reduction of air pollutant
- 9.6% fuel reduction

Item	Value
Location	Industrial estate, factory, etc.
Efficiency	94%
Capacity	2 ton/h x 6 nos
Annual fuel saving	257 kL/yr, 0.14 mil US$/yr
CO2 Reduction	674 ton/year

Source: The Study Team

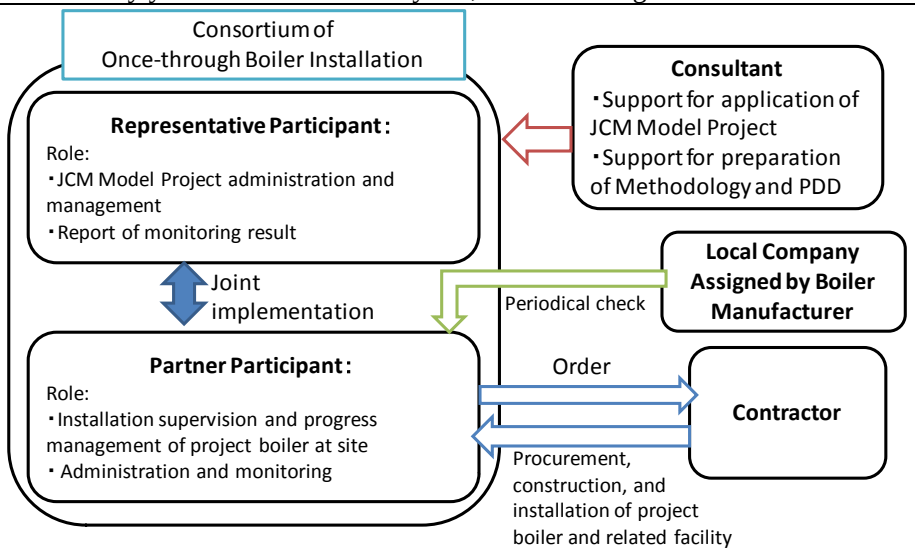
Figure 4-8 Example of Model Project Introduction as the Pilot Project of Low Carbon Action Plan

4.4 PREPARATION OF JCM MODEL OROJECT

4.4.1 Project Outlines

Following table summarizes the details of JCM Model Project which was formulated and applied in FY2016.

Table 4-10 Outline of JCM Model Project

Project owner	Local company of Japanese food processing company
Project summary	New food processing factory is under construction in Thilawa SEZ, near Yangon in Myanmar. The newly established factory once planned to install coal boiler. However, with application of the scheme of JCM Model project, oil fired compact high-efficiency once-through boiler is installed to contribute emission reduction of pollutant and CO2.
Technology	High-efficiency compact once-through boiler with quantity control
Financial plan	The initial investment is covered by Japanese food company 100%. The recovery year is more than three years, which meets guideline of JCM
Implementation Structure	
Assumed CO2 emission reduction	674 t-CO2/year (Average 12.8 hours/day operation is assumed. In case the operation is 24 hours/day, the emission reduction will be 1,264 t-CO2).

Photos of the project site are shown below.

Overview of Food Factory introduced Once-through boiler

Boiler House

CHAPTER 5 ISSUES AND FURTHER ACTION

5.1 ISSUES AND FURTHER ACTION

Issues and further actions for the study are 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) Dissemination for introduction of high efficiency boiler into factories and commercial facilities

Currently, there are many ongoing project and plans for development of factory and commercial facility in Yangon. Those facilities have needs for boilers. In turn, it is difficult to prepare coals as fuels of boilers as well as gases. In this situation, boiler fuel would tend to be oil, so it is necessary to disseminate oil boiler considering the current trend.