Ministry of Natural Resources and Environment, Socialist Republic of Viet Nam
Department of Natural Resources and Environment, Ho Chi Minh City, Socialist Republic of Viet Nam

Project to Support the Planning and Implementation of NAMAs in a MRV Manner (Capacity Enhancement of Local Governments)

Final Report

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Acronyms and Abbreviations

2006 IPCC Guidelines	2006 IPCC Guidelines for National Greenhouse Gas Inventories
AFOLU	Agriculture, Forestry, and Other Land Use
BRT	Bus Rapid Transit
C40	C40 Cities Climate Leadership Group
CCAP	Climate Change Action Plan
CCB	Climate Change Bureau
CCSB	Climate Change Steering Board
CDM	Clean Development Mechanism
CITENCO	HCMC Urban Environment Company Limited
CNG	Compressed Natural Gas
DARD	HCMC Department of Agriculture and Rural Development
DCC	Department of Climate Chang
DOC	HCMC Department of Construction
DOF	HCMC Department of Finance
DOIT	HCMC Department of Industry and Trade
DONRE	HCMC Department of Natural Resources and Environment
DOST	HCMC Department of Science and Technology
DOT	HCMC Department of Transport
DPI	HCMC Department of Planning and Investment
ECC	Energy Conservation Center
EVN HCMC	Electricity of Vietnam HCMC
GHG	Greenhouse Gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
HCMC	Ho Chi Minh City
HEPZA	Industry and Export Processing Zone in HCMC
IE	Included Elsewhere (Notation key on GHG inventory)
IGES	Institute for Global Environmental Strategies
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
JCM	Joint Crediting Mechanism
LFG	Landfill gas
LIFSAP	Livestock Competitiveness and Food Safety Project
MAUR	HCMC Management Authority for Urban Railways
MBS	HCMC Management Board for Solid Waste Treatment Complexes
MHIR	Mizuho Information and Research Institute
MOCPT	HCMC Management and Operation Center for Public Transport
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MRT	Mass Rapid Transit
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contributions
NE	Note Estimated (Notation key on GHG inventory)
NO	Not Occurring (Notation key on GHG inventory)
NTP-RCC	National Target Program to Respond to Climate Change
PDM	Project Design Matrix

SAWACO	Saigon Water Supply Corporation
SCFC	HCMC Steering Center of the Urban Flood Control Program
TMG	Tokyo Metropolitan Government
UCCI	HCMC Urban-Civil Works Construction Investment Management Authority
UDC	HCMC Urban Drainage Company Limited

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1. Introduction

1.1 Background

In Vietnam, greenhouse gas (GHG) emissions has been increasing owing to the rapid economic growth. In response, in 2008, the prime minister decided to implement the National Target Program to Respond to Climate Change (NTP-RCC) containing a comprehensive direction on climate change measures in Vietnam. All concerned agencies were mandated to formulate the climate change measures up to the target year 2020. In 2011, the prime minister adopted the National Strategy on Climate Change and the Ministry of Natural Resources and Environment (MONRE) was tasked to formulate the Nationally Appropriate Mitigation Actions (NAMAs) in collaboration with the relevant ministries.

In relation to this development, local governments are supposed to develop and implement a low-carbon action plan. The local governments are required to understand the GHG emissions in their administrative area, monitor the implementation status and the effect of NAMAs objectively, and promote measures continuously. Policies and plans have been prepared in some local governments; however, the quantification of GHG emissions, expected emission reductions and actual emission reductions remains a challenge. Alongside strengthening of the capacity to develop climate change measures, the capacity to objectively evaluate the effects of such measures and modify or add new measures accordingly needs to be enhanced.

In this context, JICA started the technical cooperation project aiming to enhance the capacity of the Vietnamese Government to plan, implement and manage NAMAs, taking MONRE as the counterpart organization. The project aimed to: 1) enhance the coordination capacity of MONRE to promote the development and implementation of NAMAs; and 2) enhance the planning and implementation capacity of relevant ministries and local governments. The scope of this work aimed to contribute to attaining the above–mentioned objective 2). It developed a Measurement, Reporting and Verification (MRV) style necessary for planning, implementation and management of NAMAs at the city level in Vietnam, taking Ho Chi Minh City (HCMC) as the model city.

