MOEJ

Final Report

City-to-City Collaboration between Osaka and Quezon

Support for Low Carbon Promoting Projects through Intercity Cooperation between Osaka and Quezon (Promotion of Energy Saving and Fluorocarbon Management Measures)

March 2020

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Osaka City

Table of Contents

Tables and Figures

Chapter 1 Study Outline

1.1 Background of the Study

The Philippines is one of the countries deemed most vulnerable to climate change and the impact of natural disasters such as typhoons, floods, and landslides. The Government of the Philippines has been formulating the National Climate Change Framework Strategy (NFSCC) since 2010, in order to build adaptation capacity for responding to climate change and optimize the activities of climate change mitigation for sustainable development by 2022. Renewable energy is positioned as a pillar of mitigation measures in the NFSCC and the three 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. In 2011, in order to materialize an action program based on the national strategy, the National Climate Change Action Plan (NCCAP) was formulated. The need for strengthening sustainable energy development is stated within this plan. In addition, a reduction of greater than 70% of the BAU scenario 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, the bilateral document to start the Joint Crediting Mechanism (JCM) was signed in the presence of Prime Minister Abe and H.E. President Duterte during the Japan-Philippines Summit in January 2017.

JCM facilitates diffusion of leading low carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions, and contributes to sustainable development of developing countries on a global scale.

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, a joint committee is to be established; 2) each country understands that each country can claim a portion of the greenhouse gas emissions reduced through JCM projects for when they claim their contributions to climate change mitigation internationally.

The Joint Committee (JC) considered the draft Joint Crediting Mechanism Guidelines and adopted it in February 2018, which facilitates formulation and implementation of JCM projects in the Philippines. To promote GHG mitigation, the Ministry of the Environment of Japan has started the scheme of the subsidized project for collection and destruction of Alternative Fluorocarbons in JCM member countries utilizing JCM scheme.

In the Philippines, Quezon City has the largest area in Metro Manila. As the population increases, issues arise in association with 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 in the city. Under the former mayor's initiative, Quezon City developed a local climate-change-action-plan, including the introduction of solar panels and LED for public schools. In addition, the Quezon City Government implemented its Green Building

Ordinance, and has published its evaluation and certification on the website. Besides, Quezon City has joined C40 (C40 Cities Climate Leadership Group) for tackling-climate change. However, lack of finance and technologies hinder effective initiatives.

Osaka City had started a waste management project together with Quezon City since 2015. To strengthen the cooperative relationship between the two cities, Osaka City has supported the formulation of Quezon City Climate Change Action Plan and the formulation of JCM projects with the help of Oriental consultants Co., Ltd.

1.2 Purpose of the Survey

Most of the fluorocarbons are used as refrigerants in air conditioning equipment. Therefore, it is important to provide climate-friendly, energy-efficient and proven alternatives to avoid the use and emissions of fluorocarbons. At the same time, appropriate recovering and destructing fluorocarbons in the existing equipment promises efficient GHG emission reduction. The survey aims to support low carbon development in Quezon City through formulating and facilitating potential JCM projects regarding promoting energy efficient air conditioners, and recovering and destructing fluorocarbons by targeting and conducting the following activities.

1. To collect information and discuss a project plan regarding promotion of AC equipment in Quezon City.
2. To observe current situation of fluorocarbons collection, recovery and destruction in the Philippines and discuss fluorocarbons collection, recovery and destruction model.
3. To support implementation of Quezon City Climate Change Action Plan
   - To confirm the status of climate change mitigation measures, implementation systems, and policies.
   - To share knowledge and information of Osaka City on the policy formulation and project implementation through capacity building workshops.

1.3 Survey Implementation Structure

1.3.1 Outline of Implementation Structure

The implementation structure of the survey is as follows: Oriental Consultants, as the representative implementer of the survey, closely works with Osaka City and Quezon City Government-Environmental Protection and Waste Management Department (EPWMD), who serve as co-implementers of the survey.

The following figure shows the implementation structure of this project while the following table shows the roles of the participants.

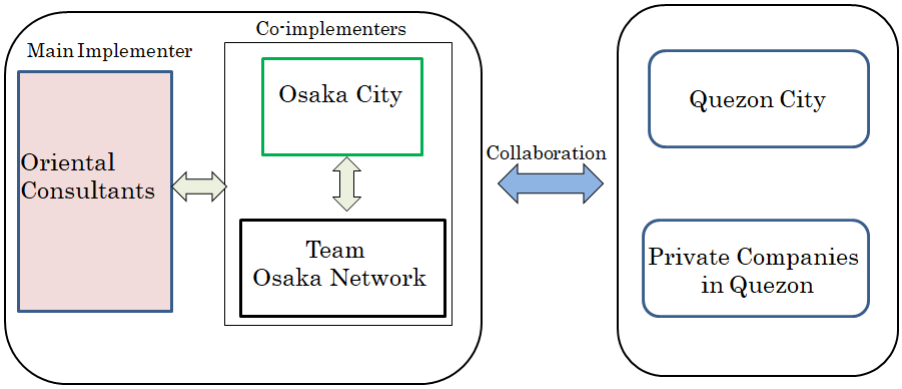


Figure 1-1 Survey Implementation Structure

Table 1-1 Roles of Participants

Role	Co-implementers	Tasks
Main implementer	Oriental Consultants Co., Ltd.	Coordinator and survey implementer Developing business models and MRV for potential JCM projects
Adviser	Global Environment Centre Foundation (GEC)	Advisory entity pertaining to the framework of collaboration with Team Osaka Networks and local stakeholders
Technical adviser on air conditioning	Team Osaka Network	Technical adviser relating to AC and fluorocarbon recovery and destruction
Technical adviser on fluorocarbon collection and destruction	Companies related to fluorocarbon recovery and destruction	Technical adviser on the fluorocarbon recovery and destruction model development
Adviser on financing	Tokyo Century Corporation	Adviser on the financial aspects of JCM projects such as loans and other financial services for project owner to implement a JCM project

1.3.2 Team OSAKA Network

Team OSAKA network is a platform, which facilitates the collaboration of enterprises holding environmental technologies in the Kansai Region with the municipal government, Global Environment Centre Foundation (GEC) and universities for developing projects, which promote low-carbon societies in different Asian cities. Through collaboration activities, Team OSAKA Network aims to expand businesses overseas, revitalize the economy of the Kansai area, and signify the contribution and participation of Japan in the area of international environmental conservation. In this survey, Team OSAKA Network provides a platform for sharing information related to JCM projects in Quezon and up to date low carbon technologies.

1.4 Workshops, Trainings and Meetings

Through City-to-City Collaboration between Osaka City and Quezon City, the survey assisted Quezon City on their update to climate change policy, and investigated the feasibility of low-carbon projects (in the fields of energy efficient AC technology promotion and fluorocarbon collection, recovery and destruction). The activities in this survey are shown in the following table.

Table 1 -2 Project Activities

Activities	Location	Date	Description
The 1st field survey	Quezon	13-22Nov	・Meeting with POD, Delsa,and Holcim
The City-to-Ccity Collaboration workshop	Tokyo	16-17 Jan	・Introduction to City to City Collaboration ・Site visits
The 2nd field survey	Quezon	20-24 Jan	・Meeting with POD, Delsa,and Holcim
The 3rd field survey	Quezon	3~8 Feb	・Workshop with EPWMD and POD ・Report the progress of the feasibility studies

Chapter 2　Support for Quezon City's Local Climate

2.1　Overview of Quezon City

Metro Manila, as the fifth largest metropolitan in the world, consists of 16 cities and 1 municipality, and is the center of politics, economy, culture, transport, and information with a population of 22.9 million as of 2016. Quezon City is the most populous and largest city in Metro Manila. As the population increases, issues in association with urban 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. The city is actively working with businesses in the environmental conservation 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. In addition, the city joined C40 Cities Climate Leadership Group as the leading actor for tackling climate change.

Figure 2-1 Map of QuezonCity

2.2　Efforts toward Climate Change Issues in Quezon City

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

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

Table 2-1 Overview of Quezon City Local Climate Change Action Plan

Effects / events due to climate change	Adaptation and Mitigation	Goals
· Frequent occurrence and severity of abnormal weather (typhoons, storm surges, floods, heavy rain) · Change in precipitation pattern · Temperature rise	1.Food safety	· In order to adapt to climate change, improve knowledge on food preservation and food safety · Improve use, supply stability, and accessibility of safe and healthy food
	2. Stable supply of water	· Sustainable, safe, adequate supply of water · Evaluation of water management · Improvement of sanitation infrastructure
	3. Ecological and environmental stability	· Development of adaptive capacity of local governments and communities · 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) · Promotion of construction of homes and services for climate change adaptation · Construction of adaptive capacity of local governments and communities
	5. Smart Industry service that contributes to climate issues	· Promotion of infrastructure development with strong climate change tolerance in Quezon City · Implementation of environmentally friendly solid waste management for mitigation and adaptation of climate change · Setting the scope of greenhouse gas emissions
	6. Sustainable energy	· Use of sustainable, renewable energy and energy-saving technologies (main components of sustainable development) · 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 · Adaptation/mitigation of climate change at local and community level · Improvement of skill relating to mitigation of disaster risk · Establishment of system related to gender and climate change, in order to educate Quezon City residents · Establishment of climate change countermeasure network sharing good practices and other resources

Quezon City is implementing with the plan through advancing various projects, including the follows.

1. Biogas power generation at landfill site
2. Introduction of solar power generation to public facilities
3. Introduction of LED to streetlights
4. Introduction of EV to Quezon City government
5. Promotion of energy saving in the industrial sector
6. Promotion of solid waste management

2.2.2 Actions towards Low Carbon Society

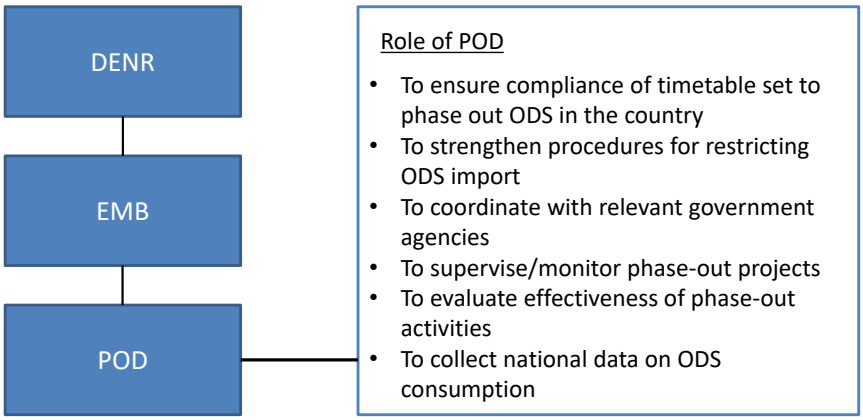
To concretize our efforts, there are four actions to be implemented by 2030 to achieve CO2 emission reduction under the LCS scenario: 1) Green Energy, 2) Sustainable Economy, 3) Smart and Eco Friendly Lifestyle, and 4) Clean and Smart Transport.

1. Green Energy – Pilot Solar Power Facility in Commonwealth HS and 50 public schools, WTE
2. Sustainable Economy – waste heat recovery in factories
3. Smart and eco friendly lifestyle – led lighting, solar water heater
4. Clean and smart transport – diffusion of fuel efficient vehicles and promotion of e-vehicle s..

2.3 Environment Conservation Initiatives

2.3.1 Philippine Ozone Desk (POD)

In 1993, the Philippine Ozone Desk (POD) was established to facilitate and coordinate ozone-depleting substances (ODS) phase-out projects and policies for the overall implementation of the country's obligations under the Montreal Protocol. The POD is under the Environmental Management Bureau, an attached agency of the DENR



Source: DENR Administrative Order No.2003-43

Figure 2-2 Philippine Ozone Desk Functions

2.3.2 About EPWMD

Established in 2000, Quezon City EPWMD is obliged to improve the health and the living environment of citizens, prevent environmental pollutions, and promote efficient waste collection and treatment. The department is responsible for development and management of comprehensive environmental protection programs including waste collection services.

The planning department of the EPWMD is responsible for GHG inventory development for Quezon City, which received support for capacity building on inventory development from USAID under the 'Climate Change/Clean Energy Project. They also have conducted a rooftop solar power generation initiative under the collaboration with the German Corporation for International Cooperation GmbH (GIZ). EPWMD, as the counterpart of the survey, has supported to the study team through providing related data/information and coordinating field works.

Chapter 3 Feasibility Study on Air Condition Promotion

3.1 Current Status of Air Conditioning System in the Philippines

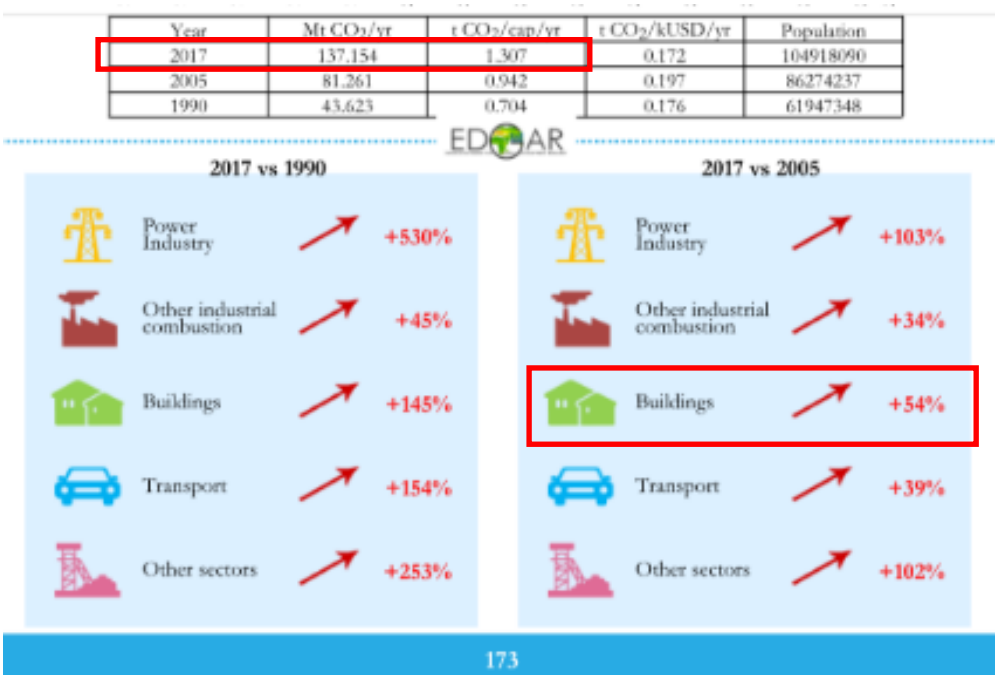
3.1.1 Current Status of GHG Emission in the Philippines

According to the statistical data published by EuroStat, the Philippines' GHG emissions in 2017 were 137Mt-CO2 and dominated by energy and transportation sectors. GHG emissions from household sector were increased by 54% comparing to the year 2005.

With nearly 5% GDP growth rate, housing demand is likely to increase and reducing GHG emissions from the sector becomes urgent.

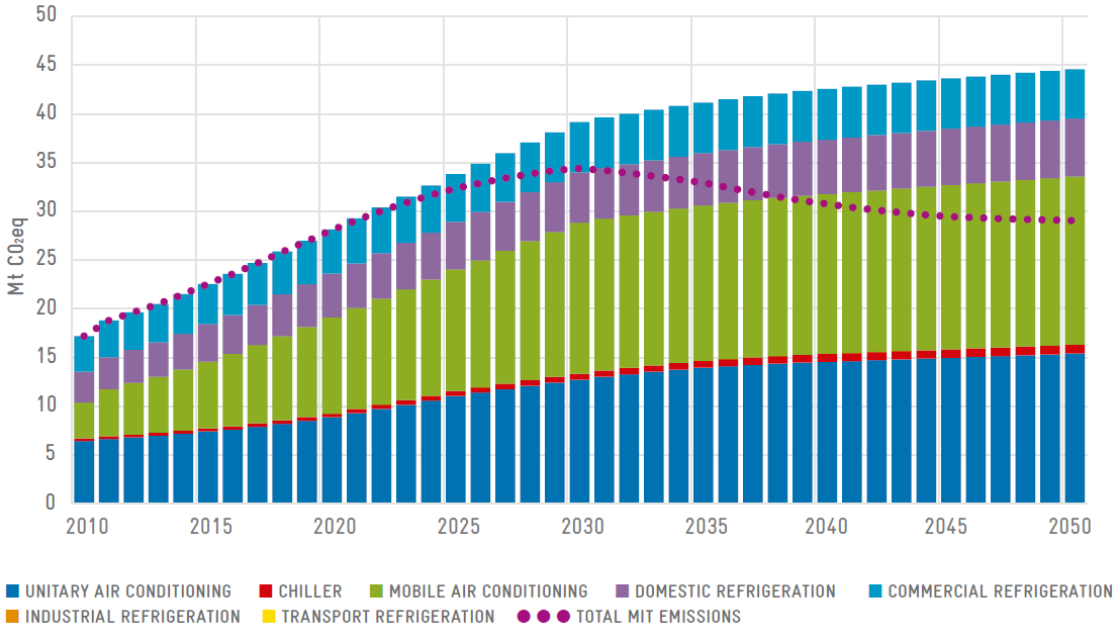
According to the report published by GIZ in 2019, refrigeration and air-conditioning equipment shared 18% (24.7 Mt-CO2) of the total GHG emissions. With the increase in demand for refrigeration and air-conditioning equipment, GHG mitigation from the source becomes urgent.

With the business-as-usual scenario, GHG emissions from refrigeration and air-conditioning equipment by 2050 are believed to reach 44.6 Mt CO2/year. Therefore, it is necessary to encourage people to buy high efficient air conditioning equipment or replace old ones with high efficient air conditioning equipment which include air conditioners with inverters.



Source: EU publications

Figure 3-1 CO2 Emission Trend of Fossil Fuel



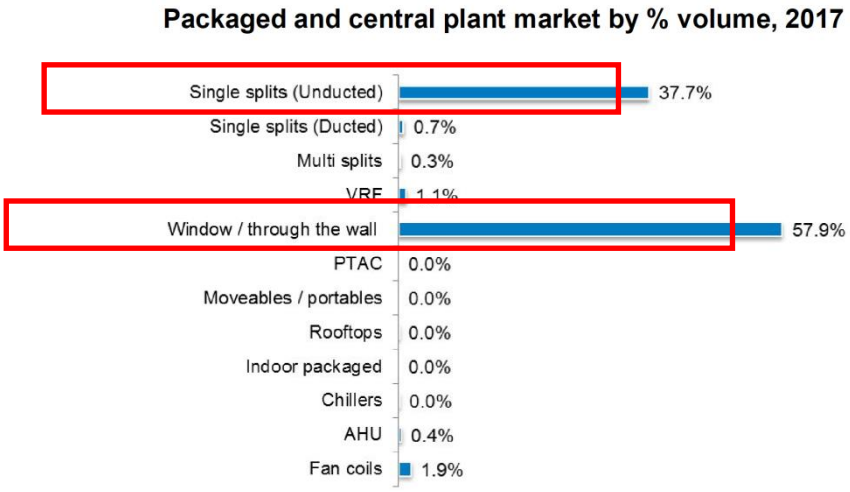
Source: GIZ 2019

Figure 3-2 Estimation of GHG Emissions from Refrigeration and Air-conditioning Equipment by 2050

3.1.2 The State of Air Conditioning Equipment Market

（1） Market Situation

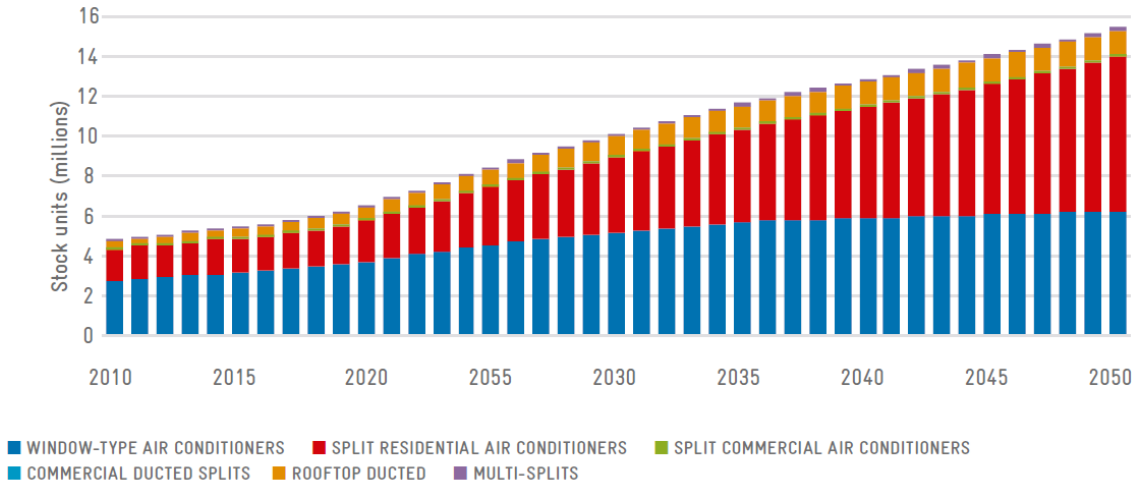
According to the report from BASRIA, among the total number of air conditioners, window type accounts for 57.9% and single split 37.7%. They have dominated the Philippines' air conditioner market.



Source: BASRIA

Figure 3-3 Type Wise Market Share of Air Conditioners

According to GIZ's report, the demand for air conditioning equipment in the Philippines is increasing, and split type air conditioners will become a mainstream replacing the current dominant window type air conditioners.



Source: GIZ 2019

Figure 3-4 Air Conditioners Inventory and Estimated Numbers by 2050

（2） Air Condition Makers Market Share

According to the information provided by Japanese air conditioner manufacturers, in 2017 the market share of Carriers was 40% followed by Panasonic 18% and Daikin 13%.

In type wise, Carrier shared 20% while Panasonic 16%, and Daikin 13%. Daikin secured the top in VRV showing Japanese companies are gaining the market share in specific types.

Table 3-1 Market Share of Air Conditioner Manufacturers (2017)

	Room Air Conditioner (Split)	Rooftop Air Conditioner	VRV	Portable Air Conditioner	UP Turnover TTL
Carieer	20%	33%	—	37%	40%
Daikin	13%	21%	40%	21%	13%
Panasonic	16%	10%	—	—	18%
LG	11%	—	14%	—	8%
Samsung	10%	—	6%	—	—
Koppler	—	29%	—	24%	16%
Mitsubishi	—	—	26%	—	—
Toshiba Carrier	—	—	7%	—	—
Trane	—	—	—	16%	—
Others	30%	6%	7%	2%	2%
TOTAL	100%	100%	100%	100%	100%

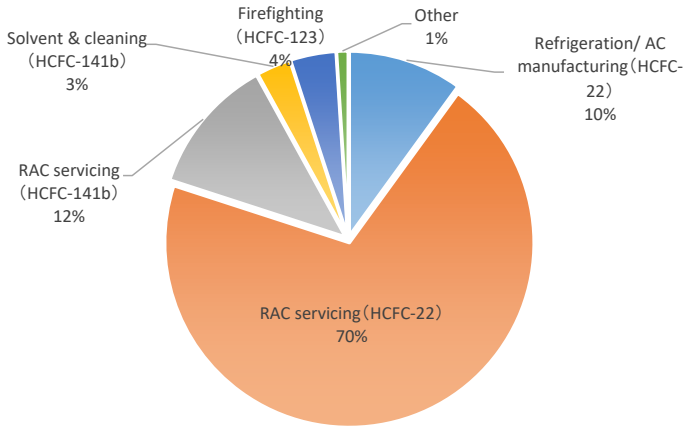
Source: Japanese Manufacturers

（３） Air Conditioners' HCFC Consumption

According to UNEP's report[1] on the fluorocarbon consumption of refrigeration and air conditioning equipment, the total consumption of HCFC in 2016 was 114.85 ODP (Ozone Depletion Potential), of which 82% was for the purpose of refrigerant use. The rest of nearly 10% was from the process of production of refrigeration and air conditioning equipment.

Therefore, it is important to provide climate-friendly, energy-efficient air conditioners which use alternatives refrigerants.

※The amount of refrigerant contained in the imported air-conditioning equipment has not been known in the Philippines. (POD: Philippine Ozone Desk)



Source: UNEP 2017

Figure 3-5 Sector Wise HCFC Consumption (2016)

3.2 Potential JCM Projects

3.2.1 Determination of Target Facilities

（１） Viewpoints

As mentioned previously, the demand for energy-efficient air conditioning equipment is increasing in the Philippines. Meanwhile, Quezon City is promoting energy conservation measures in industry sector and public facilities. Thus, energy saving concerning air conditioning systems in such public facilities becomes increasingly accentuated.

Quezon City, the former capital of the Philippines, has the largest area in Metro Manila. As many large scale shopping malls such as Gateway Mall, SM City Sta. Mesa are located in the city, they can be candidate facilities together with public facilities like Quezon City Hall, Quezon City General Hospital, Moclang Hospital. The survey identified the target facilities among the candidates based on the following criteria.

- Exemplariness and replicability
- Availability of specifications of the existing air conditioners
- Old type air conditioners from which the recommended technology can promise energy saving
- High energy consumption and ensuring high energy saving
- Large in numbers and ensuring scale economy

（２） Result of the Selection

In Japan, public facilities such as city halls which is visited by many citizens and users, are inclined to be selected for exemplary projects.

In addition, public facilities are managed and monitored through facility registry books etc and information disclosure is also easy compared with private facilities.

As a result, the Quezon City hall office buildings are selected as the target facility for the survey project.

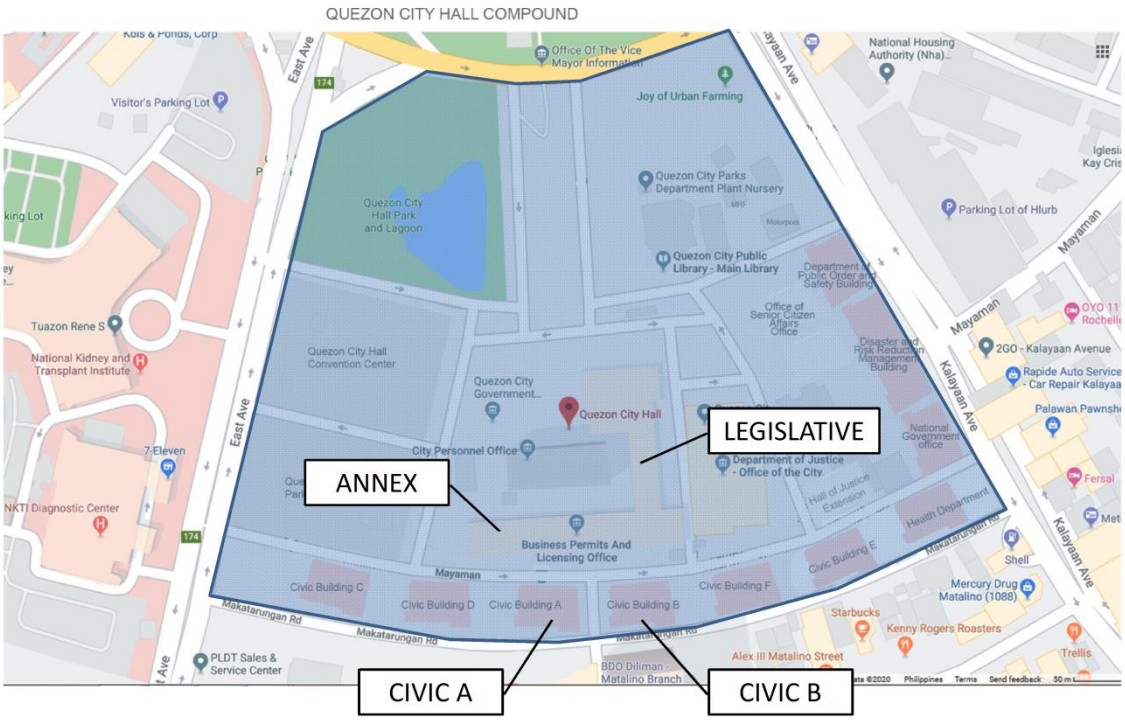
3.2.2 Overview of Quezon City Hall

（１） Building Identification

The table 3-2 shows the number of air conditioners in Quezon City Hall office buildings. Among the buildings, the building with the most old type air conditioners is CIVIC F following with HIGH RISE BUILDING and CIVIC D.

However, it was confirmed that these building were equipped with these air conditioners more recently (2017) and it is not necessary to replace with new ones. And the buildings which have old air conditioners are ANNEX, LEGISLATIVE, CIVIC A and CIVIC B. Therefore, the survey targeted the above four buildings, which have 531set air conditioners in total, of which window types are 3 sets, Floor mounted type 68 sets, and wall mounted type 98 sets and ceiling cassette type 333 sets.

CIVIC B
Old AC System



Source: Quezon City

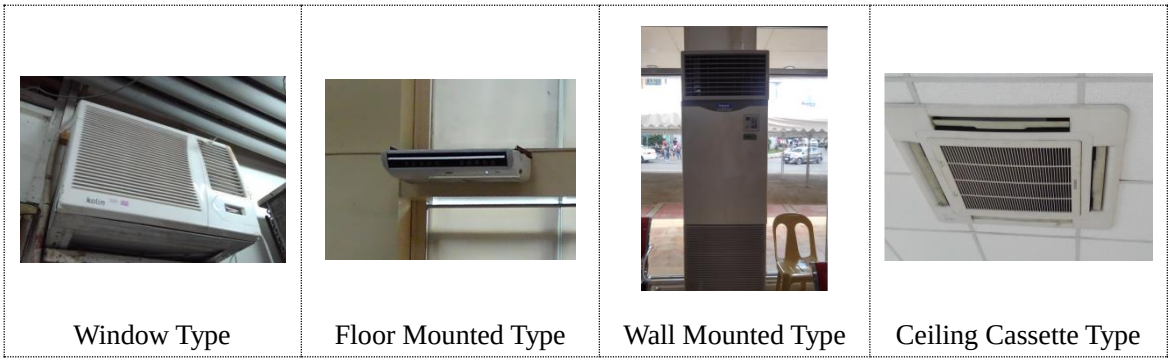
Figure 3 -6 Map of Quezon City Hall

Table 3-2 Building Wise Number of Air Conditioners

Building Name	Type of Air Conditioners				Total
	Window Type	Floor Mounted Type	Wall Mounted Type	Ceiling Cassette Type	
ANNEX	0	21	4	93	118
LIBRARY	1	1	1	24	27
NGO	0	0	0	51	51
HIGH RISE BUILDING	7	12	24	93	136
LEGISLATIVE	32	30	73	15	150
CIVIC A	0	7	12	110	129
CIVIC B	0	10	9	115	134
CIVIC C	5	0	0	61	66
CIVIC D	0	0	0	234	234
CIVIC F	0	0	0	244	244
DRRMO	1	2	7	35	45
DPOS	0	0	0	41	41
PARKING	1	0	0	0	1
YAKAP	2	0	0	0	2
MUSLIM	3	0	0	0	3
POLICE DETACHMENT	0	0	6	2	8
UNDERPASS	0	0	2	0	2
OSCA	8	0	1	0	9
HEALTH	2	2	1	0	5
MOTORPOOL	2	1	0	0	3
Total	64	86	140	1,118	1,408

※Yellow marked block refers to target buildings and air conditioners

Source: Quezon City



Window Type | Floor Mounted Type | Wall Mounted Type | Ceiling Cassette Type

Figure 3-7 Type of Air Conditions Installed in Quezon City Hall Buildings

（２） Target Air Conditioners

The 3-3 shows the number, type and refrigerant type of air conditioners in ANNEX, LEGISLATIVE, CIVIC A, and CIVIC B. Their specifications are described in the Appendix.

Table ３-3 Outline of Target Air Conditioners

Building Name	Type and Numbers	Makers	Refrigerants
ANNEX	Indoor：118 sets Indoor：80 sets Type: Ceiling cassette type	Mitsubishi Koppel Carrier	R-410a R-22
LEGISLATIVE	Indoor：150 sets Indoor：150 sets Type: Wall mounted type is dominant	Kolin Cariier LG	—
CIVIC A	Indoor：129 sets Outdoor：129 sets Type: Ceiling cassette type is dominant	Mitsubishi Koppel	R-22
CIVIC B	Indoor：134 sets Outdoor：140 sets Type: Ceiling cassette is dominant	Mitsubishi Koppel	R-22

（３） Quezon City Air Conditioner Procurement and Replacement Plan

During the survey, the following information has been confirmed.

- Around 50% of the air conditioners installed in the buildings of Quezon City Hall are non-inverter type air conditioners. There is a plan to replace them.
- The estimated cost for replacing the air conditioners is ※1 40,000 Philippine peso/set (85,200 JY※2) and it is planned to replace 550 sets with the cost of 22,000,000 peso (46,860,000 JY※2).(Notice: No budget has been allocated yet）。

  ※1 New

  ※2 Philippine peso=2.13 JY
- Currently, Quezon City is developing an inventory which includes specifications and number of air conditioners in all Government office buildings and plans to complete in March of 2020.

（４） Operating Condition

Based on the information from Quezon City, the operation hour of air conditioners is uniformly set to 8:00~17:00 (not include weekends). As air conditioners run all the year through, total annual operation hours can be estimated to be 9h*365 days=2,349h/year (Saturdays and Sundays in total are 104 days)

Regular checks are conducted once-every-four-months for cleaning, refrigerant refilling and fixing. Total budget for maintenance of the air conditioners is 3~4 million Philippine peso/year (6,390,000~8,520,000 JY ※).

※Philippine peso＝2.13 JY.

3.2.3 Recommended Technology (Air Conditioners)

As mentioned previously, the dominant types in the target buildings are split type room air conditioners and rooftop air conditioners. Among Japanese manufacturers since Daikin is maintaining its market share in the Philippines, the survey conducted studies based on the technical specifications of the Daikin's products as follows.

Table 3-4 Recommended Air Conditioners

Types	Floor Mounted Type	Ceiling Suspended Type	Ceiling Cassette Type
Indoor	FVA50AMVM	FHA50BVMA	FCF50CVM
Outdoor	RZF50CVM	RZF50CVM	RZF50CVM
Images			
Existing types	Floor mounted types	Wall mounted type Window type	Ceiling cassette type

Source: Daikin Air Conditioning Philippines Inc.

3.2.3 Potential Targets besides Quezon City Hall

（1） Public Facilities Outside of the City Hall

The city is developing inventories which include the number of air conditioners in all city owned facilities (It is planned to be completed in March 2020). The survey has confirmed that there are around 1,500 sets air conditioners need to be renewed. This replacement can be a potential JCM project.

