MOEJ

# Final Report

## Support for Low Carbon Promoting Projects through Intercity Cooperation between Osaka and Quezon (Promoting energy saving and renewable energy technologies)

February 2018

Oriental Consultants Co., Ltd.

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## Chapter 1 Outline of the Survey

### 1.1 Background of the Survey

The Government of the Philippines has been formulating the National Climate Change Framework Strategy (NFSCC) since 2010, in order to build adaptive capacity for responding to climate change and optimize climate change mitigation activities for sustainable development by 2022. Renewable energy is positioned as a pillar of of mitigation measures in the NFSCC and the cross-sectional strategies are as follows: 1) capacity development, 2) knowledge management and information, education and communication, 3) research and development (RD) and technology transfer, for determining the three strategies. In 2011, in order to materialize an action program based on national strategy, the National Climate Change Action Plan (NCCAP) was formulated. The need for strengthening sustainable energy development is stated. In addition, a reduction of greater than 70% of the BAU scenario of waste Green House Gas (GHG) emissions (CO2e) by 2030 (from 2000-2030) in the sectors of energy, transportation, waste, forestry, and industry, is stated as a mitigation objective in the Philippines' Intended Nationally Determined Contribution (INDC).

Under these circumstances, a bilateral document on the Joint Crediting Mechanism (JCM) was signed by Mr. Kazuhide Ishikawa Ambassador of the Philippines and Regina Lopez Environment Minister of Natural Resources during the Japan-Philippines Summit meeting between Japanese Prime Minister Shinzo Abe and Philippine President Duterte.

JCM quantitatively assesses Japan's contribution to reduction and absorption of greenhouse gas emissions realized through dissemination of greenhouse gas reduction technology, products, systems, services, and infrastructure to developing countries and implementing countermeasures, It is used to achieve Japan's reduction targets. In the overview of the bilateral documents, the following points are listed:

1) the establishment of JCM projects between the two countries to promote their collaborative efforts to promote low-carbon growth in the Philippines. For the operation of the JCM projects, they established a joint committee; 2) each country understands each country can claim a portion of the green house gas emissions reduced through the JCM project for when they express their climate change mitigation efforts internationally.

In the Philippines, Quezon City has the largest area in Metro Manila and has a population of over 2,680,000 people. As the population increases, issues such as waste, energy, transportation and urban greening are getting worse. The introduction and promotion of renewable energy and energy conservation technologies are positioned as major mitigation measures of the city. Quezon City is currently preparing a climate change countermeasure action plan and are looking to improve the capacity for developing and implementing the plan.

On behalf of their country, Osaka City, which has an exchange relationship with the city, has formulated the Osaka City Global Warming Countermeasure Action Plan to achieve the Japanese greenhouse gas reduction targets and contribute to international efforts to fight global warming. Based on this action plan, they are promoting the utilization of renewable energy (such as the introduction of solar power generation).

Osaka City also contributes to the formulation of a low-carbon society in the city of Ho Chi Minh, Vietnam, through the formulation of Ho Chi Minh City Municipal Climate Change Implementation Plan (2016 - 2020) as well as JCM project formulation.

It is against this background that Osaka City and Quezon City promote the formation of a low carbon society. To strengthen the cooperative relationship between the two cities, Osaka is supporting the formulation of Quezon City Climate Change Action Plan and the formulation of JCM projects.

### 1.2 Purpose of the Survey

The following three activities will institutionally and systematically support the large-scale expansion of JCM projects and support the development of Quezon into a low-carbon society

1. Support of the climate change action plan

· Confirmation of the current status of climate change measures, implementation systems, and future policy.
· Osaka City will support human resources development and find appropriate projects based on the needs of Quezon City.

2. Formulation of JCM Proposal Promotional Handbook for solar power and factory energy-saving.
3. Formulation of solar power and factory energy-saving JCM projects.

### 1.3 Survey Implementation Structure
#### 1.3.1 Outline of Implementation Structure

The survey is operated as follows: Oriental Consultants serve as the representative implementers, with Osaka City and Quezon City Government-Environmental Protection & Waste Management Department (EPWMD) serving as co-implementers.

Feasibility study on solar power and energy conservation is carried out with private enterprises in the table below, mainly based on team Osaka, and in the case of visiting Japan, under the cooperation of the Institute for Global Environmental Strategies (IGES). Capacity building of AIM related to analysis method was implemented.

The following diagram shows the implementation structure of this project while the following table shows the role of the joint proposal.

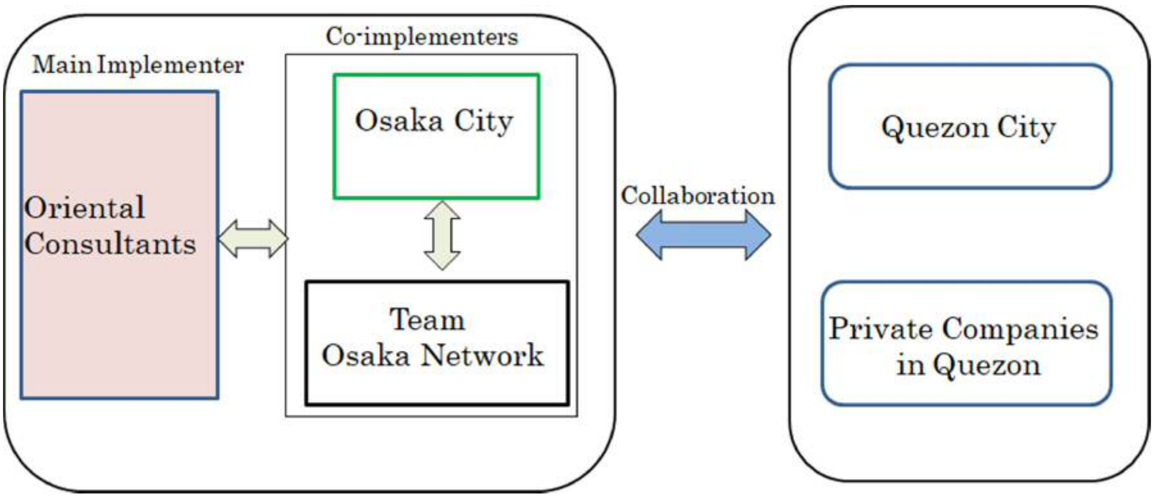


Figure 1: Survey Implementation Structure

Table 1: Roles of Participants

| Role | Co-implementers | Tasks |
|---|---|---|
| Main implementer | Oriental Consultants Co., Ltd. | Coordination with Japan and Philippines. Commercialization business,models, responsible for MRV planning,results reporting, etc. |
| Energy-saving auditing | Japan Textile Consultants Center | Technical advice pertaining to energy saving equipment factory, etc. Implementation of energy conservation diagnosis. |
| Introduction of boilers | Nippon Thermoener Co., Ltd. | Technical advice relating to boiler installation. |

| | | |
|---|---|---|
| Introduction of heat exchangers | Kurose Chemical Equipment Co.,Ltd | Technical advice of the spiral heat exchanger. |
| JCM implementation advice | Yuko Keiso Co., Ltd. | Advice pertaining to the JCM implementation. |
| Advice on financing | Resona Bank, Limited | Provide advice on loans and other financial services when shifting to JCM demonstration project etc. |
| Introduction of solar power generation facilities | Sharp Co., Ltd. | Provide technical advice on introduction to solar Photovoltanic |
| Solar-power generation equipment (power conditioner) | Daihen Corporation. | Provide technical advice on power conditioner. |

### 1.3.2 Team OSAKA Network

Team OSAKA network facilitates the collaboration of enterprises with environmental technologies in the Kansai Region and the municipal government, Global Environment Centre Foundation (GEC) and universities for the purpose of formulating projects aimed at building low-carbon societies in different cities of Asia. Through the activities of this network, Team OSAKA Network aims to expand businesses overseas, revitalize the economy of the Kansai area, and contribute to the role of Japan in the international environmental field. For the purpose of this survey, Team OSAKA Network shared information related to JCM projects in Quezon and their expansion.

## Chapter 2 Support for Quezon City's Local Climate Change Action Plan

### 2.1 Overview of Quezon City

Quezon City is the most populous and largest city in Manila Metropolitan area. The city is actively working with business in the environmental field. In 2008, Quezon City received the Galing Pook award (an award for excellent governance in the Philippines) for their efforts to rehabilitate the Payatas dumpsite. This was the first GHG reduction project at a waste disposal site in South Asia. In 2009, Quezon City was again awarded this honor for developing the nation's largest parks management and development program.

The average monthly power consumption in Quezon City is 294,069 MWh, with 134,737 MWh of this total being consumed by the commercial sector, 109,673 MWh being consumed by private residences, and 47,442 MWh being consumed by the industrial sector. The proportion of the commercial sector is about 46%; annually an average of 10,686 new enterprises entered Quezon between 2006 and 2009, which totaled at 10,686 enterprises.


Figure 2: Map of Quezon

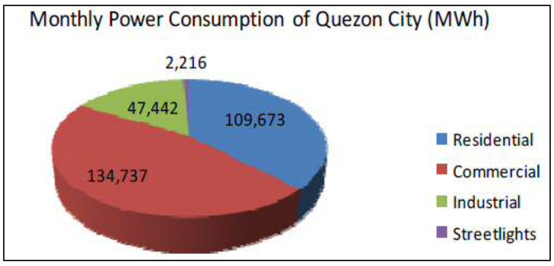


Figure 3: Power Consumption Structure

(Source: Study on Carbon Governance at Sub-national Level in the Philippines)

### 2.2 Quezon City Environmental Protection and Waste Management Bureau (EPWMD)

Quezon City Environmental Protection and Waste Management Bureau (EPWMD) was founded in 2000 to improve health and the environment, prevent environmental pollution, and increase efficient waste transport. The department is responsible for formulating a comprehensive environmental protection program including collection services.

The planning department of EPWMD is responsible for formulating the GHG inventory for Quezon City, and is receiving support for capacity building to formulate this inventory under the 'Climate Change/Clean Energy Project' of USAID. They are also participating in ICLEI 's capacity building program for the use of HEAT+ software related to reporting and management related to GHG (however, it takes time to analyze necessary data, so this program is not actually being used). In addition to the core team mentioned above, the Environmental Protection Council Technical Working Group composed of representatives of each department has been established for data collection and analysis. The group is divided into 1) buildings, 2) street lights, 3) automobiles, and 4) waste, and data quality control and analysis are handled by technical staff at EPWMD using Excel.

### 2.3 Efforts toward Climate Change Issues in Quezon City

#### 2.3.1 Quezon City Local Climate Change Action Plan (QC-LCCAP)

Quezon City has formulated Quezon City Local Climate Change Action Plan 2017-2027 as a key to measure against climate change, and seven priority areas were selected based on the National Climate Change Action Plan. The outline is as follows.

Table 2: Overview of Quezon City Local Climate Change Action Plan

| Effects / events due to climate change | Response to climate change | Purpose |
|---|---|---|
| ·Frequent occurrence and severity of abnormal weather (typhoon, storm surge, flood, heavy rain)<br>·Change in precipitation pattern<br>·Temperature rise | 1.Food safety | · In order to adapt to climate change, improve knowledge on food preservation and food safety<br>· Improve use, supply stability, and accessibility of safe and healthy food |
| | 2. Stable supply of water | · Sustainable, safe, adequate supply of water<br>· Evaluation of water management<br>· Improvement of sanitation infrastructure |
| | 3. Ecological and environmental stability | · Development of adaptive capacity of local governments and communities<br>· Improvement of the capacity of organizations and individuals to promote healthy/safe city life |
| | 4. Human rights | · Protection from danger due to climate change (such as health damage and social security)<br>· Promotion of construction of homes and services for climate change adaptation<br>· Construction of adaptive capacity of local governments and communities |
| | 5. Smart Industry service that contributes to climate issues | · Promotion of development of infrastructure with strong climate change tolerance in Quezon City.<br>· Implementation of environmentally friendly solid waste management for mitigation and adaptation of climate change<br>· Setting the scope of greenhouse gas emissions |
| | 6. Sustainable energy | · Use of sustainable, renewable energy and energy-saving technologies (main components of sustainable development)<br>· Promotion, repair, and improvement of use of |

| | | |
|---|---|---|
| | | energy systems and infrastructures affected by climate change |
| | 7. Improvement of knowledge and ability | · Improvement of scientific knowledge on climate change<br>· Adaptation/mitigation of climate change at local and community level<br>· Improvement of skill relating to mitigation of disaster risk<br>· Establishment of system related to gender and climate change, in order to educate Quezon City residents<br>· Establishment of climate change countermeasure network sharing good practices and other resources |

Quezon City is proceeding with the plan shown above by proceeding with various projects, the specifics of which follow.