HCMC, the target city of this work, established the Climate Change Steering Board (CCSB) composed of relevant departments and chaired by the Chairman of the People's Committee. In 2012, the Climate Change Bureau (CCB) was established under the Department of Natural Resources and Environment (DONRE) as the secretariat. In 2013, the People's Committee formulated and adopted the Climate Change Action Plan (CCAP) up to 2015. Later, in March 2017, the CCAP for the 2016-2020 period was adopted.

1.2 Objective

The objectives of this work were to: 1) assist the establishment and enhancement of the capacity of the cities in Vietnam to continuously quantify GHG emissions and reductions, taking HCMC as the

model city; 2) develop and recommend an MRV style applicable at the city level in Vietnam; and 3) promote the planning, implementation and management of NAMAs in Vietnam through the development and dissemination of materials to assist the capacity enhancement of the cities in Vietnam.

Initially, HCMC was not well informed on the project because it was not involved in the project planning process and selected as the model city after the project had commenced. While the JICA expert team made efforts to implement the activities according to the initial plan, it had successive discussions with HCMC. Subsequently, it was agreed by the concerned parties to modify the activity plan taking into consideration the requests of HCMC. As a result, the activities planned in cities outside HCMC were cancelled on the one hand, while on the other, emphasis was placed on the preparation of GHG inventory of HCMC, drafting of the GHG Inventory Preparation Manual and MRV Manual, institutionalization of the two manuals by HCMC, and capacity development of HCMC officials on climate change mitigation.

2. Activity Results

2.1 Overview of Activities

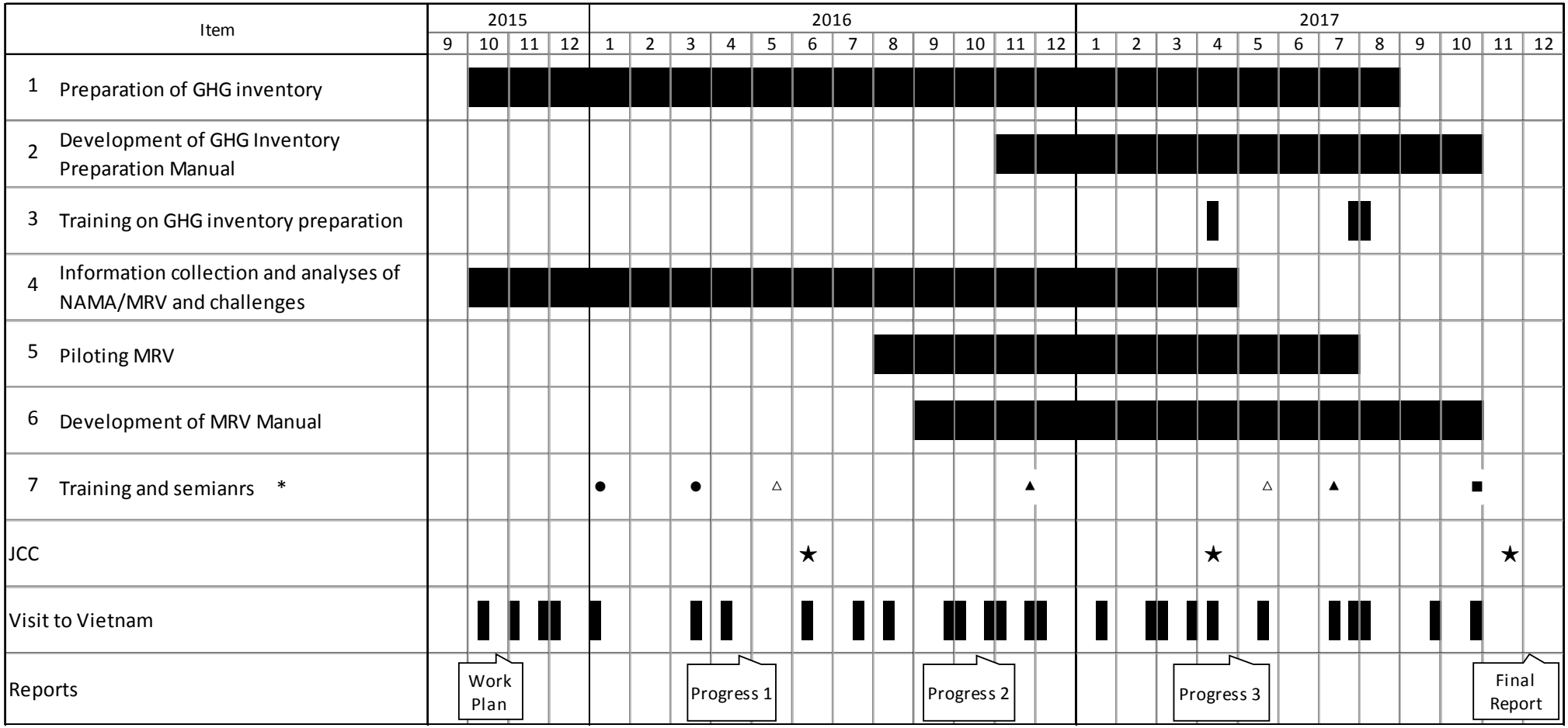
The activities started in September 2015. The activities can be largely grouped into GHG inventory, MRV on climate change mitigation measures, and training and seminars. The activities in HCMC started in October 2015 and ended in October 2017 after the Final Seminar held during the twenty-first visit, in which the achievements of the project were presented. Subsequently, the current report was prepared and the work was completed.