（2） Other Public and Private Facilities

In Quezon City, there are many large shopping malls and hospitals. Energy saving initiatives on air conditioners in these facilities is believed to make a significant contribution to reduction of GHG emissions. Discussion of potential projects regarding the kind of facilities is not in the scope of this survey and can be a topic for next fiscal year's project.

3.3 MRV Methodology for GHG Emission Reduction and Monitoring

3.3.1 Summary of the Methodology

For developing a MRV methodology for the project under the survey, the following approved JCM methodology was referenced.

Table 3-5 Methodology References

Methodologies	Notice
ID_AM004 Installation of Inverter-Type Air Conditioning System for Cooling for Grocery Store VN_AM002 Introduction of room air conditioners equipped with inverters, Version 01.1	Installation of Inverter-Type Air Conditioning System for Cooling for Grocery Store Introduction of room air conditioners equipped with inverters

The terms and definitions regarding the proposed methodology are as follows.

Table 3-6 Terms and Definitions

Terms	Definitions
Inverter-type air conditioning system	A type of air conditioning systems equipped with inverters which help adjust the speed of the compressor motor in line with different load demand. While a compressor in a non-inverter-type air conditioning system runs either in maximum capacity regardless of load or stops, the inverter-type air conditioning system adjusts the power according to the temperature in the room so that promise electrical consumption reduction and saving energy.
Coefficient of Performance (COP)	The efficiency ratio of the amount of cooling provided by a cooling unit to the energy consumed by the system. The higher the Coefficient of Performance the more efficient the system. The values of cooling capacity/power and rated power consumption are defined according to the specific temperature stated in ISO 5151:2010.
Cooling capacity	Cooling capacity is the ability of air conditioning system to remove heat, calculated with amount of heat removed per unit time at specific temperature.

Table 3-7 Summary of the Methodology

Items	Summary
1. GHG emission reduction measures	2. This methodology applies to projects that aim for saving energy by introducing inverter-type air conditioning system for cooling in office buildings in Philippines.
3. Calculation of reference emissions	Reference emissions are the GHG emissions from power/electricity consumed by reference air conditioning systems and calculated based on the amount of power consumed by the project air conditioning systems, the ratio of COPs of project/reference air conditioning systems, and the CO_2 emission factor of electricity.
4. Calculation of project emissions	Project emissions are GHG emissions from the power/electricity consumed by the project air conditioning systems and calculated as per electricity consumption of installed inverter-type air conditioning system, and CO_2 emission factor of electricity.
5. Monitoring parameters	Power consumption of project air conditioning systems.

3.3.2 Eligibility Criteria

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

Table 3-8 Eligibility Criteria

Criterion 1	The methodology is applicable to the following types of projects: 1. Installation of inverter-type air condition systems to public sector buildings. 2. Replacement of existing non-inverter type air condition systems by the inverter-type systems in all types of buildings.
Criterion 2	Wall mounted type and/or ceiling cassette type system with COP higher than that of the value indicated in the table below.
Criterion 3	Ozone Depletion Potential (ODP) of the refrigerant used in the project technology is 0

Cooling Capacity (kW)	COP
$2.5 < x \leqq 4.1$	4.00
$4.1 < x \leqq 5.3$	3.59
$5.3 < x \leqq 7.1$	2.96
$7.1 < x \leqq 14.2$	2.85

	(zero).
Criterion 4	In order to prevent any leakage and release of refrigerant into the atmosphere at the time of removing the existing systems, a prevention plan and measures are required. Implementation of the plan and other prevention measures are checked and confirmed during verification.

3.3.3 Reference and Project Emissions

（1） Inverter Type Air Condition Introduction

Reference Emissions

Reference emissions are calculated based on the power consumption of project air conditioning systems, ratio of COPs of project/reference air conditioning systems, and the CO_2 emission factor of the electricity consumed.

To ensure the conservativeness of net emission reductions from introduction of the technology, the COP of the reference air conditioning systems is defined *ex ante* with the following concerns:

1. The COP tends to decrease as the cooling capacity increases.
2. The reference COP, at a certain cooling capacity, is set at a maximum value in the respective cooling capacity range.
3. The maximum values of COP in the respective cooling capacity ranges are defined as reference COP_{RE}.

Reference emissions are calculated as follows.

$$RE_p = \sum_i \left\{ EC_{PJ,i,p} \times \left(COP_{PJ,i} \div COP_{RE,i} \right) \right\} \times EF_{elec}$$

RE_p	Reference emissions during the period *p* [tCO_2/p]
$EC_{PJ,i,p}$	Power consumption of project air conditioning system *i* during the period *p* [MWh/p]
$COP_{PJ,i}$	COP of project air conditioning system *i* [-]
$COP_{RE,i}$	COP of reference air conditioning system *i* [-]
EF_{elec}	CO_2 emission factor of the electricity consumed [tCO_2/MWh]
i	Type of air conditioning system [-]

Project Emissions

Project emissions are calculated as follows.

$$PE_p = \sum_i EC_{PJ,i,p} \times EF_{elec}$$

PE_p	Project emissions during the period *p* [tCO_2/p]

$EC_{PJ,i,p}$	Power consumption of project air conditioning system *i* during the period *p* [MWh/p]
EF_{elec}	CO_2 emission factor of the electricity consumed [tCO_2/MWh]
i	Type of air conditioning system [-]

Emission Reduction

Emission reduction is the differences between the emissions of reference and project scenario. It is calculated as follows.

$ER_p = RE_p - PE_p$

ER_p	Emission reduction during period p [t CO_2/p]
RE_p	Reference emission during period p [t CO_2/p]
PE_p	Project emission during period p [t CO_2/p]

The source of each data and parameter

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

Table 3-9 Parameters Decided Ex-Ante

<table>
<tr><th>Parameters</th><th>Description of Data</th><th>Sources</th></tr>
<tr><td>EF_{elec}</td><td>CO_2 emission factor of the electricity consumed.
In the case of project air conditioning systems consume either grid electricity or captive electricity; the project applies the respective CO_2 emission factor of each.

If the project air conditioning systems consume both grid and captive electricity, the project participants apply the CO_2 emission factor with lower value.
[CO_2 emission factor]
For grid electricity: 0.5979* [tCO_2/MWh]
*The most recent Combined Margin (CM) emission factor of Luzon-Visayas grid where the project locates is applied unless otherwise instructed by the Joint Committee.
For captive electricity: 0.8** [tCO_2/MWh]
**The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.</td><td>[Grid electricity]
National Grid Emission Factor (2015~2017), National Committee on Clean Development Mechanism, Philippines.

[Captive electricity]
CDM approved small scale methodology AMS-I.A</td></tr>
<tr><td>$COP_{RE,i}$</td><td>COP of reference air conditioning systems as indicated in as below.
Regarding cooling capacity of reference air conditioners, specifications of respective type of air conditioners from manufacturers are applied.
Air Conditioning System ($COP_{RE,i}$)<table><tr><td>Cooling capacity (kW)</td><td>COP</td></tr><tr><td>2.5＜≦4.1</td><td>4.00</td></tr><tr><td>4.1＜x≦5.3</td><td>3.59</td></tr><tr><td>5.3＜x≦7.1</td><td>2.96</td></tr><tr><td>7.1＜x≦14.2</td><td>2.85</td></tr></table></td><td>JCM_ID_AM004
The default values should be revised if necessary from survey result which is conducted by JC or project participants every three years. The survey should prove the use of clear methodology.</td></tr>
</table>

$COP_{PJ,i}$	COP of project air conditioning systems The cooling capacity and rated power consumption used in the calculation of COP are provided by the manufacturer.	Specifications of project technology from the quotation or factory acceptance test data by manufacturer.

Result of Estimated Emission Reduction

Based on the proposed methodology, the emission reduction from the project activity is calculated with the conditions given as follows.

Table 3-10 Data and Conditions for Calculating Emission Reductions

Items		Value	Unit	Source
Number of existing ACs		531	Set	Quezon city
AC operating hours		2,349	hr/year	Quezon city
Project power consumption	Floor Standing（1 phase）	1.14	kW	Daikin's product catalogue
	Ceiling Suspended（1 phase）※	1.2	kW	
	Ceiling Cassette（1 phase）	1.23	kW	
	Floor Standing（1 phase）	1,607	kWh	Capacity* Operating hours*60% (Load factor)
	Ceiling Suspended（1 phase）※	1,691	kWh	
	Ceiling Cassette（1 phase）	1,734	kWh	
Reference AC's COP		3.59	－	Approved JCM methodology ID_AM004
Project AC's COP	Floor Standing（1 phase）	4.07	－	Daikin product catalogue
	Ceiling Suspended（1 phase）	4.17	－	
	Ceiling Cassette（1 phase）	4.39	－	
Electricity emission factor		0.5979	tCO2/ MWh	(IGES's List of Grid Emission Factors updated in Feb 2019) (Philippine Combined margin in 2018)

※ Including window type

【Reference Emissions】

$$RE_p = \sum_i \left\{ EC_{PJ,i,p} \times \left(COP_{PJ,i} \div COP_{RE,i} \right) \right\} \times EF_{elec}$$

RE_p	Reference emissions during the period *p* [tCO_2/p]	649
$EC_{PJ,i,p}$	Power consumption of project air conditioning system *i* during the period *p* [MWh/p]	1,607kWh 1,691kWh 1,734kWh
$COP_{PJ,i}$	COP of project air conditioning system *i* [-]	4.07 4.17 4.39
$COP_{RE,i}$	COP of reference air conditioning system *i* [-]	3.59
EF_{elec}	CO_2 emission factor of the electricity consumed [tCO_2/MWh]	0.5979 tCO2/MWh
i	Type of air conditioning system [-]	—

【Project Emission】

$$PE_p = \sum_i EC_{PJ,i,p} \times EF_{elec}$$

PE_p	Project emissions during the period *p* [tCO_2/p]	—
$EC_{PJ,i,p}$	Power consumption of project air conditioning system *i* during the period *p* [MWh/p]	1,607kWh 1,691kWh 1,734kWh
EF_{elec}	CO_2 emission factor of the electricity consumed [tCO_2/MWh]	0.5979 tCO2/MWh
i	Type of air conditioning system [-]	—

【Result】

Table 3-11 Estimated Emission Reduction

Scenarios	Emissions
Reference Emission	649 tCO2
Project Emission	542 tCO2
Emission Reduction	107 tCO2

（２） Emission Reduction from HFC Recovery and Destruction

Reference Emission

Reference emission is calculated asper the type and amount of refrigerant used in the existing air conditioners based on the following equation.

$$RE_p = \sum_i FL_{R,i,p} \times GWP_{HFC}$$

RE_p	Reference emission [tCO2/p]
$FL_{RE,i,p}$	Quantity of refrigerant used in a reference air conditioner [kg]
GWP_{HFC}	Global Warming Potential of refrigerant used [tCO2/t]
i	Type of refrigerant [-]

Project Emission

Project emission is calculated as follows.

$$PE_p = \sum_i FL_{PJ,i,p} \times GWP_{freon}$$

PE_p	Project emission [tCO2/p]
$FL_{PJ,i,p}$	Quantity of refrigerant used in a project air conditioner [kg]
GWP_{freon}	Global Warming Potential of refrigerant used [tCO2/t]
i	Type of refrigerant [-]

Emission Reduction

The amount of Emission reduction is calculated as the difference of emissions of reference scenario and project scenario.

$ER_p = RE_p - PE_p$

ER_p	Emission reduction [tCO_2/p]
RE_p	Reference emission [tCO2/p]
PE_p	Project emission [tCO2/p]

The source of each data and parameter

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

Table 3-12 Parameters Determined Ex-Ante

Parameters	Description of Data	Source
$FL_{RE,i,p}$	Amount of refrigerant used in a reference air conditioner [kg]	Product catalogue/specifications. Or default value Approved JCM methodology ID_AM004
$FL_{PJ,i,p}$	Amount of refrigerant used in a project air conditioner [kg]	Product catalogue/specifications.

Calculation Result

The estimated reduction of CO_2 emission from the project activity is calculated based on the following conditions.

Table 3-13 Data and Conditions for Calculating Emission Reductions

Items	Values	Sources
Number of air conditioners	531 sets	Quezon City
Quantity of refrigerant used in reference air conditioners	HFC（R-410A）: 610.705 kg HCFC（R-22）: 1,673.4 kg	Quezon City
Quantity of refrigerant used in project air conditioners	HFC（R-32）: 637.2kg	Quezon City
Types of refrigerant used in	HFC（R-410A）、 HCFC(R-22)	Quezon City

reference air conditioners		
Types of refrigerant used in project air conditioners	HFC(R-32)	Quezon City
Global Warming Potential	HFC（R-410A）:1,924 HCFC(R-22):1,760 HFC(R-32)：667	IPCC AR5 Report (2015)

Quantity of Refrigerant in Reference Air Conditioners

The quantity of refrigerants used in the existing ACs is described as follows.

Table 3-14 Quantity of Refrigerant in Reference Air Conditioners

Building Name	Refrigerant Types	Quantity
ANNEX	HFC (R-410A)	268.9 kg
	HCFC (R-22)	322.9 kg
LEGISLATIVE	HFC (R-410A)	341.8 kg
	HCFC (R-22)	410.5 kg
CIVIC A	HCFC (R-22)	455.0 kg
CIVIC B	HCFC (R-22)	485.0 kg
Total	HFC (R-410A)	610.7 kg
	HCFC (R-22)	1,673.4 kg

Notice: Regarding LEGISLATIVE, due to lack of spec data, the average value of ANNEX is used.

Quantity of Refrigerant in Project Air Conditioners

The air conditioners in the project use HFC-32 (R-32) and quantity of R-32 is given as follows.

Table 3-15 Quantity of Refrigerant in Project ACs

AC Types	Refrigerant Type	Unit Quantity	Total
Floor Standing (1 phase)	HFC (R-32)	1.2kg	81.6kg
Ceiling Suspended (1 phase)	HFC (R-32)	1.2kg	156.0kg
Ceiling Cassette (1 phase)	HFC (R-32)	1.2kg	399.6kg

Emission reduction is calculated as follows.

Reference Emission

$$RE_p = \sum_i FL_{RE,i,p} \times GWP_{HFC}$$

RE_p	Reference emission [tCO2/p]	—
$FL_{RE,i,p}$	Quantity of refrigerant in reference ACs [kg]	HFC（R-410A）:610.75kg HCFC（R-22）:1,673.4kg
GWP_{freon}	Global Warming Potential [tCO2/t]	HFC（R-410A）:3,920 HCFC（R-22）:1,810
i	Type of refrigerant [-]	—

Project Emission

$$PE_p = \sum_i FL_{PJ,i,p} \times GWP_{HFC}$$

PE_p	Project emission [tCO2/p]	—
$FL_{PJ,i,p}$	Quantity of refrigerant in project ACs[kg]	637.2kg
GWP_{freon}	Global Warming Potential [tCO2/t]]	675
i	Type of refrigerants [-]	—

Project Emission

Table 3-16 Estimated Emission Reduction

Scenario	Emissions
Reference emission	5,423 tCO2
Project emission	431 tCO2
Emission reduction	4,992 tCO2

Total Emission Reduction

The emission reduction from the all project activities is concluded as follows

Table 3-17 Total Emission Reduction

Project Components	Emission Reduction
Inverter type AC promotion	107 t CO2
HFC recovery and destruction	4,992 t CO2
Project Components	Emission Reduction

The life expectancy of project air conditioners is 6 years and the total project cost is 22,000,000 peso (46,860,000JY). JCM project cost benefit ratio criteria is 4,000JY/t CO2 and then, the project cost benefit ratio is around ¥4,159/t CO2 which almost cleared JCM cost benefit requirement.

Without including the emission reduction contribution of HFC recovery project, the cost benefit ratio becomes 17,590JY/t CO2.

3.3.4 MRV System

It is recommended to implement JCM subsidy project under the product leasing business model in which the customer pays for continuous access to a product over an agreed period. The model allows integrating maintenance and monitoring activities into lease agreement so that facilitate project monitoring system which is required by JCM. Monitoring management system is established including installation of power meters.

3.4 Project Implementation Structure and Plan

3.4.1 Expected Project Implementation Entities

BPI Century Tokyo Lease & Finance Corporation: Representative project participant.

Daikin Airconditioning Philippines Inc.: Technology provider

Table 3-18 Project Implementation Structure

Roles	Participants	Notice
Customer	Quezon city	－
Representative participant Finance provider	Tokyo Century	• Member of Team OSAKA network • Holding substantial experiences on JCM project implementation • Share holder of BPI
Manufacturer	Daikin	• Member of Team OSAKA network • Holding a high market share in the Philippines

3.4.2 Discussion with Stakeholders

The discussions with stakeholders are conducted during the survey and are concluded as follows.

Quezon City (EPWMD)

Drive for project participation

- Nearly 50% of the air conditioners used in Quezon City Hall buildings belong to non-inverter type.
- Renewal cost is approx. 400,000 peso/set and total cost for the all air conditioners in 4 buildings is 22,000,000 Philippine peso (46,860,000 JY)

  ※Philippine peso＝2.13 JY
- Quezon City is developing an inventory which includes the number and types of air conditioners in all public facilities (It is planned to be completed by March 2020).

Procurement system

- Public procurement requires open tender.
- Quezon City fiscal year is from January to December. Budget proposal for next year is prepared before July and is approved by City Council during August to December.
- There is timing issue between open tender process and JCM application.
- In the case of PPP project, it allows Government looking over and accepting direct proposals from private companies and then making announcement to select the company (in the case of without other applicants, the proposed company would be chosen).
- Project conforming to City development program can be PPP project even without allocation).

BPI Century Tokyo Lease & Finance Corporation

JCM project implementation experiences

- Since 2018, the company has implemented two solar power generation projects (1.5 MW rooftop and 1.2 MW on grid). In 2019, the company was planning to implement 18MW mega solar JCM project.
- Leasing period for rooftop project is 9 years and for on grid project 17 years. The company reports MOE once a year on the project operation.
- It is necessary to tailor the leasing period with JCM project period. The company prefers leasing period less than 5 years.

Drive for project participation

- As a rule, for projects in the Philippines the leasing period is 5 years.
- Government organizations including Quezon City have no high credits from the financial institutions perspective.
- As BPI is holding 51% share of BPI Century Tokyo Lease & Finance. Private companies' participation in the project may help increase the credit of the project.
- Small scale projects are not preferable. At least 100 million JY scale projects is acceptable.

Monitoring

- It is necessary to conduct further discussions on developing monitoring system.

Daikin Airconditioning Philippines Inc.

Drive for project participation

- As a manufacturer it is difficult to the company to be JCM project participant. However, technology and maintenance service provision is ok.
- The company does not want to be a representative project participant as Government subsidy acquisition process is complicated and time consuming.

3.3.4 Project Implementation Structure and Plan

（１） Implementation Structure (draft)

The draft project implementation structure is depicted as follows.

Table 3-19 Expected Project Implementation Structure

Role	Participants	Responsibilities
Customer	Quezon city	• Operating air conditioners • Paying the lease payment agreed upon the lease agreement
Representative project participant Finance provider	Japanese leasing company	• Applying JCM subsidy project • Installation of air conditioners
Manufacturer	Japanese manufacturer	• Providing technology • Maintenance service

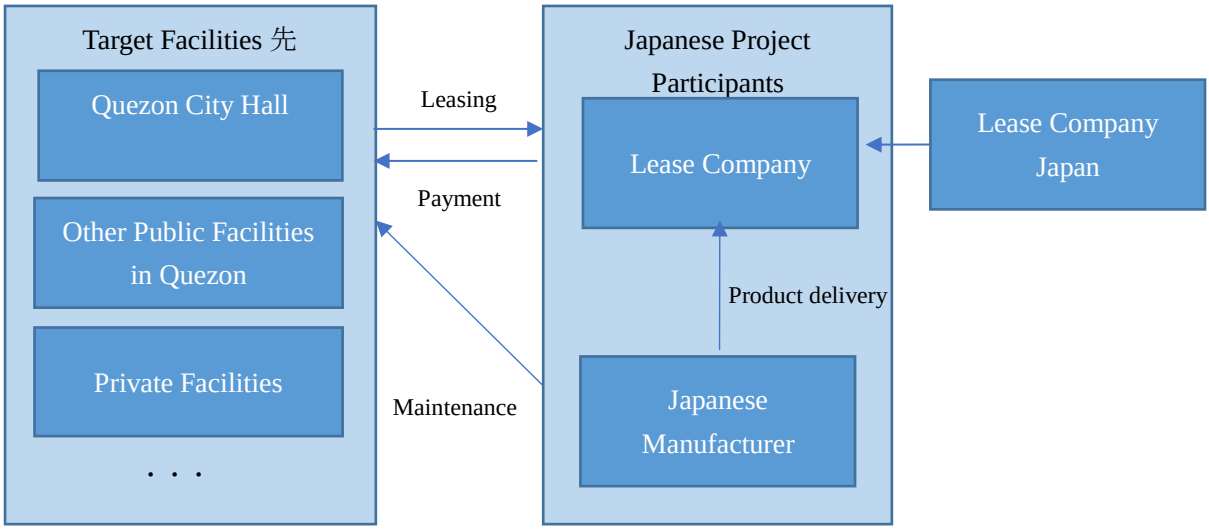


Figure 3-8 Expected Implementation Structure

（２） Project Implementation Plan

As targeting Quezon City Hall buildings alone does not reach the project scale required by JCM, it is necessary to expand the project by including other public facilities. Based on the result of inventory, integrating other public facilities into the project is considered. At the same time, private facilities also need to be taken into consideration for achieving project scale and CO2 reduction.

	2020			
	April	May	June	After July
Investigating other facilities				
Project scheme discussion				
Applying for JCM project				

3.5 JCM Manual Development

3.5.1 Overview

Quezon City has developed QC-LCCAP but there are parts where it is completed only by showing the direction of energy conservation and renewable energy without mentioning specific actions. In addition, since the Philippines just signed a bilateral agreement with Japan in FY 2017 to become a JCM member country, government officials from federal and local governments still do not have a clear understanding about the JCM system. For this reason, it is necessary to prepare a JCM manual to facilitate projects in the QC-LCCAP utilizing the JCM subsidy scheme.

The survey also developed a JCM manual for the projects, which outlines specific processes of formulating such projects and other necessary information. This manual is deemed helpful to related parties to deepen their understanding about the JCM.

3.5.2 Structure of the JCM Manual

CM Manual includes the concepts of JCM and features, implementation process and structure of JCM projects together with the proposed JCM model projects. The manual was designed to be easy to understand by readers with little experiences of JCM.

Chapter 4 Fluorocarbon Collection, Recovery and Destruction in the Philippines

4.1 Laws and Governmental Efforts Related to Fluorocarbon Regulation

4.1.1 Situation in the Philippines

The Philippines ratified the Montreal Protocol on Substances that Deplete the Ozone Layer, which establishes a timeline for the complete phase-out of fluorocarbon gases using ozone-depleting chlorofluorocarbons and hydrochlorofluorocarbons (CFCs and HCFCs). Major Philippine laws concerning fluorocarbons were enacted to implement the "HCFC Phase-out Management Plan (HPMP)" under a multilateral fund; aiming to reduce ozone-depleting substances as indicated in the Protocol. As of February 2020, the Philippines had not ratified the Kigali Amendment, which aims to reduce alternative fluorocarbons, nor have any laws regulating hydrofluorocarbons (HFCs), an alternative fluorocarbon, been developed. Currently, the Philippines is proceeding with a national arrangement to ratify the Kigali Amendment and has indicated that an HFC reduction plan would be established by the Department of Environment and Natural Resources (DENR) by June 2020. Laws related to fluorocarbons are listed on the POD website[1].

Table 4-1 Major Laws Related to Fluorocarbons

Year	Contents
1992	DENR Administrative Order No. 29 Series of 1992 - The Toxic Substance and Hazardous Waste Control and Violation Act: regulating chemical substances and mixture which may present a hazardous risk and damage human health or the environment. Penalties are set.
2000	DENR Administrative Order No. 18 Series of 2000 - Import control of CFCs, listed as substances to be regulated by the Montreal Protocol
2003	DENR Administrative Order No. 2003-43 - Improvement and reinforcement of organization (POD) for the HPMP implementation (targeting CFCs)
2005	Memorandum Circular No. 2005-23 - Obligation of ODS distributors to register
2013	DENR Administrative Order No. 2013-25 - Regulations to implement HPMP (targeting HCFCs)
2015	Memorandum of Understanding between the Environmental Management Bureau and Delsa regarding collection, transportation and storage to implement HPMP

Source: POD

"Revised Regulations on the Chemical Control Order for Ozone-Depleting Substances (ODS) DENR Administrative Order 2013-25" is a DENR Administrative Order (DAO) signed in 2013, which outlines reduction goals for ozone-depleting substances and related regulations. The main target of DAO2013 is hydrochlorofluorocarbons, or HCFCs. An overview of DAO2013-25 is as follows.

[1] Environmental Management Bureau POD http://pod.emb.gov.ph/?page_id=21

Table 4-2 Overview of DAO2013-25

Target	Contents
ODS Importation	Any importer of ODS must register with the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR). Importers of ODS must secure annually a certificate of registration from EMB and a Pre-Shipment Importation Clearance (PSIC) prior to the entry of each ODS shipment. Additionally, importers must follow updated phase-out schedule for HCFCs and the quota allocations for HCFCs and conform to the "one-shipment, one clearance" policy. Annual importation limits have been put in place by DENR. By 1 January 2020, HCFC imports shall be reduced by 35% compared to 2009.
ODS Exportation	Regulate the export of controlled substances, including ODS. Like importers, ODS exporters must secure annually a certificate of registration from OMB and a Pre-Shipment Export Clearance (PSEC) prior to the exit of each ODS shipment.
Distribution of ODS in the Country	Only dealers, resellers and retailers of ODS that are registered with the EMB and accredited by the DTI are allowed to purchase, re-sell, distribute and utilized allowable uses of ODS.
Servicing of ODS-using Equipment	Service providers of ODS-using equipment, such as air-conditioners and refrigeration equipment, must secure a certificate of registration from the DENR to assess their capability to take effective measures for the purpose of effectively handling ODS.
Records Keeping	All importers, exporters, dealers, retailers and re-sellers must keep a record of all transactions and prepare an annual report, which must be submitted to the Bureau by the 31st of January of the following year. The annual report shall be prepared according to formats prescribed by the Bureau.
Urethane Foam Manufacturing	By 1 January 2015, all importation of HCFC-141b and pre-blended polyols for urethane foam will be prohibited.
Refrigeration and Air-conditioning	By 1 January 2020, all importation of HCFC-22 for the manufacturing of refrigeration and air-conditioning will also be absolutely prohibited.
Chillers and Fire-extinguishing	By 1 January 20205, all importation of HCFC-123 as cooling agent for chillers and as fire extinguishing agent will be prohibited.
HCFC blends	By 1 January 2030, all importation of blends containing HCFCs will be prohibited.

Source: Revised regulations on the chemical control order for Ozon-Depleting Substances (ODS) 2013-25

To implement the HPMP, the Environmental Management Bureau and Delsa signed a memorandum of understanding on fluorocarbon collection and storage. Delsa is a private company[2] handling imports and wholesale of refrigerant and air-conditioner works in the Philippines. Currently, no general regulations have been established concerning the collection, recovery and destruction of fluorocarbons in the Philippines.

4.1.2 Fluorocarbon Collection, Recovery and Destruction in Japan

（1） Japanese laws and regulations related to fluorocarbons

The "Law Concerning the Protection of the Ozone Layer through the Control of Specified Substances and other Measures" establishes regulations on fluorocarbon production and importation and in 2019 was updated to include HCFs. The "Act on the Rational Use and Proper Management of

[2] Delsa, a refrigerant importer, imports fluorocarbons via tanks from China and other countries, which are then transferred into small cylinders and distributed to air-conditioner maintenance operators in the Philippines. Every year, the Department of Science and Technology checks for any leakage when transferring fluorocarbons from tanks to cylinders. Delsa uses the US-made ULTIMA (produced by Master cool) to detect the type of fluorocarbons imported and check their purity.

Fluorocarbons" and the "Act on Recycling, etc. of End-of-Life Vehicles" and "Home Appliance Recycling Law" established regulations governing how to collect and destroy fluorocarbons.

The "Act on Rational Use and Proper Management of Fluorocarbons" is an amendment to the "Fluorocarbons Recovery and Destruction Law" in 2013 and stipulates comprehensive measures for the entire life cycle from production to disposal of fluorocarbons for commercial refrigerators and air-conditioners. The "Home Appliance Recycling Law" regulates the recovery of consumer refrigerators and air conditioners. The "Act on Recycling, etc. of End-of-Life Vehicles" regulates the recovery of fluorocarbons in the air conditioning of automobiles. This law introduces a means of pooling financial resources to collect and dispose of fluorocarbons by imposing such expenses on users in the form of a deposit when they purchase a vehicle.

Commercial Equipment	Home Appliances	Vehicles
Act on Rational Use and Proper Management of Fluorocarbons	Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law)	End-of-Life Vehicle (ELV) Recycling Act
Users pay for collection and disposal of Fluorocarbons when		
disposing of Equipment	disposing of Home Appliances	purchasing a vehicle (as deposit)

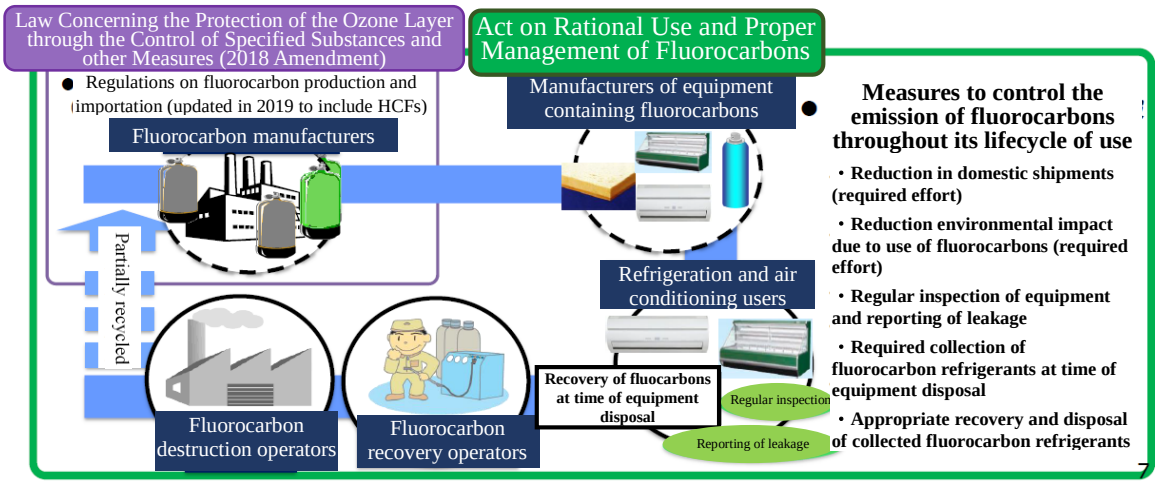
Source: MOE

An English leaflet on the End-of-Life Vehicle Recycling Act

Figure 4-1 Laws and cost burden of collecting and destroying fluorocarbons in Japan

The "Act on Rational Use and Proper Management of Fluorocarbons" targets commercial-use equipment that uses fluorocarbons, such as water coolers, commercial air conditioners, ice makers and commercial freezers and refrigerators. This law stipulates the responsibilities of users of commercial refrigeration and air-conditioning equipment to hire collection operators to pick up the equipment at the time of disposal (to collect fluorocarbon refrigerants), to maintain the equipment containing fluorocarbons, to conduct regular inspections of equipment and to report on the amount of leakage.

This law also stipulates penalties for maintenance operators, filling/recovery operators and delivery consignees. They will have fines imposed when releasing fluorocarbons from commercial refrigerators and air-conditioners unjustifiably, failing to report the amount recovered, making a false report or refusing, hindering or avoiding an on-site inspection by the prefectural or national government.



Source: Ministry of Economy, Trade and Industry, 2019

Figure 4-2 Process and Regulations of Fluorocarbon Collection, Recovery and Destruction Fluorocarbons of commercial-use equipment that uses fluorocarbons

The following table shows relevant measures under Japanese laws on fluorocarbons that could represent a benchmark for the Philippine efforts.