### 2.3.2 Efforts on Solar Power Generation

Quezon City confirmed in the GHG inventory of 2010 that power consumption is a major GHG emissions sources. For this reason, the utilization of solar power generation instead of electric power to reduce energy cost and GHG emissions is under consideration. In QC-LCCAP renewable energy was adopted as a priority item. Efforts are proceeding to introduce solar power generation to candidate sites which are buildings owned by Quezon City, such as public schools and Barangay City Hall.

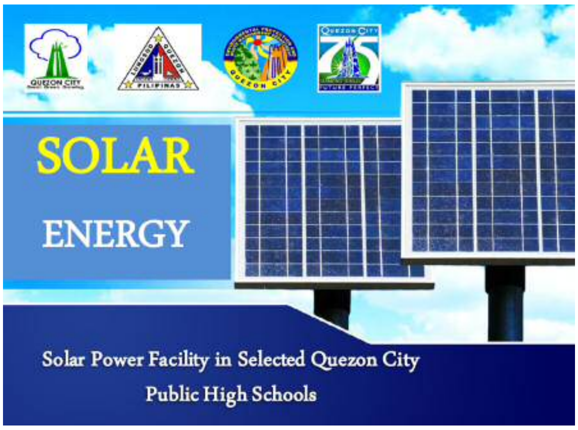

Figure 4: Introduction to solar project in Quezon City

Quezon City is considering a project to utilize solar power generation as not only a method for reducing electricity cost and GHG, but also to educate citizens about the importance of sustainable energy for reducing GHG emission. This is also in line with the city's energy security and sustainable energy development strategy.

### 2.3.3 Promotion of Low-Carbon Technologies

Besides the promotion of the implementation of sustainable energy in QC-LCCAP, the implementation of low-carbon technology is also a priority item. Specifically, efforts are proceeding to change 22,000 street lights to LED and exchange vehicles utilized by EPWMD out for electric cars.

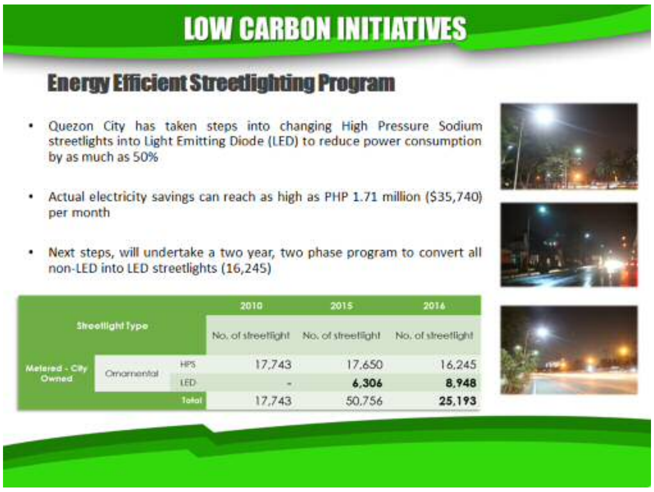


Figure 5: Streetlight project overview


Figure 6: Electric Vehicle Introduction Project Overview

### 2.4 Implementing Capacity Development

In Quezon City, the population increase causes adverse impacts on urban waste treatment, energy, transportation and urban greening. In response, projects such as those mentioned above are being deployed including those in the climate change action plan. Japan is also assisting to solve these issues by holding workshops and conducting technology transfer projects including national and local governments. These have included the 'Regional Workshop for Development and Transfer of Low Carbon Technology' organized by the Ministry of the Environment of Japan (MOE), JCM City-to-City Collaboration workshops and seminars sponsored by IGES and the MOE, and in the field of waste management, efforts for waste generation projects such as those by Hitachi.

Against this backdrop, Quezon City has shown their interest in bilateral collaboration with Osaka City through JCM projects, which led to the City-to-City Collaboration projects. For this survey, the two cities are not only working under City-to-City Collaboration contracted by the MOE, but also pursuing a comprehensive alliance regarding low-carbon energy and have signed a Memorandum of Understanding. Thus, discussions are proceeding and Quezon City expressed that they expect the following items from Japan and Osaka City:

1. Refinement of GHG inventory
2. Osaka City energy conservation and renewable energy plans and case studies

3. Sharing knowledge on JCM

The three items are detailed in the following sections.

### 2.4.1 Improvement of GHG Inventory

Quezon City is actively working on climate change issues and is developing its GHG inventory. However, there have been difficulties collecting data from each affiliated institution and establishing a calculation method. Under such circumstances, during discussions between the two cities, Osaka City introduced the AIM model which is used to simulate overall GHG inventory for a region or a country and Quezon City has shown high interest. During the training in Japan, officials from Quezon City attended a lecture about AIM to understand specifically how to create climate change scenarios for urban analysis using AIM. Case studies from Vietnam were also shared. Officials from Quezon City gave the training a high evaluation due to the fact that rather than general overviews, specific instructions on calculations, how to run the software, and international project case studies were shared.

### 2.4.2 Project Case Studies

The city to city collaboration project with Quezon City began this fiscal year and Quezon City has a high interest in the plan for countering the progression of global warming that by Osaka City is drafting. Therefore, the Osaka City Global Warming Countermeasures Action Plan (Administrative Office version and Regional version) was translated into English for the training of officials from Quezon City in Japan, and the general philosophy, amounts of GHG emissions, targets, and measures of the plan were explained in detail. During the workshop, specific examples of projects were explained, making it easier to understand Osaka City's project activities.

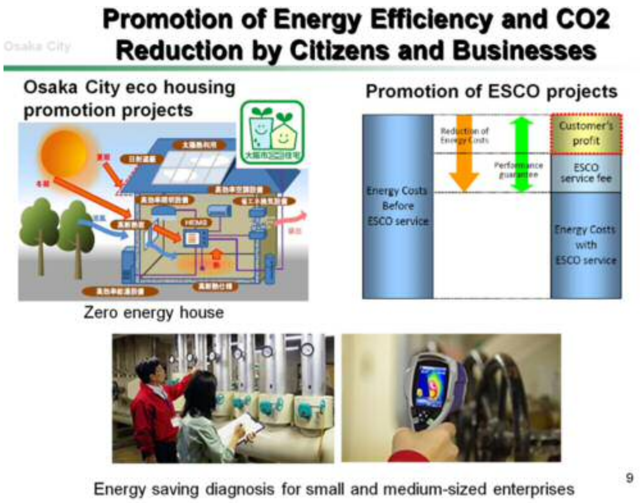


Figure 7: ESCO Case Study

### 2.4.3 Sharing JCM Knowledge

In 2017, the Philippines became the 17th country to sign a JCM agreement, and a JCM Joint Committee meeting is scheduled to be held soon. It is necessary to increase the awareness of JCM in the country. So, it would be meaningful to prepare a JCM Manual for Quezon City and related organizations to refer to. Detailed information about the JCM promotion in Quezon will be described in Chapter 4.

Chapter 3 Implementation of Feasibility Study of JCM Projects

3.1 Implementation of JCM Project Feasibility Study ( Solar Photovoltaic)

3.1.1 Overview

In this project, support was given for the formulation of Quezon into a low-carbon city under the city to city cooperation. In Quezon City, renewable energy is being promoted based on QC-LCCAP. In particular, the 'Solar Power Generation Project', is being promoted as a flagship project in Quezon City, bringing solar power systems to public schools and buildings owned by the city. In this survey, it is planned to introduce the solar PV systems through JCM in the city for facilitating the solar PV introduction project in Quezon City.

The study team investigated the following facilities with high solar introduction potential and tried to find potential JCM projects.

1. Public and private schools in Quezon
2. Hotels
3. Waste management facilities
3. Factories

Quezon City has already begun bidding for the introduction of a 100 kw solar light system to one high schools as a pilot project.

Figure 8: Common Wealth High School

There are about 50 public schools in Quezon City and it is expected that the JCM will be expanded to more of these schools in the future, but it is necessary to conduct bidding when implementing projects, so for this further consultation with the City is necessary.

One of the colleges in Quezon city, which is subject to the Green Building policy of Quezon City, is adopting LEDs for lighting and is greening the school. The school building has an area of 7,000 square meters (6 floors), and has a roof area of 1,024 square meters. It was confirmed that solar panels can be installed on the roof except on the air conditioning and water supply equipment. The school corporation operates 140 schools in the Philippines, and there are 16 school buildings in the Metro Manila area. In order to make use of JCM, it is necessary to coordinate with Quezon City and screen for larger school buildings to ensure financial viability of the project.

Figure 9: College Gym and the Roof of its Building

As for the introduction of solar power generation system to the hotel, it was found that it is possible to introduce a 40~50 kW system on the roof of one of the Hotels in Quezon. But again, as the scale would be too small for a JCM project, it is necessary to determine the needs of other hotels in the same group and determine the possibility of implementing solar power generation systems to multiple hotels.

Figure 10: Hotel Roof

An investigation of the Payatas Dumpsite (a reclaimed landfill) in Quezon City was also conducted, as there is a possibility of installing a few mega solar panels at this site. The disposal site is 30 hectares of vacant land, and the landfill completed part is greened and made into a park. There is a possibility of installing a solar panel of megawatt scale in the area. The manager also shows interest in this project; however, only seven years have passed since this land was reclaimed, so a thorough investigation on leachate, generated gas, unequal settlement etc. is required. In introducing solarpower generation to dumpsite, a foundation is necessary for deterring the transformation of ground under the power generation facilities, and a detailed investigation is required for the basic structure of the foundation (spread foundation or pile foundation, etc).

As another potential site for an energy-saving survey, one of the textile factories was targeted. As the factory has a large area, focus was placed on this survey. The survey found that the the roof of the factory of the factory is old and likely too structurally weak for the installation of solar panels. Considerable expenses would be required to replace the roof, so it was determined it would be possible to install a 264kW panel on the top of the effluent reservoir tank and the parts of the roof that are strong enough to bear the weight of solar panels.

For JCM model project, it has been determined that it is appropriate to conduct a detailed investigation on the installation of solar panels on the factory roof.

### 3.1.2 Technology to be Introduced

#### 3.1.2.1 Solar PV System

A solar power generation system is mainly composed of a solar panel, a connection box (equipment for collecting DC wiring from solar cell into one and sending it to power conditioner), and a power conditioner (equipment for converting DC power generated by a solar cell to AC power).

The proposed solar panels are from Sharp and the power conditioners are from Daihen. The pros of using these technologies are described below.

- Various sizes of systems can be installed, from residential to industrial-sized.
- Various kinds of panels can be prepared, and it efficiently use the limited space on roofs.
- The newly developed black solar panel has high power generation efficiency and the price per 1 kW is low.
- Excellent temperature characteristics and maintenance performance.


Figure 11: Solar PV Panel and Power conditioner

### 3.1.3 Host Country's Support Law System Concerning the Introduction of Solar PV System.

Philippines introduced a feed-in tariff (FIT) scheme for renewable energy power projects from July 2012. In the ERC (Energy Regulatory Committee) sixth resolution in April 2015, the second phase price is set as shown in the table below. The FIT rate for photovoltaic generation of 9.68 pesos/kWh in the first phase was reduced to 8.69 pesos/kWh in the second and is applied to solar energy projects with applications received before March 15, 2016, and the Department of Energy (DOE) is not planning to apply the FIT system to solar power generation projects after that.

Table 3: FIT Rate for Renewable Energies

| RE Technology | Approved Rates (PHP/kWh) | Installation Target (MW) |
|---|---|---|
| Wind | 7.40* | 400** |
| Solar | 8.69* | 500** |

Source: Presentation materials from representatives of the Department of Energy of the Philippines at the workshop organized the project.

Also, in May 2013, ERC approved the Net Metering system and it was implemented on July 24, 2013. The net metering system is a mechanism that enables operators to introduce a solar-grid linked power generation system for their own consumption, and balance the excess power with the power consumption from the grid. Currently, in the Philippines, it is targeted for systems of 100 kW or less. Net Metering applies to systems with 100 kW or less.

As of October 2017, 1,029 customers are using the net metering system of Manila Electric Co. (Meralco) with significant recent increases. The application procedure for this system is as follows.