On GHG inventory, from October 2015, the initiatives undertaken to date were studied, and the data sources and preparation principles were studied and considered. Subsequently, the preparation of the GHG inventory commenced and by August 2017, it was largely completed. The drafting of the GHG Inventory Preparation Manual commenced in November 2016 and after successive discussions with the stakeholders and two consultation meetings, held in March and July 2017, it was completed in October 2017. The training on preparing a GHG inventory was held in April and July-August 2017 using the draft of the GHG Inventory Preparation Manual.

On MRV, gathering and analyses of basic information on mitigation measures started in October 2015, and the measures to pilot MRV and structure for MRV was considered. The MRV piloting started in August 2016. The drafting of the MRV Manual started in September 2016 and was completed in October 2017, incorporating the results of the MRV piloting and through process similar to that of the GHG Inventory Preparation Manual.

On training and seminars, the training in Japan was held in May 2016 and May 2017, and the General Training on Climate Change Mitigation was held in November 2016 and July 2017. In addition, the Final Seminar, and several small seminars and study sessions were organized.

Table 1 Overview of Activities



* Legend: ● Regular Seminar △ Training in Japan ▲ General Training on Climate Chage Mitigation for HCMC Officials ■ Final Seminar

2.2 GHG Inventory

2.2.1 Preparation of GHG Inventory

(1) Collection of basic information

From October 2015 to January 2016, the existing situation was studied. It became apparent that all of the data necessary for preparing the GHG inventory had to be newly collected. The expert team and CCB decided to collect the information and data required to prepare the GHG inventory for the years 2013, 2014, and 2015. For the GHG inventory to be useful in development of policies and measures on GHG emissions, the expert team planned to collect data by industrial sector, technology and fuel type in detail.

Table 2 Data and Data Providing Organizations

Provider	Sector	Main Data to Provide
DARD	AFOLU	Livestock, Rice cultivation, Agricultural information
DOC	IPPU	Amount of clinker, Lime
DONRE	Waste	Municipal solid waste, Sludge, Clinical waste
	AFOLU	Land use and land use change
DOIT	Stationary Energy, Transportation	Fuel consumption
DOT	Transportation	Number of vehicles, Number of ships
EVN HCMC	Stationary Energy	Electricity consumption
	IPPU	SF_6 of electricity equipment
HEPZA	Waste	Industrial wastewater
SAWACO	Stationary Energy	Electricity consumption
SCFC	Stationary Energy, Transportation	Electricity consumption, Fuel consumption
UDC	Waste, Stationary Energy, Transportation	Sewage treatment, Electricity consumption, Fuel consumption
Statistical Office	Waste, IPPU, AFOLU	Population, Agricultural information, Products of manufacturing industry

Note: DARD: HCMC Department of Agriculture and Rural Development, DOC: HCMC Department of Construction, DOIT: HCMC Department of Industry and Trade, DOT; Department of Transport, EVN HCMC: Electricity of Vietnam HCMC, HEPZA: Industry and Export Processing Zone in HCMC, SAWACO: Saigon Water Supply Corporation, SCFC: HCMC Steering Center of the Urban Flood Control Program, UDC: HCMC Urban Drainage Company Limited, AFOLU: Agriculture, Forestry, and Other Land Use; IPPU: Industrial Process and Product Use

During the January to June 2016 period, the information and data necessary to prepare the GHG

inventory was listed. The organizations that are likely to have these data and information were identified, and questionnaires confirming the presence or absence of such data were sent. The relevant organizations were also interviewed regarding such data. As a result, the available data and information became clear.