Table 4 -3 Relevant Measures under Japanese Laws

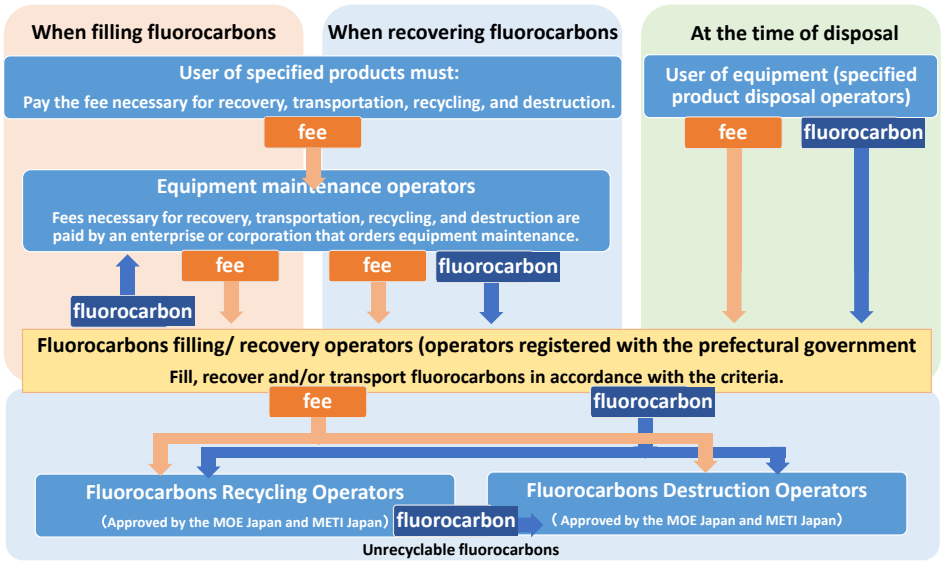
Law	Relevant Measures	Merits and Issues
Fluorocarbons Recovery and Destruction Law	At the time of fluorocarbon disposal during disposal or maintenance of commercial refrigerators or air-conditioners, users must follow the proper processes and request fluorocarbon recovery from class-1 recovery operators	Merits ・Clarifies the responsibilities of refrigeration and air conditioning users to request the service of recovery operators who have been registered with local governments (motivating users to comply with regulations (clarification of cost responsibility)) ・Promotion of business participation in the field of fluorocarbon collection and recovery through regulations on users who are required to pay for services (incentive for collection, recovery and destruction operators) Issues ・Increased burden on the government in regard to creating standards and managing the registration of recovery operators
	Public reporting of businesses that failed to report a leakage of fluorocarbons in excess of a specified amount	Merits ・Serves as an incentive for companies valuing compliance and industry and end-user ratings. Clarifies the responsibility of requesting a recovery operator (motivating users to comply with regulations (clarification of cost responsibility))
	Calculation and reporting of leakage from filling/collection certificate	Merits ・(Amendment) In addition to requiring that users make a request to registered fluorocarbon recovery operators at the time of disposal and follow the proper processes, reporting of the amount of leakage is also required, increasing companies' awareness of unintentional refrigerant leakage
	Permission for fluorocarbon recovery and destruction operators from Minister of METI/MOE	Merits ・Eliminating unauthorized operators by only allowing registered operators to issue recovery/destruction certificates (incentive for collection, recovery and destruction operators)
Act on Rational Use and Proper Management of Fluorocarbons (Appendment to Fluorocarbons Recovery and Destruction Law)	Tighter penalties related to fluorocarbon recovery	・If equipment is disposed of without collecting fluorocarbons, no administrative guidance will be issued and a fine of up to 500,000 yen will be issued (promoting fluorocarbon collection)
Act on Recycling, etc. of End-of-Life Vehicles	Collection and destruction costs are added to the vehicle purchase price and collected then	Merits ・Fees for collection and destruction of fluorocarbons are secured (creation of incentives for collection, recovery and destruction operators and motivating users to comply with regulations (clarification of cost responsibility)) ・Reduces the number of vehicle users who avoid paying destruction fees, because no new fees emerge at the time of vehicle disposal (reduced motives for non-compliance)

		Issues ・Because the fluorocarbon collection and destruction fees are automatically added to the market price of motor vehicles, consensus about appropriate costs is not obtained from stakeholders
Home Appliance Recycling Law	Consumers of home appliances are responsible for the cost of collecting, transporting and recycling home appliances to be disposed of (clarification of cost division)	Merits ・Clarifies the responsibility of users to pay collection costs (collection/transportation) and recycling costs (motivating users to comply with regulations (clarification of cost responsibility)) ・Collection and recycling fees are separated, making it easier for users to understand

Source: JICA, 2015 (partially appended)[3]

（２） Sharing of responsibilities to collect, recover and destroy fluorocarbons in Japan

When the maintenance of commercial refrigerators and air-conditioners requires fluorocarbons to be deposited or recovered, the relevant maintenance operator should consign the fluorocarbon filling/recovery work to a specialist operator. A disposal operator, for example, needs to deliver fluorocarbons to a filling/recovery operator or consign the fluorocarbon delivery to a building demolition operator. The flow of fluorocarbons when collecting, recovering and destroying these substances is shown as follows:

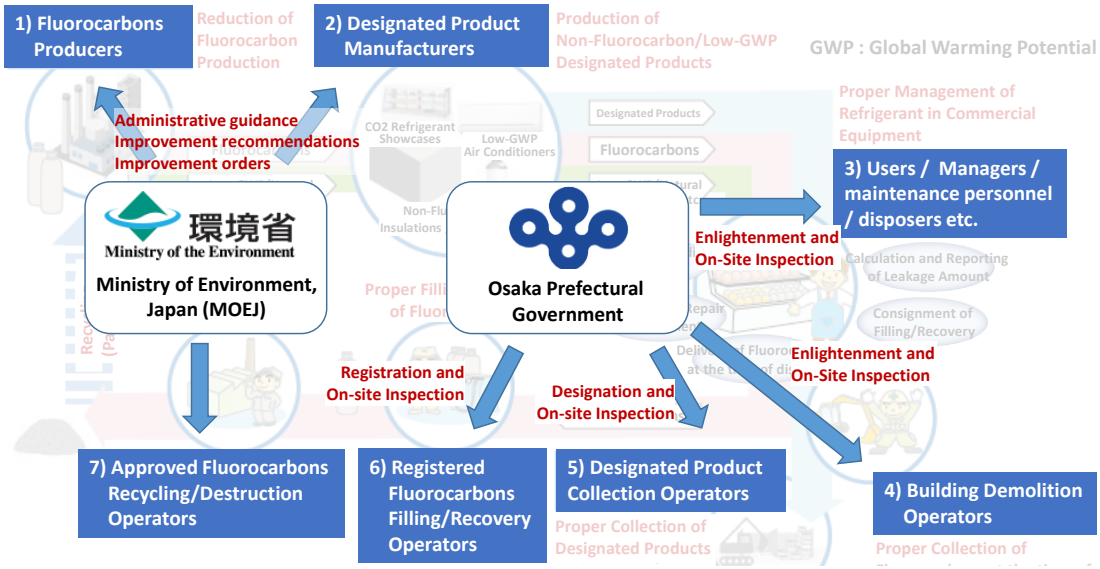


Source: prepared based on METI and MOE materials

Figure 4-3 Flow of fluorocarbon collection, recovery and destruction for commercial refrigerators and air-conditioners

[3] Excerpt (pg. 13) from Final Report for "Malaysia: Feasibility Survey for Creation of an Industry for Recovery, Reuse and Destruction of Fluorocarbons that Contributes to Protection of the Ozone Layer and Mitigation of Global Warming"

Under the Act on Recycling, etc. of End-of-Life Vehicles, prefectural governments take on the role of approving and registering recycling operators, enlightening users and operators and taking measures against illegal disposal. Following the Home Appliance Recycling Law, they approve recycling operators, collect home appliances individually, enlighten users and take measures against illegal disposal while also occupying roles involving registration and on-site inspection of fluorocarbon filling/recovering operators and enlightenment and on-site inspection of managers and maintenance personnel for products using fluorocarbons under the Act on the Rational Use and Proper Management of Fluorocarbons. The Ministry of the Environment oversees the process of issuing administrative guidance and improvement orders to fluorocarbon and related product manufacturers and fluorocarbon recovery operators and destruction operators.



Source: prepared based on MOEJ and Osaka Prefectural Government

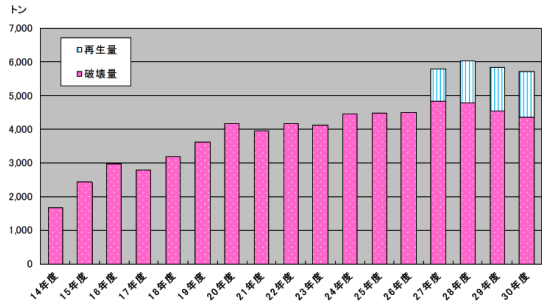
Figure 4-4 Roles of the Ministry and the Prefectural Government under the Act on the Rational Use and Proper Management of Fluorocarbons

（３） Current situation of fluorocarbon collection, recovery and destruction in Japan

The target recovery rate for refrigerants in Japan was set at 50% for FY 2020 and 70% for FY 2030 respectively. The rate remained at around 30% for more than a decade after the law was enforced and reached almost 40% in 2018. It has emerged that unrecovered refrigerant is attributable to failure to recover refrigerant at the time of equipment disposal associated with building demolition; equipment is likely to be disposed of by disposal and recycling operators without recovering the refrigerant, while some refrigerants present in multi-air-conditioners for building use remain uncollected due to the recovery work.

To ensure thorough legal compliance, Japan will also strengthen systems to monitor recovery performance by imposing a direct penalty on those users who neglect their duty to recover fluorocarbons and banning disposal/recycling operators from receiving such equipment without first proving that they have recovered refrigerants.

In FY 2019, a total of around 1,351 tons of fluorocarbons were recovered in Japan, as opposed to around 4,364 tons that were destroyed. Previous figures in these categories are shown as follows:



Source: MOE

Figure 4-5 Trend of amounts of fluorocarbon recovery and destruction in Japan[4]

（4） Costs for collection, recovery and destruction in Japan

A hearing survey of fluorocarbon recovery operators located in the Kansai region revealed that they handled 130 tons of fluorocarbons annually, 70% of which were recovered and the remaining 30% destroyed or disposed of. They receive some 1,500 to 2,000 yen per 1 kg as the recovery cost when they collect fluorocarbons. In case the fluorocarbons collected are non-recoverable and thus have to be destroyed, an additional 700 yen per 1 kg is levied as the treatment cost. Recovered fluorocarbons are then sold to fill supermarket and factory refrigerators. They consign the fluorocarbon destruction process to other companies at a cost of 400 to 450 yen per 1 kg. Recovery is somewhat cheaper than destruction, according to the survey.

Rotary kiln, cement kiln, liquid injection incineration and superheated steam reaction are popular methods introduced for destroying fluorocarbons and applicable as alternative fluorocarbon destruction technologies. According to a manufacturer of the destruction machines used for the superheated steam reaction method, which is used to destroy 20 tons of fluorocarbons each year, the machine price ranges from 50 to 60 million yen, including transportation and installation costs. Using the machine to destroy 40 tons of fluorocarbons annually costs 75 to 90 million yen.

Figure 4-6 Fluorocarbon recovery machine owned by a fluorocarbon recovery operator in the Kansai region

[4] A statistical survey on the recovery amount started in FY 2015, the actual values before then were unknown.

4.1.3 Fluorocarbon-related regulations in the Philippines compared to Japanese regulations

（1） Laws and regulations stipulating fluorocarbon recovery

In the Philippines, the import of fluorocarbons is regulated by DAO2013-25 and other orders whereas there are no laws enacted stipulating emission-control measures governing how fluorocarbons are used, collected, recovered and destroyed, such as the Act on the Rational Use and Proper Management of Fluorocarbons, Home Appliance Recycling Law and Act on Recycling, etc. of End-of-Life Vehicles in Japan. Accordingly, no duty and responsibility has been imposed on users of products using fluorocarbons and fluorocarbon-handling operators, nor any cost burden mechanism to collect, recover and destroy fluorocarbons. Given the lack of regulations banning the release of fluorocarbons into the atmosphere in the Philippines, many fluorocarbons are highly likely to be released.

4.1.4 Cases involving fluorocarbon emission reduction in the Philippines by international support

The following table shows cases of international support for fluorocarbon emission reduction under multilaterally funded initiatives for ODS phase-out projects. The World Bank is responsible for implementing the HCFC Phase-out Management Plan (HPMP) Stage I, while the United Nations Industrial Development Organization handles Stage II. As the HPMP is implemented, moves to shift from CFCs and HCFCs to alternative fluorocarbons and recover and store fluorocarbons have progressed.

In COP25, held in December 2019, Japan launched an initiative to promote the life cycle management of fluorocarbons, which promotes collaborative activities among governments, the private sector and international organizations for mutual benefit by cooperating with efforts to establish and implement emission-control plans, encourage the compilation of emission inventories and boost capacity development and innovation, as part of support for managing the life cycle of fluorocarbons.

Table 4-4 Projects involving fluorocarbon reduction under international support

Funded by	Contents	Year
UNEP, etc.	HCFC Phase-out Management Plan (HPMP) Stage I: targeting foam manufacturing and freezer, refrigerator and air-conditioner maintenance sectors	2012 – 2015
	HPMP Stage II: abolishing HCFC-22 in the air-conditioner manufacturing sector and air conditioning sector and HFC phase-down plan	2017 – 2021
GIZ	Help investigating fluorocarbon inventory related to air-conditioners	2019
	Cool Contributions fighting Climate Change (C4) (targeting HFC reduction)	2016 – 2021

4.2 Situation in the market and logistics related to fluorocarbons

4.2.1 Situation in the Philippines

（1） Determining the amount of fluorocarbons

Operators registered by DENR are permitted to handle fluorocarbon imports to the Philippines[5]. The Bureau of Customs decides on which annual imports of fluorocarbons are allocated by importer, then checks on the type and amount of fluorocarbons imported. POD collects and manages monthly statistical data on the imported amount by type of fluorocarbons.

According to an on-site hearing, fluorocarbons are not produced in the Philippines. Under DAO2013-25 regulations, the import of HCFC-141b and pre-blended polyol for use in foam manufacturing and HCFC-22 for use in manufacturing freezer, refrigerator and air-conditioners were all banned in January 2015 and January 2020, respectively. As shown in the table below, the amount of HCFCs imported between 2013 and 2018 declined, with the 2016 figure about 30% below the baseline defined by the Montreal Protocol. Since the HCFC consumption as described in a UNEP document[6] and the amount of HCFCs imported as determined by POD are almost aligned, those HCFCs distributed in the Philippines are considered imported. However, the amount of fluorocarbons imported are only determined by those imported as chemical substances by tank and POD does not include the amount of fluorocarbons contained in final imported products, such as air-conditioners.

Such fluorocarbons imported as chemical substances by tanks are used to fill both refrigerators and air-conditioners during maintenance and manufacturing of air-conditioners in the Philippines.

Table 4-5 Amount of HCFCs imported (kg) (between 2013 and 2018)

	2013	2014	2015	2016	2017	2018
HCFC-141b	408,665.00	390,640.00	159,720.00	153,580.00	183,456.00	144,495.60
HCFC-22	1,652,224.50	1,860,032.40	1,837,425.60	1,685,118.80	1,653,691.00	1,615,380.25
HCFC-123	69,051.20	66,071.20	66,125.00	66,060.00	57,132.00	57,130.15
HCFC-142b	0.00	0.00	0.00	0.00	0.00	0.00
HCFC-225ca	1,390.00	420.00	1,520.00	210.00	307.00	14.95
HCFC-225cb	1,390.00	420.00	1,520.00	210.00	308.00	16.03
Additional allocation	-	140,000.00	161,215.00	197,000.00	0.00	0.00
Total	2,132,720.70	2,457,583.60	2,227,525.60	2,102,178.80	1,894,894.00	1,817,036.97

Source: POD

Based on the HPMP Stage II, administrative guidance was given to four air-conditioner manufacturers in the Philippines and they subsequently discontinued air-conditioners using HCFC-22 in January 2020. Accordingly, they started shifting from using HCFCs to HFCs for air-conditioner refrigerants. The vehicle air-conditioner refrigerant of choice has already shifted from CFCs to HFCs during the HPMP Stage II and to non-fluorocarbon isobutane for those in refrigerators.

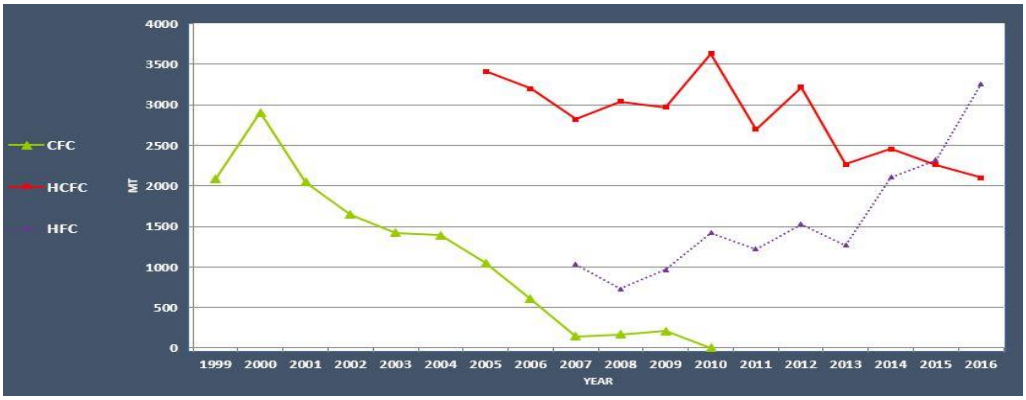
Regulating the use of HCFCs has seen HFC consumption rise, with 2018 imports triple the size of those in 2013. The following table shows the volume of HFCs imported between 2013 and 2018. Like HFCFs, HFCs are not manufactured in the Philippines. POD does not determine how many alternative fluorocarbons are contained in final imported products.

[5] A list of registered operators importing ozone-depleting substances is published on the POD's website.
[6] 「HCFC phase-out management plan (stage II, first tranche) 」
http://www.multilateralfund.org/80/Document%20Library1/1/8048.pdf

Table 4-6 The amount of HFCs imported (Kg) (between 2013 and 2018)

	2013	2014	2015	2016	2017	2018
R-23	540	90	585	0	360	0
R-32	811	6,764	8,032	15,781	28,520	42,740
R-134A	847,689.5	1,347,813.36	1,291,421.46	1,677,772.78	1,637,346.76	1,992,752.83
R-404A	125,650	205,366.5	170,400	301,593.1	311,583.23	378,097
R-407C	31,150	41,115	27,172	51,730.5	52,143.2	102,288.5
R-410A	195,589.5	383,560.4	311,586	681,610.95	778,364.7	1,235,469.8
R-417A	0	0	0	204.3	737	226
R-507	23,108.5	39,847.9	29,712.7	53,505.5	57,849.7	93168.5
R-508B	108	144	135	275	174	340
HFC-152A	0	0	0	0	0	0
HFC-227ea	815.79	1,615.7	3,590.35	1406.78	19480.04	4554.13
HFC-236fa	40,700	54,200	23,700	6298	44400	138100
HFC-245fa	0	12,386.4	0	0	13205	31000
HFC-43-10mee	1,300	875	0	0	0	0
Total	1,269,475.29	2,095,792.26	1,868,349.51	2,792,193.91	2,946,180.63	4,020,754.76

Source: POD



Source: POD

Figure 4-7 Changing CFC, HCFC and HFC consumption in the Philippines (1999-2006)

Despite a decline in the annual consumption of CFCs and HCFCs in the Philippines, the total amount of fluorocarbons consumed has accumulated, given that fluorocarbons are not destroyed in the country. Since annual HFC consumption has also grown, the fluorocarbon accumulation is expected to continue.

（2） Amount of fluorocarbons recovered in Metropolitan Manila

In Metropolitan Manila, fluorocarbons collected during the multilaterally funded HPMP are stored at a center of the DENR Environmental Management Bureau and Delsa. According to feedback from POD, the volume of fluorocarbons collected by customs enforcement was 150 fluorocarbon cylinders, equivalent to three containers, which was stored at a local DENR office. However, the fluorocarbons collected and stored in a single container were released into the air due to the cylinder deterioration. The following tables show the amount of fluorocarbons stored based on POD estimates.

Table 4-7 The amount of fluorocarbons stored at a center of the DENR Environmental Management Bureau

Stored substances	KLS.	GWP	CO_2 eq.	ODP t
CFC (R-12)	1,867	10,900	20,350,300	1,867
Mixture (R-134a, R-12, R-22)	103.3	1,820	188,006	5.68
CFC (R-502)	37.8	10,900	412,020	37.8

Source: POD

Table 4-8 The amount of fluorocarbons stored in two containers collected by customs enforcement

Container	Stored substance	KLS.	GWP	CO_2 eq.	ODP t
No. 1	CFC (R-12)	12,594.70	10,900	137,282,230	12,594.70
	HCFC (R-22)	1,726.10	1,820	3,141,502	94.94
No. 2	CFC (R-12)	15,221.70	10,900	165,916,530	15,221.70
	HCFC (R-22)	845.50	1,820	1,538,810	46.51

Source: POD

Delsa stores fluorocarbons collected by the HPMP after a memorandum of understanding has been signed with the Environmental Management Bureau, but POD's understanding of the amount stored by Delsa and Delsa's own measurement vary, with the relevant figures shown in the following tables. The weight of fluorocarbons stored, which Delsa comprehends by type, totals 33,146 kg. Delsa has a sorting method and submits the updated amount stored to POD. Although HFC collection was not stipulated in the memorandum of understanding of the HPMP, Delsa collected such substances in line with DENR's instructions to cooperate in such process.

Table 4-9 The amount of fluorocarbons stored at Delsa according to POD

Stored substance	KLS.	GWP	CO_2 eq	ODP t
CFC (R-12)	4,861.6	10,900	52,991,440	4,861.6
Mixture (R-134a, R-12, R-22)	1,302.8	1,820	2,371,096	71.65

Source: POD

Table 4-10 The amount of fluorocarbons stored at Delsa (kg)

	2010-2012	2013	2014	2015	2016	2017	2018	2019	Total
A. Contaminated R22	4,188.46	314.60	2,149.10	1,444.37	970.50	684.50	1,278.70	1,722.74	12,752.97
B. Contaminated R134A	596.94	150.50	2.00	88.37	1,890.20	452.50	169.50	850.00	4,200.01
C. Contaminated Mix	4,162.51	6,898.20	4.00	277.14	118.00	14.00	-	-	11,473.85
D. Contaminated R12	328.15	27.20		20.00	2,164.30	-	-	-	2,539.65
E. Contaminated R123	221.50			264.00		-	-	-	485.50
F. Contaminated R 404a	132.10	47.50	75.00	6.77	35.00	64.70	65.00	74.55	500.62
G. Contaminated R 141b	90.25	13.70				-	-	-	103.95
H. Contaminated R11	55.75				406.00	-	-	-	461.75
I. Contaminated R410a	20.09		14.00	2.35	62.50	149.00	54.50	-	302.44
J. ISCEON69 Total	20.50								20.50
K. Contaminated 502	8.65								8.65
L. Contaminated 407c	5.30				152.00	117.00	8.00	10.10	292.40
M. Contaminated R424A				4.00		-			4.00
Total	9,830.20	7,451.70	2,244.10	2,107.00	5,798.50	1,481.70	1,575.70	2,657.39	**33,146.29**

Source: Delsa

Figure 4-8 Fluorocarbons collected under the HPMP and stored at Delsa

Those fluorocarbons collected under the HPMP are only stored, and the processing approach, recovery or destroy, remains undecided.

4.2.2 Fluorocarbon collection

（1） Situation of fluorocarbon collection in the Philippines

In the Philippines, fluorocarbons were collected under the HPMP, which was supported by multilateral funds, but other than HPMP, no other systems or regulations concerning fluorocarbon collection have emerged. In 2015, POD established collection points in Cebu and northern Luzon to establish a fluorocarbon collection and destruction system, whereupon a plan to collect fluorocarbons at Delsa via the points emerged. However, it proved impossible to set up the system successfully, given the inability to allocate transportation costs.

In the air-conditioner sector, used fluorocarbons are not collected when replacing an air-conditioner and rather than being recovered or destroyed, they tend to be released into the air. In the absence of any clear duty, responsibility and cost burden for fluorocarbon collection, fluorocarbon-handling operators have no incentive for fluorocarbon collection. Conversely, when the government tightens regulations and penalties and establishes proper monitoring mechanisms to handle the operational cost burden and non-compliance with regulations going forward, fluorocarbon collection will emerge as a business.

（2） Fluorocarbon collection operators in the Philippines

Delsa is the only fluorocarbon collection operator in the Philippines to be registered and funded during the HPMP by the Environmental Management Bureau. Fluorocarbon collection operators meeting the requirements designated by the Bureau are registered accordingly, but the lack of any incentive to collect fluorocarbons prevents other operators from registering as collection operators.

When collecting fluorocarbons under the HPMP, the air-conditioner maintenance operator, a Delsa contractor, collects and delivers fluorocarbons to Delsa and purchases new fluorocarbons from Delsa to refill it. Delsa itself collects fluorocarbons from large-sized air-conditioners such as commercial refrigerants. Transporting 1 to 2 tons of fluorocarbons at once costs 25000 to 50,000 pesos.

Fluorocarbon-collecting equipment for old fluorocarbons during filling operations [7] is disseminated among air-conditioner maintenance operators. Since Delsa's fluorocarbon storage site has reached the storage capacity limit, Delsa has suspended collections of new fluorocarbons since last year, which is why the fluorocarbons collected by maintenance operators are not currently being delivered to Delsa.

4.2.3 Fluorocarbon recovery and destruction

（1） Fluorocarbon recovery, distribution and destruction operators in the Philippines

Delsa is the only operator which is authorized to recover, distribute and destruct fluorocarbons in the Philippines, but given the cost burden involved, the fluorocarbon recovery and destruction business is not considered feasible except by the user's agreement. Since no laws are established in the Philippines, the duty, responsibility and cost burden are not clarified for the sector, since the collection process is not established as an industry. Accordingly, it is difficult to promote fluorocarbon collections without establishing a methodology of fluorocarbon processing after collection.

The cost of recovering fluorocarbons is lower than the destruction process since fluorocarbons can be distributed on and sold once recovered. If the fluorocarbon recovery is properly promoted, a profit-making business can be established.

Although Delsa has fluorocarbon recovery equipment transferred as part of previous overseas assistance, it does not conduct recovery work since the inspection machine is currently out of order. According to Delsa, the scope of their business does not extend to recovery, because recovered fluorocarbons include those with worse purity mixed with the lubricant of the compressor. Delsa considers it difficult to recover fluorocarbons, since those already stored (particularly CFCs) are mixed with various refrigerants, which explains their lack of current interest in starting a fluorocarbon recovery business. The current lack of fluorocarbon destruction equipment in the Philippines means the approach taken to handle fluorocarbons stored at Delsa post-recovery also remains undecided.

（2） Market price for recovered fluorocarbons

A field survey revealed that fluorocarbons are not recovered or distributed in the Philippines and the Montreal Protocol stipulates reducing the amount of HCFC-22 used for room air-conditioner refrigerant. Developed countries have stopped manufacturing it while other countries continue to manufacture and distribute the same. The cost of HCFCs in the Philippines at the time of arrival in port is 160 pesos per kilogram (when the exchange rate: 1 dollar = 53 pesos). Delsa sells HCFC-22 at 180 pesos per kilogram. Although all imports of HCFC-22 used to manufacture freezers, refrigerators and air-conditioners have been banned since January 1, 2020, HCFC-22 has been sold at around 300 pesos in the Philippines as searched by the Internet.

[7] Costs for fluorocarbon collection as part of air-conditioner installation services are reportedly around 6,500 pesos in fluorocarbon filling service for split-type air conditioners, 2,500 pesos for room air conditioners, 2,000 pesos for window air conditioners while the service contents vary according to businesses.

When distributing recovered fluorocarbons in the Philippines, the business can be viable provided the sale price for the recovered HCFC-22 is less than 300 pesos per kilogram.

（３） Fluorocarbon destruction equipment

The fluorocarbon destruction has not been implemented in the Philippines yet. A cement kiln of the cement-lime mixed combustion type is considered a candidate fluorocarbon destruction facility in the Philippines in future. In the Philippines, Holcim owns cement kilns at four sites[8]. Although fluorocarbon destruction work needs to be certified by DENR, Holcim has yet to obtain such certification. The cement kiln allows for processing at 1,450 degrees Celsius, which suffices for destroying fluorocarbons. In Indonesia, 0.5 tons of fluorocarbons in an hour could be successfully destroyed using a cement kiln of equivalent size.

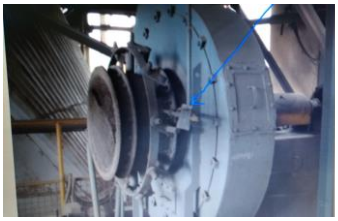
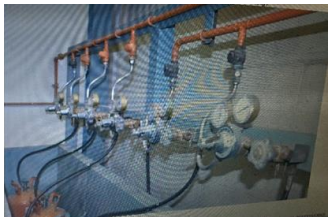


Figure 4-9 The arrow indicates a cement kiln burner



Injecting fluorocarbons (an Indonesian case)

According to Holcim, refurbishment of the cement kiln for fluorocarbon destruction does not require specific equipment in place – the economical solution of simply connecting the fluorocarbon cylinder with a burner and collection will suffice. Maintaining an adequate combustion temperature throughout the fluorocarbon destruction process is also possible. Meanwhile, there is also a need to install equipment to reduce emissions of dust and hazardous substances generated during the destruction and exhaust gas treatment equipment[9]. Holcim does not plan to improve its cement kiln for fluorocarbon destruction at the moment, despite being interested in the viability of the process as a business if such fluorocarbon destruction service is properly charged for, including transportation fees.

4.3 Potential of the a business for collecting, recovering and destroying fluorocarbons

（１） Conditions of developing a business for collecting, recovering and destroying fluorocarbons environment

To ensure processes for collecting, recovering and destroying fluorocarbons remain expedient, regulations for the collection and destruction process and a clear policy cost allocation are required. Establishing fluorocarbon regulations must be handled not only by Quezon City but also national government.

Moreover, the government must make policy efforts to establish a business for collecting, recovering and destroying fluorocarbons, such as establishing regulations for users of equipment

[8] One site in La Union in northern Luzon (7 hours by car from Manila), one site in Boracay and two sites in Mindanao.
[9] In relation to exhaust gas regulations, the Republic Act 8749 regulates NOx and SOx in the Philippines

using fluorocarbons, a cost burden mechanism to ensure regulatory compliance and incentivizing those who enter the collection, recovery and destruction business.

As well as establishing fluorocarbon policies and regulations, efforts to promote understanding on the part of air-conditioner maintenance workers, who collect and fill fluorocarbons, regarding how to handle refrigerant and improving their technical scope to handle fluorocarbons are also needed. For fluorocarbon recovery in particular, collected fluorocarbons cannot be recovered if the gas purity is reduced by mixing different types of fluorocarbon gases together. This compels operators to be required for destruction under such circumstances.

（２） Matters to keep in mind when considering a business for collecting, recovering and destroying fluorocarbons

The purchase cost of recovery equipment, equipment for treating exhaust gas and other substances during the destruction process and measurement equipment needed for use and management are considered part of the initial costs necessary to collect, recover and destroy fluorocarbons. Operational costs include collection and transportation, labor, utility and maintenance and management costs.

The previous recovery plan, which involved collecting fluorocarbons at Delsa via collection points in Cebu and northern Luzon was not established, while the case of Polychlorinated Biphenyls (PCBs) in the Philippines[10] shows a mechanism whereby operators oversee their collection and transport to national treatment facilities. As PCBs are treated at national facilities rather than by private entities, it seems difficult if the fluorocarbon collection and destruction processes are implemented under a private sector mechanism. Developing the industry for collecting, recovering and destroying fluorocarbons means clarifying the obligations of those who operate equipment using fluorocarbons to incur treatment costs by law and reduce collection and transportation costs by increasing the number of operators capable of collecting, storing and destroying fluorocarbons properly.

（３） Future fluorocarbon collection, recovery and destruction efforts

Local governments will need to establish policies and define responsibility and roles concerning fluorocarbons and there is also a need to develop the capacity of office staff who engage in work to collect and destroy fluorocarbons and take measures against illegal dumping. Osaka City can help Quezon City via city-to-city collaboration in future and in which the Japanese experience of boosting public awareness and developing a training system for air-conditioner maintenance operators can be shared. Moreover, as part of the city-to-city collaboration, Osaka City can cooperate with fluorocarbon collection associated with updating air-conditioners in the Quezon City Hall and other places.

Meanwhile, storage, recovery and destruction of collected fluorocarbons remain challenges at a national level, for which the government needs to establish policies. Accordingly, under the scheme

[10] Although it is difficult to describe the case of PCBs as ‘successful’, it is relatively easy to implement as operators are identified as the electricity sector. Accordingly, plan in the fluorocarbon area may become more difficult to implement.

of the Subsidized Project for Collection and Destruction of Alternative Fluorocarbons, etc. Utilizing the Joint Crediting Mechanism[11] of the Ministry of the Environment, in which measurement, reporting and verification (MRV) of greenhouse gas emission reduction effects are promoted, the treatment of fluorocarbons stored in Metropolitan Manila and the collection and destruction of alternative fluorocarbons of used equipment will be supported.

[11] In FY 2018, two projects were adopted: The Project to Introduce Fluorocarbon Collection and Destruction Scheme Utilizing Waste Combustion Facilities and the Project to Establish Fluorocarbon Collection Scheme and Introduce Mono-Fuel-Combustion-Type Destruction Facility.

Chapter 5 Support for developing capacity

5.1 Progress of Support by Osaka City

5.1.1 Background

The significance of waste disposal, energy, traffic and urban greening and other issues in Quezon City has intensified with the growing population. To address these issues, the Japanese national and local governments have provided support.

In the field of climate change measures, the Ministry of the Environment (MOE) organized a "Community Workshop for Development of and Transfer to Low-Carbon Technology", "JCM Intercity Collaboration Workshop" and other events. In the waste management field, Hitachi Zosen Corporation and EX Research Institute Ltd. conducted a feasibility study of a waste power-generation project in Quezon City between FY 2015 - 2016 after their project entitled "Incubation and Overseas Promotion of Waste Management and Recycling Industry" was adopted by the MOE.

During the project, Osaka City supported activities in the survey and the efforts of Quezon City to improve their waste management by participating in an on-site workshop and cooperating with the training program in Japan.

In FY 2017, Osaka City expanded its cooperative relationship to encompass climate change measures and conducted a feasibility study for installing solar power-generation and energy-saving systems, which was then adopted by the MOE as an "Intercity Cooperation Project for Realization of a Low-Carbon Society".

5.1.2 Signing an MOU and Holding Mayoral-level Policy Dialog

Amid a deepening cooperative relationship between Quezon and Osaka cities through collaboration in the waste management field, both cities discussed in FY 2017 about building mid- and long-term cooperative relationship as part of efforts to realize a low-carbon city. In FY 2018, both cities jointly gave a presentation about boosting their intercity cooperation in the Regional 3R Forum in Asia and the Pacific held in Indore City in India in April. On August 30, 2018, Mr. Herbert M. Bautista, the then Mayor of Quezon City, visited Osaka City and signed a "Memorandum of Understanding on Developing Low-Carbon City in Cooperation between Quezon City and Osaka City (MOU)" with Mr. Hirofumi Yoshimura, the Osaka City Mayor.

Signing the MOU (on August 30, 2018)

Under the MOU, both cities agree to establish standards and systems that support low-carbon policies of Quezon City, share professional skills and knowledge to develop a low-carbon city, promote public-private partnership projects in the field of climate change and environmental conservation and proceed with capacity development as part of steady progress on implementing the low-carbon policy as well as engaging in ongoing policy dialog at mayoral level once a year. After signing the MOU, the first mayoral-level policy dialog was held, during which both participants exchanged views on the latest measures for climate change.

In May 2019, Mr. Tanaka, then Vice Osaka City Mayor, visited Quezon City and participated in the second mayoral-level policy dialog toward making their efforts to develop a low-carbon city. In order, Quezon City, Osaka City, the Japanese private sector and the Japan International Cooperation Agency (JICA) gave presentations on the low-carbonization progress in Quezon City, Osaka City's support for the intercity collaboration going forward and the JCM project progress and subsequently exchanged their views during the dialog session.

In exchanging views, on the topic of utilizing JCM to install a solar power-generation facility in the former Payatas controlled waste disposal site in Quezon City, as proposed by a Japanese company, the fact that guidelines for JCM procedures were not developed in the Philippines was acknowledged as an issue. Accordingly, participants, including the Japanese private sector, discussed the installation and operation system for the solar power-generation facility. Moreover, Quezon City plans to review its climate change planning program, which sets out the policies and actions of Quezon City's climate change mitigation measures, based on a survey of a greenhouse gas inventory conducted in 2016. It was confirmed that Osaka City will transfer its knowledge and experience of climate change measures as part of intercity collaboration when reviewing the program.