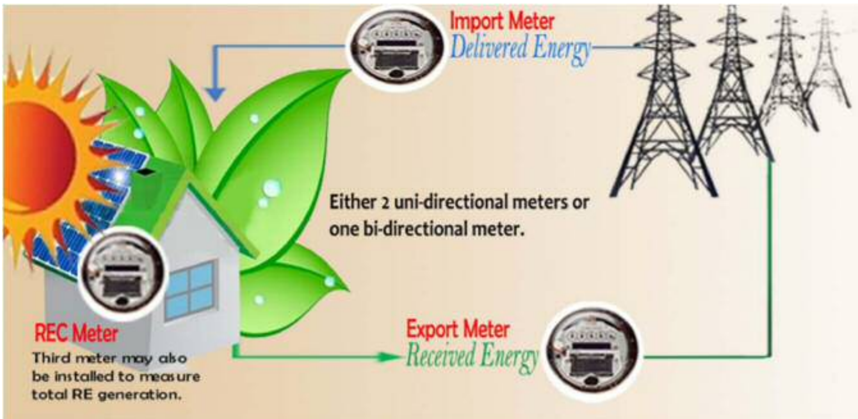


Figure 12: Image of the Net Metering for Solar PV System

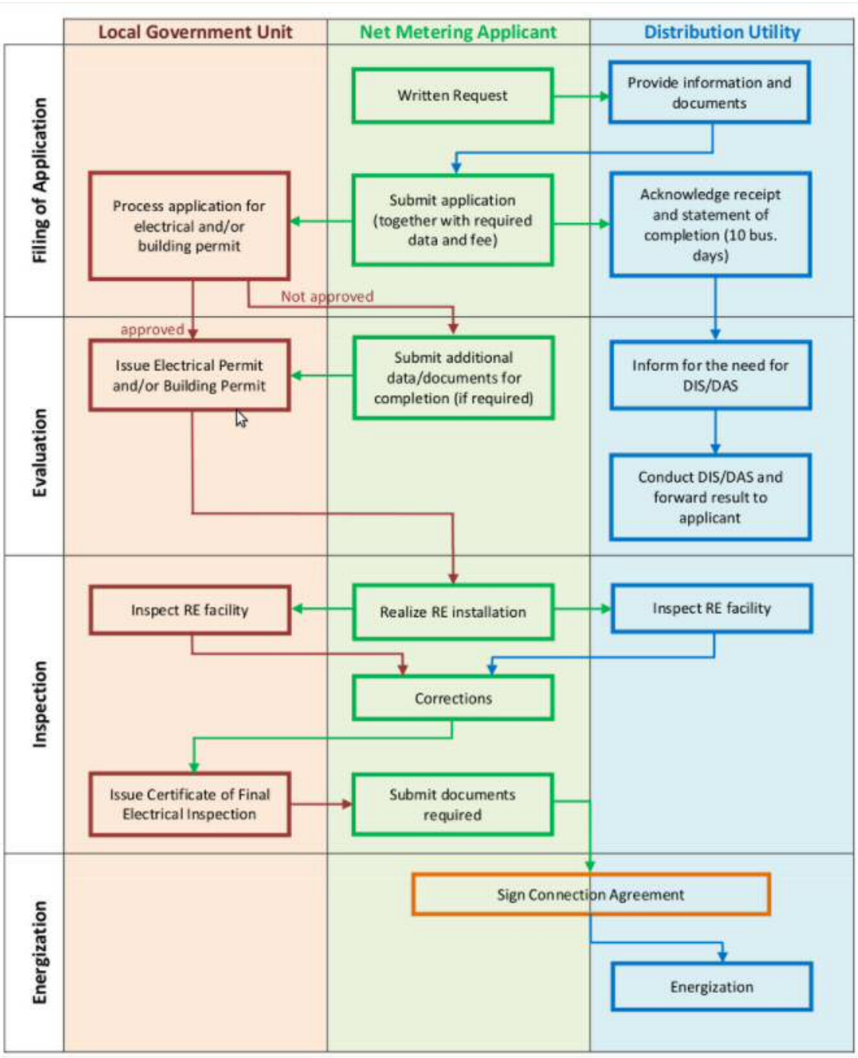

Figure 13: Net Metering Procedure Flow

Source: Philippine Department of Energy website https //www.doe.gov.ph/2-how-apply-net-metering-services-your-distribution-utility

Note that in the case of a system of 100 kW or more, it is considered to be a complete self-consumption system.

### 3.1.4 Development of MRV Methodology for Green House Gas (GHG) Reduction and Monitoring

#### 3.1.4.1 Summary of the Methodology (Solar PV)

For developing MRV methodology, the following approved JCM methodology is referred.

| Methodology | Notice |
|---|---|
| VN_AM007 “Installation of Solar PV System” | Approved on October 10, 2017. |

Table 4: Terms and Definitions

| Terms | Definitions |
|---|---|
| Solar photovoltaic (PV) system | An electricity generation system which converts sunlight into electricity by the use of photovoltaic (PV) modules. The system also includes ancillary equipment such as power conditioner required to change the electrical current from direct current (DC) to alternating current (AC). |
| Grid | The spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved). |

This methodology is applied for displacement of grid electricity and/or captive electricity by installation and operation of the solar PV system(s).

Table 5: Summary of the Methodology

| Items | Summary |
|---|---|
| GHG emission reduction measures | Displacement of grid electricity and/or captive electricity by installation and operation of the solar PV system(s). |
| Calculation of reference emissions | Reference emissions are calculated on the basis of the AC output of the solar PV system(s) multiplied by either 1) the conservative emission factor of the grid, or 2) conservative emission factor of diesel power generator. |
| Calculation of project emissions | Project emissions are calculated on the basis of electricity consumption of the solar PV system(s) multiplied by either 1) the conservative emission factor of the grid, or 2) conservative emission factor of diesel power generator. |
| Monitoring parameters | The quantity of electricity generated by the project solar PV system(s).<br>The quantity of electricity consumed by the project solar PV system(s). |

**3.1.4.2 Eligibility Criteria**

The following eligibility criteria are identified for the methodology application. Based on the field survey and domestic literature survey, eligibility criteria are shown in Table 6. Criterion 1 and 2 are requirements concerning the definition of the project, and Criteria 3, 4, and 5 are requirements relating to the technology to be introduced into the project. This methodology can be applied to projects which satisfy all of the requirements below.

Table 6: Eligibility Criteria

| | |
|---|---|
| Criterion 1 | This project introduces either new solar power systems or replaces existing systems with new units. |
| Criterion 2 | The project is to supply electricity to the grid for in-house consumption of the operator's facility or to the connected grid. |
| Criterion 3 | The photovoltaic power generation system introduced in the project can measure the net electric energy supplied to the grid. |
| Criterion 4 | Photovoltaic solar cells introduced in the project are certified by the International Electrotechnical Commission (IEC) for performance |

| | |
|---|---|
| | certification standards and safety certification standards, or are certified with national standards that are fully consistent with these standards. |
| Criterion 5 | The power conditioner of solar power generation system introduced in the project is a device with power conversion efficiency of 95% or more. |

Criteria 1 and 2 ensure the flexibility of the project. The methology can be applied to projects that utilize FIT, Net Metering, etc. in the host country, as well as self-consumption projects. Also, this methodology can be applied to either existing or new equipment. Criteria 3-5 ensure the quality of the technology.

### 3.1.4.3 Development of MRV Methodology for Greenhouse Gas Emission Reduction and Monitoring

The following approved JCM methodology is referred for developing MRV methodology regarding the solar power generation JCM projects in this study.

#### 1) Emission Reduction Calculation

Reference emissions include only CO2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants or captive power generators.
Reference emissions is calculated as follows:

$RE_p = \sum_i (EC_{p,i} \times EF_{CO2})$

$RE_P$ Reference emissions during the period p [tCO2/p]
$EG_{p,i}$ Quantity of electricity consumed or sold to the power company from electricity generated by the project solar PV system i during the period p [MWh/p]
$EF_{CO2}$ Reference CO2 emission factor [tCO2/MWh]

On the other hand, the project emission is the CO2 emission from the electricity consumption of the solar PV system and calculated as follows.

$PE_p = EC_{PJ,p} \times EF_{CO2}$

$PE_p$ Project emissions during period p [tCO2/p]
$EC_{PJ,p}$ Electricity consumption by the project solar PV system [MWh/p]
$EF_{CO2}$ Reference CO2 emission factor [tCO2/MWh]

Emission reduction can be calculated as follows:
$ER_p = RE_p - PE_p$

$RE_p$ : Reference emission in period p [t CO2/p]
$\mathbf{PE_p}$ : Project emission in period p [t CO2/p]

#### 2) Data and Parameters Fixed Ex-Ante

The source of each data and parameter fixed ex ante is as listed below.

Table 7: Data and Parameters Fixed Ex-Ante

| Parameters | Description of Data | Sources |
|---|---|---|
| $EF_{RE,i}$ | Reference CO2 emission factor. In the case of the PV system connecting to the national grid, a conservative grid eission factor is applied.<br>In the case of the project replacing a captive power generator, the lower emission factor between the grid emission factor and a captive power generator is applied.<br>EFRE,i =<br>min (EFgrid, EFcaptive) | Grid emission factor:<br>Grid emission factor published by the host country (If there is no any requirement from Joint Committee)<br>(IGES's List of Grid Emission Factors updated in Agust 2017).<br>0.670　tCO2/MWh (Philippine Combined margin)<br>Captive power generator (diesel power generator):<br>(Table2 I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2)<br>0.8 kgCO2/kWh |

### 3) Estimated Emission Reduction

The estimated reduction of CO2 emission from the project actity is calculated based on the following conditions.

Table 8: Data and Conditions for Calculating Emission Reductions

| Items | Values |
|---|---|
| System capacity (kW) | 264 |
| Solar irradiance in the host country (kWh/m²/day) | 5.28 |
| Loss factor | 0.75 |
| Grid emission factor　(t CO2/MWh) | 0.670 |

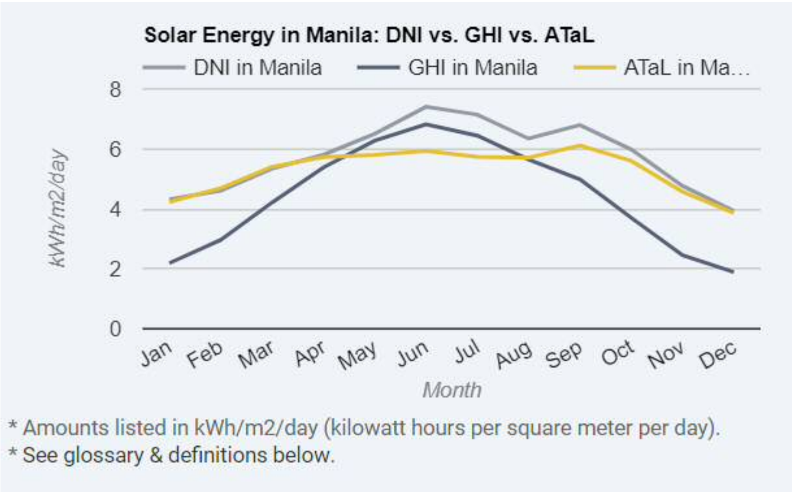


Figure 14: Solar Irradiance in Manila
Source: https://solarenergylocal.com/states/utah/manila/

The estimated power generation from the solar PV system in the project is calculated based on the following equation in the Guide book of NEDO for solar power generation. The average of solar irradiance in Manila 5.28 kWh/m²/day is applied for the calculation.

EGp ＝ H * K * P * 365 ÷ 1

| | |
|---|---|
| EGp | Estimated power generation of the solar PV system (kWh/year) |
| H | Solar irradiance in Manila (kWh/m²/day)＝5.28 |
| K | Loss factor 75% |
| | ・Loss due to cell temperature 15%(average rate for [redacted] solar panels) |
| | ・Power condition loss rate 5% (average rate of [redacted] technology) |
| | ・Loss from cables and soiling on panels (around 5%). |
| P | System capacity (kW)＝264 kW |
| 365 | Days (day) |
| 1 | Standard solar irradiance (kW/m²) |

The estimated emissions of reference and project scenarios, and emission reduction are given in the table below.

Table 9: Estimated Emission Reductions

| Emissions | Values |
|---|---|
| Reference Emission tCO2/y | 273 |
| Project Emission CO2/y | 14 |
| Emission Reduction tCO2/y | 259 |

## 4) MRV System

The two following parameters should be monitored.

1: The amount of new electricity generated by the project solar PV system in the period p (MWh/p).

2: Electricity consumption of the solar PV system in the period p (MWh/p).

The table below shows information about the monitoring.

The parameters can be measured and recorded automatically by the system; however, it is required to collect the data and record into the prepared data sheet by a designated person from a factory.