During the August to October 2016 period, the data collection forms for HCMC were developed referring to the data collection forms of the national GHG inventory in Vietnam. After a letter on the project requesting cooperation was issued by the People's Committee on 19 September 2016, CCB sent these data collection forms to the organizations concerned with the GHG inventory. After that, the following activities were conducted: 1) listing of data sources; 2) consideration of additional data items; 3) rearrangement of data collection forms; and so on. The organizations providing the data for the GHG inventory were named the Data Providing Organizations. The data and the Data Providing Organizations are shown in Table 2.

(2) Preparation of GHG inventory based on GPC

During the October 2016 to August 2017 period, the 2013 GHG inventory of HCMC was prepared in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). During this period, the following activities were conducted repeatedly: 1) consideration of the data collected and insufficient data; 2) improvement of the data collection forms; 3) improvement of the GHG inventory calculation files described below; and 4) examination and improvement of the draft GHG inventory.

The GHG inventory calculation files, which use Excel, were developed. Separate worksheets were prepared considering their functions; where one group are the worksheets to enter data from the data collection forms, and others are the worksheets used to set the parameters and emission factors in advance. The composition and usage of the GHG inventory calculation files are as follows:

1) The GHG inventory compiler enters the data collected into the *Input Data* worksheet of the GHG inventory calculation files.
2) The input data are converted into the activity data using parameters. These parameters are set up in advance in the *Parameter* worksheet. The activity data are derived in the *Activity Data* worksheet. The calculation formula is set beforehand.
3) The emission factors are set up in advance in the *Emission Factor* worksheet.
4) The emissions are calculated in the *Emissions* worksheet using data of the *Activity Data* worksheet and the *Emission Factor* worksheet.
5) The emissions are compiled in the *GPC Inventory* worksheet in accordance with the GHG emission report format of the GPC. The calculation formula is set beforehand.
6) The Global Warming Potential (GWP) values of major GHG gases are entered in advance into the *GWP* worksheet.
7) All GHG emission data are reported as CO_2 equivalents using the GWP in the *GPC Inventory (GWP)* worksheet.
8) The GHG inventory is re-categorized into the ten sectors of the CCAP of HCMC in the *10*

Sectors Inventory worksheet.

The emissions in the Stationary Energy Sector and Transportation Sector were calculated together using the same GHG inventory calculation files because they use many common data. The emissions were calculated distinguishing electricity consumption, fuel consumption and fuel fugitive emissions. The emissions were categorized according to the sub-sectors of the GPC using the information on energy in Vietnam given in the World Energy Statics of International Energy Agency.

The emissions in the Waste Sector were calculated using calculation files of each sub-sector: 1) Solid Waste Disposal Sub-sector; 2) Biological Treatment of Solid Waste Sub-sector; 3) Incineration and Open Burning of Waste Sub-sector; and 4) Wastewater Treatment and Discharge Sub-sector.

The emissions in the IPPU Sector were calculated using the files of the Industrial Process Sub-sector and Product Use Sub-sector.

The emissions and removals in the AFOLU Sector were calculated using the calculation files of the following emission and removal sources: 1) Livestock; 2) Rice Cultivation; 3) Direct and Indirect N_2O from Managed Soils; 4) Biomass Burning, Liming, and Urea Application; and 5) Land Use and Land-use Change.

The calculation equations are based on the GPC. The emission factors and parameters are taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) and information in the national GHG inventory of Vietnam.

The summary of the 2013 GHG inventory of HCMC based on the GPC is shown in Table 3. The reporting form is based on the GPC. The Scope 1 of Table 3 is emissions from sources located within the city boundary. The Scope 2 of Table 3 is emissions from the use of grid-supplied electricity, heat, steam, and/or cooling within the city boundary. The Scope 3 of Table 3 is all other emissions occurring outside the city boundary because of activities within the city boundary. IE is Included Elsewhere; NE is Not Estimated; and NO is Not Occurring.