Taking the opportunity for dialog on policy, the participants visited the former Patayas-controlled waste disposal site, where a project implemented to generate methane gas from landfill waste as biomass was registered as a United Nation's Clean Development mechanism (CDM). The project is attracting considerable attention from Southeast Asian countries as a model case that effectively utilizes the disposal site and helps realize a sustainable society and there is also consideration of how best to use it effectively to generate solar power.

Visiting the former Patayas-controlled waste disposal site

5.1.3 Sharing knowledge and experience on JCM

In 2017, the Philippines became the 17th member country of JCM and the first JCM Joint Committee was held in February 2018. However, the country needs to improve its awareness and recognition to develop JCM projects. Accordingly, under the intercity collaboration project in FY 2018, a guidebook for promoting JCM project formation was prepared to promote the superiority of JCM and Japanese technologies as well as info-sharing. At the same time, a workshop was held targeting Quezon City personnel as well as government personnel and the private sector to build capacity for JCM and renewable-energy and energy-saving technologies. This fiscal year, a guidebook for promoting JCM project formulation was enriched with contents on energy-saving air-conditioning technology and was detailed in Chapter 3.

5.2 Training Program in Japan hosted by the MOE

An intercity collaboration workshop hosted by the MOE was held in Tokyo on January 16 and 17, 2020 as part of the “Intercity Collaboration for Realizing Low-Carbon Society” initiative, which the MOE has put on since 2013, aiming to support the leapfrog development of developing cities by linking with policies to help introduce low-carbon technologies. A seminar was also organized by inviting personnel from 17 cities/regions in six countries (Indonesia, Malaysia, Myanmar, Philippines, Thailand and Vietnam) where survey projects were implemented this year to build a network to further promote collaboration. Two Quezon City officers participated in the seminar and gave the following presentation/comments, reflecting their interest in and expectation of the collaboration:

- Quezon City focuses on incorporating sustainable development in all its programs, projects and activities by leveraging synergy among the economy, society and environment as three sustainable development pillars.
- In terms of Quezon City, this intercity collaboration spawned the opportunity to collect information on efforts made by Osaka City. Accordingly, we could seek applicable programs to reduce GHG emissions and achieve Sustainable Development Goals (SDGs).

- Quezon City has made the following efforts mainly in six areas: ((i) Mitigating climate change to reduce GHG emissions, (ii) renewable energy and energy efficiency, (iii) wastewater treatment, (iv) water supply project, (v) waste disposal and (vi) environmental conservation):
  1) Promoting green energy: trial introduction of a solar power-generation facility in 50 public schools
  2) Promoting a sustainable economy: exhaust heat recovery project in factories
  3) Promoting smart and environment-friendly lifestyles: introducing LED lighting and solar-powered water heaters
  4) Promoting clean and smart transportation: promoting fuel-efficient cars and electronic vehicles
- Quezon City considers that JCM and its platform need to be developed, not only in the City but also across the Philippines, to promote low-carbon and sustainable urban development. Accordingly, we have been striving for a comprehensive approach by encouraging all stakeholders to participate in all seminars and workshops.
- Quezon City has established ordinances concerning waste management, air pollution control, water quality control and other issues to advance its environmental efforts. Since JCM is expected to expand to other local cities the City considers that ongoing sharing of new technical knowledge and supporting capacity development is required.

5.3 Workshop

Quezon City is highly interested in the action plan and projects for global warming measures of Osaka City, which previously resolved many environmental issues associated with the public-private partnership. In the workshop held in Quezon City in February 2020 (27 participants from Japan and the Philippines), the progress of activities in FY 2019 based on the MOU signed in 2018 was confirmed and the “feasibility of the JCM project for energy-saving air-conditioning technology” and “the situation of fluorocarbon collection, recovery and destruction in the Philippines” were reported as targets of this survey.

Quezon City reported that as part of efforts to promote activities to develop a new mechanism for reducing GHG emissions from global perspectives, they participated in C40, a large global network to tackle climate change to cooperate and share knowledge among cities initiating climate change measures. Accordingly, it has promoted collaboration by building a network with other cities.

Meanwhile, Quezon City shared a future issue to improve the wastewater treatment facility in the City and revise the Philippine Green Building Code issued in 2015; stipulating the efficiency of air-conditioners and other equipment in the form of specifications. In addition, the City also requested support for considering and making decisions on improvements gleaned by ascertaining impact via the Quezon City GHG Reduction Initiatives and low-carbonization projects to be implemented in future. Specifically, the task involves confirming the extent to which Quezon City could reduce GHG emissions under the initiatives and the current GHG reduction amount based on the GHG inventory of 2016.

Osaka City introduced details of the fluorocarbon control mechanism in Japan, including legal information related to fluorocarbon collection and destruction in Japan and the roles of the MOE and local governments, aiming to promote and nurture intercity collaboration projects and support the efforts of Quezon City personnel to develop capacity. After the workshop, Osaka City provided Quezon City personnel with English materials about the legal framework in Japan concerning proper fluorocarbon management and end-of-life vehicle recycling, underlining the opportunity to enhance capacity by sharing proper information.

During the Q&A workshop session, participants asked about details of the JCM model project and how the private sector participated in specific terms. Moreover, for air-conditioning equipment in the Quezon City Hall, currently expected as a target in the JCM project for energy-saving air-conditioning technology, it was confirmed that prior arrangements, such as formulating a PPP project, would be necessary to procure equipment. Potential to target other facilities, such as elementary and junior-high school buildings and hospitals, was also mentioned. Regarding fluorocarbon management in the Philippines, it was confirmed that the amount of those imported was currently only managed and no system had yet been established to collect, recover and destroy fluorocarbons.

Based on these discussions, dialog on future fluorocarbon collection, recovery and destruction in the Philippines is considered to promote global warning measures in future in the 11th EAS High-Level Seminar on Sustainable Cities (HLS-SC), in which DENR and Quezon City from the Philippines and the MOE and Osaka City from Japan will participate. Given the need to establish national policies to store, recover and destroy fluorocarbons collected in Metropolitan Manila, which has become a key concern, the seminar will mark an occasion to expand the initiative on the life-cycle management of fluorocarbons launched by the MOE at COP25 under the Japan-Philippines collaboration.

Osaka City intends to implement technical assistance and support for developing capacity, such as leveraging administrative experience to share key knowledge and promote the management of fluorocarbons to be collected under the JCM project of energy-saving air-conditioning technology within the intercity collaboration framework with Quezon City. However, fluorocarbon systems differ between Japan and the Philippines, since Japan imposes penalties when emissions are generated without permission while the Philippines does not, for example and it is infeasible to introduce Japanese efforts directly in the Philippines' context. Accordingly, it is considered important to develop activities along with the context and expand the scope to include technical assistance and capacity enhancement based on the activities.

Regarding energy-saving air-conditioning technology, as described in Chapter 3, the proposed project size does not meet the requirements of a JCM model project for equipment while target air-conditioners were selected. As well as updating air-conditioners in the Quezon City Hall, those air-conditioners in other public and private facilities in Quezon City were also selected in the workshop. It was confirmed among the workshop participants that a plan would be made to apply for the JCM model project as early as possible; targeting air-conditioners in public facilities in Quezon

City based on the list it had prepared by March 2020. A working group for the application will be launched for specific preparation in future.

Workshop (held on February 6)

Appendix 1　MRV

Joint Crediting Mechanism Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	The Republic of the Philippines
Name of the methodology proponents submitting this form	Oriental Consultants Co., Ltd
Sectoral scope (s) to which the Proposed Methodology applies	Energy demand
Title of the proposed methodology, and version number	Installation of Inverter-Type Air Conditioning Systems to Office Buildings Version number:01.0
List of documents to be attached to this form (please check):	☐ The attached draft JCM-PH-PDD: ☐ Additional information
Date of completion	19 February 2020

History of the proposed methodology

Version	Date	Contents revised
01.0	19 February 2020	

A. Title of the methodology

Installation of Inverter-Type Air Conditioning Systems to Office Buildings

B. Terms and definitions

Terms	Definitions
Inverter-type air conditioning system	A type of air conditioning systems equipped with inverters which help adjust the speed of the compressor motor in line with different load demand. While a compressor in a non-inverter-type air conditioning system runs either in maximum capacity regardless of load or stops, the inverter-type air conditioning system adjusts the power according to the temperature in the room so that promise electrical consumption reduction and saving energy.
Coefficient of Performance (COP)	The efficiency ratio of the amount of cooling provided by a cooling unit to the energy consumed by the system. The higher the Coefficient of Performance the more efficient the system. The values of cooling capacity/power and rated power consumption are defined according to the specific temperature stated in ISO 5151:2010.
Cooling capacity	Cooling capacity is the ability of air conditioning system to remove heat, calculated with amount of heat removed per unit time at specific temperature.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology applies to projects that aim for saving energy by introducing inverter-type air conditioning system for cooling purpose in office buildings in Philippines.
Calculation of reference emissions	Reference emissions are the GHG emissions from the consumed electricity by reference air conditioning systems and calculated based on the amount of electricity consumed by the project air conditioning systems, the ratio of COPs of project and reference air conditioning systems, and the CO_2 emission factor of the electricity.
Calculation of project emissions	Project emissions are GHG emissions from the electricity consumed by the project air conditioning systems and calculated as per the electricity consumption of installed inverter-type air conditioning systems, and CO_2 emission factor of the electricity.
Monitoring parameters	Power consumption of project air conditioning systems.

D. Eligibility criteria

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

<table>
<tr><td>Criterion 1</td><td>The methodology is applicable to the following types of projects:
Installation of inverter-type air condition systems to public sector buildings.
Replacement of existing non-inverter type air condition systems by the inverter-type systems in all types of buildings.</td></tr>
<tr><td>Criterion 2</td><td>Wall mounted type and/or ceiling cassette type system with COP higher than that of the value indicated in the table below.<table><tr><th>Cooling Capacity [kW]</th><th>Reference COP</th></tr><tr><td>$2.5 < x \leqq 4.1$</td><td>4.00</td></tr><tr><td>$4.1 < x \leqq 5.3$</td><td>3.59</td></tr><tr><td>$5.3 < x \leqq 7.1$</td><td>2.96</td></tr><tr><td>$7.1 < x \leqq 14.2$</td><td>2.85</td></tr></table></td></tr>
<tr><td>Criterion 3</td><td>Ozone Depletion Potential (ODP) of the refrigerant used in the project technology is 0 (zero).</td></tr>
<tr><td>Criterion 4</td><td>In order to prevent any leakage and release of refrigerant into the atmosphere at the time of removing the existing systems, a prevention plan and measures are required. Implementation of the plan and other prevention measures are checked and confirmed during verification.</td></tr>
</table>

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Power consumption by reference air conditioning system	CO_2
Project emissions	
Emission sources	GHG types
Power consumption by project air conditioning system	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated based on the power consumption of project air conditioning systems, ratio of COPs of project/reference air conditioning systems, and the CO_2 emission factor of the electricity consumed.
To ensure the conservativeness of net emission reductions from introduction of the technology, the COP of the reference air conditioning systems is defined *ex ante* with the following concerns:

1. The COP tends to decrease as the cooling capacity increases.
2. The reference COP, at a certain cooling capacity, is set at a maximum value in the respective cooling capacity range.
3. The maximum values of COP in the respective cooling capacity ranges are defined as reference COP_{RE}.

F.2. Calculation of reference emissions

$$\Re_p = \sum_i \left\{ EC_{PJ,i,p} \times \left(COP_{PJ,i} \div COP_{\Re,i} \right) \right\} \times EF_{elec}$$

RE_p : Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project air conditioning system i during the period p [MWh/p]
$COP_{PJ,i}$: COP of project air conditioning system i [-]
$COP_{RE,i}$: COP of reference air conditioning system i [-]
EF_{elec} : CO_2 emission factor of the electricity consumed [tCO_2/MWh]
i : Type of air conditioning system [-]

G. Calculation of project emissions

$$PE_p = \sum_i EC_{PJ,i,p} \times EF_{elec}$$

PE_p : Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$: Power consumption of project air conditioning system i during the period p [MWh/p]
EF_{elec} : CO_2 emission factor of the electricity consumed [tCO_2/MWh]
i : Type of air conditioning system [-]

H. Calculation of emissions reductions

$ER_p = RE_p - PE_p$

ER_p : Emissions reductions during the period p [tCO_2/p]
RE_p : Reference emissions during the period p [tCO_2/p]
PE_p : Project emissions during the period p [tCO_2/p]

I. Data and parameters fixed *ex ante*

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

<table>
<tr><th>Parameter</th><th>Description of Data</th><th>Source</th></tr>
<tr><td>EF_{elec}</td><td>CO_2 emission factor of the electricity consumed.
In the case of project air conditioning systems consume either grid electricity or captive electricity, the project applies the respective CO_2 emission factor of each.
If the project air conditioning systems consume both grid and captive electricity, the project participants apply the CO_2 emission factor with lower value.
For grid electricity: 0.5979* [tCO_2/MWh]
*The most recent Combined Margin (CM) emission factor of Luzon-Visayas grid where the project locates is applied unless otherwise instructed by the Joint Committee.
For captive electricity: 0.8** [tCO_2/MWh]
**The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.</td><td>[Grid electricity]
National Grid Emission Factor (2015~2017), National Committee on Clean Development Mechanism, Philippines.

[Captive electricity]
CDM approved small scale methodology AMS-I.A</td></tr>
<tr><td>$COP_{RE,i}$</td><td>COP of reference air conditioning systems as indicated in as below.
Air Conditioning System ($COP_{RE,i}$)
<table>
<tr><th>i</th><th>Cooling capacity [kW]</th><th>Reference COP</th></tr>
<tr><td>1</td><td>2.5kW<x≦4.1kW</td><td>4.00</td></tr>
<tr><td>2</td><td>4.1kW<x≦5.3kW</td><td>3.59</td></tr>
<tr><td>3</td><td>5.3kW<x≦7.1kW</td><td>2.96</td></tr>
<tr><td>4</td><td>7.1kW<x≦14.2kW</td><td>2.85</td></tr>
</table></td><td>JCM_ID_AM004
The default values should be revised if necessary from survey result which is conducted by JC or project participants every three years. The survey should prove the use of clear methodology.</td></tr>
<tr><td>$COP_{PJ,i}$</td><td>COP of project air conditioning systems
The cooling capacity and rated power consumption used in the calculation of COP are provided by the manufacturer.</td><td>Specifications of project technology from the quotation or factory acceptance test data by manufacturer.</td></tr>
</table>

Appendix 2 List of Air Conditionering Equipment per Building

ANNEX

	FLOOR															
	BASEMENT	GROUND	2	3												
WINDOW TYPE																
FLOOR MOUNTED		21														
WALL MOUNTED		2	1	1												
CEILING CASSETTE		2	42	49												
OUTDOOR UNITS			9	11												

SUMMARY PER TYPE
0
21
4
93

118

Ground floor

18 units 5TR Koppel Floor Mounted
2 units 3TR Koppel Floor Mounted
1 unit 3TR Condura Floor Mounted
2 units 5TR Carrier Cassette Type

Second floor

42 units Mitsubishi Ceiling Cassette Type VRF
1 unit Carrier Wall Mounted

Outdoor Units

4 units
Model: PUHY-P350THM-A
Refrigerant: R410A (9.0kg)
Rated Voltage: 220 ; Rated Current: 37.9A
Rated Input: 13.01 kW
Capacity: 40.0 kW

3 units
Model: PUHY-P400THM-A
Refrigerant: R410A (11.5kg)
Rated Voltage: 220 ; Rated Current: 39.6A
Rated Input: 13.24 kW
Capacity: 45.0 kW

1 unit
Model: PUHY-P300THM-A
Refrigerant: R410A (9.0kg)
Rated Voltage: 220 ; Rated Current: 26.5A
Rated Input: 9.10 kW
Capacity: 33.5 kW

1 unit
Model: PUHY-P250THM-A
Refrigerant: R410A (6.5kg)

Rated Voltage: 220 ; Rated Current: 23.9A
Rated Input: 8.20 kW
Capacity: 28.0 kW

Third floor

49 units Mitsubishi Ceiling Cassette Type VRF
1 unit Mitsubishi Wall Mounted

Outdoor units

6 units
Model: PUHY-P350THM-A
Refrigerant: R410A (9.0kg)
Rated Voltage: 220 ; Rated Current: 37.9A
Rated Input: 13.01 kW
Capacity: 40.0 kW

3 units
Model: PUHY-P300THM-A
Refrigerant: R410A (9.0kg)
Rated Voltage: 220 ; Rated Current: 26.5A
Rated Input: 9.10 kW
Capacity: 33.5 kW

2 units
Model: PUHY-P250THM-A
Refrigerant: R410A (6.5kg)
Rated Voltage: 220 ; Rated Current: 23.9A
Rated Input: 8.20 kW
Capacity: 28.0 kW

1 unit
Model: PUHY-P250THM-A
Refrigerant: R410A (6.5kg)
Rated Voltage: 220 ; Rated Current: 16.7A
Rated Input: 5.73 kW
Capacity: 22.4 kW

INDOOR UNIT SPECS

Rated Voltage: 220V
Frequency: 50/60 Hz
Capacity: 9.0 kW
Rated Input: 0.07 kW
Rated Current: 0.51 A ; Max Current: 0.58 A
Fan Motor: 0.050 kW

LIBRARY

	FLOOR															SUMMARY PER TYPE
		GROUND	2													
WINDOW TYPE			1													1
FLOOR MOUNTED			1													1
WALL MOUNTED			1													1
CEILING CASSETTE		13	11													24
OUTDOOR UNITS																0

27

Ground floor

13 units LG Ceiling Cassette Type VRF

Second floor

11 units LG Ceiling Cassette Type VRF
1 unit 1Hp Mabe Ge window type
1 unit 3TR Daikin Floor Mounted
1 unit 1.5Hp LG wall mounted

OUTDOOR UNITS

3 units Model: ARUV200BTS4
Source: 220V 60Hz 3 Phase
Refrigerant: R410A (6.5 kgs)
Minimum Circuit Ampacity: 48.0 A
Fusible Max: 60A
Total Load : 43.2 A

1 unit Model: ARUV160BTS4
Source: 220V 60Hz 3 Phase
Refrigerant: R410A (6.0 kgs)
Minimum Circuit Ampacity: 40,3 A
Fusible Max: 60A
Total Load : 32.9 A

1 unit Model: ARUV100BTS4
Source: 220V 60Hz 3 Phase
Refrigerant: R410A (5.0 kgs)
Minimum Circuit Ampacity: 28.0 A
Fusible Max: 45A
Total Load : 23.0 A

NGO

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4											
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		15	14	12	10											51
OUTDOOR UNITS																0

51

Ground floor

15 units Hitachi Ceiling Cassette Type VRF

Second floor

14 units Hitachi Ceiling Cassette Type VRF

Third floor

12 units Hitachi Ceiling Cassette Type VRF

Fourth floor

10 units Hitachi Ceiling Cassette Type VRF

OUTDOOR UNITS

6 units

Model: RAM-12MQ
Power Supply: 3 Ph 230 V 60 Hz
Refrigerant: R410A (7.5kg)
Compressor motor: 4.8 kW
Outdoor fan motor: 440 W
Nominal capacity: 33.5 kW
Input: 8.89 kW
Running Current: 24.8 A
Max. Starting Current: 15 A

3 units

Model: RAM-16MQ
Power Supply: 3 Ph 230 V 60 Hz
Refrigerant: R410A (7.5kg)
Compressor motor: 4.8x2 kW
Outdoor fan motor: 660 W
Nominal capacity: 45.0 kW
Input: 12.57 kW
Running Current: 35.1 A
Max. Starting Current: 172 A

AIR CONDITIONING UNITS AT QUEZON CITY HALL COMPOUND

HIGH RISE BUILDING

	FLOOR															SUMMARY
	BASEMENT	GROUND	2	3	4	5	6	7	8	9	10	11	12	14	15	PER TYPE
WINDOW TYPE	2	5														7
FLOOR MOUNTED	1		11													12
WALL MOUNTED		1	1	3	2	1		7	5	3		1				24
CEILING MOUNTED								1	21	24		18			29	93
CEILING CASSETTE				22	21	20	23	20		1						107
																243

15th floor — 29 units Hitachi Ceiling cassette VRF

14th floor

12th floor

11th floor — 18 units Hitachi Ceiling cassette VRF
1 unit Hitachi Wall Mounted VRF

10th floor

9th floor — 24 units Hitachi Ceiling mounted VRF
1 unit Hitachi Ceiling Cassette VRF
3 units Hitachi Wall Mounted VRF

8th floor — 21 units Hitachi Ceiling mounted VRF
5 units Hitachi Wall Mounted VRF

7th floor — 20 units Hitachi Ceiling cassette VRF
1 unit Hitachi Ceiling mounted VRF
7 units Hitachi Wall Mounted VRF

6th floor — 23 units Hitachi Ceiling cassette VRF

5th floor — 20 units Hitachi Ceiling cassette VRF
1 unit Hitachi Wall Mounted VRF

4th floor — 21 units Hitachi Ceiling cassette VRF
2 units Hitachi Wall Mounted VRF

3rd floor — 22 units Hitachi Ceiling cassette VRF

	3 units Hitachi Wall Mounted VRF
2nd floor	Millionaire's Lounge
	5 units 5TR Mitsubishi Floor Mounted
	QC ITDD
	3 units 10TR Koppel Floor Mounted
	3 units 5TR Alenaire Floor Mounted
	1 unit 1.5Hp Carrier Wall Mounted
Ground floor	PDAO
	2 units 3TR Koppel floor mounted
	Power House
	1 unit 2Hp Sharp window type
	PABX
	1 unit 3TR Ceiling Mounted
Basement	Storage
	1 unit 3TR Mitsubishi Floor Mounted
	Aircon Barracks
	1 unit 1.5Hp Kolin window type
	Lockheed
	1 unit 1Hp Carrier window type

LEGISLATIVE

	FLOOR														
		GROUND	2	3											
WINDOW TYPE		17	5	10											
FLOOR MOUNTED		11	5	14											
WALL MOUNTED		7	45	21											
CEILING CASSETTE		9	4	2											
															150

SUMMARY PER TYPE
32
30
73
15

District 1

Coun. Anthony Peter D. Crisologo	2 units 1.5Hp Kolin wall mounted
Coun. Lena Marie P. Juico	2 units 1Hp Carrier wall mounted
Coun. Elizabeth A. Delarmente	1 unit 1.5Hp Alenaire wall mounted
	1 unit 1.5Hp Kolin wall mounted
Coun. Victor V. Ferrer, Jr.	2 units wall mounted
Coun. TJ Calalay	2 units 1.5Hp Koppel wall mounted
Coun. Alexis R. Herrera	1 unit 1Hp Markes wall mounted
	1 unit 1Hp Whirlpool wall mounted

District 2

Coun. Winnie Castelo	2 units 1.5Hp Kolin wall mounted
Coun. Voltaire Godofredo L. Liban III	2 units 1.5Hp Daikin wall mounted
Coun. Ramon P. Medalla	2 units 1.5Hp Carrier Wall mounted
Coun. Belmonte	2 units 1.5Hp Koppel wall mounted
Coun. Estrella C. Valmocina	2 units 1.5Hp Koppel wall mounted
Coun. Medina	2 units 1.5Hp Koppel wall mounted

District 3

Coun. Defensor	1 unit 1.5Hp Samsung wall mounted inverter
	1 unit 1.5Hp Samsung wall mounted inverter
Coun. Banal	1 unit 1Hp Koppel wall mounted
	1 unit 1.5Hp Koppel wall mounted
Coun. Kate Abigael G. Coseteng	1 unit 1.5Hp Koppel wall mounted
	1 unit 1.5Hp LG window type

	Coun. Jose Mario Don S. De Leon	1 unit 1.5Hp Condura wall mounted
		1 unit 2Hp Carrier window type
	Coun. Franz S. Pumaren	1 unit 3TR Condura Cassette Type
		2 units 1.5Hp LG window type
	Coun. Eufemio C. Lagumbay	1 unit 1.5Hp Carrier wall mounted
		1 unit 2Hp Carrier window type
District 4		
	Coun. Marvin C. Rillo	1 unit 2Hp Panasonic wall mounted
		1 unit 1Hp Samsung wall mounted
	Coun. Raquel S. Malangen	1 unit 1Hp Koppel wall mounted inverter
		1 unit 1.5Hp Panasonic wall mounted inverter
	Coun. Ivy Xenia L. Lagman	1 unit 1Hp Kolin wall mounted inverter
		1 unit 2Hp Kolin wall mounted inverter
	Coun. Irene R. Belmonte	1 unit 1Hp Haier wall mounted inverter
		1 unit 2Hp Panasonic wall mounted
	Coun.Maria Aurora C. Suntay	1 unit 1.5Hp Carrier wall mounted
		1 unit 2Hp Kolin window type
	Coun. Hero Clarence M. Bautista	1 unit 1.5Hp Koppel wall mounted inverter
		1 unit 1.5Hp Koppel wall mounted inverter
District 5		
	Coun. Jose A. Visaya	2 units 1 Hp Koppel Wall Mounted
	Coun. Julienne Alyson Rae V. Medalla	1 unit 2Hp LG window type
	Coun. Shay Liban	1 unit 2.5Hp Daikin wall mounted
		1 unit 2Hp LG window type
	Coun. PM Vargas	1 unit 1Hp Koppel wall mounted
		1 unit 2Hp LG window type
	Coun. Allan Butch T. Francisco	1 unit 1Hp Panasonic wall mounted
		1 unit 2Hp LG window type
	Coun. Karl Edgar C. Castelo	1 unit 2Hp LG window type
District 6		
	Coun. Eric Rey Z. Medina	1 unit 1.5Hp Idec wall mounted
		1 unit 2Hp LG window type
	Coun. Diorella Maria G. Sotto	2 units 1Hp Koppel wall mounted

	Coun. Ma. Victoria Co-Pilar	2 units 1Hp Koppel wall mounted
	Coun. Rogelio P. Juan	1 unit 2Hp LG window type
	Coun. B. Castelo	1 unit 2Hp LG window type
	Coun. Donato C. Matias	1 unit 2Hp LG window type
OVM Ground floor		
	4 units 3TR Carrier floor mounted	
	3 units 3TR Kolin floor mounted	
	1 unit 3TR Fuji Air Floor Mounted	
GSD Records		
	1 unit 2Hp Panasonic window type	
PLEB		
	2 units 3TR Kolin floor mounted	
	1 unit 1Hp Gree window type	
	1 unit 1.5 Hp Natural window type	
TFB		
	1 unit 1Hp Samsung wall mounted	
	2 units 1.5Hp Koppel window type	
QCADAAC		
	4 units 1Hp Kolin wall mounted	
	1 unit 3TR Koppel floor mounted	
BREASTFEEDING		
	1 unit 3TR Samsung Cassette type	
QCADAAC		
	1 unit 1.5Hp Kolin window type	
	2 units 1Hp LG window type	
CITY SECRETARY		
	8 units 3TR Samsung Cassette type	
	1 unit 1.5Hp Markes wall mounted	
	4 units 2Hp Markes window type	
	3 units 1.5Hp LG window type	
	1 unit 1.5Hp Carrier window type	
	1 unit 1.5Hp Koppel window type	
	1 unit 1.5Hp Samsung wall mounted	

OVM 2nd FLOOR	
	3 units 3TR Carrier Ceiling Cassette Type
	7 units 1.5Hp Koppel Wall Mounted
	1 unit 3TR Fuji Floor Mounted
SK FEDERATION	
	1 unit 1.5Hp Matrix wall mounted
	1 unit 1.5Hp Carrier wall mounted
LIGA NG MGA BGY.	
	1 unit 2Hp Koppel wall mounted inverter
	1 unit 1.5Hp Kolin wall mounted
SGT. AT ARMS	
	1 unit 1Hp Kolin wall mounted
Councilors' Lounge	
	2 units 3TR Fuji Floor Mounted
Lecture Room A & B	
	4 units 5TR Fuji Floor mounted
Legislative Lounge	
	2 units 5TR Fuji Floor Mounted
	2 units 3TR Carrier Cassette Type
Session Hall	
	6 units 10TR Fuji Floor Mounted
	2 units 5TR Fuji Floor Mounted

ANNEX

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3												
WINDOW TYPE																0
FLOOR MOUNTED		21														21
WALL MOUNTED		2	1	1												4
CEILING CASSETTE		2	42	49												93

118

Ground floor

18 units 5TR Koppel Floor Mounted
2 units 3TR Koppel Floor Mounted
1 unit 3TR Condura Floor Mounted
2 units 5TR Carrier Cassette Type
2 units 1.5Hp Carrier Wall Mounted

Second floor

42 units Mitsubishi Ceiling Cassette Type VRF
1 unit Carrier Wall Mounted

Third floor

49 units Mitsubishi Ceiling Cassette Type VRF
1 unit Mitsubishi Wall Mounted

CIVIC A

	FLOOR														
	BASEMENT	GROUND	2	3	4	5	6	7	8						
WINDOW TYPE															
FLOOR MOUNTED	7														
WALL MOUNTED		12													
CEILING CASSETTE			14	16	16	16	16	16	16						

SUMMARY PER TYPE
0
7
12
110

129

Basement

7 units 5TR Mitsubishi Floor Mounted

Ground floor

12 units 3TR Koppel Ceiling Mounted

Second floor

13 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Third floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Fourth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Fifth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Sixth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Seventh floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Eighth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

CIVIC B

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	MEZZ.	2	3	4	5	6	7	8						
WINDOW TYPE																0
FLOOR MOUNTED	7	2	1													10
WALL MOUNTED		9														9
CEILING CASSETTE			5	14	16	16	16	16	16	16						115

134

Basement

7 units 5TR Mitsubishi Floor Mounted

Ground floor

2 units 3TR Carrier Floor Mounted

9 units 5TR Carrier Ceiling Mounted

Mezzanine floor

5 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 3TR Carrier Floor Mounted

Second floor

13 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Third floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Fourth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Fifth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Sixth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Seventh floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

Eighth floor

15 units 3TR Mitsubishi Ceiling Cassette Type

1 unit 5TR Mitsubishi Ceiling Cassette Type

CIVIC C

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3												
WINDOW TYPE				5												5
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		21	20	20												61

66

Ground floor

18 units Mitsubishi Ceiling Cassette Type VRF

3 units Carrier Ceiling Cassette Type Individual

Second floor

20 units Mitsubishi Ceiling Cassette Type VRF

Third floor

20 units Mitsubishi Ceiling Cassette Type VRF

5 units 1.5 Hp Carrier window type

CIVIC D

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4	5	6	7								
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		28	34	35	36	40	51	10								234

234

Ground floor

28 units Hitachi Ceiling Cassette Type VRF

Second floor

34 units Hitachi Ceiling Cassette Type VRF

Third floor

35 units Hitachi Ceiling Cassette Type VRF

Fourth floor

36 units Hitachi Ceiling Cassette Type VRF

Fifth floor

40 units Hitachi Ceiling Cassette Type VRF

Sixth floor

51 units Hitachi Ceiling Cassette Type VRF

Roofdeck

10 units Hitachi Ceiling Cassette Type VRF

CIVIC F

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4	5	6	7								
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		44	40	40	40	40	40									244

244

Ground floor

44 units Hitachi Ceiling Cassette Type VRF

Second floor

40 units Hitachi Ceiling Cassette Type VRF

Third floor

40 units Hitachi Ceiling Cassette Type VRF

Fourth floor

40 units Hitachi Ceiling Cassette Type VRF

Fifth floor

40 units Hitachi Ceiling Cassette Type VRF

Sixth floor

40 units Hitachi Ceiling Cassette Type VRF

NGO

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4											
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		15	14	12	10											51

51

Ground floor

15 units Hitachi Ceiling Cassette Type VRF

Second floor

14 units Hitachi Ceiling Cassette Type VRF

Third floor

12 units Hitachi Ceiling Cassette Type VRF

Fourth floor

10 units Hitachi Ceiling Cassette Type VRF

DRRMO

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	MEZZ.	2	3											
WINDOW TYPE					1											1
FLOOR MOUNTED					2											2
WALL MOUNTED					7											7
CEILING CASSETTE		2	6	16	11											35

45

Ground floor

2 units Koppel Ceiling Cassette Type VRF

Mezzanine floor

6 units Koppel Ceiling Cassette Type VRF

Second floor

16 units Koppel Ceiling Cassette Type VRF

Third floor

11 units Koppel Ceiling Cassette Type VRF

7 units Koppel Wall Mounted VRF

2 units Koppel Floor Mounted

1 unit 1.5 Hp Carrier window type

DPOS

	FLOOR															SUMMARY PER TYPE
		GROUND	2	3	4											
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		12	14	12	3											41

41

Ground floor

12 units Hitachi Ceiling Cassette Type VRF

Second floor

14 units Hitachi Ceiling Cassette Type VRF

Third floor

12 units Hitachi Ceiling Cassette Type VRF

Fourth floor

3 units Hitachi Ceiling Cassette Type VRF

LIBRARY

	FLOOR															SUMMARY PER TYPE
		GROUND	2													
WINDOW TYPE			1													1
FLOOR MOUNTED			1													1
WALL MOUNTED			1													1
CEILING CASSETTE		13	11													24

27

Ground floor

13 units LG Ceiling Cassette Type VRF

Second floor

11 units LG Ceiling Cassette Type VRF

1 unit 1Hp Mabe Ge window type

1 unit 3TR Daikin Floor Mounted

1 unit 1.5Hp LG wall mounted

PARKING

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE		1														1
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE																0

1

1 **unit 1Hp Carrier window type inverter**

YAKAP

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE		2														2
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE																0

2

1 **unit** 1Hp Panasonic window type
1 **unit** 2Hp Midea floor mounted

MUSLIM

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE		3														3
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE																0

3

2 units 1Hp Carrier window type

1 unit 1Hp Panasonic floor mounted

POLICE DETACHMENT

	FLOOR															SUMMARY PER TYPE
		GROUND	2													
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED		6														6
CEILING MOUNTED		2														2

8

2 units 3TR Gree Ceiling Mounted Inverter
4 units 1Hp Gree wall mounted Inverter
2 units 1.5Hp Gree inverter wall mounted

UNDERPASS

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED		2		Defective												2
CEILING CASSETTE																0

2

2 units 3TR Koppel Wall Mounted Defective

OSCA

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE		8														8
FLOOR MOUNTED																0
WALL MOUNTED		1														1
CEILING CASSETTE																0

9

7 units 1.5Hp Condura window type
1 unit 1.5Hp Koppel window type
1 unit 1.5Hp Koppel wall mounted

HEALTH

	FLOOR															SUMMARY PER TYPE
		GROUND														
WINDOW TYPE		2														2
FLOOR MOUNTED		2														2
WALL MOUNTED		1														1
CEILING CASSETTE																0

5

2 units 1.5Hp Condura window type
1 unit 2Hp Koppel wall mounted inverter
2 units 3TR Kolin floor mounted