Table 10: Monitoring Parameters and Frequencies

| No | Parameter | | Monitoring Method | Frequency of the Monitoring |
|---|---|---|---|---|
| 1 | $\mathbf{EG_{i,p}}$ | The amount of new electricity generated by the project solar PV system in the period p (MWh/p) | Continuous measurement by electricity meters. Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/collected once a week |
| 2 | $\mathbf{EC_{PJ,p}}$ | Electricity consumption of the solar PV system in the period p (MWh/p) | Continuous measurement by electricity meters. Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/collected once a week |

MRV methodology in detail will be developed by OC together with JCM representative participant and project owners. Monitoring is implemented by the factory based on the MRV methodology developed. Parameters will be measured consistently and automatically by power meters. However, it is necessary for a designated person from the factory to collect the data periodically and record it into a prepared data sheet. The collected and recorded data should be reported to a section which is responsible for the JCM project. The section should check the data and prepare a data sheet which calculates emission reduction on a monthly basis. The monthly prepared data should be checked and compiled by a person who is responsibe for the JCM project and reported to the representative participant to submit to the Joint Committee.

The representative participant is responsible for training the staff of the factory (project owner) on the implementation of monitoring and OC will support the representative participant if necessary.

### 3.1.5 Project Implementation Structure and Business Model

A business model is being formulated for the introduction of a solar power system in a factory. The target factory is textile factory A, a textile manufacturing/dyeing factory, and it is proposed to introduce a completely sustainable captive solar power system (264 kW). The specifications of this system are listed in the table below.

Table 11: Specifications of technology

| Target facility | Panel type | Power Conditioner |
|---|---|---|
| Textile factory | polycrystalline | 10kW×25 |

The quotation for the project estimated the initial investment (system (panel, power conditioner)) including construction expenses to be [redacted], which does not include shipping, packaging and tariffs.

The following tariffs and taxes are applicable between Japan and the Philippines: the most favorable nation tax rate, the Japan-Philippine Economic Partnership Agreement applicable tax rate, ASEAN-Japan Comprehensive Economic Partnership applicable tax rate, and 12% VAT on imported goods.

These rates were checked online (http://tariffcommission.gov.ph/finder/index.php?page=tariff-finder) and in the case of solar panels and power conditioners, there is no tariff. But experts should be consulted to confirm this when applying for the JCM model project. Regarding the structure and amount of earnings from this project, the above is an estimation as the final figures are not yet available.

Based on this estimation, the results of the project economic feasibility study (project cash flow calculation) are shown in the tables below.

Table 12: Estimated Power Generation

| Net power generation (kWh / year) | Electricity price (yen / kWh) and power saving amount (thousand yen) | |
|---|---|---|
| 381,586 | 15 | 5,724 |

Note: The average electricity price of the plant from September 2016 to September 2017 is 6.99 pesos / kWh. 1 Peso = 2.15 yen

With a JCM subsidy the cash flow is as shown in the following table.

Table 13: Project Cash Flows

| No | Items | Total | Construction Period | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Cash inflow | 57,240 | 0 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 |
| 1.1 | Saved coal cost | 57,240 | 0 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 | 5,724 |
| 2 | Cash outflow | 56,300 | 55,300 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2.1 | Initial cost | 55,300 | 55,300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.2 | Maintenance | 1000 | 0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3 | Net cash flow | **940** | -55,300 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 | 5,624 |

| | |
|---|---|
| Payback period (year) | 9.8 |
| Net benefit | 940 |
| IRR | 0% |

In the case where the factory loan its investment from financial institutions, the economic feasibility is as shown below.

The bank interest rate was assumed to be 3.5% and the repayment period was assumed to be 7 years, based on January 2018 long-term loan interest rate information (http://www.bsp.gov.ph/statistics/keystat/intrates.htm) from various banks in the Philippines.

Table 14: Project Cash Flow (In the case of loan)

| No | Items | Total | Construction Period | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Cash inflow | 75,880 | 0 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 |
| 1.1 | Saved coal cost | 75,880 | 0 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 | 7,588 |
| 2 | Cash outflow | 63,076 | 27,650 | 5,018 | 5,018 | 5,018 | 5,018 | 5,018 | 5,018 | 5,018 | 100 | 100 | 100 |
| 2.1 | Initial cost | 27,650 | 27,650 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.2 | Maintenance | 1000 | 0 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2.3 | Loan payback | 34,426 | 0 | 4,918 | 4,918 | 4,918 | 4,918 | 4,918 | 4,918 | 4,918 | 0 | 0 | 0 |
| 3 | Net cash flow | **12,804** | -27,650 | 2,570 | 2,570 | 2,570 | 2,570 | 2,570 | 2,570 | 2,570 | 7,488 | 7,488 | 7,488 |

| | |
|---|---|
| Payback period (year) | 10.8 |
| Net benefit | 12,804 |
| IRR | 6% |

The price of electricity in the Philippines is expected to rise from the current 89 US dollars per ton to 96 US dollars in 2010, showing sufficient merit for implementing the project. The solar panels usually have a warranty of 20 years or more, making the total final total income even higher.

The project implementation system for the JCM project is shown in the following figure. The representative participant is not currently decided. Once the representative participant has been decided, a consortium will be formed, an application will be made for at JCM model project, and an MRV will be conducted.

In the consortium, representative participants are responsible for fund procurement and management. [redacted] is responsible for developing methodology on MRV if necessary.

In order to start the project, it is necessary to confirm the investment decision of the factory owner and develop a detailed design and implementation schedule.

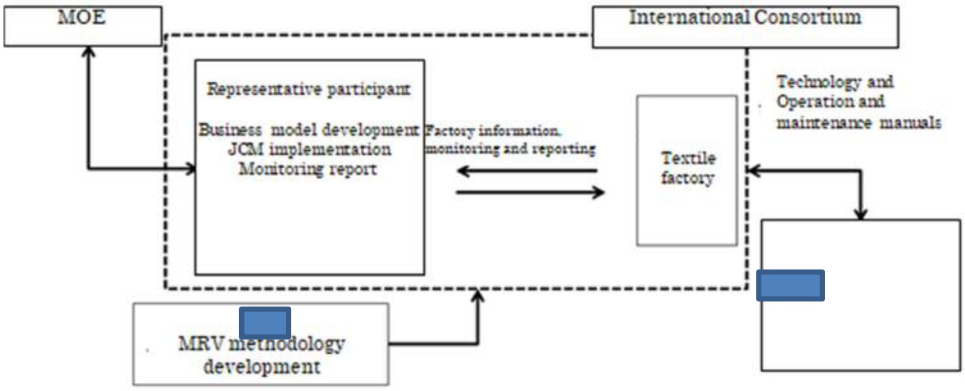

Figure 15: Project Implementation Structure

### 3.2 Implementation of JCM Project Feasibility Study (Energy Saving)

#### 3.2.1 Overview

In Quezon City, energy-saving programs are being promoted based on QC-LCCAP. To facilitate Quezon City's energy-saving programs, this study targeted the textile industry which has high energy saving potentiality to introduce waste heat recovery system and high efficient boiler.

In order to clarify the energy saving potentiality in factories, the study conducted energy auditing to a factory.

As there is a large amount of energy saving potentiality at the textile factory and a large amount of $CO_2$ reduction can be expected.

#### 3.2.2 Technology to be Introduced

For waste heat recovery system, spiral heat exchanger provided by Kurose Chemical Equipment Co., Ltd. for high efficiency boiler, boilers provided by Nippon Thermoener Co.,Ltd were recommended.


Figure 16: Spiral heat exchanger and Once-through boiler and coal boiler

#### 3.2.2.1 Heat Exchanger

The Kurose' heat exchanger has may advantages like easy to maintenance, low life cycle cost and others as follows.

1. Reliable operation, no fouling and no clogging
2. Excellent heat transfer characteristics
3. Easy to clean and inspection
4. Small carbon footprint

This technology is widely used in Japan in textile factories for waste heat recovery from dyeing section and in sewage treatment plants to adjust temperature of sludge treatment tanks. It is also used in U.S., China and Korea.

#### 3.2.2.2 High Efficiency Boiler

The high efficiency boiler recommended for the project has the following natures.

1. Flexible for factories due to coming in different sizes and fuel types
2. Optimal operation ability
3. For factories consuming heat, super high efficient system can be realized by combining it with a heater
4. Received the Technology Award from the Japan Combustion Society and Award from Chairman of Japan Society of Industrial Machinery Manufactures.
5. Efficiency of 98%
6. Remote monitoring system
7. Has a heat management and observation unit that promises easy monitoring the result of energy saving and CO2 emission reduction.

### 3.2.3 Energy Auditing

In August 2017 experts were dispatched from Japan to the textile factory in Quezon City to conduct energy auditing over 2.5 days. The main purpose of the energy auditing is to determine the possibility of energy saving at the factory, especially the operation condition of boiler and dyeing machines, the temperature of waste water from knit and yarn dyeing machines, the drainage temperature, whether and how cooling water is reused, and heat insulation treatment situation. Since the drying machines and tenter are using a heat boiler, detailed investigation has not been conducted this time.

Based on the results of the energy auditing, the project can be implemented to use waste heat to preheat the feedwater to dyeing machines that reduce steam used for heating the feed water. This will result in a reduction of consumption of fossil fuels for boilers for steam supply and GHG emissions can be reduced too.

Condensation and cooling water pool and cooling tower

Drainage pipe which unified all outlets

Figure 17: Cooling tower condition

The proposals based on the results of energy auditing are summarized below.

#### 3.2.3.1 Knit dyeing

1) Drain collection
   Collect all the drained water and return it to the boiler.
2) Reuse of warm cooling water
3) Separation of warm waste water from dyeing machines and cold waste water

#### 3.2.3.2 Yarn dyeing

1) Separation of warm cooling and drain pipes
   Warm cooling pipe and drain be reused if their pipes are separated. Drain should be returned to the boiler using stainless steel pipes.
2) Addition of valve
   In the yarn dyeing machine, in addition to the current dyeing water pipe, valves for separating hot and cold waste water are necessary to recover waste heat

#### 3.2.3.3 Boiler

1) Control of combustion air

There is one steam boiler (coal fluidized bed type) (capacity: 18 ton/h), pressure control according to load (6 kg/cm2 to 9.0 kg/cm2), but the combustion air is constantly operated.

2) Installation of air heater

The fuel uses coal (from Indonesia). In order to make effective use of the exhaust gas heat, a feed water pre-heater (economizer) is installed. In addition, inverters are adopted for pushing fans (one out of two) and induction fans. However, the air pre-heater (air heater) is not installed and the drained water is not recovered.

#### 3.2.3.4 Calculations of Energy Saving

The amount of energy saved through the implementation of the aforementioned improvements have been calculated and are shown below.

Table 15: Energy saving

| | | | | |
|---|---|---|---|---|
| | Unit | Knit | Yarn | Total |
| Total consumption | Mcal | 95,700 | 60,500 | 156,200 |
| | | | | |
| Drain collection | Mcal | 10,368 | 6,554 | 16,922 |
| Reusable cooling | Mcal | 10,868 | 4,660 | 15,528 |
| Exhaust heat | Mcal | 30,000 | 22,000 | 52,000 |
| Total | Mcal | 51,236 | 33,214 | 84,450 |

### 3.2.4 Development of MRV Methodology for Greenhouse Gas Emission Reduction and Monitoring

In order to develop MRV methodologies for the projects of waste heat recovery and high efficiency boiler introduction, the following existing methodologies are referred.

Table 16:MRV Methodologies Referred

| Methoologies | Explanations |
|---|---|
| 〈CDM Methodologies〉<br>AMS-II.I.: Efficient utilization of waste energy in industrial facilities (Version 1.0)<br>AM0044 :Energy efficiency improvement projects - boiler rehabilitation or replacement in industrial and district heating sectors (Version 02.0)<br>〈JCM Methodologies〉<br>MN_AM002 "Replacement and Installation of High | Since there has been no approved JCM methodolgy related to waste heat recovery from in textile industry, the CDM and JCM feasibility study regarding waste heat recovery from industrial process are refered |

| | |
|---|---|
| Efficiency Heat Only Boiler (HOB) for Hot Water Supply Systems"<br>ID_AM001 "Power Generation by Waste Heat Recovery in Cement Industry" | to develop a methodology. |

### 3.2.4.1 Summary of the Methodology (Waste heat recovery)

The reference and project scenarios are given in following figures.

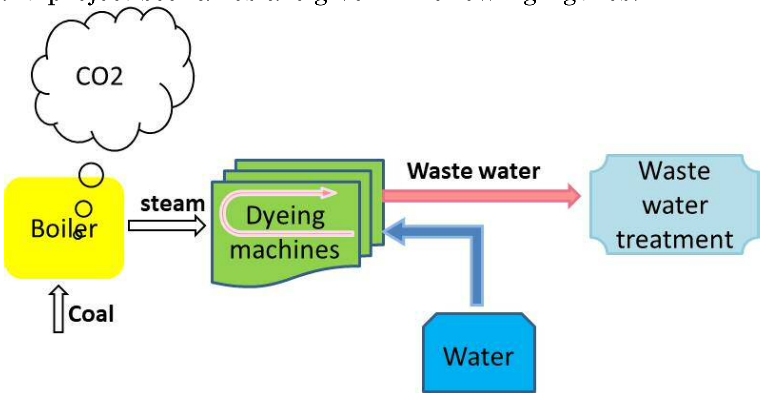


Figure 18: Reference Scenario

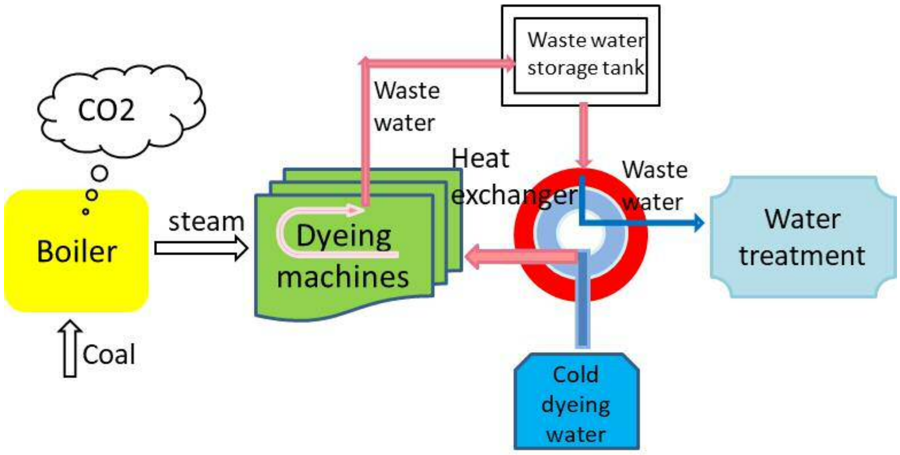


Figure 19: Project Scenario

Table 17: Terms and Definitions

| Terms | Definitions |
|---|---|
| Textile dyeing and finishing | The procedures from fabric pre-treatment to finishing in textile and garment dyeing houses.<br>Including main procedures of fabric pre-treatment, dyeing and finishing (washing, drying) that is the chemical and physical treatments of consuming heat and steam. |
| Waste heat | Heat energy of boiler exhaust and/or waste water from dyeing machines |

Table 18: Summary of the Methodology

| Items | Summary |
|---|---|
| GHG emission reduction measures | Recovered waste heats are used for preheating feed-water to boilers and dyeing machines to reduce fuel consumption of boilers that provide steam for dyeing and finishing process. |
| Calculation of reference emissions | Reference emission is calculated based on the amount of waste energy/heat utilized, boiler efficiency and CO2 emission factor of the fossil fuel that is used for providing energy to the dyeing process. Conservative values of the parameters are used to ensure the reference emission is lower than BaU emission. For example, 100% is used for the efficiency of boiler in the reference scenario.<br>[(Temperature of feed water in the inlet of the waste heat recovery system) - (Temperature of feed water in the outlet of the waste heat recovery system)] *(The amount of the feed water providing to dyeing machines in the project)*(the specific heat of water)/(boiler efficiency)*(CO2 emission factor the fossil fuel that is used to provide energy for dyeing and finishing process). |
| Calculation of project emissions | The project emission is calculated based on the electricity consumption of waste heat recovery system and CO2 emission factor of electricity |
| Monitoring parameters | The following parameters need to be monitored.<br>1. The temperature of the feed-water to the heat exchange system in the project (degrees C)<br>2. The amount and temperature of the feed-water to the dyeing machines through the heat exchange system in the project (degrees C) and (t/p)<br>3. The amount of electricity consumed by the waste heat recovery system (Mwh/p) |

**3.2.4.1.1 Eligibility Criteria**

The following eligibility criteria are identified for the methodology application.

Table 19: Eligibility Criteria

| | |
|---|---|
| Criterion 1 | Waste heat (heat from dyeing waste water) recovery from dyeing and finishing process in the existing or new textile and garment factories. |
| Criterion 2 | Spiral heat exchanger is applied for heat recovery. |
| Criterion 3 | Targeting factories with dyeing capacity more than 10 ton/day |

Criterion 1 ensures the methodology can be applied to projects introducing waste heat recovery systems in both of existing and new facilities (dyeing and finishing machines) to reduce steam consumption in the dyeing process that results in the reduction of fossil fuel consumption of boilers that provide steam for dyeing process in the factories.

Criterion 2 is to ensure the quality of waste heat recovery system that the spiral type heat exchanger introduced in the project is with low fouling and easy to clean. Compare to tubular heat exchangers, it has advantages of high efficiency, low maintenance and space saving.

Criterion 3 limits the production capacity of factories from the perspective of cost efficiency.

### 3.2.4.1.2 Establishment and Calculation of Reference and Project Emissions

**1) Establishment of reference emissions**

The reference emission is the emission from consumption of fossil fuel to gain the same amount of energy recovered and utilized through the waste heat recovery system.

**2) Calculation of Reference Emissions**

$$RE_p = \sum_{ta} (\mathrm{T_{af,ta}} - \mathrm{T_{be,ta}}) \times \mathrm{W}_{th} \times \mathrm{F_{w,ta}} \times \frac{1}{\mathrm{Ef}} \times \mathrm{EF_{CO2,fuel}} \times 10^{-6}$$

| | |
|---|---|
| $RE_p$ | Reference emission [tCO2/y] |
| $T_{af,ta}$ | Temperature of feed-water to machines through the waste recovery system [degree C] |
| $T_{be,ta}$ | Temperature of feed-water in the inlet of waste heat recovery system [dgree C] |
| $W_{th}$ | The specific heat of water [kJ/kg degree C] |
| $F_{w,ta}$ | The amount of the feed-water to machines through the waste recovery system [t/p] |
| Ef | Boiler efficiency [ratio] |
| $EF_{CO2,fuel}$ | CO2 emission factor the fossil fuel that is used to provide energy for dyeing and finishing process [tCO2/TJ] |
| **ta** | The number of waste water storage tanks. |

**3) Calculation of Project Emissions**

Project emission is calculated based on the amount of electricity consumed by the waste heat recovery system and electricity CO2 emission factor.

$$PE_p = EC_{PJ,y} \times EF_{elec}$$

| | |
|---|---|
| $PE_p$ | Project emissions [t CO2/p] |
| $EC_{PJ,p}$ | Electricity consumption by the waste heat recovery system [MWh/y] |
| $\mathbf{EF_{elec}}$ | CO2 emission factor of electricity [tCO2/MWh] |

**4) Calculation of Emission Reduction**

$$ER_p = RE_p - PE_p$$

| | |
|---|---|
| $RE_p$ | Reference emissions [t CO2/p] |
| $\mathbf{PE_p}$ | Project emissions [t CO2/p] |

**5) Data and Parameters Fixed Ex Ante**

The source of each data and parameter fixed *ex ante* is listed as below.

Table 20: Data and Parameter fixed *ex ante*

| Parameter | Description of data | Source |
|---|---|---|
| Ef | Boiler efficiency<br>100% is used for for conservativeness. However, for energy saving to financial analysis actual boiler efficienct 75% (Just Textile) is applied. | Textile factories |
| $EF_{CO2,fuel}$ | CO2 emission factor of the fuel used for steam generation<br>Coal: 87.3 tCO2/TJ (lower case of default value) | 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.4) |
| $EF_{elec}$ | CO2 emission factor of electricity<br>In the case of grid: 0.670 tCO2/MWh | Grid emission factor published by the host country |

| | | |
|---|---|---|
| | In the case of captive power plant (diesel): 0.8 $tCO_2/MWh$ | (If there is no any requirement from Joint Committee)<br>(IGES's List of Grid Emission Factors updated in Agust 2017).<br>0.670 $tCO_2/MWh$ (Philippine Combined margin) power plant.<br><br>(Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2). |

**6) Estimated Emission Reduction**

The estimated emission reduction from the factory by introducing a spiral heat exchanger waste heat recovery system is as follows.

Table 21: Data and Conditions for Estimating Emission Reductions

| Items | Values |
|---|---|
| Operation days (d/y) | 350 |
| Feed water temprerature to the waste heat recovery system (degree C) | 30 |
| Feed water temperature to dyeing machines through the system (degree C) | 70 |
| Specific heat capacity of water (kJ/kg degrees C) | 4.184 |
| Amount of feed water to dyeing machines through the waste heat recovery system (t/h) | 26 |
| Emission factor of coal ($tCO_2/TJ$) | 87.3 |
| Operation ratio of dyeing machines | 0.8 |
| Capacity of pumps (kW) | 6 |

Based on the data and conditions given in the table above, the calculation of estimated emission reduction from the project is as follows.

Table 22: The Result of Estimated Emission Redection

| Emissions | Results |
|---|---|
| Reference emissions $tCO_2/y$ | 2,386 |
| Project emissions $tCO_2/y$ | 27 |
| Emission reduction $tCO_2/y$ | 2,358 |

**7) MRV Scheme**

Parameters are selected carefully from the perspective of developing a methodology that is simple, transparent and conservative as well compare to methodologies of CDM. As a result, the following 4 parameters are selected for monitoring ex post of the project.

1: Temperature of the feed water (hot) to dyeing machines through the waste heat recovery system (degrees C)

2: Temperature of feed water (fresh) in the inlet of waste heat recovery system (degrees C)

3: Amount of the feed water (hot) to the dyeing machines through the waste heat recovery system (t/p)

4: Amount of the electricity consumption of the waste heat recovery system (MWh/y)

For measuring parameters 1 and 2, temperature meters which have functions of data transmission through frequency conversions will be installed to ensure continuous data collection and recording. For parameter 3, flow meters with data transmission functions will be installed to promise continuous data collection and recording. A dyeing master (or a person assigned to the task) in the factory will collect the data recorded automatically once a week and record them into data sheets prepared beforehand.

For parameter 4, power meters will be installed to control panels of the system introduced to measure accumulated power consumption of the system. A dyeing master (or a person assigned to the task) in each factory will read power meters and record the figures after each shift. Factory managers will collect all data once a week and record them into data sheets prepared beforehand. All meters with sensors will be inspected, maintained and calibrated regularly as per specifications, guidelines from makers.

QA/QC system is very important to ensure reliability of a monitoring. As situations are different by factories, it is hard and inappropriate to develop a uniform QA/QC system for all factories. Concrete monitoring plans for the factories will be developed in due course of implementation process. In the study, a monitoring and MRV scheme shown in the figure below is developed in a general way.

Table 23: Monitoring Parameters and Frequencies

| No | Parameters | | Monitoring methods | Frequencies |
|---|---|---|---|---|
| 1 | $\mathbf{T_{af,ta}}$ | Temperature of the feed water (hot) to dyeing machines through the waste heat recovery system (degrees C) | Continuous measurement through thermometers meters.<br>Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/ collection and recording once a week |
| 2 | $\mathbf{T_{be,ta}}$ | Temperature of feed water (fresh) in the inlet of waste heat recovery system (degrees C) | Continuous measurement through thermometers meters.<br>Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/ collection and recording once a week |
| 3 | $\mathbf{F_{w,ta}}$ | Amount of the feed water (hot) to the dyeing machines through the waste heat recovery system (t/p) | Continuous measurement through flow meters.<br>Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/ collection and recording once a week |
| 4 | $\mathbf{EC_{PJ,y}}$ | Amount of the electricity consumption of the waste heat recovery system (MWh/p) | Continuous measurement through power meters.<br>Collected and recorded into prepared data sheets by a designated person once a week. | Continuous measurement/ collection and recording once a week |

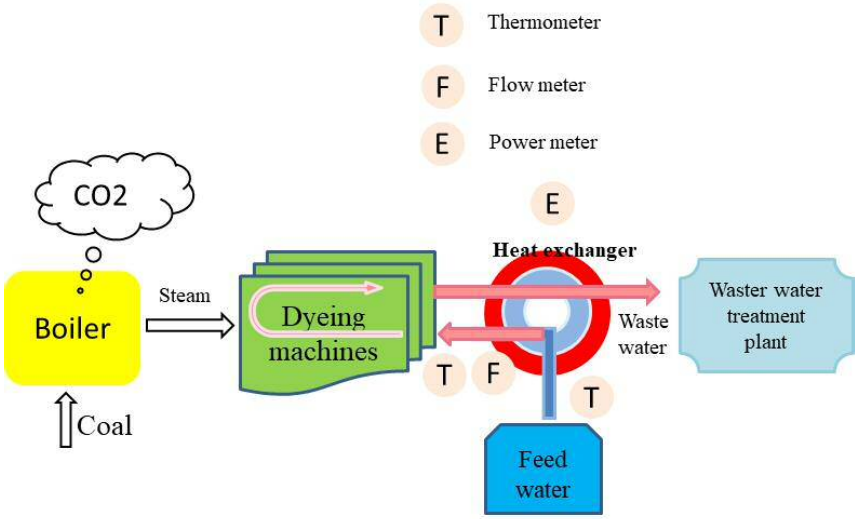

Figure 20: Monitoring Items and Points

MRV methodology will be developed in detail by OC together with the JCM representative participant and project owners. Monitoring will be implemented by a project owner based on the MRV methodology developed. Parameters will be measured consistently and automatically by power meters. However, it is necessary to collect the data periodically and record into a prepared data sheet by a designated person from the factory. The collected and recorded data should be reported to a section which is responsible for the JCM project. The section should check the data and prepare a data sheet which calculates emission reduction in monthly basis. The monthly prepared data should be checked and accumulated by a person who is responsibe for the JCM project and reported to the representative participant to submit to the Joint Committee.