MOTORPOOL

	FLOOR															SUMMARY PER TYPE
		GROUND	2													
WINDOW TYPE			2													2
FLOOR MOUNTED			1													1
WALL MOUNTED																0
CEILING CASSETTE																0

3

1 unit 1Hp Condura window type
1 unit 1Hp Carrier window type
1 unit 5TR Alenaire floor mounted

AIR CONDITIONING UNITS AT QUEZON CITY HALL COMPOUND

(INVERTOR) NEW ACU HIGH RISE BUILDING – Mayor

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4	5	6	7	8	9	10	11	12	14	15	
CEILING MOUNTED	2	5														7
FLOOR MOUNTED	1		11													12
WALL MOUNTED		1	1	3	2	1		7	5	3		1				24
CEILING MOUNTED								1	21	24		18			29	
CEILING CASSETTE				22	21	20	23	20		1						107

243

LEGISLATIVE – CT

	FLOOR															SUMMARY PER TYPE
		GROUND	2	3												
WINDOW TYPE		17	8	13												38
FLOOR MOUNTED		10	2	16												28
WALL MOUNTED		6	50	8												64
CEILING CASSETTE		10	3	7												20

150

ANNEX – older Inverter

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3												
WINDOW TYPE																0
FLOOR MOUNTED		21					Carrier and Koppel									21
WALL MOUNTED		2	1	1												4
CEILING CASSETTE		2	42	49			Mitsubishi Electric VRF									93

118

CIVIC A – conventional type

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4	5	6	7	8							
WINDOW TYPE																0

FLOOR MOUNTED	7															7
WALL MOUNTED		12														12
CEILING CASSETTE			14	16	16	16	16	16	16			Mitsubishi Electric				110

129

CIVIC B ~ CT

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	MEZZ.	2	3	4	5	6	7	8						
WINDOW TYPE																0
FLOOR MOUNTED	7	2	1													10
WALL MOUNTED		9														9
CEILING CASSETTE			5	14	16	16	16	16	16	16		Mitsubishi Electric				115

134

5 years old

CIVIC C

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3												
WINDOW TYPE				5												5
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		22	20	20		Mitsubishi Electric VRF										62

67

2 years
NEW BLDG

CIVIC D

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4	5	6	7								
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		28	34	35	36	40	51	10								234

234

NEW BLDG

CIVIC F

	FLOOR	SUMMARY

	BASEMENT	GROUND	2	3	4	5	6	7								PER TYPE
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		44	40	40	40	40	40									244

244

5 YEAR OLD NGO

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	2	3	4											
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		15	14	12	10		Hitachi VRF									51

51

5 years old DRRMO

	FLOOR															SUMMARY PER TYPE
	BASEMENT	GROUND	MEZZ.	2	3											
WINDOW TYPE					1											1
FLOOR MOUNTED					2											2
WALL MOUNTED					7											7
CEILING CASSETTE		2	6	16	11		Koppel VRF									35

45

5 years old DPOS

	FLOOR															SUMMARY PER TYPE
		GROUND	2	3	4											
WINDOW TYPE																0
FLOOR MOUNTED																0
WALL MOUNTED																0
CEILING CASSETTE		12	14	12	3		Hitachi VRF									41

41

3 years

LIBRARY

	FLOOR														SUMMARY PER TYPE
		GROUND	2												
WINDOW TYPE			1		1 pc. Mabe Ge 1Hp										1
FLOOR MOUNTED			1		1pc. 3 TR Daikin										1
WALL MOUNTED			1		1pc. 1.5Hp LG										1
CEILING CASSETTE		13	11		LG VRF										24

27

MOTORPOOL CT

	FLOOR														SUMMARY PER TYPE
		GROUND	2												
WINDOW TYPE			2		1pc. 1Hp Condura				1pc. 1Hp Carrier						2
FLOOR MOUNTED			1		1pc. 5TR Alenaire										1
WALL MOUNTED															0
CEILING CASSETTE															0

3

POLICE DETACHMENT CT

	FLOOR														SUMMARY PER TYPE
		GROUND	2												
WINDOW TYPE															0
FLOOR MOUNTED															0
WALL MOUNTED		6		4 pcs. Gree Inverter 1 Hp					2 pcs. 1.5Hp Gree Inverter						6
CEILING MOUNTED		2		2 pcs. 3 TR Gree Inverter											2

8

OSCA CT

	FLOOR														SUMMARY PER TYPE
		GROUND													
WINDOW TYPE		8		7 pcs. 1.5Hp Condura				1pc. 1.5Hp Koppel							8
FLOOR MOUNTED															0
WALL MOUNTED		1		1pc. 1.5Hp Koppel											1
CEILING CASSETTE															0

9

HEALTH CT

	FLOOR				SUMMARY PER TYPE
		GROUND			
WINDOW TYPE		2		2 pcs. 1.5Hp Condura	2
FLOOR MOUNTED		2		2pcs. 3 TR Kolin	2
WALL MOUNTED		1		1pc. 2 Hp Koppel Inverter	1
CEILING CASSETTE					0

5

YAKAP CT

	FLOOR				SUMMARY PER TYPE
		GROUND			
WINDOW TYPE		2		1 pc. Panasonic 1 Hp	2
FLOOR MOUNTED				1 pc. Midea 2 Hp	0
WALL MOUNTED					0
CEILING CASSETTE					0

2

MUSLIM CT

	FLOOR				SUMMARY PER TYPE
		GROUND			
WINDOW TYPE		3		2 pcs. Carrier 1 Hp	3
FLOOR MOUNTED				1 pc. Panasonic 1 Hp	0
WALL MOUNTED					0
CEILING CASSETTE					0

3

PARKING

	FLOOR				SUMMARY PER TYPE
		GROUND			
WINDOW TYPE		1		1pc. Carrier 1Hp Inverter	1
FLOOR MOUNTED					0

WALL MOUNTED															
CEILING CASSETTE															

0
0

1

UNDERPASS

	FLOOR														
		GROUND													
WINDOW TYPE															
FLOOR MOUNTED															
WALL MOUNTED		2		Defective											
CEILING CASSETTE															

SUMMARY PER TYPE
0
0
2
0

2

TOTAL AIR CONDITIONING UNITS WITHIN QC HALL COMPOUND 1516

Appendix 3 Specification List of Air Conditioning Equipment (3 Facilities)

ANNEX BUILDING AIR CONDITIONING SYSTEM (OUTDOOR SYSTEM)

BRAND	MODEL	SERIAL NO.	YEAR OF	REFRIGERANT	ALLOWABLE	ALLOWABLE	WEIGHT	RATED INPUT	FREQUENC	RATED VOLTAGE	RATED CURRENT	EER/COP	CAPACITY			COMP. MOTOR
													kW	kcal/h	Btu/h	
MITSUBISHI ELECTRIC VRF	PUHY-P400THM-A	9ZW00148	2009.1	R410A 11.5 kg	4.15 Mpa	2.21 Mpa	240 kg	13.24 kW	60 Hz	208/ 220/ 230	40.8/ 38.6/ 36.9		45	40,000	153,500	
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00253	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500	
MITSUBISHI ELECTRIC VRF	PUHY-P300THM-A	9ZW00135	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	9.1 kW	60	208/ 220/ 231	28.0/ 26.5/ 25.3		33.5	30,000	114,300	
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00260	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500	
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00243	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500	
MITSUBISHI ELECTRIC VRF	PUHY-P400THM-A	9ZW00146	2009.1	R410A 11.5 kg	4.15 Mpa	2.21 Mpa	240 kg	13.24 kW	60 Hz	208/ 220/ 230	40.8/ 38.6/ 36.9		45	40,000	153,500	
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9YW00242	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500	
MITSUBISHI ELECTRIC VRF	PUHY-P200THM-A	9ZW00056	2009.1	R410A 6.5 kg	4.15 Mpa	2.21 Mpa	185	5.73 kW	60	208/ 220/ 230	17.6/ 16.7/ 15.9		22.4	20,000	76,400	
MITSUBISHI ELECTRIC VRF	PUHY-P250THM-A	9ZW00273	2009.1	R410A 6.5 kg	4.15 Mpa	2.21 Mpa	185	8.20 kW	60	208/ 220/ 230	25.2/ 23.9/ 22.8		28	25,000	95,500	
MITSUBISHI ELECTRIC	PU-5TJSA	9XP00125	2009.1	R22 5.1 kg	3.3 Mpa	1.3 Mpa	114 kg	5.63 kW	60	220	16.83					3.5 kW
MITSUBISHI ELECTRIC	PU-5TJSA	9XP00118	2009.1	R22 5.1 kg	3.3 Mpa	1.3 Mpa	114 kg	5.63 kW	60	220	16.83					3.5 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00098	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00054	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW

MITSUBISHI ELECTRIC	PU-4TJSA	9YP00097	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00094	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00093	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00096	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00101	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-3NJA	9YP00477	2009.1	R22 3.5 kg	3.3 Mpa	1.3 Mpa	73 kg	3.44 kW	60	220	17.6					2.2 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00102	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00099	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00053	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00103	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW

KOPPEL	KPC-60IH0A	MH323391		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h		
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR07PC-0450489		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h			
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR07PC-0450490		R22 2.5 kg				5.4 kW	60	208/230/3P	15.7		63,300 kJ/h			
CARRIER	38ASB360BA-1	38ASBCDUCAR03TEXT08PC-0803599		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h			

KOPPEL	KPC-36IH2	DJ820248		R22 2.65 kg	24.0 bar	10.4 bar		3.95 kW	60	230/1P	18.6		37,980 kJ/h	36,000 BTU/h			
CARRIER	38ASB240BA-1	38ASBCDUCARX02TEXK13PC-0365536		R22 2.1 kg				2.8 kW	60	208/230/1P	12.9		25,000 kJ/h				
KOPPEL	KPC-36IH2	GH820690		R22 2.65 kg	24.0 bar	10.4 bar		3.95 kW	60	230/1P	18.6		37,980 kJ/h	36,000 BTU/h			
CARRIER	38CVUR013-703	32501169		R410A 0.80 kg	4.15 Mpa	2.21 Mpa	33 kg	1.80 kW	60	220-230/	8.5		3.50 kW				
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR07PC-0450436		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR07PC-0450472		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR08PC-0752482		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
KOPPEL	KPC-60IH0A	MH323396		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323406		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IV0A	EH323627		R22 3.75 kg	26.0 bar	16.0 bar		5.8 kW	60	230/3P	17.5		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323404		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220/3P	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323393		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220/3P	17.4		63,000 kJ/h	60,000 BTU/h			

KOPPEL	KPC-12HH5B2	LJ540327		R22/0.83 kg				1.488 Kw	60	208-230/1P	6.6A	10.7 kJ/h-W	12,260 kJ/h	11,620 BTU/h		LRA 29.5A	
KOPPEL	KPC-60IH0A	MH323405		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323392		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			

CARRIER	38ASB600DC	38ASBCDUCAR05TKXR07PC-0450475		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
CARRIER	38ASB600DC	38ASBCDUCAR05TKXR08PC-0776752		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
KOPPEL	KPC-60IH0A	HH323402		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	HH323399		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323402		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-36IH0A	BM323518		R22 2.1 kg	24.0 bar	10.4 bar		3.66 kW	60	230/1P	16.4		37,980 kJ/h	36,000 BTU/h			
KOPPEL	KPC-60IH0A	MH323401		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
CARRIER	38ASB600DC	38ASBCDUCAR05TKXM08PC-0657348		R22 2.5 kg				5.4 kW	60	208/230	15.7		63,300 kJ/h				
KOPPEL	KPC-36IH2	DJ820351		R22 2.65 kg	24.0 bar	10.4 bar		3.95 kW	60	230/1P	18.6		37,980 kJ/h	36,000 BTU/h			
KOPPEL	KPC-60IH0A	HH323400		R22 3.75 kg	26.0 bar	16.0 bar		5.73 kW	60	220	17.4		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IV0A	LH323086		R22 3.75 kg	26.0 bar	16.0 bar		5.8 kW	60	230/3P	17.5		63,000 kJ/h	60,000 BTU/h			
KOPPEL	KPC-60IV0A	LH323084		R22 3.75 kg	26.0 bar	16.0 bar		5.8 kW	60	230/3P	17.5		63,000 kJ/h	60,000 BTU/h			

MITSUBISHI ELECTRIC VRF	PUHY-P250THM-A	9ZW00276	2009.1	R410A 6.5 kg	4.15 Mpa	2.21 Mpa	185	8.20 kW	60	208/ 220/ 230	25.2/ 23.9/ 22.8		28	25,000	95,500		
MITSUBISHI ELECTRIC VRF	PUHY-P300THM-A	9ZW00134	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	9.1 kW	60	208/ 220/ 231	28.0/ 26.5/ 25.3		33.5	30,000	114,300		
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00256	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00257	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		

MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00255	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00254	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		
MITSUBISHI ELECTRIC VRF	PUHY-P250THM-A	9ZW00266	2009.1	R410A 6.5 kg	4.15 Mpa	2.21 Mpa	185	8.20 kW	60	208/ 220/ 230	25.2/ 23.9/ 22.8		28	25,000	95,500		
MITSUBISHI ELECTRIC VRF	PUHY-P300THM-A	9ZW00136	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	9.1 kW	60	208/ 220/ 231	28.0/ 26.5/ 25.3		33.5	30,000	114,300		
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00259	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		
MITSUBISHI ELECTRIC VRF	PUHY-P350THM-A	9ZW00258	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	13.01 kW	60	208/ 220/ 230	40.1/ 37.9/ 36.2		40	35,000	136,500		
MITSUBISHI ELECTRIC VRF	PUHY-P300THM-A	9ZW00137	2009.1	R410A 9.0 kg	4.15 Mpa	2.21 Mpa	210	9.1 kW	60	208/ 220/ 231	28.0/ 26.5/ 25.3		33.5	30,000	114,300		
MITSUBISHI ELECTRIC VRF	PUHY-P200THM-A	9YW00055	2009.1	R410A 6.5 kg	4.15 Mpa	2.21 Mpa	185	5.73 kW	60	208/ 220/ 230	17.6/ 16.7/ 15.9		22.4	20,000	76,400		
MITSUBISHI ELECTRIC	PU-4TJSA	99P00030	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00034	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00058	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	9YP00100	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00040	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
KOPPEL	KPC-36IH0A	BM323520		R22 2.1 kg	24.0 bar	10.4 bar		3.66 kW	60	230/1P	16.4		37,980 kJ/h	36,000 BTU/h			
MITSUBISHI ELECTRIC	PU-5TJSA	9XP00115	2009.1	R22 5.1 kg	3.3 Mpa	1.3 Mpa	114 kg	5.63 kW	60	220	16.83					3.5 kW	0.10 + 0.10 kW

MITSUBISHI ELECTRIC	PU-4TJSA	99P00029	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00055	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00056	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA			R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-4TJSA	99P00038	2009.1	R22 4.6 kg	3.3 Mpa	1.3 Mpa	94 kg	4.27 kW	60	220	12.2					2.7 kW	0.065 + 0.065 kW
MITSUBISHI ELECTRIC	PU-5TJSA	9XP00117	2009.1	R22 5.1 kg	3.3 Mpa	1.3 Mpa	114 kg	5.63 kW	60	220	16.83					3.5 kW	0.10 + 0.10 kW
MITSUBISHI ELECTRIC	PU-5TJSA	9XP00119	2009.1	R22 5.1 kg	3.3 Mpa	1.3 Mpa	114 kg	5.63 kW	60	220	16.83					3.5 kW	0.10 + 0.10 kW

CIVIC CENTER A AIR CONDITIONING SYSTEM (OUTDOOR SYSTEM)

TAGGING	MODEL NO.	SERIAL NO.	COOLING CAPACITY	VOLTAGE	CURRENT	INPUT	REFRIGERANT	WEIGHT	COMP. MOTOR	FAN MOTOR
CCA-8F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-8F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-8F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-7F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-7F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW

CCA-6F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-6F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-6F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-5F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-5F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-4F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-4F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW

CCA-3F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-3F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-3F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-12	PU-5TJSA			220	19.61	6.68 Kw	R22 5.1 kg	114 kg	3.5 kW	0.10 + 0.10 kW
CCA-2F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-2F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW
CCA-GF-12	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	2.2 kW	0.085 kW

CCA-B-01	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-02	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-03	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-04	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-05	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-06	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-07	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			

CIVIC CENTER B AIR CONDITIONING SYSTEM (OUTDOOR SYSTEM)

TAGGING	MODEL NO.	SERIAL NO.	KJ/Hr	VOLTAGE	CURRENT	INPUT	REFRIGERANT	WEIGHT	ALL. PRESSURE	COMP. MOTOR	FAN MOTOR
CCB-8F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-8F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-8F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-7F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-7F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW

CCB-6F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-6F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-6F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-5F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-5F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-4F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-4F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW

CCB-3F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-3F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-15	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-3F-16	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-11	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-12	PU-5TJSA			220	19.6	6.68 Kw	R22 5.1 kg	114	3.3 Mpa	3.5 kW	0.10 + 0.10
CCB-2F-13	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-2F-14	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-01	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-02	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-03	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-04	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-05	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-06	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-07	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-08	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-09	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW
CCB-GF-10	PU-3NJA			220	20.9	4.09 kW	R22 3.5 kg	73 kg	3.3 Mpa	2.2 kW	0.085 kW

CCA-B-01	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-02	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-03	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-04	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-05	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-06	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			
CCA-B-07	KPC-36IH0A		37,980 kJ/h	230/1 P	19	4.02 kW	R22 2.4 kg			

Appendix 4　JCM Manual

Joint Crediting Mechanism (JCM) Manual

1. Background

The Philippines become the 17th member country of Joint Crediting Mechanism (JCM), which can provide technological and financial support for climate change mitigation projects in member countries. JCM may help facilitate the existing energy efficiency and renewable energy promotion programs in the Philippines such as the Philippine Energy Efficiency Roadmap 2014–2030 and the National Renewable Energy Program (NREP).

The Energy Efficiency Roadmap shall guide the Philippines in building an energy-efficient nation, and in making energy efficiency and conservation a way of life for all Filipinos. The NREP signals the country's big leap from fragmented and halting renewable energy initiatives into a focused and sustained drive towards energy security and improved access to clean energy.

Along with a JCM feasibility study in the field of promoting energy efficiency and renewable energy projects under the City-to-City Collaboration between Osaka and Quezon, the JCM manual was developed for accelerating the development and implementation of JCM projects in the Philippines. It can also promote Quezon Climate Change Action Plan.

The objective of the manual is to provide consice introductionn of the procedures of JCM project implementation, methods of calculationg the amount of greenhouse gas emission reduction for the proposed JCM projects.

2. Introduction of JCM

2.1. Basic Concepts of JCM

The Joint Crediting Mechanism (JCM) is a project-based bilateral offset crediting mechanism initiated by the Government of Japan. JCM aims to facilitate diffusion of leading low carbon technologies, products, systems, services and infrastructure as well as implementation of mitigation actions, and contributing to sustainable development of developing countries. JCM also seeks to contribute to GHG emission reductions or removals by facilitating global actions.

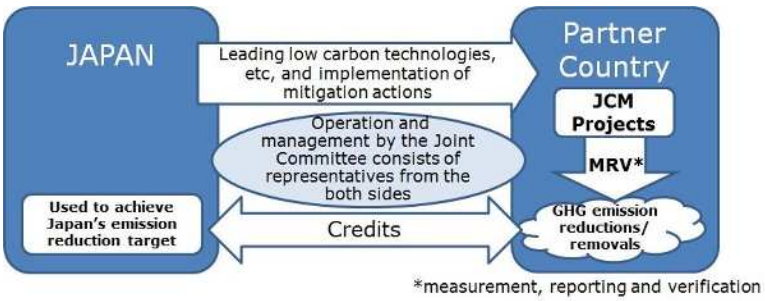


Figure 1 JCM Scheme

The JCM is implemented by Japan and a JCM partner country through bilateral agreements. A JCM project is implemented in the host country using an advanced low carbon technology to reduce GHG emissions.

The JCM was designed to take into consideration robust methodologies, transparency, and environmental integrity of its procedures, rules, and guidelines, while maintaining simplicity and practicality. JCM procedures also address double counting of emission reductions by establishing registries, which track relevant information for the issued credits. The registries will also prevent registered JCM projects from being used under any other international climate mitigation mechanisms.

Emission reductions are calculated as the difference between "reference emissions" defined as emissions estimated below business-as-usual (BaU), and the "project emissions." The reference emissions and the project emissions can be calculated based on an approved methodology

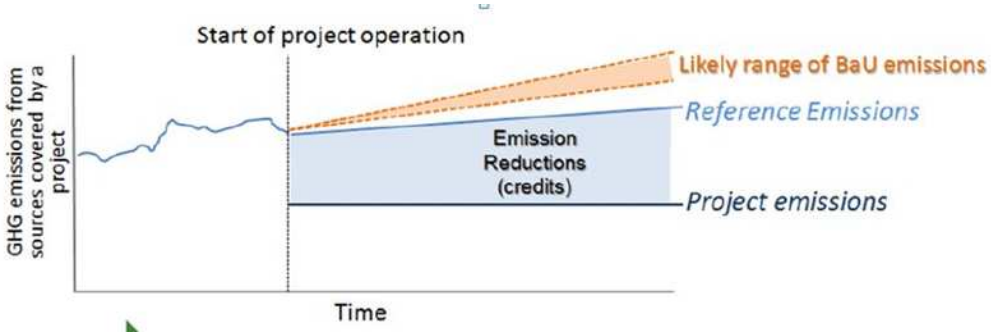


Figure 2 Emission Reduction Calculation Concept[1]

2.2. JCM Stakehloders

Figure 3 below provides an overview of the various stakeholders involved in the JCM and their interface during the implementation of a JCM project.

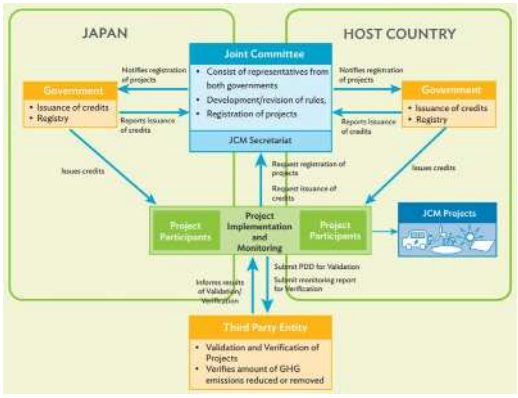


Figure 3 Overview of JCM Stakeholders

[1] All figures about JCM scheme are reffered to Ministry of Environment, Japan

2.3. JCM Project Cycle

Figure 4 below depicts the project development cycle of of JCM.

Figure 4 JCM Project Developmet Cycle

PDD:Project design document

2.4. Eligible Projects under the JCM

There are 15 sectors under the JCM which are based on the CDM sectoral scopes. A JCM project may fall within more than one sectoral scope.

(i) Energy industry (renewable and nonrenewable sources) (ii) Energy distribution (iii) Energy demand (iv) Manufacturing industries (v) Chemical industry (vi) Construction (vii) Transport (viii) Mining/mineral production (ix) Metal production (x) Fugitive emissions from fuel (solid, oil, and gas) (xi) Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride (xii) Solvent use (xiii) Waste handling and disposal (xiv) Afforestation and reforestation15 (xv) Agriculture

2.5. JCM Model Projects

Japanese Government facilitate JCM model projects by providing subsidy up to 50% of the investment cost of a JCM model project. The subsidy covers contruction and cost of facilities, equipment, vehicles, etc which directly contribute to reduction of CO_2 emission reduction. Model projects should complete installation and contruction of systems within 3 years.

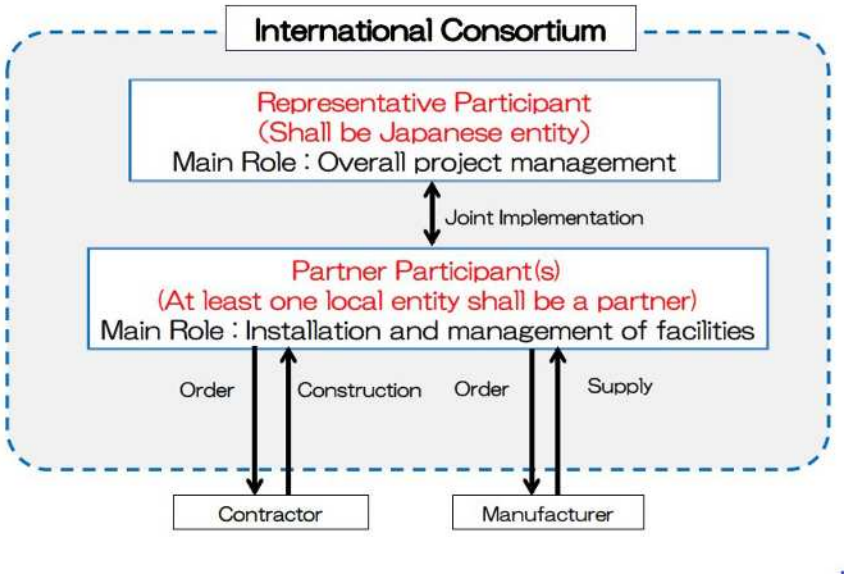


Figure 5 Example of International Consortium

The functions of Japanese participant are as follows:

- Applying for the model project;
- Project management and coordination;
- Introducing technology;
- Purchasing, installing facilities using the construction period and managing the facilties during the project period (life time of the technology stipulated by Japanesse law); and
- Return and compensate the finance resulting from any violation of financial regulation by any of the project participants.

3. Technologies Examples

3.1. Waste Heat Recovery (WHR)

In most cases, a WHR system generates electricity through the recovery of exhaust heat from production facilities such as textile, cement, and other type of industries. In the case of textile or food processing factories, it is possible to recover heat from waste water from dyeing processes.

Table 1 Charateristics of Textile Industry Energy Consumption

	Spinning	Knitting	Dyeing	Sewing
Electric energy	◎	◎	○	○
Heat energy	×	×	◎	×

In the textile industry, electric energy is mostly consumed by motors and compressors (partly). On the other hand, dyeing process also consumes a large amount of heat energy, which is provided by boilers. Dyeing process also generates a huge amount of heated wastewater.

From the perspective of energy saving potentiality in textile factories, introducing energy saving technologies or practices to dyeing and finishing process promises significant energy saving results.

Heat exchangers are the technology for recovering and applying waste heats from waste water generated in dyeing processes. Recovered waste heat is used to heat up the temperature of supply water (clean water) to the dyeing process or boilers. Generally, the temperature of the supply water is increased if necessary by using steam from boilers.

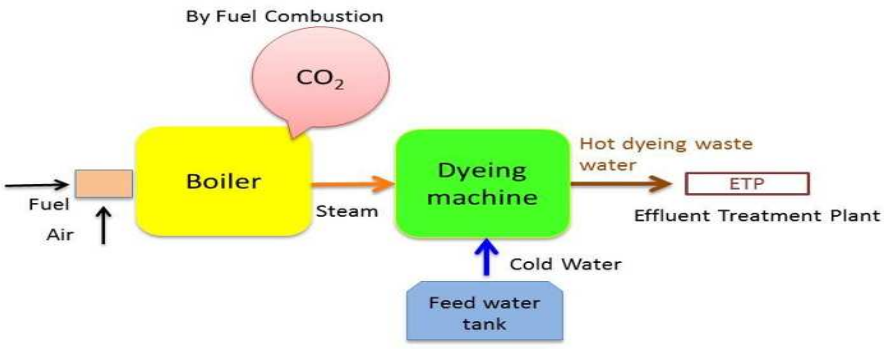


Figure 6 Situation without Waste Heat Recovery

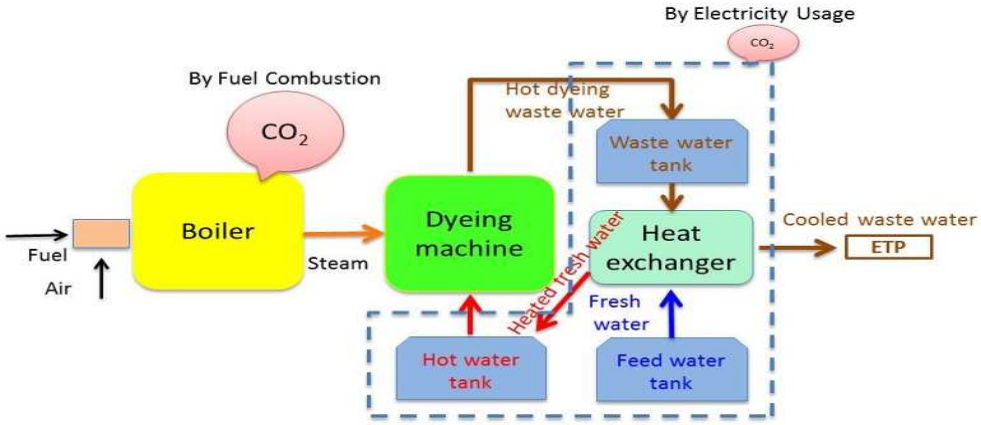


Figure 7 A Case of Introduction of Waste Heat Recovery

There are several types of heat exchangers such as tube types, plate types and spiral types. The comparison of different type of heat exchangers is given in the table below.

Table 2 Comparison of Different Types of Heat Exchangers

	Advantages	Disadvantage
Shell & Tube type	Long history High temperature & pressure	Low efficiency Large space Easy to be fouled and clogged.
Plate type	High efficiency Low initial cost Compact	Easy to be fouled and clogged. Expensive rubber packing & maintenance.
Spiral type	High efficiency Suitable for dirty fluid Low cost for maintenance Compact	Pressure drop of the spiral flow is slightly high.

As depicted in the table above, the spiral type heat exchangers are suitable for recovering waste heat from fluids containing suspended solids such as hairs, threads and films. Therefore, for projects which try to recover waste heat from waste dyeing water in textile industries, the spiral type heat exchangers are recommended to be applied.

This type of heat exchangers can also be applied to recover and apply heat from edible oil used for frying foods in restaurants and plants.

3.2. The GHG Emission Reduction Estimation Methodology for Waste Heat Recovery and Utilization in Textile Industries

3.2.1.Terms and Definitions

Textile dyeing and finishing: The processes from pre-treatment to finishing in yarn and garment dyeing houses. Including main procedures of pre-treatment, dyeing and finishing (washing/rinsing) of yarns or fabrics that is the chemical and physical treatments of yarn and fabrics by consuming heat (steam).

Waste heat: Heat energy from boiler exhaust air and/or waste water from dyeing machines.

3.2.2. Summmary of the Methodology

Items	Summary
GHG emission reduction measures	Recovered waste heat is used for preheating feed-water to boilers and dyeing machines so that reduce the fossil fuel consumption of boilers which 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 CO_2 emission factor of the fossil fuel that is used in boilers for providing energy to the dyeing process. Conservative values of the parameters are used to ensure the reference emission are lower than BaU emissions.
Calculation of project emissions	The project emission is calculated based on the electricity consumption of waste heat recovery system and CO_2 emission factor of the electricity
Monitoring parameters	The following parameters need to be monitored. The temperature and the amount of feed-water for dyeing machines and/or boiler in the project. The amount of electricity consumed by the waste heat recovery system.

This methodology is applicable to the projects of recovering heat from waste water generated in the processes of yarn and fabric dyeing in the textile factories or food processing factories.

3.2.3. Establishment of Reference Emissions

The reference emission is the emission from the consumption of fossil fuel to gain the same amount of waste energy utilized.

3.2.4. Calculation of Reference Emissions

$$RE_y = (T_P - T_{Re}) \times W_{th} \times F_w \times \frac{1}{Ef} \times EF_{CO2,fuel} \times 10^{-6}$$

RE_y: Reference emission [tCO_2/y]

T_P: Temperature of feed-water to the heat exchanger the project (°C)

T_{Re}: Temperature of feed-water from the heat excher to dyeing machines in the case of project (°C)

W_{th}: The specific heat of water (kJ/kg °C)

F_w: The amount of the feed-water in the project (t/y)

Ef: Boiler efficiency (ratio)

$EF_{CO2,fuel}$: CO_2 emission factor the fossil fuel that is used to provide energy for dyeing or other production processes (tCO_2/TJ)

3.2.5. Calculation of Project Emissions

Project emission is calculated based on the amount of electricity consumed by the waste heat recovery system and electricity CO_2 emission factor.

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

PE_y : Project emissions (tCO_2/y)

$EC_{PJ,y}$: Electricity consumption by the waste heat recovery system (MWh/y)

EF_{elec} : CO_2 emission factor of electricity (tCO_2/MWh)

3.2.6. Calculation of Emissions Reduction

$ER_y = RE_y - PE_y$

RE_y: Reference emissions (tCO_2/y)

PE_y: Project emissions (tCO_2/y)

3.2.7. Data and Parameters Fixed Ex-ante

Parameter	Description of data	Source
Ef	Boiler efficiency	Factories (100% is used for conservativeness)
$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for steam generation Natural gas:54.3 t CO_2/TJ (54.3–58.3) Coal:87.3 t CO_2/TJ (87.3–101) Heavy oil:71.1 t CO_2/TJ (71.1–75.5)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2.
EF_{elec}	CO_2 emission factor of electricity In the case of grid: 0.508 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	In the case of grid (Combined margin emission factor for Philippine) (IGES's List of Grid Emission Factors). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).

3.3. Energy Efficient Boiler

Boiler is an important equipment of the most industrial facilities and power plants.Boiler is a closed pressure vessel used to produce high pressure or low pressure steam or to produce hot water, heat for industrial or domestic use. Industrial steam boilers are classified in too many ways like. According to type of fuel used, there are coal fired boilers, oil fired boilers, gas fired boilers, biomass boilers and electric boilers and waster heat recovery boilers; according to steam pressure, there are low pressure boilers, medium pressure boilers and high pressure boilers.

Nippon Thermoener is a manufacturer of boilers and provides high efficient boilers, such as steam boilers, hot-water heaters, and heat medium boilers, and other energy-saving and environmentally friendly equipment and systems. As a boiler needs a huge amount of investment, the feasibility of replacement of exisiting boilers with high effiency boilers relies on the timing, condition of existing boilers and type of fuel used for the boiler.

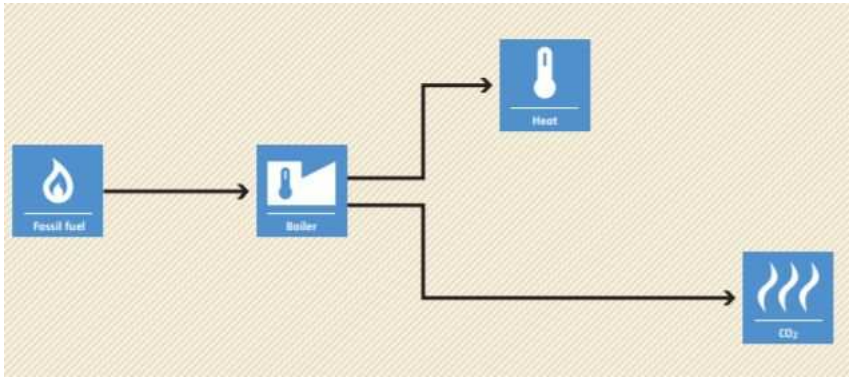


Figure 8 Reference Scenario (without project)

Without introduction of high efficiency boilers (HOB), boiler(s) with lower efficiency will continue to operate at multiple locations, thereby consuming high amounts of fossil fuel.