The representative participant is responsible for training the staff of the factory (project owner) on the implementation of monitoring and OC will support the representative participant if necessary.

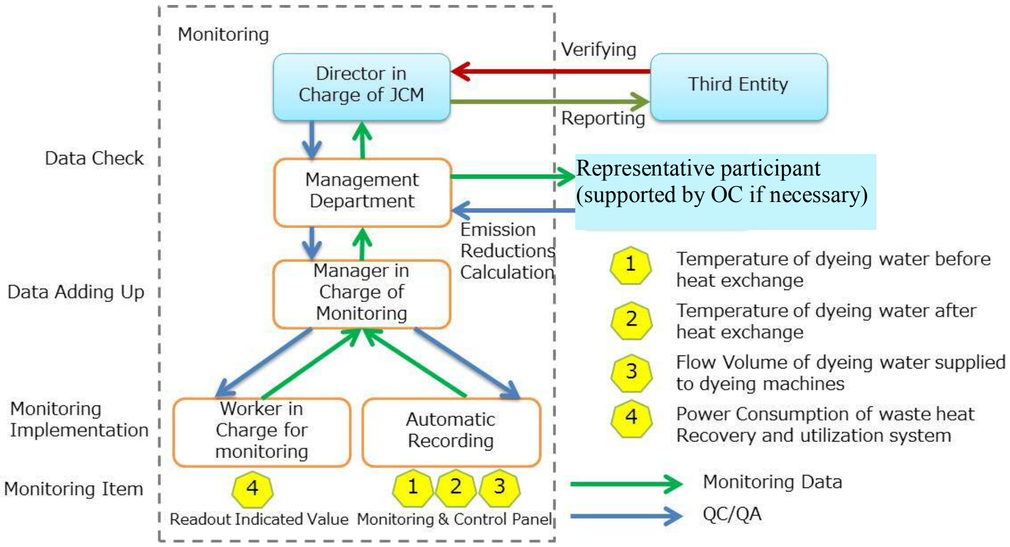

Figure 21: Monitoring Scheme and Process

#### 3.2.4.2 Summary of the Methodology (high efficiency boiler)

This methodology is applied for projects which install a new high efficiency boiler or conduct rehabilitation to existing boilers.

Table 24: Terms and Definitions

| Terms | Definitions |
|---|---|
| High efficiency boilers (HEB) | Coal boilers with efficiency higher than 85%, which provide steam for production processes |

Table 25: Summary of the Merthodology

| Items | Summary |
|---|---|
| GHG emission reduction measures | This project involves the installation of new HEB or rehabilitation of existing boilers for steam supply.<br>The boiler efficiency of the reference scenario is typically lower than that of the project HEB. Therefore, the project activity leads to the reduction of coal consumption, resulting in lower emission of GHGs as well as air pollutants. |
| Calculation of reference emissions | Reference emissions are calculated by the net heat quantity supplied by the project HEB, boiler efficiency of the reference boiler and CO2 emission factor of coal. |
| Calculation of project emissions | The sources of project emissions are coal consumption. |
| Monitoring parameters | The amount of coal consumed the project HEB |

##### 3.2.4.2.1 Eligibility Criteria

This methodology is applicable to the projects that satisfy all of the following criteria.

Table 26: Eligibility Criteria

| | |
|---|---|
| Criterion 1 | The technology to be employed in this methodology is a coal boiler for providing steams to production processes |
| Criterion 2 | Projects install coal boilers with efficiency higher than 85% |
| Criterion 3 | Project activities installing new boilers or conducting rehabilitation of existing boilers |
| Criterion 4 | The boiler is equipped with an operation and maintenance manual and fulfill the requirements of environmental standards in host countries |

Criteria 1 and 2 are the technological requirements for project activities that require boilers with efficiency higher that 85% that is higher than the efficiency of boilers available in the markets of host countries without a JCM subsidy.

Criterion 3 is the definition of project activities that covers installation of new boilers and also rehabilitation of existing boilers. Criterion 4 is for ensuring the safety and environmental friendliness of project activities.

##### 3.2.4.2.2 Establishment and Calculation of Reference and Project Emissions

**1) Establishment of Reference Emissions**

In Philippine, without financial assistance, it is expected that the existing conventional type of coal boilers, which have efficiency 70-75% are continuously used.

2) **Calculation of Reference Emissions**

Reference emissions are calculated calculated by the amount of the reference coal consumption and CO2 emission factor of coal. The amount of coal consumption in the reference scenario is calculated by dividing net heat quantity supplied by the project by boiler efficiency of the reference boiler. This is because the net heat quantity of the reference boiler is equal to the net heat quantity of the project boiler. Both CO2 emission factors and boiler efficiency of the reference and project are set as default values. Therefore, the reference emissions are calculated as follows.

$RE_p = PT_p / \eta_{Re} \times EF_{CO2,coal}$

| | |
|---|---|
| $RE_p$ | Reference emissions [tCO2/p] |
| $PT_p$ | Amount of heat provided by the project in the period of p [TJ/p] |
| $\eta_{Re}$ | Efficiency of reference boiler |
| $EF_{CO2,coal}$ | CO2 emission factor of coal [tCO2/TJ] |

Here,

$PT_p = FC_{RE,p} \times NCV_{coal} / \eta_P$

| | |
|---|---|
| $FC_p$ | Amount of coal consumed by the project boiler in the period of p [t/p] |
| $NCV_{coal}$ | Net caloric value of coal [TJ/Gg] |
| $\eta_P$ | Efficiency of project boiler |

3) **Calculation of Project Emissions**

Project emissions are calculated by the amount of the project coal consumption and CO2 emission factor of coal.

$PE_p = FC_{PJ,p} \times NCV_{coal} \times EF_{CO2,coal}$

| | |
|---|---|
| $PE_p$ | Project emissions [t CO2/p] |
| $FC_{PJ,p}$ | Amount of coal consumed by project boiler in the period of p [t/p] |
| $EF_{CO2,coal}$ | CO2 emission factor of coal [tCO2/TJ] |
| $NCV_{coal}$ | Net caloric value of coal [TJ/Gg] |

4) **Calculation of Emissions Reductions**

$ER_p = RE_y - PE_y$

| | |
|---|---|
| $RE_p$ | Reference emissions [t CO2/p] |
| $\mathbf{PE_p}$ | Project emissions [t CO2/p] |

5) **Data and Parameters Fixed ex-ante**

The source of each data and parameter fixed *ex ante* is listed as below.

Table 27: Data and Parameter fixed ex ante

| Parameters | Description of Data | Sources |
|---|---|---|
| Ef | Boiler efficiencies<br>Reference boiler 75%<br>Project boiler 85% | Boiler catalogs |
| $EF_{CO2,fuel}$ | CO2 efficiency of coal<br>87.3 tCO2/TJ | 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.4) |
| $NCV_{coal}$ | Net caloric value of coal | 2006 IPCC Guidelines for National |

| | | |
|---|---|---|
| | 24 TJ/Gg | Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.2) |

### 6) Estimated Emission Reduction

The estimated emission reduction by the project through introducing a high efficiency boiler is given in the table below.

Table 28: Data and Conditions for Calculating Estimated Emission Reduction

| Items | Values |
|---|---|
| Operation days (d/y) | 350 |
| Reference boiler efficiency (%) | 75 |
| CO2 emission factor of coal tCO2/TJ | 87.3 |
| Net caloric value of coal (TJ/Gg) | 24 |
| Project boiler coal consumption (t/d) | 40 |
| Operation rate of boiler | 0.87 |

The result of calculation of estimated emission reduction through the project is given the table below.

Table 29: Result of Estimated Emission Reduction

| Scenarios | Emission Results |
|---|---|
| Reference emissions tCO2/y | 14,461 |
| Project emissions tCO2/y | 12,760 |
| Emission reduction tCO2/y | 1,701 |

### 7) MRV Scheme

Monitoring parameters are selected carefully from the perspective of developing a methodology that is simple, transparent and conservative. As a result, the amount of coal consumed by the project boiler is selected as a monitoring parameter.

Table 30: Monitoring Parameter and Methods

| Parameter | | Monitoring Method | Monitoring Frequencies |
|---|---|---|---|
| $FC_{PJ,p}$ | Amount of coal consumed by the project boiler | Measurement by weighing scale prior to feeding | Recording for every time/Collecting once a week |

MRV methodology will developed in detail by OC together with the JCM representative participant and project owners. Monitoring is implemented by a project owner based on the MRV methodology developed. Parameters will be measured consistently and automatically by power meters. However, it is necessary for a designated person from the factory to collect the data periodically and record it into a prepared data sheet. The collected and recorded data should be reported to a section which is responsible for the JCM project. The section should check the data and prepare a data sheet which calculates emission reduction on monthly basis. The monthy prepared data should be checked and accumulated by a person who is responsible for the JCM project and reported to the representative participant to submit to the Joint Committee.

The representative participant is responsible for training the staff of the factory (project owner) on the implementation of monitoring and OC will support the representative participant if necessary.

### 3.2.5 Project Structure and Business Model Development

#### 3.2.5.1 Waste Heat Recovery

The equipment in the waste heat recovery and utilization project at the textile factory consists of a heat exchanger and its peripheral equipment such as a pump, a flow meter, and a control panel. The spiral type heat exchanger is assumed to be KSH-1 HK type, which does not cause clogging due to fiber scraps

Specifically, the project is to implement a waste heat recovery system comprised of a heat exchanger with a heat transfer area of 56 $m^2$ and peripheral equipment (pump (wastewater and fresh water), flow meter, and control panel) to the knit dyeing and yarn dyeing sections of the Just Textile factory.

The specifications and quantities of heat exchangers in each factory are shown below based on estimation acquired and on the system design tailored to the factory.

Table 31: Specification and Number of Heat Exchanger

| Target | Model | Size of heat exchangers | Material | Regulations | Quantity |
|---|---|---|---|---|---|
| Factory A | KSH-1HK | 56 $m^2$ | SUS316 | None | 1 |

Figure 22: 1-HK type heat exchanger

Table 32: Estimated Initial Cost (Unit: Ten thousand yen)

| KSH-1HK | Initial cost | | | | | |
|---|---|---|---|---|---|---|
| Heat transfer area | Heat exchanger | Piping / installation | Pump, flow meter, control panel and installation work | Transportation · Packing | Tariff etc. | total |
| [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

The following tariffs and taxes are applicable between Japan and the Philippines: the most favorable nation tax rate, the Japan-Philippine Economic Partnership Agreement applicable tax rate, ASEAN-Japan Comprehensive Economic Partnership applicable tax rate, and 12% VAT on imported goods.

These rates were checked online (http://tariffcommission.gov.ph/finder/index.php?page=tariff-finder) and there are no tariffs for heat exchangers and pumps. But experts and related institutions should be consulted to confirm this when applying for the JCM model project.

The initial costs for equipment and installation of waste heat recovery systems are estimated based on the information from the technology providers (heat exchanger, pumps and meters) and investigating related sources. The amount of waste heat that can be recovered by the systems was estimated as per data and information collected from the factories and specification of the heat exchangers applied. The cost savings from coal reduction through the application of waste heat recovery system of the project was counted as the benefit of each factory. The cash flow of the factories for the project is given in the tables below.

Table 33: Energy saving effect at Just Textile factory

| Wastewater | | | Feed water | | |
|---|---|---|---|---|---|
| Flow rate (ton/h) | Inlet temperature (degrees C) | Outlet temperature (degrees C) | Flow rate (ton/h) | Inlet temperature (degrees C) | Outlet temperature (degrees C) |
| 32 | 83 | 51 | 26 | 30 | 69 |
| | | | | | |
| Factory operation time (h / day) | Factory working days (day/year) | Occupancy rate(%) | Recovered heat energy (Gcal/year) | Calorific value of coal (Kcal/kg) | Coal equivalent (ton/year) |
| 24 | 350 | 81 | 6,899 | 5,900 | 1,599 |
| | | | | | |
| Boiler efficiency (%) | Coal price (yen/ton) | Energy saved (Ten thousand yen /year) | | | |
| 75 | 9,000 | 1,439 | | | |

For the calorific value of coal, the value of Indonesian coal used is higher than the actual value of coals used in the factories.
Cash flows are shown below.

Table 34: Project Cash Flow

| No | Items | Total | Construction Period | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Cash inflow | 14,390 | 0 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 |
| 1.1 | Saved coal cost | 14,390 | 0 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 |
| 2 | Cash outflow | 3,302 | 2,802 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 2.1 | Initial cost | 2,802 | 2,802 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.2 | Maintenance | 500 | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 3 | Net cash flow | **11,088** | -2,802 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 |

| | |
|---|---|
| Payback period (year) | 2.0 |
| Net benefit | 11,088 |
| IRR | 49% |

The case of the factory taking out a loan from a financial institution for their investment part is shown below.

The loan interest rate of the bank was estimated from the January 2018 loan interest rate information of of banks in the Philippines (http: //www.bsp.gov.ph/statistics/keystat/intrates.htm), and is assumed to be 7.5% for medium term loans (from the Bank of Philippine Islands) with a repayment period of 5 years. The economic feasibility of the factory in that case is presented in the following table.

Table 35: Project Cash Flow (with loan)

| No | Items | Total | Construction Period | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | Cash inflow | 14,390 | 0 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 |
| 1.1 | Saved coal cost | 14,390 | 0 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 | 1,439 |
| 2 | Cash outflow | 3,831 | 1,401 | 436 | 436 | 436 | 436 | 436 | 50 | 50 | 50 | 50 | 50 |
| 2.1 | Initial cost | 1,401 | 1,401 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.2 | Maintenance | 500 | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 2.3 | Loan payback | 1,930 | 0 | 386 | 386 | 386 | 386 | 386 | 0 | 0 | 0 | 0 | 0 |
| 3 | Net cash flow | **10,559** | -1,401 | 1,003 | 1,003 | 1,003 | 1,003 | 1,003 | 1,389 | 1,389 | 1,389 | 1,389 | 1,389 |
| | | | | | | | | | | | | | |
| | Payback period (year) | 1.9 | | | | | | | | | | | |
| | Net benefit | 10,559 | | | | | | | | | | | |
| | IRR | 73% | | | | | | | | | | | |

Based on the estimated costs, it seems that there are plenty of merits for implementing the project at the factory. However, the investment decision is ultimately determined by the factory owner.


Figure 23: Changes in coal prices in the Philippines
https://www.indexmundi.com/commodities/?commodity=coal-australian&months=12&currency=php

The fluctuation in the coal price in the Philippines is indicated above, and the project is sufficiently economally feasible even at the lowest price of 3.7 pesos/kg tons.

Figure 24 below shows the project implementation framework in promoting JCM projects. The representative participant has not been decided yet. A consortium will be formed as soon as the representative participant is decided, an application for the JCM model project will be formulated, and an MRV will be conducted.

In the consortium, representative participants are responsible for fund procurement and management. OC is responsible for developing methodology on MRV if necessary.

In order to start the project, it is necessary to confirm the investment decision of the factory owner and develop a detailed design and implementation schedule.

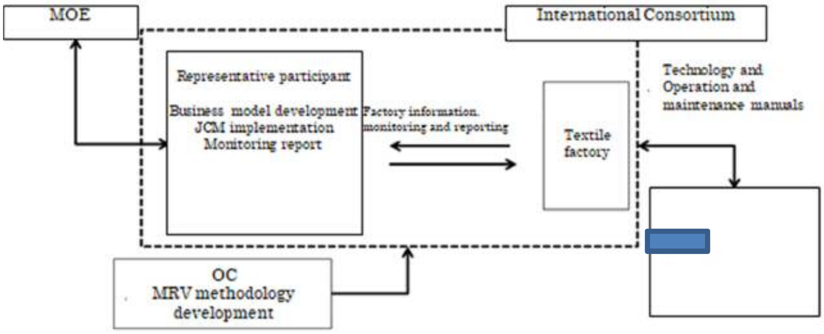


Figure 24: Project Implementation Structure

#### 3.2.5.2 High Efficient Boilers

For high efficiency boilers, based on the results of the survey, we will consider introducing a high-efficiency coal boiler instead of the original once through gas boiler. In Japan, coal boilers for production are generally not manufactured, so we are considering a boiler (85% efficiency, 16 t/h capacity) from an overseas parter of Nippon Thermoener Co., Ltd.

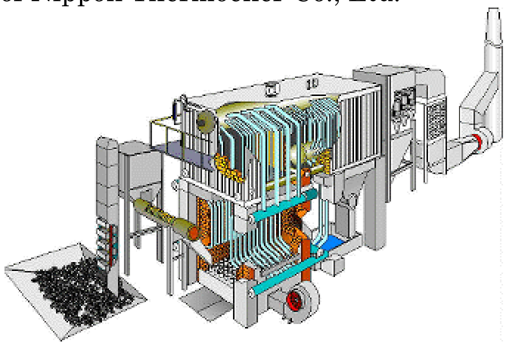

Figure 25: Fluidized Bed Boiler

Regarding the initial investment, the boiler main body (including the input belt conveyor and scrubber) is [redacted], and the installation is [redacted] estimating to a total of [redacted]. In addition, there will be [redacted] in tariffs and taxes, and no additional expenses will be incurred for maintenance and operation.

By introducing a high-efficiency boiler, [redacted] can be saved in the cost of coal. In the project implementation, 50% of the initial investment is procured by the JCM subsidy scheme of the Ministry of the Environment, and in the case where the remaining 50% is funded by the factory, the payback time is more than 20 years.

The boiler is an indispensable equipment in the sustainable production of the factory, and production losses due to boiler breakdowns can cause major lose. Recently the current boiler in the factory has been experiencing technical problems and there have been production losses, and the factory is currently considering replacing their boiler.

The following figure shows the project implementation structure for the JCM project. The representative participant has not yet been decided.

A consortium will be formed as soon as the representative participant is decided, an application for the JCM model project will be formulated, and an MRV will be conducted.

In the consortium, representative participants are responsible for fund procurement and management. OC is responsible for developing methodology of MRV if necessary.

In order to start the project, it is necessary to confirm the investment decision of the factory owner and develop a detailed design and implementation schedule.

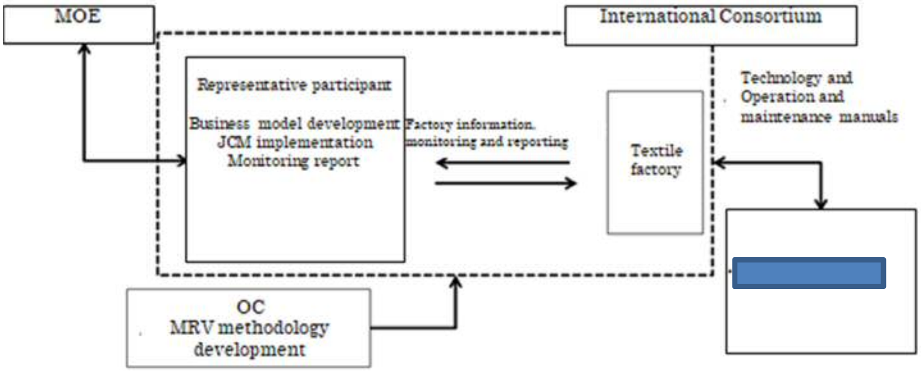

Figure 26: Project Implementation Structure

### 3.3 Risks and Solutions

The tentative schedule of the implementation of the project (solar power system and waste heat recovery system) is as follows.

| | |
|---|---|
| February 2018 | Completion of the feasibility study |
| March 2018 | Finalization of investment decision of factories |
| March 2018 | Determination of project implementation structure<br>Establishment of Consortium<br>Development of project design documents, MRV methodology and monitoring plan |
| April 2018 | Apply for JCM Model project |
| In 2018 | Start construction of solar power and waste heat recovery systems |
| In 2018 | Check the applicability of MRV methodology. |
| In 2018 | Application for registration the JCM project to Joint Committee |
| In 2018 | Test operation of solar power and waste heat recovery systems<br>Technology transfer of system operation and maintenance<br>MRV capacity building |
| February 2019 | Start operation and monitering |

In order to implement the project along the schedule above, there are some points need to be taken into consideration.

First of all, the factory owners' awareness of energy-saving needs to be raised. The auditing under the study revealed ways to improve operation that will not require large additional investments to improve energy efficiency. Energy saving technologies like efficient boilers were also introduced with its benefits.

The second point is the matter of technology. The construction will be undertaken by local companies. Therefore, quality control of the construction works is very important to ensure the standards of the technology and on-time completion based on design and schedule. Before applying for a JCM model project, it is necessary to complete a detailed design and engineering of boiler system and select a local contractor for construction to finalize final initial cost for the system and the implementation schedule. The operation and maintenance manual of the system will also be provided to the factories and related staff of the factories will be trained if necessary before operation of the systems. At the same time, in the capacity building on MRV, it is also important for factory staff to understand maintenance and operation of sensors used for monitoring so as to collect accurate data.

Other than the issues listed above, it is believed that there are no other obstacles that would hinder the implementation of the project. In the future, the implementation the JCM project by will proceed through formulating more detailed and concrete plans and facilitating mutal understanding between stakeholders.

# Chapter 4 Development of JCM Manual

## 4.1 Overview

Quezon City has formulated the QC-LCCAP but there are places where it is completed only by showing the direction of energy conservation and renewable energy and it is difficult to imagine specific plans for projects. In addition, the Philippines just signed a bilateral agreement to start the JCM in FY 2017, and federal and local government officials do not have a clear understanding of the JCM system. For this reason, it is necessary to prepare a JCM manual to facilitate planning projects in the QC-LCCAP, and so that related parties have an understanding of the steps involved in utilizing the JCM subsidy scheme.

In this survey, the study team closely worked with Quezon City to develop proposals to introduce solar power systems, heat exchanging systems and high-efficiency boilers. For these projects, the JCM manual which outlines the specific process of formulating such projects and other necessary information was developed. This manual is thought to be useful in helping related parties to deepen their understanding necessary information related to JCM.

## 4.2 Structure of the JCM Manual

In the JCM Manual, the concepts JCM and its and features, projects, and the international consortium are explained. Since technical terms are highly used in this field, the manual was designed to be easier for readers with little experience with JCM. In addition, specific solar power and heat exchanger projects were used to make JCM easier to understand.

The structure of the JCM Manual is shown below.

1. Background
2. Introduction of JCM
    - Basic concepts of JCM
    - JCM stakeholders
    - JCM project cycle
    - Eligible projects under the JCM
    - JCM model projects
3. Technology examples
    - Waste heat recovery
    - High efficiency boiler
    - Solar PV power generation
4. Points for JCM project implementation
5. Future prospects
    - Expansion of JCM
    - Populirize JCM scheme

## 4.3 JCM Manual

See Appendix 3

## Chapter 5 Workshops, Trainings and Meetings

### 5.1 Overview

Through city to city collaboration between Osaka City and Quezon City, it was aimed to formulate a JCM Manual for the factory energy-saving and energy generation project, and to investigate the feasibility of low-carbon projects (in the fields of solar power and energy conservation). The results of each activity in this project are shown in the following table.

Table 36: Project Activities

| Activities | Date | Description |
|---|---|---|
| Kick off meeting in Osaka | 25th May | ・Kick off meeting with co-implementers and Osaka city to implement the study |
| The 1st field survey in Quezon | 4th-7th June | ・Meeting and discussions with EPWMD, Department of Environment and Natural Resources, and Department of Energy |
| The 1st city-to-city collaboration workshop in Kawasaki | 24th-29th July | ・Visit Osaka city and technology providers facility (heat exchanger and boiler factories)<br>・Visit the waste power generation facilities in Kawasaki city<br>・Share the issues on low carbon city development in Quezon |
| The 2nd field survey in Quezon | 21st-25th August | ・Meet with EPWMD on climate change action plan and future projects<br>・Site visits to textile factories and waste disposal facilities |
| Training in Japan | 20th October | ・Site visit to solar power generation facility<br>・Lecture on AIM model |
| The 3rd field survey in Quezon | 19th-25th November | ・First workshop in Quezon with EPWMD<br>・Survey of feasibility of introducing solar power systems to hotels, etc.<br>・Energy auditing of textile factories |
| The 2nd City-to-City Collaboration Workshop (Tokyo) | 29th-31st January | ・Role of city to city collaboration and progress of this study |
| The 4th field survey in Quezon | 9th-5th February | ・Report the progress of the study<br>・Capacity building of Quezon City officials, in regards to JCM |

### 5.2 The 1st and 2nd Field Surveys

A kickoff meeting and factory tour was held in Quezon, with Quezon city officials (from EPWMD, the Department of Environment and Natural Resources, and the Department of Energy) and related parties from Japan (Osaka City, Oriental Consultants, Yuko-Keiso, Japan Textile Consultants Center, and Nippon Thermoener) in attendance.