Employing HOBs through their rehabilitation or replacement will result in a reduction of fossil fuel consumption and related CO2 emissions.

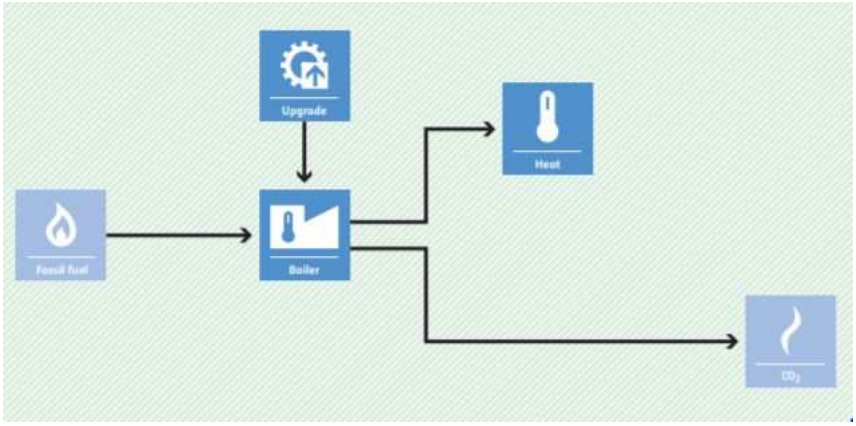


Figure 9 Project Sceneario

3.4. The GHG Emission Reduction Estimation Methodology for High Efficiency Boilers

3.4.1.Terms and Definitions

HOB: The HOB is defined as a boiler to supply steam or heat or hot water.

3.4.2. Summmary of the Methodology

Items	Summary
GHG emission reduction measures	Installation of new HOB for steam or heat or hot water supply system and the replacement of existing coal or gas or oil fired boiles.The boiler efficiency of the reference HOB is typically lower than that of the project HOB. 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 HOB, boiler efficiency of the reference HOB and CO_2 emission factor of the fuel
Calculation of project emissions	The sources of project emissions are the fuel consumption and electricity consumption of project HOB.Project emissions are calculated by the net heat quantity supplied by the project HOB, boiler efficiency of the project HOB and CO_2 emission factor of coal. In addition, project emissions due to auxiliary electricity consumption are included, on the basis of electricity consumption and CO_2 emission factor of the grid
Monitoring parameters	The quantity of fule used by the project HOB. Total hours of the project HOB operation during the monitoring period

3.4.3. Establishment of Reference Emissions

Reference emissions are calculated by the amount of the reference fuel consumption and CO_2 emission factor. The amount of fuel consumption in the reference scenario is calculated by dividing “net heat quantity supplied by the project HOB” by “boiler efficiency of the reference HOB”. This is because the net heat quantity of the reference HOB is equal to the net heat quantity of the project HOB. Both “CO2 emission factor” and “boiler efficiency of the reference HOB” are set as default values. The reference emissions are calculated as follows.

3.4.4. Calculation of Reference Emissions

$RE_p = FC_{P,y} \times NCV_{P,fuel} \times \eta_{P,HOB}/\eta_{RE,HOB} \times EF_{CO2,coal}$

Where;

RE_y : Reference emissions during the period y (tCO_2/y)

$FC_{P,y}$: Quantity of fuel used by the project HOB during the period y (t/y)

$NCV_{P,fuel,y}$: Net calorif value of the fuel used by the project HOB during the period y [GJ/t]

$\eta_{RE,HOB}$: Boiler efficiency of the reference HOB (-)

$\eta_{P,HOB}$:Boiler efficiency of the project HOB (-)

$EF_{CO2,coal}$: CO_2 emission factor of coal (tCO_2/GJ)

The reference HOB may use electricity,but it is not counted to ensure conservativeness (less reference emission).

3.4.5. Calculation of Project Emissions

Project emissions are calculated by “the amount of the project fuel consumption” and “CO_2 emission factor of the fuel”. Both “CO_2 emission factor” and “boiler efficiency of the project and reference HOB” are set as default values. Additionally, electricity consumption of the project HOB is calculated in a conservative manner.
Therefore, the project emissions are calculated as follows.

$PE_y = FC_{P,y} \times EF_{CO2,fuel} + EC_{P,y} \times EF_{CO2,grid}$

Where;

PE_p : Project emissions during the period y (tCO_2/y)

$PC_{P,y}$: Quantity of fuel used by the project HOB during the period y (t/y)

$EF_{CO2,fuel}$: CO2 emission factor of fuel (tCO_2/GJ)

$EC_{P,y}$:Electricity consumption of the project HOB during the period p (MWh/y)

$EF_{CO2,grid}$:CO2 emission factor of the grid electricity consumed by the project HOB (tCO_2/MWh)

$EC_p = RPC_{PJ,HOB} \div 1000 \times HMP_p$

Where;

EC_y : Electricity consumption of the project HOB during the period y (MWh/y)

$RPC_{PJ,HOB}$: Rated power consumption of the project HOB (kW)

HMP_y : Total hours of the project HOB operation during the monitoring period y (h/y)

3.4.6. Calculation of Emissions Reduction

$ER_y = RE_y - PE_y$

RE_y: Reference emissions (tCO_2/y)

PE_y: Project emissions (tCO_2/y)

3.4.7. Data and Parameters Fixed Ex-ante

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

Parameter	Description of data	Source
$\eta_{RE,HOB}$	Boiler efficiency of the reference HOB calculated from published information and measured data	Actual measured values.
$\eta_{P,HOB}$	Boiler efficiency of the project HOB calculated from published information and measured data	Actual measured values.
$EF_{CO2,coal}$	CO_2 emission factor of fuel Natural gas:54.3 t CO_2/TJ (54.3–58.3) Coal:87.3 t CO_2/TJ (87.3–101) Heavy oil:71.1 t CO_2/TJ (71.1–75.5)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2.
$EF_{CO2,\text{grid}}$	CO_2 emission factor of the grid electricity consumed by the project HOB. In the case of grid: 0.508 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. In the case of grid (Combined margin emission factor for Philippine) (IGES's List of Grid Emission Factors)). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).
$RPC_{PJ,HOB}$	Rated power consumption of the project HOB	Catalog value provided by the manufacturer of the project HOB

3.5. Regenerative Burner System

Burners are indispensable for the factories using industrial furnaces. Especially, regenerative burners are equipped with a conventional reheating furnace to reduce fuel consumption of the reheating furnace in the factory. Regenerative burner systems are equipped with a pair of burners that each have a regenerator. These burners fire alternately to recover the sensible heat from waste gas for the preheating of combustion air. Regenerative burner system generally ignites a pair of burners (A and B) integrated with the heat reservoirs alternately at intervals of several tens of seconds. While one (A) burner is burning, the exhaust gas passes through and heats the other burner's (B) heat reservoir to recover the energy of the exhaust gas. Then, when the other burner burns (B), the air for combustion in turn passes through the preheated heat reservoir to recover the exhaust gas energy which had conventionally been wasted so that the system is able to provide high efficient combustion and secure at least 1,000℃ preheated air.

In general, 35-50% of energy can be saved by adopting the regenerative burner system, though depending on the furnace temperature, air ratio, and operating patterns of the installed unit. Moreover, regardless of high temperature preheated air, the system is able reduce NOx emission under 150ppm. The main features of the system are as follows.

- Automatically controlling air ratios according to fuel condition and the temperature of air.
- Applicability for various type of fuels such as diesel and fuel oil (bunker oils).
- Low NOx emission

3.6. The GHG Emission Reduction Estimation Methodology for Regenerative burner system

3.6.1. Terms and Definitions

Regenerative burner : Burner systems which absorb exhaust gas heat to a reservoir and preheat combustion air using the absorbed heat in the reservoir to improve energy efficiency.

Conventional burner : Burner systems which do not have combustion air preheating facility.

3.6.2. Summary of the Methodology

Items	Summary
GHG emission reduction measures	By replacing conventional burners with regenerative burners in reheating furnaces, consumption of fossil fuels can be reduced, which leads to reduction of GHG emissions.
Calculation of reference emissions	Reference emissions are the CO_2 emissions from the use of reheating furnaces with reference burners, which are calculated based on the amount of production in the project and the energy intensity of the reference furnaces
Calculation of project emissions	The project emission is calculated based on the fuel and electricity consumption of the furnaces in the project and the CO_2 emission factors of the electricity and fuel.
Monitoring parameters	The following parameters need to be monitored. 1) The quantity of fuel consumed by furnaces in the project. 2) The quantity of steel produced in the project. 3) The quantity of electricity consumed by the project furnace

3.6.3. Establishment of Reference Emissions

The reference emission is the emissions from consuming fossil fuels to produce the same amount of steel bars in the project under the reference condition. In this methodology, the energy intensity of the reference condition is determined ex-ante as a default value through a survey before project implementation.

CO_2 emissions from electricity consumption of reference furnaces are not considered for conservatives.

3.6.4. Calculation of Reference Emissions

$$RE_y = FC \times P_y \times NCV \times EF_{co2}$$

RE_y	Reference emissions (tCO_2/y)
FC	Energy intensity of a reference furnace (l/t)
P_y	The quantity of steel bars produced in the project (t/y)
NCV	Net caloric value of furnace fuel (TJ/Gg)
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ)

3.6.5. Calculation of Project Emissions

Project emissions are calculated based on the quantity of electricity and fuel consumed by a project furnace and the respective CO_2 emission factors

$$PE_y = EC_{PJ,y} \times EF_{e,co2} + FC_y \times NCV \times EF_{co2}$$

PE_y	Project emissions tCO_2/y)
$EC_{PJ,y}$	Electricity consumption by a project furnace (MWh/y)
$EF_{e,co2}$	CO2 emission factor of electricity (tCO_2/MWh)
FC_y	Fuel consumption by a project furnace (t/y)
NCV	Net caloric value of furnace fuel (TJ/Gg)
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ)

3.6.6. Calculation of Emissions Reduction

$$ER_y = RE_y - PE_y$$

PE_y	Emission reduction (tCO_2/y)
RE_y	Reference emissions (tCO_2/y)
PE_y	Project emissions (tCO_2/y)

3.6.7. Data and Parameters Fixed Ex-ante

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

Parameter	Description of data	Source
FC	Energy intensity of a reference furnace (liter/ton)	The most steel bar manufacturing plants in Philippine have fuel intensity over 450Mcal/t. For this project, 43 l/ton (411 Mcal/ton) is applied
$EF_{RE,i}$	CO_2 emission factor of electricity In the case of grid: 0.670 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	In the case of grid (Official data from Philippine Government). ((IGES's List of Grid Emission Factors updated in August 2017)). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).
NCV	Net caloric value of furnace fuel (TJ/Gg) Residual fuel oil: 39.8 TJ/Gg Coking Coal: 24 TJ/Gg Natural gas:40.9 TJ/Gg (lower case of default value)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.2, Chapter 1, Volume 2.
EF_{co2}	CO_2 emission factor of furnace fuel (tCO_2/TJ) Residual fuel oil: 75.5 tCO_2/TJ Coking Coal: 87.3 tCO_2/TJ Natural gas:58.3 tCO_2/TJ (lower case of default value)	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2.

3.7. Solar Photovoltic Power Generation

A photovoltaic system, also PV system or solar power system, is a power systemdesigned to supply usable solar powerby means of photovoltaics. It consists of an arrangement of several components, including solar panels to absorb and convert sunlight into electricity, a solar inverter to change the electric current from DC to AC, as well as mounting, cabling and other electrical accessories to set up a working system.

It may also use a solar tracking system to improve the system's overall performance and include an integrated battery solution, as prices for storage devices are expected to decline. Strictly speaking, a solar array only encompasses the ensemble of solar panels, the visible part of the PV system, and does not include all the other hardware. Moreover, PV systems convert light directly into electricity and shouldn't be confused with other technologies, such as concentrated solar power or solar thermal, used for heating and cooling.

PV systems range from small, rooftop-mounted or building-integratedsystems with capacities from a few to several tens of kilowatts, to large utility-scale power stations of hundreds of megawatts. Nowadays, most PV systems are grid-connected, while off-grid or stand-alone systemsonly account for a small portion of the market.

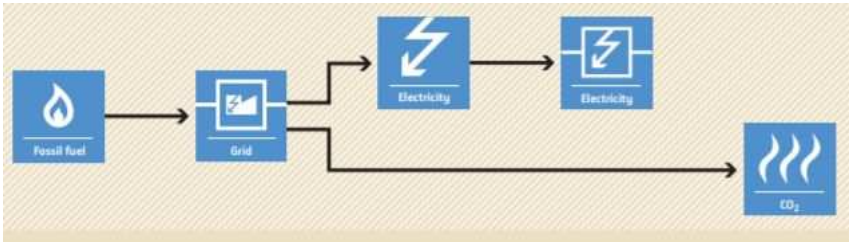


Figure 10 Reference Scenario (without project)

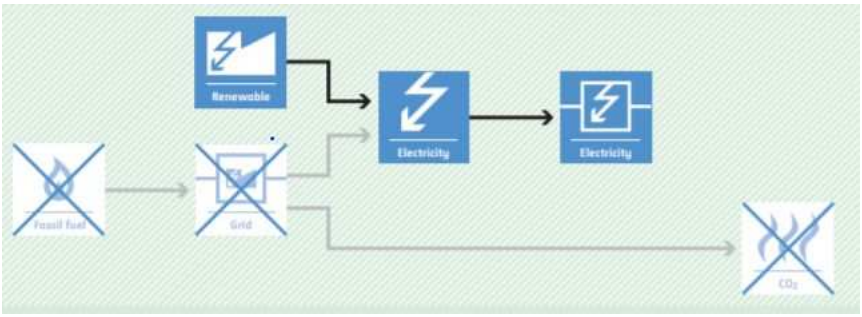


Figure 11 Project Sceneario

A complete PV system includes different components that should be selected taking into consideration your individual needs, site location, climate and expectations.
Grid-connected PV systems are designed to operate in parallel with and interconnected with the electric utility grid. The primary component is the inverter, or power conditioning unit (PCU). The inverter converts the DC power produced by the PV array into AC power consistent with the voltage and power quality required by the utility grid. The inverter automatically stops supplying power to the grid when the utility grid is not energized. A bi-directional interface is made between the PV system AC output circuits and the electric utility network, typically at an on-site distribution panel or service entrance. This allows the power produced by the PV system to either supply

on-site electrical loads, or to back feed the grid when the PV system output is greater than the on-site load demand. During periods when the electrical demand is greater than the PV system output (night-time), the balance of power required is received from the electric utility This safety feature is required in all grid-connected PV systems, it also ensures that the PV system will not continue to operate and feed back onto the utility grid when the grid is down for service or repair.

3.8. The GHG Emission Reduction Estimation Methodology for Solar PV System Introduction

3.8.1.Terms and 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 inverters required to change the electrical current from direct current (DC) to alternating current (AC).

3.8.2. Summmary of the Methodology

Items	Summary
GHG emission reduction measures	Displacement of grid electricity and/or captive electricity by installation and operation of 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 the emissions from the solar PV system(s), which are assumed to be zero.
Monitoring parameters	The quantity of the electricity generated by the project solar PV system(s).

3.8.3. Establishment of Reference Emissions

The reference emission is the emission from the grid or a captive disel generator to generate the same of amout of electricity as the PV system in the project.
In the case of grid, a combined margin emission factor (IGES's List of Grid Emission Factors)) of host country is used. Foe example, 0.508 tCO_2/MWh for Philippine.
In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2), 0.8 tCO_2/MWh is used.

3.8.4. Calculation of Reference Emissions

$$RE_y = \sum_i \left(EG_{i,y} \times EF_{RE,i}\right)$$

REy :Reference emissions during the period y (tCO2/y)

EGi,y :Quantity of the electricity generated by the project solar PV system i during the period y (MWh/y)

$EF_{RE,i}$: CO_2 emission factor of grid or a captive generation which is replaced by the project solar PV i (tCO2/MWh)

3.8.5. Calculation of Project Emissions

Project emissions are the emissions from electricity consumption of PV system installed. However, in the case of small scale PV projects in the size of less than megawatt. The project emission can be neglected as follows.

PEy = 0

PEy : Project emissions during the period y (tCO_2/y)

Otherwise, project emissions are calculated based on the amount of electricity consumed by project PV systems and the CO_2 emissio factor of electricity. Electricity consumption in the project needs to be monitored.

3.8.6. Calculation of Emissions Reduction

$$ER_y = RE_y - PE_y$$

RE_y: Reference emissions (tCO_2/y)

PE_y: Project emissions (tCO_2/y)

3.8.7. Data and Parameters Fixed Ex-ante

Parameter	Description of data	Source
EF_{elec}	CO_2 emission factor of electricity or a captive generator. In the case of grid: 0.508 tCO_2/MWh In the case of captive power plant (diesel): 0.8 tCO_2/MWh	In the case of grid (Combined margin emission factor for Philippine) (IGES's List of Grid Emission Factors). In the case of diesel captive power plant (Table I.F.1, Small Scale CDM Methodology: AMS I.F. ver.2).

3.9. Diesel-Duel-Fuel (DDF) system

DDF is a system, which injects diesel and Liquefied Petroleum Gas (LPG) at the same time by controlling the portion of each through an electronic control for reducing diesel fuel consumption, CO_2 emission and other roadside air pollutant emissions as well. DDF can be developed through introducing additional kits to a regular diesel engine. Main parts include a LPG tank, Engine Control Unit (ECU) and regulator.

3.9. The GHG Emission Reduction Estimation Methodology for diesel- duel- fuel (DDF) system

3.9.1. Terms and Definitions

Diesel Duel Fuel (DDF) engine : The engine, which uses both conventional diesel fuel and liquefied petroleum gas (LPG) fuel, is referred to as 'LPG–diesel dual fuel engines'. Diesel engines are modified to engines, which use primary fuel as diesel and secondary fuel as LPG.

Overhaul : An overhauled engine is an engine which has been removed, disassembled (torn down), cleaned, inspected, and repaired as necessary and tested using factory service manual approved procedures.

3.9.2. Summary of the Methodology

Items	Summary
GHG emission reduction measures	DDF helps improve in fuel efficiency, reduce the quantity of fossil fuel consumption and partly replace diesel with LPG, which has a lower CO_2 emission factor than diesel.
Calculation of reference emissions	Reference emission is calculated based on the distance of a target truck travelled, the fuel efficiency of the truck before retrofitted and the CO_2 emission factor of diesel used by the truck.
Calculation of project emissions	The project emission is calculated based on the quantity of fuel consumed by a truck and the CO_2 emission factors of the fuels.
Monitoring parameters	The following parameters need to be monitored. 1) The quantity of fuel consumed by a truck in the project. 2) The distance traveled by a target truck in the project.

3.9.3. Establishment of Reference Emissions

The reference emission is the emissions from diesel consumption of target trucks for travelling the same distance as happened in the project.

3.9.4. Calculation of Reference Emissions

$$RE_y = \sum_i RE_{i,y} \quad (1)$$

$$RE_{i,y} = PD_{i,y}/FE_{RE,i,diesel} \times De_{diesel} \times NCV_{diesel} \times EF_{co2,diesel} \times 10^{-6} \quad (2)$$

RE_y	Reference emissions (tCO_2/y)
i	Target vehicle
$RE_{i,y}$	Reference emission of a target vehicle i (tCO_2/y)
$FE_{RE,i,diesel}$	Fuel efficiency of a target vehicle i (Km/l)
$PD_{i,y}$	Distance travelled by a target vehicle i (Km)
De_{diesel}	Density of diesel (Kg/l)
NCV_{diesel}	Net caloric value of diesel (TJ/Gg)
$EF_{co2,diesel}$	CO_2 emission factor of diesel (tCO_2/TJ)

3.9.5. Calculation of Project Emissions

Project emissions are calculated based on the quantity of fuel consumed by target vehicles and the CO_2 emission factors of the fuels

$$PE_y = \sum_i PE_{i,y} \quad (3)$$

$$PE_{i,y} = (FC_i \times Ra_{diesel,i} \times NCV_{diesel} \times EF_{co2,diesel} \times 10^{-3}) + ((FC_i \times Ra_{LPG,i} \times NCV_{LPG} \times EF_{co2,LPG} \times 10^{-3}) \quad (4)$$

PE_y	Project emissions (tCO_2/y)
i	Target vehicle
FC_i	The quantity of fuel consumed by a target vehicle i (t/y)
$Ra_{diesel,i}$	Ratio of diesel in the fuel of a vehicle i in the project
NCV_{diesel}	Net caloric value of diesel（TJ/Gg）
$EF_{co2,diesel}$	CO_2 emission factor of diesel (tCO_2/TJ)
$Ra_{LPG,i}$	Ratio of LPG in the fuel of a vehicle i in the project
NCV_{LPG}	Net caloric value of LPG（TJ/Gg）
$EF_{co2,LPG}$	CO_2 emission factor of diesel (tCO_2/TJ)

3.9.6. Calculation of Emissions Reduction

$ER_y = RE_y - PE_y$

RE_y: Reference emissions (tCO_2/y)

PE_y: Project emissions (tCO_2/y)

3.9.7. Data and Parameters Fixed Ex-ante

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

Parameter	Description of data	Source
$FE_{RE,i,diesel}$	Fuel efficiency of a target vehicle	Field survey data (calculated based on the measured distance and fuel consumption of a target vehicle)
$EF_{co2,diesel}$ $EF_{co2,LPG}$	CO_2 emission factor of fuels consumed by vehicles: Diesel: 72.6 tCO_2/TJ LPG:61.6 tCO_2/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.4) Lower
NCV_{diesel} NCV_{LPG}	Net caloric values of fuels consumed by vehicles Diesel: 41.4 TJ/Gg LPG: 44.8 TJ/Gg	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 1.4, Chapter 1, Volume 2. (Table 1.2)
De_{diesel}	Density of diesel (Kg/liter) Diesel: 0.832 Kg/liter (Average density)	Philippine National Standards on Petroleum, Department of Energy (DOE) Density at 15 °C: 0.820-0.860 Kg/liter

3.10. Inverter-Type Air Conditioning System for Cooling for office building

Type of GHG emissions mitigation action is displacement of more-GHG-intensive service by use of more-efficient technology. This provides guidance to estimate emission reductions for project activities that involve the installation of new, energy-efficient air conditioners as replacement or new sales projects. Also, this emission reductions due to the reduction in electricity consumption from use of new and more efficient units as well as the avoidance of use of high GWP refrigerants in the air conditioning equipment.

3.11. The GHG Emission Reduction Estimation Methodology for Installation of Inverter-Type Air Conditioning System for Cooling for office building

3.11.1.Terms and Definitions

Terms	Definitions
Inverter-type air conditioning system	Inverter-type air conditioning system is a type of air conditioning system which contains inverter, an apparatus to control the speed of the compressor motor in order to maintain the ambient temperature. While the compressor in a non-inverter-type air conditioning system can only either operates in maximum capacity or stops entirely, the compressor in an inverter-type air conditioning system operates at adjustable speeds.
Coefficient of Performance (COP)	Coefficient of Performance (COP) is the cooling capacity per rated power consumption of the air conditioning system. The values of cooling capacity and rated power consumption are defined under specific temperature stated in ISO 5151:2010.
Cooling capacity	Cooling capacity is the ability of air conditioning system to remove heat, calculated with amount of heat removed per unit time at specific temperature.

3.11.2. Summmary of the Methodology

Items	Summary
GHG emission reduction measures	This methodology applies to the project that aims for saving energy by introducing inverter-type air conditioning system for cooling for office building in Philippines. 提案:インバーター型空調機器を導入することで省エネができ、消費電力からのGHG排出量が削減可能となる。
Calculation of reference emissions	Reference emissions are GHG emissions from using reference air conditioning system, calculated with power consumption of project air conditioning system, ratio of COPs of project/reference air conditioning system, and CO_2 emission factor for consumed electricity.
Calculation of project emissions	Project emissions are GHG emissions from using project air conditioning system, calculated with power consumption of installed inverter-type air conditioning system, and CO_2 emission factor for consumed electricity.
Monitoring parameters	Power consumption of project air conditioning system

3.11.3. Establishment of Reference Emissions

Reference emissions are calculated with power consumption of project air conditioning system, ratio of COPs of project/reference air conditioning system, and CO_2 emission factor for electricity consumed.

The COP of reference air conditioning system is conservatively set *ex ante* in the following manner to ensure the net emission reductions.

1. The COP value tends to decrease as the cooling capacity increases.
2. The reference COP, at a certain cooling capacity, is set at a maximum value in the respective cooling capacity range.

The maximum values of COP in the respective cooling capacity ranges are defined as COP_{RE}.

3.11.4. Calculation of Reference Emissions

$$\mathbf{RE_p = \sum_i \left\{ EC_{PJ,i,p} \times \left(COP_{PJ,i} \div COP_{RE,i} \right) \right\} \times EF_{elec}}$$

RE_p	: Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Power consumption of project air conditioning system i during the period p [MWh/p]
$COP_{PJ,i}$	: COP of project air conditioning system i [-]
$COP_{RE,i}$	: COP of reference air conditioning system i [-]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	: Type of air conditioning system [-]

3.11.5. Calculation of Project Emissions

$$\mathbf{PE_p = \sum_i EC_{PJ,i,p} \times EF_{elec}}$$

PE_p	: Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Power consumption of project air conditioning system i during the period p [MWh/p]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	: Type of air conditioning system [-]

3.11.6. Calculation of Emissions Reduction

$$ER_p = RE_p - PE_p$$

ER_p : Emissions reductions during the period p [tCO_2/p]

RE_p : Reference emissions during the period p [tCO_2/p]

PE_p : Project emissions during the period p [tCO_2/p]

3.11.7. Data and Parameters Fixed Ex-ante

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

Parameter	Description of Data	Source
EF_{elec}	CO_2 emission factor for consumed electricity. When project air conditioning system consumes only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When project air conditioning system may consume both grid electricity and captive electricity, the project participant applies the CO_2 emission factor with lower value. **[CO_2 emission factor]** For grid electricity: The most recent value available from the source stated in this table at the time of validation For captive electricity: 0.8* [tCO_2/MWh] *The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.	**[Grid electricity]** Updates on Grid Electricity Emission Factors (calculated in year 2013), National Committee on Clean Development Mechanism, Philippines, unless otherwise instructed by the Joint Committee. **[Captive electricity]** CDM approved small scale methodology AMS-I.A
$COP_{RE,i}$	COP of reference air conditioning system i, as indicated in Table 2. The values of cooling capacity and rated power consumption used in the calculation of COP are obtained from product catalogs, specification documents or website of major manufacturers in Philippines.	Nominal value available on product catalogs, specification documents or websites. The default values are derived from the result of

<table>
<tr>
<td></td>
<td>
Table 2 : COP for Reference Air Conditioning System ($COP_{RE,i}$)
<table>
<tr><th>i</th><th>Cooling capacity [kW]</th><th>Reference COP</th></tr>
<tr><td>1</td><td>2.5kW<x≦4.1kW</td><td>4.00</td></tr>
<tr><td>2</td><td>4.1kW<x≦5.3kW</td><td>3.59</td></tr>
<tr><td>3</td><td>5.3kW<x≦7.1kW</td><td>2.96</td></tr>
<tr><td>4</td><td>7.1kW<x≦14.2kW</td><td>2.85</td></tr>
</table>
</td>
<td>survey on COP of air conditioning system from manufacturers that have high market share. The default values should be revised if necessary from survey result which is conducted by JC or project participants every three years. The survey should prove the use of clear methodology.</td>
</tr>
<tr>
<td>$COP_{PJ,i}$</td>
<td>COP of project air conditioning system i. The value of cooling capacity and rated power consumption used in the calculation of COP prepared by manufacturer is applied.</td>
<td>Specifications of project air conditioning system for the quotation or factory acceptance test data by manufacturer.</td>
</tr>
</table>

4. Key Points for JCM project implementation

The following points need to be determined to implement a JCM model project. These are also seen as challeneges to realize JCM model projects.

- Determination of a representative project participant early
- Confirmation of local participants an their decision
- Conclusion of international consortium agreement
- Confirmation of the budget adjustment of local participants
- Financing plan
- Profitability analysis
- Project schedule
- Confirmation of law, regulations and licenses.

5. Future Prospects

5.1. Expansion of JCM Project

JCM model project supports initial investment cost and contribute to CO_2 reduction.However, recognition of JCM is still insufficient in Philippines. Therefore, it is important to introduce technologies to potential counterparts such as industrial parks,

hotels, hospitals, schools, and public buildings with huge energy consumption. Introduction of successful JCM model projects into an overall country is a key challenge forward.

5.2 Promotion of JCM

JCM scheme has been evolved into a win-win scheme which requires various players participation and open to different business models such as ESCO, lease and PPP. Therefore, it is important to activate industrial association groups to encourage their members to benefit from JCM through applicable business models.

Appendix 5　Workshop Presentation Papers

Climate Change and Environmental Sustainability

City-to-City Collaboration with Osaka City Government

The City-to-City Collaboration with Osaka City is a 3-year partnership focusing on the development of low carbon initiatives through the promotion of Joint Crediting Mechanism (JCM) in Quezon City.

The MOU between the two the Cities: Osaka and Japan was signed last August 30, 2018

Cooperation Areas:

(1) Climate Change Mitigation for Greenhouse Gas (GHG) Emission Reduction;
(2) Renewable Energy and Energy Efficiency;
(3) Waste Water Management;
(4) Water Supply;
(5) Solid Waste Management, and
(6) Environmental Conservation

Quezon City as a Member of International Organizations

C40 CITIES

ICLEI Local Governments for Sustainability Southeast Asia

CITYNET

- Pursue global awareness towards developing new mechanisms to reduce GHG emissions
- Promote and support voluntary action to combat climate change and move to a low emission, resilient society
- Establish networks and linkages with other Cities for the conduct of studies on existing and emerging technologies and systems

C40 Cities Climate Leadership Group

- C40 is a network of the world's megacities committed to addressing climate change
- C40 supports cities to collaborate, share knowledge and drive meaningful, measurable and sustainable action on climate change

C40 Networks

- Climate Risk Assessment Network
- Connecting Delta Cities Network
- Cool Cities Network
- Municipal Building Efficiency Network
- Private Building Efficiency Network
- Sustainable Infrastructure Network
- Sustainable Waste Systems Network
- Waste-to-Resources Network
- Low Emission Vehicles Network
- Mobility Management Network
- Food Systems Network
- Land Use Planning Network
- Transit Oriented Development Network
- Clean Energy Network
- Urban Flooding Network
- Air Quality Network

Presentation heading

C40 and Quezon City Engagement: Technical Assistance

C40 Climate Action Planning Programme

What it means to be compliant with the Paris Agreement?

- Two-year program designed to help cities enhance their **climate action plans** in line with the ambitions of the Paris Agreement
- **Technical assistance**, delivered by C40 in partnership with expert city climate planners, covers a wide range of support including training, workshops, peer-to-peer collaboration, stakeholder engagement, planning tools, research and others
- The program aims to **build capacities** of Quezon City at individual and institutional level to design and implement **ambitious climate actions**

Where we are in QC-CAP: Workshops

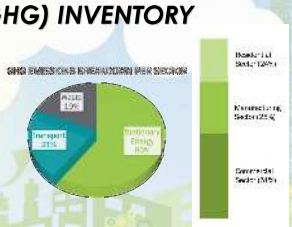
Major Workshops/Activities	Month/Year
GHG CapBuild Workshop	November 2018
Strategic CAP Appraisal Technical Workshop	Jan 2019
Strategic CAP Appraisal Validation Workshop	February 2019
Strategic CAP Appraisal SWOT Analysis Workshop	March 2019
GHG Inventory Management Plan Development and CapBuild Wokrshop	May 2019
Jakarta Regional Academy	June 2019
GHG Scenario Development Workshop	September 2019
Climate Risk Assessment (CRA) Webinar-Workshop 1	January 2020
Climate Risk Assessment (CRA) Workshop 2	January 2020
Rotterdam Adaptation Academy / CRA Workshop 3	February 2020
Inclusive Climate Action CapBuild + Data Collection Workshop	March 2020
Inclusive Climate Action Validation Workshop	April 2020
Action Prioritization and Definition Workshop	May 2020
Draft CAP and Consultation Workshops	June – Aug 2020

Presentation heading

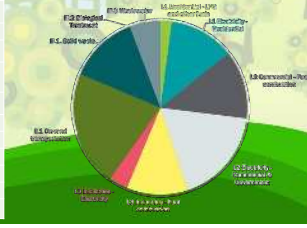
2016 GREENHOUSE GAS (GHG) INVENTORY

The city-wide GHG inventory will enable Quezon City to measure its overall emissions, as well as understand the contribution of different activities within the city.

It covers stationary energy, transportation, and waste sectors following the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC), a GHG Protocol standard developed by C40, World Resources Institute and ICLEI. The calculations were done using C40's City Inventory and Reporting Information System (CIRIS) tool, designed to support cities in reporting GPC-compliant inventories.



Emission source	% share	tCO2e
I.1 Residential - LPG and other fuels	2.1%	168472
I.1 Electricity - Residential	12.1%	969393
I.2 Commercial - Fuel combustion	12.8%	1022830
I.2 Electricity - Commercial & Government	17.9%	1438137
I.3 Industries - Fuel combustion	11.4%	915400
I.3 Industries - Electricity	3.5%	283514
II.1 On-road transportation	21.5%	1721176
III.1. Solid waste	12.9%	1033341
III.2 Biological Treatment	0.0%	594
III.3 Wastewater	5.8%	461509
Total		8014366 tCO2e



Ambitious Actions: Energy and buildings sector

Meet national RE targets

This is contingent on the national government meeting its RE targets for the Philippines

This assumes increased renewable energy comes from hydro, geothermal, wind, biomass, and solar sources based on the Philippine Energy Plan

Scale up solarization in government-owned, commercial and residential buildings (national and local)

Scale up installation of solar photovoltaic units in feasible establishments

Make clean energy technologies available and accessible

Develop enhanced Local Green Building Code

Conduct institutional review of QC's green building unit and conduct building energy performance evaluation

Incorporate building efficiency measures such as energy efficient design and technologies (lighting and cooling) and improved insulation in new and existing buildings

Ambitious Actions: Transport

Enhance walking and cycling infrastructure in Quezon City

Achieve 40% mode share for walking and cycling by 2030

Mode shift to mass public transport

Expand mass public transport systems in QC including bus rapid transit, subway, and mass railway transit

Achieve 40% mode share in efficient mass transit by 2030

Assume 15% electric and engines efficient by 30% by 2030 for PUVs (tricycles, jeepneys and buses) and cars

Ambitious Actions: Waste sector

management program

Optimize waste diversion and recycling rates

Managing organic waste

Food waste diversion program through composting and anaerobic digestion

Policies and advocacies on food waste reduction

MANILA WATER Maynilad

Enhanced wastewater management

100% sewerage treatment coverage for residential, commercial and industrial establishments

C40 and Quezon City Engagement: Technical Assistance

C40 CITIES FINANCE FACILITY (CFF) : Quezon City Solar Energy Project for Fifty (50) Public Schools

- The **C40 Cities Finance Facility (CFF)** provides assistance and facilitates finance access for climate change mitigation and resilience projects.
- The program aims to:
  - ✓ Develop sustainable priorities by providing capacity development
  - ✓ Establish partnerships between cities and financiers that will enable cities to accelerate ambitious emission reduction projects

Quezon City is one of the 9 cities that will receive technical support from the CFF. The CFF assistance will include technical feasibility studies for rooftop solar projects and development of public private partnership models.