Figure 27: Department of Energy (Philippines)

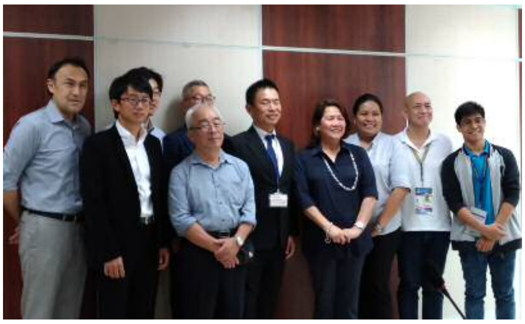

Figure 28: Quezon City Hall

## 5.3 The 1st City-to-City Collaboration Workshop

### 5.3.1 Overview

The workshop was organized by MOE on 27~28 July, 2017 in Kawasaki, Japan. Together with the workshop, a training course and site visits were held in Osaka also.

Table 37: Invited guests

| Name | Position |
|---|---|
| Mr. Vinarao, Vincent Ferdinand Paul Gonzales | Acting Chief, Plans and Programs Development Division, Quezon City |
| Mr. Isidro, Luisito Bulaong | Property/Supply Officer, Quezon City |
| Mr. Capili, Joemar Villaspin | Planning and Research Officer, Quezon City |

### 5.3.3 Training Course in Japan

#### 5.3.3.1 Visiting Osaka City Hall

Officials from Quezon City were invited to Osaka, and the Osaka City officials introduced the role of Osaka City and the efforts of the city-to-city collaboration thus far. Quezon City introduced their efforts towards becoming a low-carbon city and energetically exchanged opinions on the efforts of both cities

#### 5.3.3.2 Visiting Heat Exchanger Factory

The delegates together with the study team members visited the factory of Kurose Co., Ltd, the heat exchanger provider. Delegates came to understand the production process of spiral type exchanger and its features. The spiral type heat exchanger is widely applied in Japan for textile factories and sewage treatment factories as it has a nature of being easy to open and clean, virtually no fouling and clogging.


Figure 29: Factory of Kurose (Heat Exchanger)

#### 5.3.3.3 Visiting Boiler Factory

The participants also visited the factory of Nippon Thermoener Co., Ltd. the high efficiency boiler provider. The factory is engaged in manufacture and sales of boilers and has provided highly efficient boilers, such as steam boilers, hot-water heaters, and heat medium boilers, and energy-saving and environmentally friendly equipment and systems as well.

During the visit, the participants also had an opportunity to have discussions with factory staff.


Figure 30: Discussions in the Plant of Boiler

## 5.4 Training in Japan organized by Osaka City (October)

### 5.4.1 Overview

The training course was conducted on the 20th of October 2017 in Osaka. In order to see an example from Japan, Quezon City officials visited Osaka Hikari no Mori solar power generation facility. Additionally, specialists from the Institute for Global Environmental Studies, E-Konzal, and Ritsumeikan University were invited to present about the AIM method and the formulation of climate change scenarios.

Table 38: Invited Guests

| Name | Position |
|---|---|
| Ms. Andrea Valentine Po | Assistant Department Head, Environmental Protection and Waste management Department, Quezon City |
| Ms. Vanessa Vinarao | Senior Environmental Management Specialist, Quezon City |

### 5.4.3 Details of Training Course in Japan

#### 5.4.3.1 Mega Solar Site Visit

The delegates from Quezon City visited a mega solar facility (Osaka Hikari no Mori). The solar facility is a public-private partnership project cooperated by Osaka City and private enterprises, and it is a case where a reclaimed waste disposal site is effectively utilized. Quezon City also showed high interest in the effective utilization of reclaimed waste disposal sites and the introduction of solar energy, and opinions were exchanged on the details of this project.

Figure 31: Site Visit to Osaka Hikaro no Mori

#### 5.4.3.2 Formulation of Climate Change Scenarios

Specialists from the Institute for Global Environmental Studies, E-Konzal, and Ritsumeikan University were invited to present about the AIM method and the formulation of climate change scenarios. Officials from the City of Osaka also presented the city's climate change action plan. The officials from Quezon City showed a great deal of interest in the AIM simulation and asked many questions and expressed an interest in utilizing it in Quezon.

Figure 32: Training at Osaka City Hall

### 5.5 The 3rd Field Survey

#### 5.5.1 Overview

A kickoff workshop and reports of the survey on the feasibility of implementing solar power systems and theresults of the energy auditing were shared during the 3rd field survey in Quezon (November 19-25, 2017). In attendance were officials from EPWMD, the Department of Environment and Natural Resources, and the Department of Energy, Osaka City, Oriental Consultants, Osaka Water & Environment Solutions Associations, and contractors from the field of green building in the Philippines.

Figure 33: 1st Workshop

The workshop agenda was as follows:

Workshop on the Promotion of Low Carbon Development in Quezon City
under the City to City Cooperation between Quezon and Osaka
Jointly Organized by Quezon City, Osaka City and Oriental Consultants.

Date: November 20th, 2017, 8:30-11:35
Venue: Quezon City Conference Room
Language: English

The objectives of the workshop were to:

1) share information and knowledge on the renewable energy, especially in solar power generation and industry energy saving practices by introducing JCM projects
2) share information on the potentiality of industry energy saving and renewable energy in Quezon City for future JCM projects
3) share information on the progress of low carbon city development in Quezon City and Osaka City, and discuss future prospects for low carbon and environmentally friendly society.

Programme

| | |
|---|---|
| 8:30-8:50 | <Opening Remarks><br>◆ "Opening Remarks" by Environmental Protection and Waste Management Department (EPWMD)<br>◆ "Opening Remarks" by Osaka City |
| 8:50-9:45 | <Presentations ><br>◆ "Progress on low carbon development and prospects of activities based on CCAP" by EPWMD<br>◆ "Osaka City Initiatives on Climate change" by Osaka City<br>◆ "Osaka City international cooperation in environmental areas" by Osaka Water and Environment Solutions assosiation |
| 9:45-10:00 | Photo and Break |

| | |
|---|---|
| 10:00-11:00 | <Presentations ><br>◆ "Philippines support and potential projecs" by Climate Change Division, Department of Environment and Natural Resources, Philippines<br>◆ "Japan's support for low carbon projects in Asian cities" by Institute for Global Environmental Strategies, Japan<br>◆ "Outline of energy saving and renewable energy feasibility study in this fiscal year and introduction of JCM scheme" by Oriental Consultants<br>◆ "Renewable energy and energy saving potential in Philippines" by Department of Energy, Philippines |
| 11:00-11:30 | <Discussion> |
| 11:30-11:35 | <Closing Remark><br>◆ "Closing Remarks" by Director, Oriental Consultants |

### 5.6 2nd City to City Collaboration Workshop

#### 5.6.1 Overview

The workshop was organize by MOE on the 30th of January, 2018 in Tokyo, Japan. In addition to the workshop, discussions regarding the JCM model project were held.

Table 39: Invited Guests

| Name | Position |
|---|---|
| Mr. Joemar V. Capili | Quezon City, Planning and Research Officer |
| Mr. David John S. Vergara | Quezon City, Planning and Research Officer |

#### 5.6.2 Details of the Workship

An overview and the future schedule of the JCM project were explained and discussed.

### 5.7 4th Field Survey

#### 5.7.1 Overview

The 4th Field Survey was held February 5th-9th, 2018 and the results of the survey and proposals for future plans were presented. In attendance were related parties from the Philippines (from EWPMD, the Department of Environment and Natural Resources, the factory, the hotel, and companies related to plant maintenance) and Japan (Osaka City, Tokyo Century, companies in the field of solar power, and Oriental Consultants).

The workshop agenda was as follows:

2nd Workshop on the Promotion of Low Carbon Development in Quezon City
under the City to City Cooperation between Quezon and Osaka
Jointly Organized by Quezon City, Osaka City and Oriental Consultants.

Date: February 6th, 2018, 9:00-11:35
Venue: Quezon City Conference Room
Language: English

The objectives of the workshop are to:

4) share information and knowledge on the renewable energy, especially in solar power generation and industry energy saving practices by introducing JCM projects
5) share information on the potentiality of industry energy saving and renewable energy in Quezon City for future JCM projects
6) share information on the progress of low carbon city development in Quezon City and Osaka

City, and discuss future prospects for low carbon and environmentally friendly society.

Programme

| | |
|---|---|
| 9:00-9:15 | <Opening Remarks><br>◆ "Opening Remarks" by Environmental Protection and Waste Management Department (EPWMD)<br>◆ "Opening Remarks" by Director, Oriental Consultants |
| 9:15-10:00 | <Presentations ><br>◆ "Outcome of the feasibility study in this fiscal year " by Oriental Consultants<br>◆ "Introduction to Tokyo Century and JCM model project in Philippines" by Tokyo Century Corporation, Japan |
| 10:00-10:15 | Photo and Break |
| 10:15-11:00 | <Presentations ><br>◆ "Osaka City Initiatives on Climate change" by Osaka City<br>◆ "Expectation and potential projects on low carbon development along CCAP" by EPWMD |
| 11:00-11:30 | <Discussion><br>Topics: Potential projects on low carbon development along CCAP<br>Sector: Energy saving, renewable energy, transportation, waste and water management |
| 11:30-11:35 | <Closing Remark><br>◆ "Closing Remarks" by Osaka City |

In the proposal for future activities, Osaka City proposes that the two cities collaborate to develop a list of JCM and other projects based on the QC-LCCAP. Also, GHG reduction simulations should be run using the AIM method. Also, as requested by Quezon City, the methods of calculating and evaluating GHG emission volumes were examined during workships and trainings, and surveys for the implementation of JCM model projects were proposed.

It was also confirmed that in order to continue Quezon City's low-carbon efforts, it was planned to sign a Memorandum of Understanding in 2018 and continue with the city to city collaboration.

## Chapter 6 Future Tasks and Proposals

This survey conducted a feasibility study on the potential JCM projects, which introduce solar power and waste heat recovery systems to textile factories. The survey examined renewable energy and energy-saving potential, economic feasibility, and business models.

Quezon City is actively working on photovoltaic power generation projects and it is planned to introduce solar panels to high schools in Quezon City. In addition, there are many sites with potential for the implementation of solar panels in the city and surrounding factories. Although the timing of bidding for solar power implementation at high schools is still undecided, based on the survey results of the solar introduction survey of the high school and the factory surveyed this fiscal year, it can be considered that it is possible to formulate JCM model projects.

Factory A, the target of this detailed survey, was less conscious of energy conservation at the beginning of energy auding, but this survey made it possible for them to visualize the amount of saving of coal, as a result, the company developed high interest in the project's implementation. Their previous boilers have also frequently failed, so they are interested in Japan-made boilers. Utilizing the JCM subsidy scheme, the factory can obtain subsidies of up to half needed investment, so the are seriously considering the possibility of formulating a JCM project. As previously mentioned, we believe that it will be possible to create projects in Quezon City and across the Philippines in the future by clearly indicating the coal saving effect by energy saving and the economic profitability using JCM for relatively wealthy factories .

The challenge found through this project is that of increasing the awareness of JCM. Currently, JCM has not caught the attention of many local companies and organizations. However, various organizations, including the Department of Energy of the Philippines and the United Nations organization, hold seminars for domestic companies in the Philippines, and by expanding JCM's success stories and benefits through these organizations, it is thought that the number of JCM projects can be increased. In this fiscal year's workshop, not only the introduction of Japanese technology but also the explanation of the JCM scheme itself was thoroughly conducted, and devised to deepen the understanding of local companies and organizations to JCM.

Moving forward, in order to begin implementing Quezon City's QC-LCCAP, further energy-saving and renewable energy projects related to climate change need to be packaged as JCM projects through collaboration between Osaka City and Quezon City. The JCM Manual created this fiscal year shows how to proceed with solar energy and waste energy recovery systems. It is aimed that as this project progresses, more related parties will become aware of JCM and the JCM scheme will come to be commonly used.