Quezon City Local Climate Change Action Plan

The Quezon City Government partnered with the UP Planning and Development Research Foundation Inc. (UP Planades) for the formulation of the QC LCCAP.

The formulation of the QC LCCAP 2017-2027 was also based on international policies and initiatives, national policies and initiatives, and the National Climate Change Action Plan (NCCAP) Seven Priority Areas.

The Quezon City Local Climate Change Action Plan (QC LCCAP) 2017-2027 is the consolidation of following documents:

- *Legal Mandates*
- *Background on Quezon City*
- *Climate Change Vulnerability*
- *Mission, Vision and Objectives*
- *Climate Change (CC) Vulnerability/Sensitivity Analysis*
- *GHG Emissions and Opportunities for Reductions*
- *Situation Analysis*
- *Climate Change Adaptation and Mitigation Programs, Projects and Activities*

The above documents are the outputs of the workshops and forums conduct with direct and indirect stakeholders of Quezon City Government (QCG) during the Project period.

Support Requested from Osaka City Government

- **Waste Water Treatment Facility –** Establishment of QC Waste Water Treatment Facility for QC-owned buildings
- **Revision of QC Green Building Code**

Support Requested from Osaka City Government

- **Assessment of the impact of Quezon City GHG Reduction Initiatives vis-à-vis 2016 GHG Inventory Baselines**

Thank You!

City-to-city Collaboration Between Quezon City and Osaka City

Current Progress and Proposed Way Forward

February 6, 2020

ORIENTAL CONSULTANTS

What is "City-to-City Collaboration Program"?

- Launched by the Ministry of the Environment (MOEJ) in 2013 to assist the collaboration between cities in Japan and cities in JCM partner's countries to realize the low-carbon society.
- Aimed to contribute to the achievement of leapfrog-style development in cities in developing countries through the development and packaging of knowledge and knowhow on these technologies and policies.
- So far, 27 local governments in Asia and 13 local governments and a number of private companies in Japan are involved.
- For FY2019, projects are implemented in 17 cities/regions in 6 countries: Philippines (Quezon and Davao), Indonesia, Malaysia, Myanmar, Thailand and Vietnam.

2nd Mayor Level Policy Dialogue May 6, 2019 in Quezon

- Contents of the Presentation
  - Quezon City Local Climate Change Action Plan (Quezon)
  - Promotion of climate change mitigation measures for Quezon's development as a low-carbon city (Osaka)
  - Development of low-carbon projects using the JCM scheme (OC)
  - Experience with JCM model projects (Tokyo Century Corporation)
  - JICA's climate change mitigation efforts

Left: Deputy Mayor of Osaka, Center: Mayor of Quezon

Vice Mayor of Osaka's site visit to Former Payatas Landfill

Policy Dialogue

Contents of Osaka's presentation

City-to-City Collaboration promotes the review of the climate change planning policies and actions in Quezon

Seminar on City-to-City Collaboration January 16 - 17, 2020 in Tokyo

The seminar was organized by the Ministry of the Environment (MOEJ) to facilitate building a network among cities for further implementation of the City-to-City Collaboration Program.

The seminar was attended by representatives of 17 projects currently being implemented. Quezon City and Osaka City participated in the panel discussion on respective topics.

Mr. Vergara from Quezon City

Mr. Mihara from Osaka City

Contents of Project in FY2019

- Air Conditioning Energy Saving

  - Survey and analysis of current air conditioning situation, including type of equipment in use
  - Calculation of energy-saving effects of implementation of high efficiency air conditioners
- Collection, Recovery and Destruction of Ozone Depletion Substances (ODS)

  - Confirmation of the legal framework in the Philippines
  - Research on the current fluorocarbon market and its logistics
  - Study toward the development of a project model
- Capacity Development Support

  - Provision of information of Japanese regulations related to ODS
  - Provision of information useful for implementing Quezon's climate change mitigation measures
  - Updating the JCM Manual

Air Conditioning Energy Saving Current Progress and Next Steps

Current Progress

- Survey and analysis of current air conditioning situation, including type of equipment in use
- Interview survey about the plans to upgrade Quezon City Hall's air conditioning; 550 units have been identified for replacement

Next Steps

- Confirm the demand to upgrade air conditioning in other buildings
- Collect detailed information about equipment to be upgraded
- Consider the system for implementing the project under JCM financial support scheme

JCM Manual

- Provide energy saving air conditioning case studies

Fluorocarbon Collection, Recovery and Destruction Current Progressand Next Steps (1)

Current Progress

- Interview surveys regarding the legal framework pertaining to ODS, an overview of the inventory, the logistics (collection, transportation and storage) as well as the solution for the destruction of ODS
  - Philippine Ozone Desk: legal framework, actions taken, inventory control of ODS
    → *Good progress: laws and regulations in place are clarified on its website, the inventory data of CFC and HCFC has been shared.*
  - Interview survey to local fluorocarbon-related companies (importer, distributor, service companies, collection company, etc.)
    → *Recognized the value chain and logistics related to ODS. Identified certain quantities of CFC and HCFC remains outstanding in CTS and other facilities.*

Fluorocarbon Collection, Recovery and Destruction Current Progress and Next Steps (2)

- Interview survey to local cement manufacturing companies about ODS destruction
  → *They have shown interest in providing destruction services on a fee basis.*

Inlet of burner of a typical cement kiln

Next Steps

- Continue researching the current legal framework pertaining to ODS
- Using statistical data, further investigate the quantitative data of ODS (CFC and HCFC) related to the air conditioning
- Conduct a conceptual study on ODS destruction project development

Fluorocarbon destruction facility

Ongoing Schedule

Expected Outcomes of Project in 2019

- Investigation of applicability of JCM financial support scheme for air conditioning energy saving
- Confirmation of the quantitative information on ODS (CFC and HCFC), current situation of the collection, recovery and destruction of ODS in the Philippines
- Provision of information about fluorocarbon measures in Japan and their importance to Quezon City

Preparation for the Project in 2020

- Discussions with Quezon City on the development of an air conditioning energy saving JCM project
- Survey of specifics related to the logistics of ODS and a study on the destruction project development in preparation for utilizing the financial support for JCM model projects
- Strengthening the collaboration between Quezon City and Osaka City by supporting capacity development related to climate change measures

Thank you for your attention!

ORIENTAL CONSULTANTS

Agenda

1 City to City Cooperation between Quezon and Osaka

2 Cooperation Projects in 2020
- High Efficiency Air Conditioner
- Considering Life Cycle Costs
- Towards Proper Management of Fluorocarbons
  - Initiatives in Japan-

Agenda

1 City to City Cooperation between Quezon and Osaka

2 Cooperation Projects in 2020
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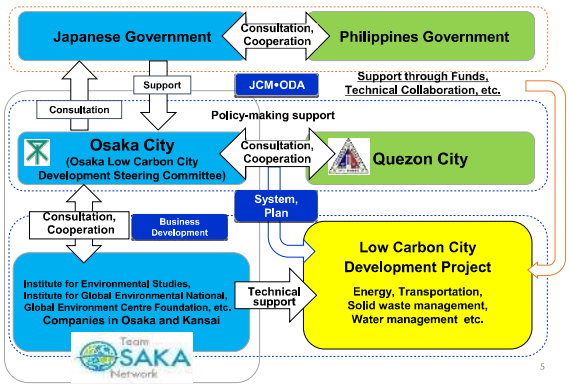
  - Initiatives in Japan-

Development of a Low Carbon City MOU Signing Between Quezon City and Osaka City

30 August 2018
at Osaka City Hall

a) Establishing standards and systems supporting the Low-Carbon Policies of Quezon
b) Sharing the professional skills and knowledge in order to smoothly implement measures, research and assessment of Greenhouse Gas Emissions toward the development of Low-Carbon City
c) Promoting Public-Private Partnership Projects in the field of Climate Change and Environmental Conservation
d) Proceeding development of human resources and an organization in order to develop a Low-Carbon
e) Both cities make reasonable efforts to continuously hold a mayor-level policy dialogue once a year toward the development of a low-carbon society in Quezon City

Cooperative Framework Between Quezon City and Osaka City



Agenda

1 City to City Cooperation between Quezon and Osaka

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  - Initiatives in Japan-

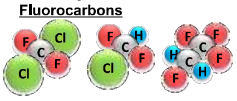
Cooperation Projects in 2020

JCM Model Project Feasibility Studies : Towards low carbon society (LCS) scenarios

◆ High Efficient Air Conditioner

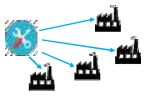
×

◆ Recovery and Destruction of Fluorocarbons



JCM Project Scale : Equipment introduction costs should be 100 million yen or more when applying JCM subsidy (≒PHP 45 million)

Unifying the Project :
It is also possible to apply for multiple projects as one.



Novelty as a JCM Project

Projects with novelty will achieve higher reputation and higher subsidy rate.

Adoption of similar technologies	0 case	1 to 3 cases	More than 4 cases
Subsidy rate	Up to 50%	Up to 40%	Up to 30%

Subsidy adoption results in Philippines

5 cases	Solar Power
4 cases	Small-scale Hydropower
2 cases	Biomass Power

JCM Air Conditioner Project (Vietnam)

Arising from city to city cooperation between Ho Chi Minh and Osaka

Introduction of
high-efficiency air conditioners and
air-cooled chillers
in hotels and offices
(Ho Chi Minh City, etc.)


Hotel


Office

Estimated GHG emission reductions : 2,661 ton-CO_2/year

⇒November 2019
Adopted by the Government of Japan as a JCM equipment subsidy project

Comprehensive Evaluation Considering Life Cycle Costs

< Life Cycle Costs >
Total cost including not only the procurement cost but also the running costs until the end of use.

For the facilities that are used for a long period of time, repair and maintenance costs account for a large proportion. That's why products should be selected in consideration of Life Cycle Costs.

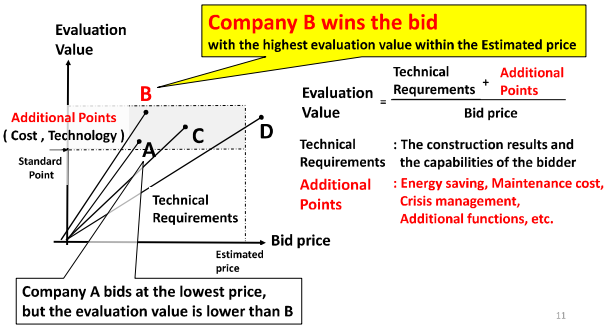

Most cars seen in Japan are made in Japan in consideration of Life Cycle Costs.

Problems when Life Cycle Costs is not considered

- High operating and maintenance costs (even if bidding is cheap)
- Cost effectiveness worsens over time
- Unexpected works occurs and additional contracts are required and so on

Facility Procurement Considering Life Cycle Costs

Comprehensive evaluation bidding method in facility procurement considering Life Cycle Costs

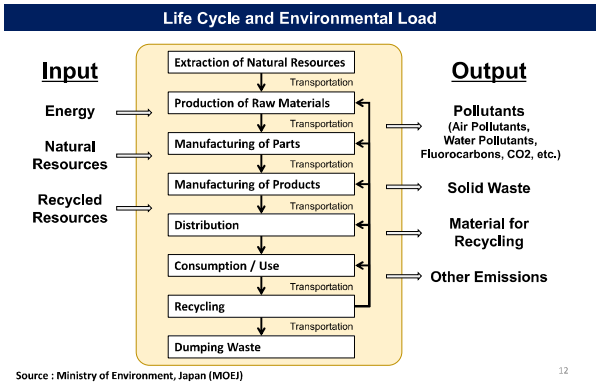


Evaluation Value = (Technical Requirements + Additional Points) / Bid price

Technical Requirements : The construction results and the capabilities of the bidder

Additional Points : Energy saving, Maintenance cost, Crisis management, Additional functions, etc.

Life Cycle Assesment (LCA)



Source : Ministry of Environment, Japan (MOEJ)

Life Cycle Assesment (LCA)

Benefits of considering Life Cycle Assesment (LCA)

⇒Contribute to

Reducing Costs and Environmental impact

over the long term

In the field of JCM, Osaka City would like to spread the concept of considering Life Cycle Costs.

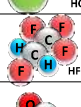
Agenda

1 City to City Cooperation between Quezon and Osaka

2 Cooperation Projects in 2020
High Efficiency Air Conditioner
Considering Life Cycle Costs

Towards Proper Management of Fluorocarbons
- Initiatives in Japan-

Fluorocarbons

Type of Refrigerants	ODP Ozone Destruction Potential	GWP Global Warming Potential
ChloroFluoroCarbons (CFCs)  CFC-12	High (ODP=1)	Very High (GWP=10,900)
HydroChloroFluoroCarbons (HCFCs)  HCFC-22	Low (ODP=0.055)	High (GWP=1,810)
HydroFluoroCarbons (HFCs)  HFC-134a	None (ODP=0)	High (GWP=1,430)
Natural Refrigerants  CO2	None (ODP=0)	Low (GWP=1)

Source : Ministry of Environment, Japan (MOEJ)

Fluorocarbons

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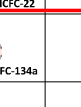
HydroFluoroCarbons (HFCs)  HFC-134a	None (ODP=0)	High (GWP=1,430)
Natural Refrigerants  CO2	None (ODP=0)	Low (GWP=1)

Banned by
"Montreal Protocol on Substances that Deplete the Ozone Layer"

Source : Ministry of Environment, Japan (MOEJ)

Comprehensive Emission Control of Fluorocarbons in Japan

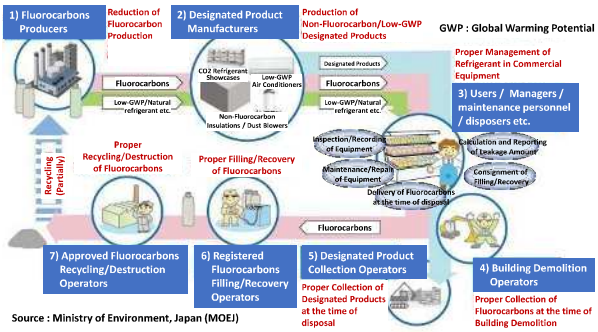
Legal framework for proper management of fluorocarbons in Japan

Commercial Equipment	Home Appliances	Vehicles
Act on Rational Use and Proper Management of Fluorocarbons	Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law)	End-of-Life Vehicle (ELV) Recycling Act
Users pay for collection and disposal of Fluorocarbons when		
disposing of Equipment	disposing of Home Appliances	purchasing a vehicle (as deposit)
Users also pay for recycling of Equipment / Home Appliances / Vehicles		

Source : Ministry of Environment, Japan (MOEJ)

Comprehensive Emission Control of Fluorocarbons in Japan

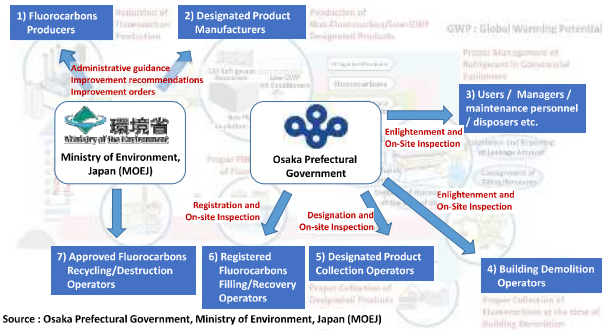
Act on Rational Use and Proper Management of Fluorocarbons



Source : Ministry of Environment, Japan (MOEJ)

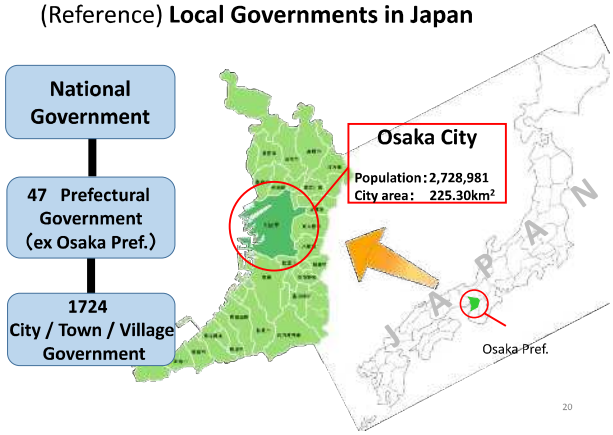
Comprehensive Emission Control of Fluorocarbons in Japan

Efforts to Ensure Effectiveness by National Government and Local Governments



Source : Osaka Prefectural Government, Ministry of Environment, Japan (MOEJ)

(Reference) Local Governments in Japan



Comprehensive Emission Control of Fluorocarbons in Japan

Act on Rational Use and Proper Management of Fluorocarbons

Administrators who violate the obligations of the law will be punished.

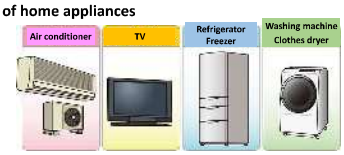
- **Unnecessary release of fluorocarbons**
  - ⇒ **up to one year in prison or 500,000 JPY fine**
- **Violating a prefectural governor's order regarding the use and dispose of equipment ⇒ up to 500,000 JPY fine**
- **Unreported or false reporting of the calculated leakage amount**
  - ⇒ **up to 100,000 JPY fine**

Source : Ministry of Environment, Japan (MOEJ)

Comprehensive Emission Control of Fluorocarbons in Japan

Law for the Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law)

Specified kinds of home appliances



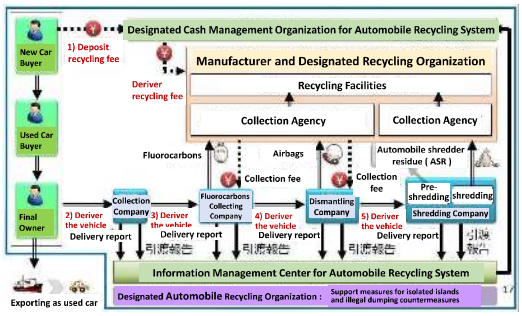
Work in local governments

- Approval to recycling operators
- Separately collection of home appliances
- Enlightment for residents
- Measures against illegal dumping

Source : Ministry of Environment, Japan (MOEJ)

Comprehensive Emission Control of Fluorocarbons in Japan

End-of-Life Vehicle (ELV) Recycling Act



Source : Ministry of Environment, Japan (MOEJ)

Comprehensive Emission Control of Fluorocarbons in Japan

End-of-Life Vehicle (ELV) Recycling Act

Work in local governments

- Approval / Registration to recycling operators
- On-site inspection
- Enlightment for residents / business operators
- Measures against illegal dumping

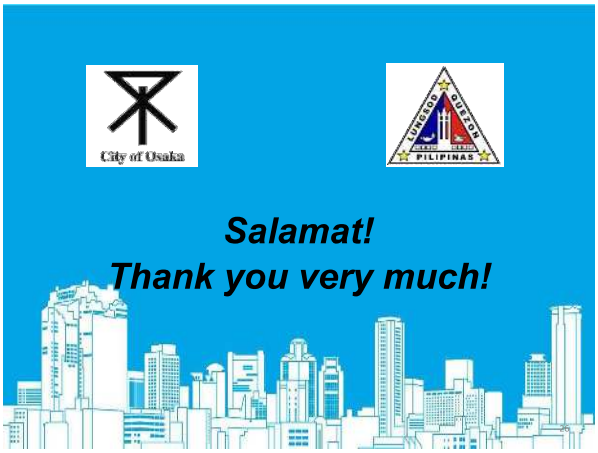
Of course illegal dumping will be punished by law.

- **Illegal dumping**
  - ⇒ **up to five (5) year in prison and/or up to 10,000,000 JPY fine**

Source : Ministry of Environment, Japan (MOEJ)

Conclusions

Under the city to city cooperation between Quezon and Osaka, we will work to further reduction of CO_2 and achieving proper management of fluorocarbons in Quezon City by making efficient use of the JCM framework.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ENVIRONMENTAL MANAGEMENT BUREAU

PCEAS, INC

Key Learning Objectives

- Legal Framework for Ozone Layer Protection
- Global Response to Ozone Layer Depletion
- Philippine Response to Ozone Layer Depletion
- Climate-Ozone Link
- Challenges

PCEAS, INC

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ENVIRONMENTAL MANAGEMENT BUREAU

PCEAS, INC

Montreal Protocol on Substances that Deplete the Ozone Layer

- On 16 Sept 1987, the Montreal Protocol was signed into a treaty.

Note: ***The Philippines became a signatory to the Montreal Protocol on 14 September 1988.***

PCEAS, INC

Objective of the Montreal Protocol (MP)

- Gradually phase-out the consumption of Ozone Depleting Substances (ODS)
  - **Consumption** = import – export + production

Note: Only virgin substances are counted in the consumption; not included used and recycled ODS

PCEAS, INC

Controlled Substances of the Montreal Protocol

Annex	Group	Substance	No. of Species
Annex A	Group I	Chlorofluorocarbons (CFCs)	5
	Group II	Halons	3
Annex B	Group I	Other fully halogenated CFCs	10
	Group II	Carbon tetrachloride	1
	Group III	1,1,1-trichloroethane (methyl chloroform)	1
Annex C	Group I	Hydrochlorofluorocarbons (HCFCs)	40
	Group II	Hydrobromofluorocarbons (HBFCs)	34
	Group III	Bromochloromethane	1
Annex E	Group I	Methyl bromide	1

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Philippine Commitment to the Montreal Protocol

Implementation of activities supported by the Multilateral Fund (MLF):

- Phase-out of ODS;
- Capacity building and training for handling ODS alternatives in the servicing, manufacturing, and production sectors;
- Institutional strengthening;
- Licensing system for import-export of ODS;
- Reporting of ODS consumption and country program;
- Development of national strategies to phase-out ODS.

PCEAS, INC

PH Achievements in Ozone Layer Protection

- Establishment of Philippine Ozone Desk
- Policy and regulatory framework
- 92 ODS projects approved
- Phase-out of all ODS by 2010, except for HCFCs and MeBr for QPS

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Montreal Protocol's ODS Phase out Schedule for Article 5 Countries (in percent)

Name of ODS	Base Level	1999	2002	2003	2005	2007	2010	2013	2015	2020	2025	2030	2040
CFC (Annex A)	1995-1997	FRZ			50	85	100						
CFC (Annex B)	1998-2000			20		85	100						
Halon	1995-1997		FRZ				100						
Methyl Bromide (Non-QPS only)	1995-1998		FRZ		20				100				
Methyl Chloroform (1, 1, 1 TCA)	1998-2000				30				100				
Carbon Tetrachloride	1998-2000				85		100						
HCFC	2009-2010							FRZ	10	35	67.5	97.5	100

PCEAS, INC

ODS Phase-out Schedule: Status of Compliance of Philippines

Name of ODS	Base Level	1999	2002	2003	2005	2007	2010	2013	2015	2020	2025	2030	2040
CFC Annex A PHASED OUT (2010)													
CFC Annex B PHASED OUT (2010)													
Halon PHASED OUT (1999)													
MB PHASED OUT (2009)													
1, 1, 1 TCA PHASED OUT (1996)													
CTC PHASED OUT (1996)													
HCFC	2009-2010							FRZ	10	35	67.5	97.5	100

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ODS Chemicals (HCFCs) and Climate Impact

Chemical name	ODP	GWP
HCFC-22 (CHF_2Cl)	0.055	1780 (Highest GWP)
HCFC-141b ($C_2H_3FCl_2$) (Highest ODP)	0.11	780
HCFC-225cb ($C_3HF_5Cl_2$)	0.033	620
HCFC-225ca ($C_3HF_5Cl_2$)	0.025	180
HCFC-123 ($C_2HF_3Cl_2$) (Lowest ODP)	0.02	93 (Lowest GWP)

11

HCFCs

HCFC-22 or Chlorodifluoromethane


HCFC-123 or Dichlorotrifluoroethane


HCFC-141b or Dichlorofluoroethane

HCFC-225

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Uses of HCFC:

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COMMON USES OF HCFCs

- Cooling Agent (HCFC 22 and HCFC 123)
- Cooling Agent; Fire Extinguishing Agent (HCFC 123)
- Foam Blowing Agent (HCFC 141b, HCFC 142b)
- Cleaning Agent/Solvent; Flushing Agent in burnt out air con lines (HCFC 141b, HCFC 225)

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14

DAO 2013-25 Revised Regulations on CCO for ODS Overview

Precursor: DAO 2004-08 Chemical Control Order for Ozone Depleting Substances (ODS)

Rationale for revising DAO 2004-08:

- **update the phase-out status of controlled substances covered by the Montreal Protocol on Substances that Deplete the Ozone Layer**
- **reflect the requirements for the phase-out of hydrochlorofluorocarbons (HCFCs)**
- **provide the continuing legal basis for ODS phase-out in the country**

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15 2/6/2020 Add a footer

DAO – Section 2: Objectives

- This Order aims to:

2.1 Strengthen the legal infrastructure to support the implementation of the Philippine Hydrochlorofluorocarbon (HCFC) Phase-out Management Plan (HPMP); and

2.2 Sustain the phase-out of other ozone depleting substances.

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16 2/6/2020 Add a footer

DAO Section 5: Ban on Importation of ODS

Category	ODS	Date of import ban
Annex A, Group I	CFCs	01 January 1998
Annex A, Group II	Halons	01 January 1999
Annex B, Group I	Other CFCs	01 January 1999
Annex B, Group II	CCl_4	01 January 1996
Annex B, Group III	TCE	01 January 1996
Annex E	Non-QPS methyl bromide	01 January 2009
	CFC-11 CFC-12	01 January 2005 01 January 2010

DAO – Section 6: Phase-out Schedule and Control of Importation of ODS (HCFCs)

Date	Import Reduction	Sector affected/Remarks
01 Jan 2013	Recorded baseline shall not be exceeded	
01 Jan 2015	10%	Foam manufacturing (HCFC-141b) . By this date, all importation of HCFC-141b and pre-blended polyols for foam (rigid and flexible) manufacturing will also be absolutely prohibited, except for the servicing and solvent sectors.
01 Jan 2020	35%	Manufacturing of refrigeration and air-conditioning equipment (HCFC-22). By this date, all importation of HCFC-22 for the manufacturing of refrigeration and air-conditioning will also be absolutely prohibited, except for the servicing sector.

DAO – Section 6: Phase-out Schedule and Control of Importation of ODS (HCFCs)

Date	Import Reduction	Sector affected/Remarks
01 Jan 2025	67.5%	Chillers and fire extinguishing (HCFC-123). By this date, all importation of HCFC-123 as cooling agent for chillers and as fire extinguishing agent will likewise be absolutely prohibited, except for the servicing sector.
01 Jan 2030	97.5%	All import of HCFC blends prohibited
2030-2039 01 Jan 2040	 100%	2.5% per annum allowed for the servicing sector By this date, all kinds of importation of HCFC substances for the manufacturing and servicing sectors, except for essential use, will be prohibited.

DAO – Section 6: Phase-out Schedule and Control of Importation of ODS (HCFCs)

An **annual import quota allocation system** shall be implemented by the Department through the Bureau.

The **annual import quota is non-cumulative**, thus, any remainder of the quota allocation for a particular substance is deemed consumed at the end of the calendar year.

DAO – Section 7: Registration and Renewal of Registration of Importers of ODS

Any person who imports ODS for any industry or activity must register with the Department through the Bureau

Documentary requirements for the issuance of the Certificate of Registration

A Certificate of Registration issued by the Department through the Bureau is valid only for the calendar year when it was obtained. An application for the renewal of registration for every succeeding period prior to any importation must be submitted within the last thirty (30) days of the current calendar year.

ODS Online Permitting & Monitoring System (OPMS)

Website : opms.emb.gov.ph

DAO – Section 8 Pre-Shipment Importation Clearance (PSIC) for ODS

Section 8:

Registered importers must secure a PSIC from the Department through the Bureau prior to the entry of ODS in any area within the Philippine territory.

Any shipment not covered by the PSIC shall be deemed to have been illegally imported, in which case, the same shall be confiscated and forfeited in favor of the government.

ODS Online Permitting & Monitoring System (OPMS)

Website : opms.emb.gov.ph

DAO – Section 9: Registration and Renewal of Registration of Dealers, Retailers, and Re-sellers of ODS

Documentary requirements for the Certificate of Registration

A Certificate of Registration issued by the Department through the Regional Offices of the Bureau is valid only for the calendar year when it was obtained. Applicants are thus encouraged to submit their respective applications for renewal and accompanying documents within the last thirty (30) days of the current calendar year

Only dealers, retailers, and re-sellers registered by the Department through the Regional Offices of the Bureau may purchase, re-sell, and distribute ODS

ODS may only be sold or distributed to registered service providers

ODS Online Permitting & Monitoring System (OPMS)

Website : opms.emb.gov.ph

DAO – Section 10: Registration and Renewal of Registration of Service Providers of ODS-using Equipment

-TESDA-certified technicians

-DTI accredited service shops

Service providers should have the capability to take effective measures, including the necessary equipment, technology, training and infrastructure, for the purpose of effectively handling ODS, including responsible re-use of refrigerants, minimizing their emissions, and ultimately, phasing out their use by replacing with substitutes or alternatives duly recognized and certified by the Department and the Bureau

DAO – Section 9: Registration and Renewal of Registration of Dealers, Retailers, and Re-sellers of ODS

Service providers shall

-adhere to the good practices in handling and working with refrigerants…Code of Practice for Refrigeration and Air conditioning

-participate in a system to recover, reclaim and re-use refrigerants

Certificate of Registration with a 3-year validity

Applications for renewal may thus be submitted within the last thirty (30) days of the third calendar year.

Note: EMB Memorandum Circular for the implementation of this Section has been drafted. Condcted Public Consultation Meeting on 7 August 2019, 10am-3pm at Sulo Hotel prior to its approval by the EMB Director.

DAO – Sections 11, 12, and 13

Section 11: Regulation of the Export of ODS (new)

-Export of controlled substances, in any form, whether alone or in mixtures, including those that are used, stored, reclaimed, recycled, or recovered as well as unwanted ODS.

-Export of wastes containing ODS shall be governed by the appropriate DENR rules and regulations on hazardous waste management and the Basel Convention.

Section 12: Registration and Renewal of Registration of Exporters of ODS (new)

A Certificate of Registration issued by the Department through the Bureau is valid only for the calendar year when it was obtained. Applicants are thus encouraged to submit their applications for renewal and accompanying documents within the last thirty (30) days of the current calendar year

Section 13: Pre-Shipment Export Clearance (PSEC) (new)

DAO – Section 14: Records Keeping

-Importers, Exporters, Dealers, Retailers, and Re-sellers must keep a record of all transactions and submit annual reports to the Bureau by the 31st of January of the following year

-Service providers must keep a record of all transactions, including quantity of recovered refrigerants – subject to validation by the EMB (new)

-Records retained must be available for inspection by an authorized officer of the DENR through the EMB

DAO – Section 16: Capability-Building Program (new)

to increase research and

information, education and communication efforts (IEC)

DAO – Section 17: Administrative violations

17.1 Back conversion;

17.2 Installation of CFC-using system;

17.3 Sale and use of small disposable containers (< 1 kg) with CFCs;

17.4 Importation or manufacturing or placing in the market of products or equipment containing halons or CFCs;

17.5 Use of CFC-containing equipment in mobile transportation starting in 2012;

17.6 Use of CFC-11 as blowing agent for foam manufacturing;

17.7 **Intentional release or venting of ODS;**

17.8 Use of CFC-11 and other banned ODS as flushing or cleaning agent; and

17.9 **Possession of un-registerered refrigerants, including mislabeling of controlled substances.**

Inspection and Investigation of unregistered ODS and ODS alternatives

Inspection and Investigation of unregistered ODS and ODS alternatives

NOTICE TO REFRAIN

The Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR) issued this **Notice to Refrain from moving, selling, distribution and transferring** these chemical substances for violating the provisions under the DAO 2013-25 and MC 2005-03 which are as follows:

1. _____ _____kilograms
2. _____ _____kilograms
3. _____ _____kilograms
4. _____ _____kilograms
5. _____ _____kilograms
6. _____ _____kilograms

Abovementioned chemical substances/refrigerants are found unregistered to EMB or mislabeled based on the use of the Refrigerant Identifier with the following results:

R-134A = _____%; R-12 = _____%; R-22 = _____% HC = _____%
Air = _____%

This Notice to Refrain for the abovementioned chemical substances/refrigerants were equivalent to confiscation and will serve as evidence for the said violation. It will be marked and labeled "confiscated". Violating this Notice will be automatically penalized up to Php50,000.00 and existing permit issued by EMB will be revoked.

Agreed and signed by both parties:

_____ _____
EMB Authorized Representative Dealer/Enterprise Representative

DAO – Section 18: Penal Provisions

Administrative and criminal liability

-Sections 13, 14, and 15 of RA 6969

-Sections 43 and 44 of DAO 92-29

Consequences of violations: (new)

-cancel the registration of importers, exporters, dealers, retailers and resellers

-recommend the cancellation of the DTI accreditation

-recommend the cancellation of the TESDA certificates of competency

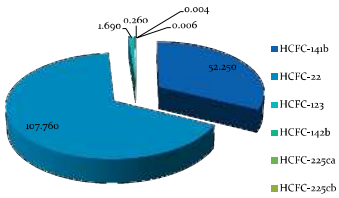
Take Note: You may **call at 888** if you found technician/s that are conducted intentional venting for malpractice. TESDA may cancel his TESDA certificates of competency

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ENVIRONMENTAL MANAGEMENT BUREAU

PCEAS, INC

Philippines' HCFC Baseline Consumption

SUBSTANCE	ODP TONNES	%
TOTAL HCFC-22	107.76	67%
TOTAL HCFC 141B	52.25	32%
TOTAL HCFC -123	1.69	1%
TOTAL HCFCs	161.97	100%



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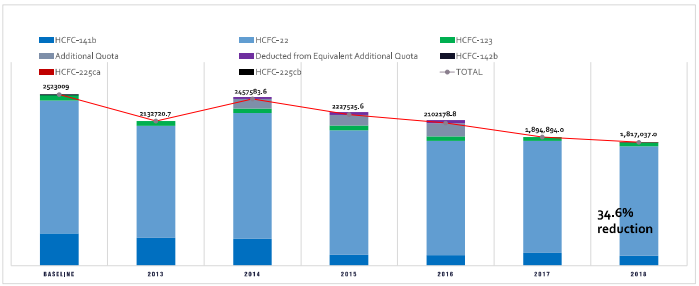
HCFC CONSUMPTION (KGS.)



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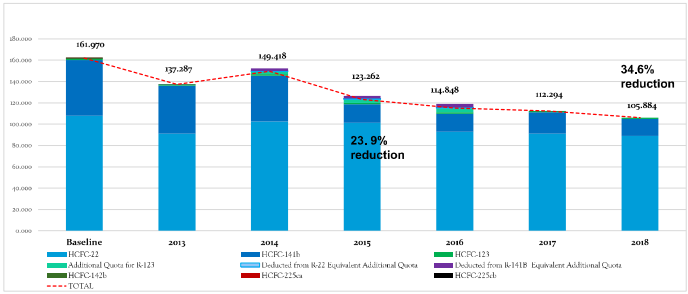
HCFC CONSUMPTION (ODP TON)



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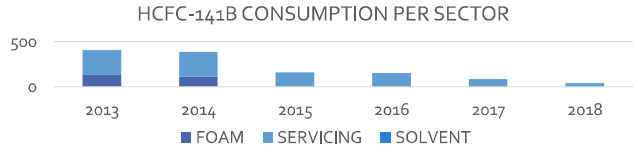
HCFC-141B CONSUMPTION PER SECTOR

SECTOR	2013	2014	2015	2016	2017	2018
FOAM	130.27	113.28	0	0	0	0
SERVICING	273.9	273.45	158.12	153.04	77.86	37.06
SOLVENT	4.49	3.91	1.6	0.54	6.46	2.42



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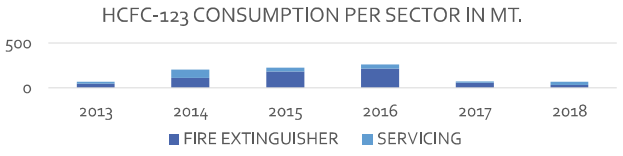
HCFC-123 CONSUMPTION PER SECTOR

SECTOR	2013	2014	2015	2016	2017	2018
FIRE EXTINGUISHER	44.88	111.28	184.15	213.324	57.8	33.4
SERVICING	24.17	94.79	43.2	49.735	14.73	34.87



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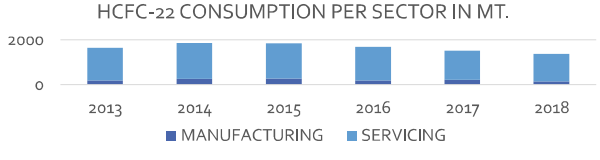
HCFC-22 CONSUMPTION PER SECTOR

SECTOR	2013	2014	2015	2016	2017	2018
MANUFACTURING	180.56	260.4	275.62	176.11	203.69	134.35
SERVICING	1460.9	1599.63	1561.82	1509.01	1307.82	1241.62



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HCFC Phase-out Management Plan (HPMP)

- Mix of investment and non-investment projects aimed to phase-out HCFCs in the different sectors:
  - Investment Projects – provide technical assistance, projects to assist industries in shifting to non-HCFC technologies
  - Non-investment projects – provide training, capacity building, public awareness activities, policy and regulatory support

HPMP Stage 1 (2013-2016)

- Overarching strategy for HCFC phase-out
- Phase-out of HCFC-141b in the foam sector
  - ODP = 0.11; GWP = 700
- Alternative Foam Blowing agents:

Continuous/ Discontinuous Insulation Panels	Hydrocarbon: Cyclopentane
Thermoware and Commercial Refrigeration	Water blown technology
Flexible Molded Foam	Liquid carbon dioxide
Spray Foam	Supercritical carbon dioxide, Methyl formate, Water blown technology, Hydrofluoro-olefins (HFOs)

Foam Manufacturing Equipment

CYCLOPENTANE TECHNOLOGY

WATER BLOWN TECHNOLOGY

INJECTION INTO HP FOAMING MACHINE

GRACO REACTOR SPRAY FOAM APPLICATION

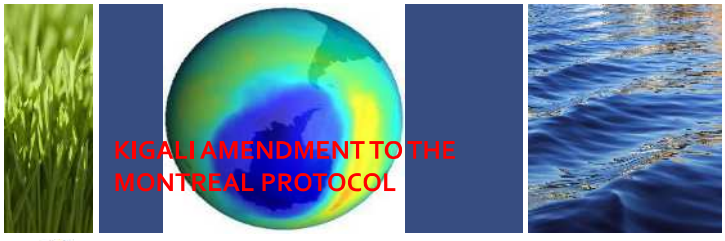
HPMP Stage 2 (2017-2020)

- Phase-out of HCFC-22 in the refrigeration and air conditioning equipment sector
  - ODP = 0.055
  - GWP = 1,700
- Alternative cooling agents in the domestic air-conditioning sector being considered:
  - Hydrocarbon (R-290) (Zero ODP; very low GWP but flammable)
  - HFC-32 (R-32) (Zero ODP; GWP = 675; slightly flammable)

Note: We are expected to implement the HPMP Stage 2 by last quarter of this year. Our recipient for the project are Koppel, Inc., Concepcion Carrier, Johnson Controls-Hitachi and Panasonic.

HPMP Stage 3 (beyond 2020)*

- Phase-out of the remaining HCFCs (HCFC-22 in the commercial and industrial refrigeration and air conditioning sectors)
- Phase-out of HCFC-123 in the manufacturing and servicing sectors
  - ODP = 0.02
  - GWP = 70
- Phase out of all HCFCs in the servicing sector



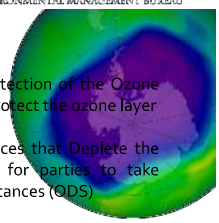
VI. Kigali Amendment to Phase down HFCs

- MOP Decision XXVIII/1 and Accompanying Decision XXVIII/2 : Successful Agreement in the Kigali Amendment

The Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer reached agreement at their 28th Meeting of the Parties on 15 October 2016 in Kigali, Rwanda to phase down hydrofluorocarbons (HFCs).

HFCs are commonly used alternatives to ozone depleting substances (ODS). While not ODS themselves, HFCs are greenhouse gases which can have high or very high global warming potentials (GWPs) ranging from 12 to 14,800

OZONE LAYER PROTECTION TREATIES

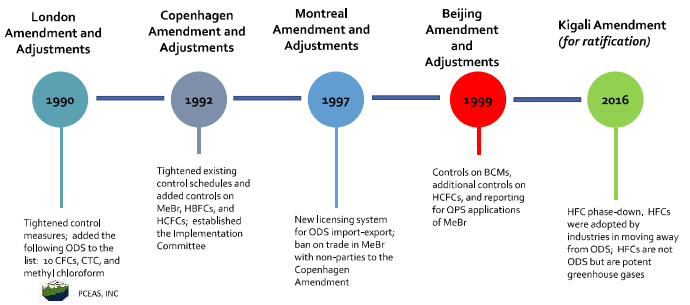


1985: Adoption of the Vienna Convention for the Protection of the Ozone Layer, the framework convention for efforts to protect the ozone layer

1987: Adoption of the Montreal Protocol on Substances that Deplete the Ozone Layer, the legally binding agreement for parties to take concrete actions to control ozone depleting substances (ODS)

The two ozone treaties have been ratified by 197 parties (196 states and the European Union) by the year 2009 making them the first universally ratified treaties in United Nations history.

History of Montreal Protocol Amendments



KEY ACHIEVEMENTS OF THE MONTREAL PROTOCOL

- ✓Elimination of ozone depleting substances
- ✓Healing the ozone layer
- ✓Contribution to prevent global warming
- ✓Global participation
- ✓Supporting developing countries
- ✓High rates of compliance
- ✓Global recognition of the Montreal Protocol
- ✓Health benefits

Main Elements of the Kigali Amendment

Kigali Amendment Overview

Kigali Amendment to enter into force on 01 January 2019	Two groups each of Article 5 and Non-Artide 5 countries with different baseline years and phase-down schedules	New Annex F (HFCs) added to the Montreal Protocol	Global warming potential values for HFCS and selected HCFCs and CFCs added to the text	Reporting for consumption expressed in carbon dioxide (CO_2) equivalents
Baselines are calculated from HFC and HCFC production/ consumption	Exemption for high ambient temperature countries	Import-export licensing for HFCs must be in place by 01 January 2019	Trade with non-Parties will be banned from 01 January 2033	Executive Committee of the Multilateral Fund will develop guidelines for financing HFC phase-down

Objective of the Kigali Amendment

The Kigali Amendment, adopted by the Parties to the Montreal Protocol on 15 October 2016, aims to reduce the emissions of powerful greenhouse gases that could prevent up to 0.5 degrees Celsius of global warming by the end of this century, while continuing to protect the ozone layer.

Controlled Substances of the Montreal Protocol

Annex	Group	Substance	No. of Species
Annex A	Group I	Chlorofluorocarbons (CFCs)	5
	Group II	Halons	3
Annex B	Group I	Other fully halogenated CFCs	10
	Group II	Carbon tetrachloride	1
	Group III	1,1,1-trichloroethane (methyl chloroform)	1
Annex C	Group I	Hydrochlorofluorocarbons (HCFCs)	40
	Group II	Hydrobromofluorocarbons (HBFCs)	34
	Group III	Bromochloromethane	1
Annex E	Group I	Methyl bromide	1
Annex F	Groups I & II	*Hydrofluorocarbons (HFCs)*	*18*

Amended Annex A of the Montreal Protocol

Group	Substance	Ozone-Depleting Potential	100-Year Global Warming Potential
Group I			
$CFCl_3$	(CFC-11)	1.0	4,750
CF_2Cl_2	(CFC-12)	1.0	10,900
CF_3Cl_3	(CFC-113)	0.8	6,130
$C_2F_4Cl_2$	(CFC-114)	1.0	10,000
C_2F_5Cl	(CFC-115)	0.6	7,370

Group	Substance	Number of Isomers	Ozone-Depleting Potential	100-Year Global Warming Potential
Group I $CHFCl_2$	(HCFC-21)**	1	0.04	151
CHF_2Cl	(HCFC-22)**	1	0.055	1810
CH_2FCl	(HCFC-31)	1	0.02	
C_2HFCl_4	(HCFC-121)	2	0.01 – 0.04	
$C_2HF_2Cl_3$	(HCFC-122)	3	0.02 – 0.08	
$C_2HF_3Cl_2$	(HCFC-123)	3	0.02 – 0.06	77
$CHCl_2CF_3$	(HCFC-123)**	-	0.02	
C_2HF_4Cl	(HCFC-124)	2	0.02 – 0.04	609
$CHFClCF_3$	(HCFC-124)**	-	0.022	
$C_2H_2FCl_3$	(HCFC-131)	3	0.007 – 0.05	
$C_2H_2F_2Cl_2$	(HCFC-132)	4	0.008 – 0.05	
$C_2H_2F_3Cl$	(HCFC-133)	3	0.02 – 0.06	
$C_2H_3FCl_2$	(HCFC-141)	3	0.005 – 0.07	
CH_3CFCl_2	(HCFC-141b)**	-	0.11	725
$C_2H_3F_2Cl$	(HCFC-142)	3	0.008 – 0.07	
CH_3CF_2Cl	(HCFC-142b)**	-	0.065	2310
C_2H_4FCl	(HCFC-151)	2	0.003 – 0.005	
C_3HFCl_6	(HCFC-221)	5	0.015 – 0.07	
$C_3HF_2Cl_5$	(HCFC-222)	9	0.01 – 0.09	
$C_3HF_3Cl_4$	(HCFC-223)	12	0.01 – 0.08	

Amended Annex C of the Montreal Protocol

Amended Annex C of the Montreal Protocol

Group	Substance	Number of Isomers	Ozone-Depleting Potential	100-Year Global Warming Potential
$C_3HF_5Cl_2$	(HCFC-224)	12	0.01 – 0.09	
$C_3HF_4Cl_3$	(HCFC-225)	9	0.02 – 0.07	
$CF_3CF_2CHCl_2$	(HCFC-225ca)**	-	0.025	122
CF_2ClCF_2CHClF	(HCFC-225cb)**	-	0.033	595
C_3HF_6Cl	(HCFC-226)	5	0.02 – 0.10	
$C_3H_2FCl_5$	(HCFC-231)	9	0.05 – 0.09	
$C_3H_2F_2Cl_4$	(HCFC-232)	16	0.008 – 0.10	
$C_3H_2F_3Cl_3$	(HCFC-233)	18	0.007 – 0.23	
$C_3H_2F_4Cl_2$	(HCFC-234)	16	0.01 – 0.28	
$C_3H_2F_5Cl$	(HCFC-235)	9	0.03 – 0.52	
$C_3H_3FCl_4$	(HCFC-241)	12	0.004 – 0.09	
$C_3H_3F_2Cl_3$	(HCFC-242)	18	0.005 – 0.13	
$C_3H_3F_3Cl_2$	(HCFC-243)	18	0.007 – 0.12	
$C_3H_3F_4Cl$	(HCFC-244)	12	0.009 – 0.14	
$C_3H_4FCl_3$	(HCFC-251)	12	0.001 – 0.01	
$C_3H_4F_2Cl_2$	(HCFC-252)	16	0.005 – 0.04	
$C_3H_4F_3Cl$	(HCFC-253)	12	0.003 – 0.03	
$C_3H_5FCl_2$	(HCFC-261)	9	0.002 – 0.02	
$C_3H_5F_2Cl$	(HCFC-262)	9	0.002 – 0.02	
C_3H_6FCl	(HCFC-271)	5	0.001 – 0.03	

Annex F of the Montreal Protocol

Group	Substance	100-Year Global Warming Potential
Group I CHF_2CHF_2	HFC-134	1,100
CH_2FCF_3	HFC-134a	1,430
CH_2FCHF_2	HFC-143	353
$CHF_2CH_2CF_3$	HFC-245fa	1,030
$CF_3CH_2CF_2CH_3$	HFC-365mfc	794
CF_3CHFCF_3	HFC-227ea	3,220
$CH_2FCF_2CF_3$	HFC-236cb	1,340
CHF_2CHFCF_3	HFC-236ea	1,370
$CF_3CH_2CF_3$	HFC-236fa	9,810
$CH_2FCF_2CHF_2$	HFC-245ca	693
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee	1,640
CH_2F_2	HFC-32	675
CHF_2CF_3	HFC-125	3,500
CH_3CF_3	HFC-143a	4,470
CH_3F	HFC-41	92
CH_2FCH_2F	HFC-152	53
CH_3CHF_2	HFC-152a	124
Group II CHF_3	HFC-23	14,800

Article 5 Parties – HFC phase-down (Kigali Amendment)

	Article 5 Parties: Group 1 *Philippines and other A5 Parties		Article 5 Parties: Group 2 (10 Parties)	
Baseline Years	2020, 2021 & 2022		2024, 2025 & 2026	
Baseline Calculation	Average production/consumption of HFCs in 2020, 2021 & 2022 Plus 65% of HCFC baseline production/consumption		Average production/consumption of HFCs in 2024, 2025 & 2026 Plus 25% of HCFC baseline production/consumption	
Reduction steps Freeze	2024		2028	
Step 1	2029	10%	2032	10%
Step 2	2035	30%	2037	20%
Step 3	2040	50%	2042	30%
Step 4	2045	80%	2047	85%

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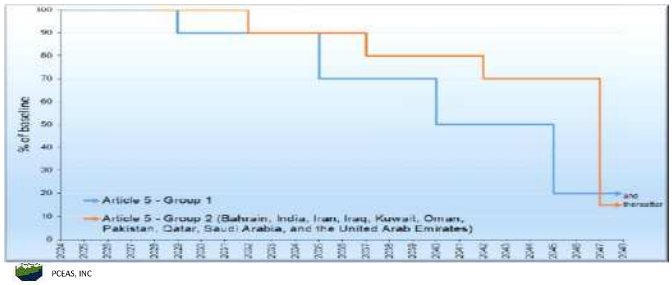
Phase-down Schedule



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Non-Article 5 Parties – HFC phase-down (Kigali Amendment)

	Non-Article 5 Parties: Main Group		Non-Article 5 Parties: (5 Parties)	
Baseline Years	2011, 2012 & 2013		2011, 2012 & 2013	
Baseline Calculation	Average production/consumption of HFCs in 2011, 2012 & 2013 Plus 15% of HCFC baseline production/consumption		Average production/consumption of HFCs in 2011, 2012 & 2013 Plus 25% of HCFC baseline production/consumption	
Reduction steps Step 1	2019	10%	2020	5%
Step 2	2024	40%	2025	35%
Step 3	2029	70%	2029	70%
Step 4	2034	80	2034	80%
Step 5	2036	85	2036	85%

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Ratification of the Kigali Amendment

- IMPLICATIONS OF RATIFICATION:
- Key Reasons to become a Party to the Kigali Amendment

HEALING OF THE OZONE LAYER AND MITIGATION OF CLIMATE CHANGE

NEW TECHNOLOGIES

LEADING ROLE

ACCESS TO FINANCIAL AND TECHNICAL SUPPORT

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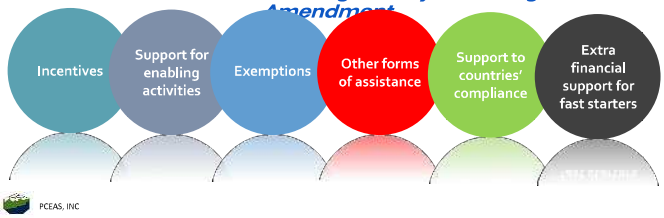
Ratification of the Kigali Amendment

IMPLICATIONS OF RATIFICATION:

The Benefits of becoming a Party to the Kigali Amendment



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Ratification of the Kigali Amendment

IMPLICATIONS OF RATIFICATION :

Administrative costs of becoming a party to the Kigali Amendment

- Adapting existing laws or introducing new ones to achieve the HFC phase-down
- Extending the ODS import and export licensing system to cover HFCs
- Putting in place, where appropriate, any practical arrangements that may be required for customs officers to assume extra responsibilities concerning HFCs
- Surveying existing HFC consumption and production;
- Developing the resources to report under the Amendment ; and
- Developing a strategy for HFC phase-down, including monitoring and enforcement .

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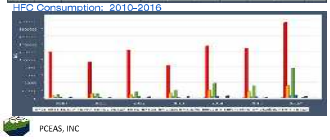
Readiness of the Philippines in ratifying the Kigali Amendment

HFC Consumption: 2010-2016



Consumption Patterns of ODS and Alternatives in the Philippines

Track Record of Philippines in Implementing the Montreal Protocol for the period 1999 to present:

- Obligations to the Kigali Amendment
- Stakeholders and roles and responsibilities
- Survey of HFC consumption and production
- Collection of other relevant information

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RATIFICATION STEPS

- Review of the Amendment and the supporting documents at the national level: DFA, Cabinet Cluster, President, Senate
- Instrument of ratification to be executed by the country
- Deposit by the party of the duly executed instrument of ratification through the Permanent Mission to the United Nations to the Treaty Section, Office of Legal Affairs, New York, USA

UPDATES: Technical Working Committee members have already met ; Requested for each members to issue Certificate of Concurrence (COC) for the Ratification of Kigali Amendment to Phase down HFCs; Out of nine (9) members, six (6) members have already submitted their COC, we are waiting for the other three (3) members.

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Memorandum Circular 2005-03 known as "List of Alternatives to Ozone Depleting Substances (ODS)"

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EMB MEMORANDUM CIRCULAR 2005-03

Title: List of Alternatives for Ozone Depleting Substances (ODS)

Basis:

- Section 3 of Republic Act 6969 known as Toxic Substances, Hazardous Wastes and Nuclear Wastes Control Act of 1990 referring to unregulated substances and mixtures in the Philippines
- In connection with DAO 2004-08 "Revised Chemical Control Order for ODS"

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EMB MEMORANDUM CIRCULAR 2005-03

Coverage:

- TETRAFLUOROETHANE (HFC-134A)
- DICHLOROMETHANE (Methylene Chloride)
- HEPTAFLUOROPROPANE (HFC-227EA)
- HEXAFLUOROPROPANE (HFC-236FA)
- TRIFLUOROMETHANE (HFC-23)
- TETRAFLUOROMETHANE (CF_4) or (R14)
- HYDROFLUOROCARBONS (HFCs) BLENDS

- **Other HFCs and HFCs blends shall be directed with EMB through the EQD for proper evaluation and assessments.**

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Hydrofluorocarbons (HFCs)

Substance	100 y GWP	Chemical name
HFC-32*	675	Difluoromethane
HFC-41	92	Methyl fluoride
HFC-125	3,500	Pentafluoroethane
HFC-134	1,100	1,1,2,2-Tetrafluoroethane
HFC-134a*	1,430	1,1,1,2-Tetrafluoroethane
HFC-143	353	1,1,2-Trifluoroethane
HFC-143a	4,470	1,1,1-Trifluoroethane
HFC-152	53	1,2-Difluoroethane
HFC-152a*	124	1,1-Difluoroethane
HFC-161	12	Monofluoroethane
HFC-227ea**	3,220	1,1,1,2,3,3,3-Heptafluoropropane
HFC-236cb	1,340	1,1,1,2,2,3-Hexafluoropropane
HFC-236ea	1,370	1,1,1,2,3,3-Hexafluoropropane
HFC-236fa**	9,810	1,1,1,3,3,3-Hexafluoropropane
HFC-245ca**	693	1,1,2,2,3-Pentafluoropropane
HFC-245fa	1,030	1,1,1,3,3-Pentafluoropropane
HFC-365mfc	794	1,1,1,3,3-Pentafluorobutane
HFC-43-10mee***	1,640	1,1,1,2,2,3,4,5,5,5-Decafluoropentane
HFC-23*	14,800	Trifluoromethane

EMB MEMORANDUM CIRCULAR 2005-03

REQUIREMENTS FOR THOSE ENGAGED IN THE LIST OF ALTERNATIVES TO ODS

- **FOR IMPORTERS**

Shall register annually to EMB and secure Pre-Shipment Importation Clearance (PSIC) prior to the entry in the area of the Philippines Territory at prescribed fee imposed by EMB **(Please refer to On-Line Permitting System (OPMS) for ODS re application and requirements for Certificate of Registration and Pre-Shipment Importation Clearance to import alternative to ODS)**

- **FOR USERS, DEALERS AND MANUFACTURERS**

Shall submit quarterly report as to their institutes distribution and utilization processes to the EMB

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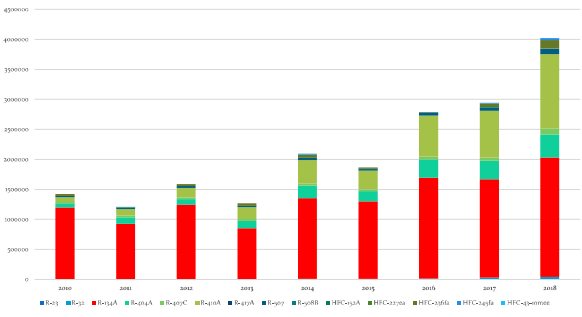
EMB MEMORANDUM CIRCULAR 2005-03

Penal Provisions:

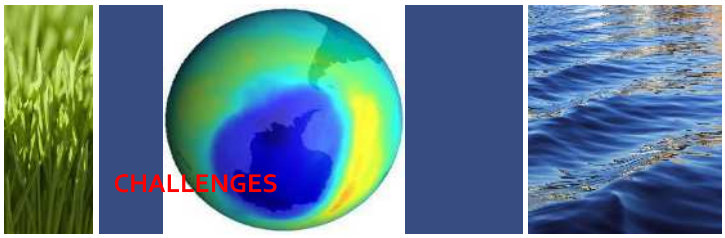
Administrative and criminal liability
-Sections 14 and 15 of RA 6969
-Sections 43 and 44 of DAO 92-29
Effectivity:
- **Signed on 19 APRIL 2005 by EMB DIRECTOR**

PCEAS, INC

HFC CONSUMPTION (KG.)



PCEAS, INC



PCEAS, INC

Challenges

- Selection of alternative technologies
  - zero ODP, low GWP
  - energy use/efficiency
  - health and safety considerations
    - toxicity,
    - flammability, etc.,
  - economic aspects –availability in the market, cost)
- Illegal trade in ODS
- Use of HCFC-141b as a flushing agent
- Disposal of unwanted ODS

PCEAS, INC

76

Thank you for your attention!

For more information:

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PCEAS, INC

77

JCM Activities of Tokyo Century Group

Feb 6, 2020

BPI Century Tokyo Lease & Finance Corporation

CONFIDENTIAL

Company Background

BPI CENTURY TOKYO LEASE & FINANCE CORPORATION

- Founded : May 14th, 1970 (as known BPI Leasing Corporation)
- Line of Business : Finance Lease, Operating Lease, Term Loan, Factoring
- Investor : Bank of the Philippine Islands 51%
  Tokyo Century Corporation 49%

Bank of the Philippine Islands
Founded : August 1st, 1851
Investor : Ayala Corporation 21.8%, Ayala DBS Holdings 21.3% and others
Line of Business : Banking
Stock Listing : Philippine Stock Exchange

Tokyo Century Corporation
Founded : July 1st, 1969
Investor : Mizuho Financial Group 35%, ITOCHU Corporation 25% and others
Line of Business : Diversified leasing business, various types financing
Stock Listing : Tokyo Stock Exchange 1st Section

Introduction of BPI

- Founded in **1851**
- **Oldest bank** in the Philippines and Southeast Asia
- **First Central Bank**
- **Universal Bank** that offers a wide range of financial solutions along with its subsidiaries
- BPI is financially stable with **P2.085Tn** total assets, **1.586Tn** total deposits and **23.1Bn** net income
- Rated **investment-grade** by international rating agencies

Introduction of Tokyo Century

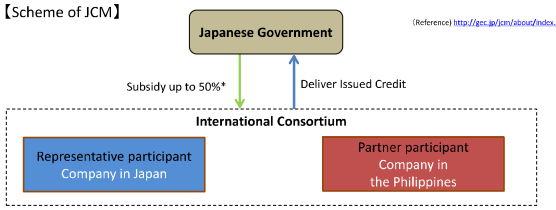
- Founded in **1969**
- **Diversified Financing company** providing leasing and other financial services around the world
- Operating in **37 countries**
- Partnership with Global companies such as China UnionPay, Grab, Lippo Gr., CSI Leasing, GA Telesis, Yoma Gr
- Tokyo Century is financially growing with **¥4.865Tn** total assets, **¥52.3Bn** net income
- Rated **AA- (JCR), A (R&I)** by Japanese rating agencies

Outline of JCM

JCM (The Joint Crediting Mechanism) is...

- the mechanism for the Japanese government to achieve the goal of CO2 emission reduction by introducing low-carbon technologies to selected countries.
- **Up to 50% of the initial cost of low-carbon technology is subsidized** by the Japanese government.

【Scheme of JCM】



Why JCM?

- ✓ **Maximize Profit** Up to 50% subsidy enables to introduce a high quality technologies/products at a competitive price.
- ✓ **Improve Company's Eco-Friendly Image** JCM as an environmental-related program initiated by Japanese government contributes to improve its eco-friendly image and help achieve CSR of the company

Why Tokyo Century?

- ✓ **Extensive Experience** Tokyo Century is the first company handling JCM Project as a financial institution. Also, two projects were selected as ones of the first JCM projects in the Philippines.
- ✓ **Strong Relationship with Japanese Manufacturers** Tokyo Century has close and strong relationship with various Japanese Manufacturers/Vendors with high energy efficient products
- ✓ **JCM application and Finance in One-Package** Tokyo Century processes JCM application at a lower price than consulting firm and BPI Century Tokyo as an affiliate company of Tokyo Century provides a financing/leasing for the Company in one-package

Achievement of JCM Projects

Projects of **Total 45.73MW** Solar Power System proposed by Tokyo Century have been selected by GEC, an affiliate of The Ministry of Environment of Japan.
Tokyo Century is the first company who has participated as financial institution.

Year	Country	Representative	Project Title	Expected CO2 Emission Reduction
2017	Philippines	Tokyo Century Corporation	Introduction of **1.53MW** Rooftop Solar Power System in Auto Parts Factories	1,124 (tCO2/year)
2017	Philippines	Tokyo Century Corporation	Installation of **1.2MW** Rooftop Solar Power System to the Cold Storage	838 (tCO2/year)
2017	Indonesia	Tokyo Century Corporation	Introduction of **Absorption Chiller** to Chemical Factory	1,084 (tCO2/year)
2018	Thailand	Tokyo Century Corporation	**25MW** Rooftop and Floating Solar Power Project in Industrial Park	10,620 (tCO2/year)
2019	Philippines	Tokyo Century Corporation	**18MW** Rooftop Solar System	11,743 (tCO2/year)

Source: http://gec.jp/jcm/kobo/mp/180625list_en.pdf

JCM Project in the Philippines (1)

JCM Projects in FY2017 / Host Country : the Philippines

Project : Introduction of 1.53MW Rooftop Solar Power System in Auto Parts Factories
Participants : 【Japan】 Tokyo Century Corporation 【Philippines】Enomoto Philippine Manufacturing, Inc. / Aikawa Philippines, Inc.

Project Outline

- Installation 1.53MW solar panel on the rooftop of the Enomoto Philippine's factory and the Aikawa Philippines's factory in the south of Manila.
- Electricity generated by solar system is used for their power-consumption and reduce CO2 emissions by displacing part of grid electricity. **Estimated CO2 reduction is 1,124 tCO2 / Year**


Solar Panel Layout for Enomoto Factory
(175W x 5,408 panel = 946.4kW)

Solar Panel Layout for Aikawa Factory
(175W x 3,328 panel = 582.4kW)

JCM Project in the Philippines (2)

JCM Projects in FY2017 / Host Country：the Philippines

Name：Installation of 1.2MW Rooftop Solar Power System to the Cold Storage
Participants：【Japan】Tokyo Century Corporation 【Philippines】TRANSNATIONAL UYENO SOLAR CORP (TUSC)

Project Outline

- Installsation of 1.2MW solar panel on the rooftop of the cold storage in Manila.
- Electricity generated by solar system is purchased by owner of the storage and reduce CO2 emissions by displacing part of grid electricity. **Estimated CO2 reduction is 838.13 tCO2 / Year**


(Solar Panel)


(Photo of the Project Site)

JCM Project in Indonesia

JCM Projects in FY2017 (2nd call) / Host Country：Indonesia

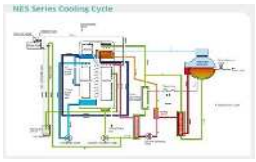
Name：Introduction of Absorption Chiller to Chemical Factory
Participants：【Japan】Tokyo Century Corporation 【Indonesia】PT. Timuraya Tunggal

Project Outline

- Installation of absorption chiller to the chemical factory of PT Timuraya Tunggal in Karawang, West Java Province.
- The absorption chiller produces chilled water from wasted steam, and reduces the power consumption of electric chiller and GHG emission. **Estimated CO2 reduction is 1,084 tCO2 / Year**

(Absorption Chiller)


(PT. Timraya Tunggal)



(Cooling Cycle)

JCM Project in Thailand

JCM Projects in FY2018 / Host Country：Thailand

Project Title: Introduction of 25MW Rooftop and Floating Solar Power System in Industrial Park
Representative: (Japan) Tokyo Century Corporation (Philippines) Tisco Tokyo Leasing Co., Ltd.

Project Outline

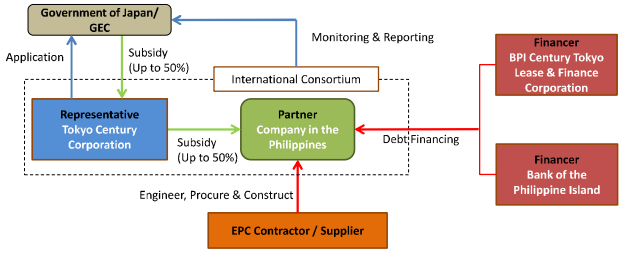
- Introduction of **25MW** Solar PV system with leasing to the rooftop on the factories and the reservoir in industrial park owned by Thai Conglomerate company. By substituting the Solar energy for the electricity from the grid, CO2 emission will be reduced. **Estimated CO2 reduction is 10,625 tCO2 / Year**


Project Site


Reservoir

Scheme Example

[Scheme Example]



[Project flow]
(1) Representative applies to GEC (The Global Environment Centre Foundation), an affiliate of the Ministry of Environment of Japan.
(2) After the approval, Partner issues PO to EPC contractor / Supplier, and start constructing low carbon technology. Construction must be finished within 3 fiscal years of Japan (April to March)
(3) After the completion of the construction, the Japanese government remits subsidy to Representative.

Roles of Each Entity & Project Term

The project must be continued until the end of the project term determined by Japanese government

【Representative/Tokyo Century】
- Apply to the GEC
- Develop methodology to calculate CO2 emission reduction
- Manage & control the project
- Monitor & report the amount of CO2 emission reduction during the project term
- Issue & deliver the credit

【Partner/Company in the Philippines】
- Construct and use low carbon technology properly
- Do proper operation and maintenance
- Deliver the data necessary to calculate CO2 emission reduction
- Accept the investigation by the Third Party Entity

【Supplier/EPC Contractor】
- Provide Representative with the data such as quotation, performance of CO2 reduction etc.
- Engineer, Procure & Construct low-carbon technologies

Appendix: Criteria for JCM Approval

Eligible Asset	・Renewable Energy System (e.g. Solar, Hydro, Biogas, Biomas, Wind, Geo-Thermal etc.) ・Energy-Saving System
Target Project Amount	Minimum: USD 3Mm Maximum: USD 60 Mn (Max. subsidy: USD 18Mn/Project)
Preference	・Something attractive for Japanese Government (e.g. New technologies/scheme/structure, Huge size over 10MW, Highly trusted parties/projects) ・Japanese product or Japanese Vendor/EPC* (Non-Japanese products/vendor/EPC, but Top Tier, can be eleigible)

* Timely assistance and support from EPC contractor is very important since Tokyo Century has to make monthly Construction Progress Report to GEC

BPI
Make the best happen.

Thank you very much.

BPI Century Tokyo Lease & Finance Corporation

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