The GHG emissions of HCMC in 2013 are around 38.5 million tCO_2e. The GHG emissions of Vietnam in 2010 are around 246.8 million tCO_2e. The emissions of HCMC account for 16% of the national GHG emissions while its population is only around 9% of the national total[1].

[1] For the national inventory, the 2010 results are referred to because the 2013 results do not exist. Because the emissions in Vietnam is on an increasing trend, the emissions in HCMC may have a share smaller than 16% if its 2013 emissions were compared with the 2013 national emissions.

Table 3 2013 GHG Inventory of HCMC based on GPC

GPC ref No.	GHG Emissions and Removals GHG Emissions Sources (By Sector and Sub-sector)	Total GHG (metric ton CO2e/year) in 2013 Scope 1	Scope 2	Scope 3	Total
I	**STATIONARY ENERGY**				
I.1	Residential buildings	269,780	5,301,680	262,963	5,834,424
I.2	Commercial and institutional building and facilities	440,575	2,505,610	124,278	3,070,463
I.3	Manufacturing industries and construction	2,597,202	5,386,028	267,147	8,250,377
I.4.1/2/3	Energy industries	0	0	0	0
I.4.4	Energy generation supplied to the grid	10,316			
I.5	Agriculture, forestry and fishing activities	621,570	36,366	1,804	659,740
I.6	Non-specified sources	0	0	0	0
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	0			0
1.8	Fugitive emissions from oil and natural gas systems	23,378			23,378
	SUB-TOTAL	**3,952,505**	**13,229,684**	**656,192**	**17,838,381**
II	**TRANSPORTATION**				
II.1	On-road transportation	14,544,176	NO	NE	14,544,176
II.2	Railways	IE	IE	NE	0
II.3	Waterborne navigation	149,134	NO	NE	149,134
II.4	Aviation	IE	NO	2,701,073	2,701,073
II.5	Off-road transportation	IE	IE	NE	0
	SUB-TOTAL	**14,693,310**		**2,701,073**	**17,394,382**
III	**WASTE**				
III.1.1/2	Solid waste generated in the city	1,293,241			1,293,241
III.2.1/2	Biological waste generated in the city	24,900			24,900
III.3.1/2	Incinerated and burned waste generated in the city	5,606			5,606
III.4.1/2	Wastewater generated in the city	926,142			926,142
III.1.3	Solid waste generated outside the city	NE			0
III.2.3	Biological waste generated outside the city	NE			0
III.3.3	Incinerated and burned waste generated outside the city	NE			0
III.4.3	Wastewater generated outside the city	NE			0
	SUB-TOTAL	**2,249,889**			**2,249,889**
IV	**INDUSTRIAL PROCESSES and PRODUCT USES (IPPU)**				
IV.1	Emissions from industrial processes occurring within the city boundary	565,704			565,704
IV.2	Emissions from product uses occurring within the city boundary	873			873
	SUB-TOTAL	**566,577**			**566,577**
V	**AGRICULTURE, FORESTRY and OTHER LAND USE (AFOLU)**				
V.1	Emissions from livestock	372,891			372,891
V.2	Emissions from land	-161,037			-161,037
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	211,508			211,508
	SUB-TOTAL	**423,362**			**423,362**
Total	**GHG Emissions and Removals**	**21,885,641**	**13,229,684**	**3,357,265**	**38,472,590**

The GHG emissions and removals by sector are shown in Figure 1. The emissions from the Stationary Energy Sector comprise 46%; the emissions from the Transportation Sector comprise 45%; the emissions from the Waste Sector comprise 6%; and the emissions from the IPPU Sector comprise 2%. The AFOLU Sector contributes to removals and emissions with a net 1% emission contribution.

The GHG emissions in the Stationary Energy Sector are shown in Figure 2. The emissions from the Manufacturing Industries and Construction Sub-sector comprise 46%; the emissions from the Residential Buildings Sub-sector comprise 33%; the emissions from the Commercial and Institutional Building and Facilities Sub-sector comprise 17%; the emissions from the Agriculture, Forestry and Fishing Activities Sub-sector comprise 4%; and the Fugitive Emissions from Oil and Natural Gas Systems comprise less than 1%. The emissions in the Transportation Sector are mainly from gasoline combustion and diesel combustion.

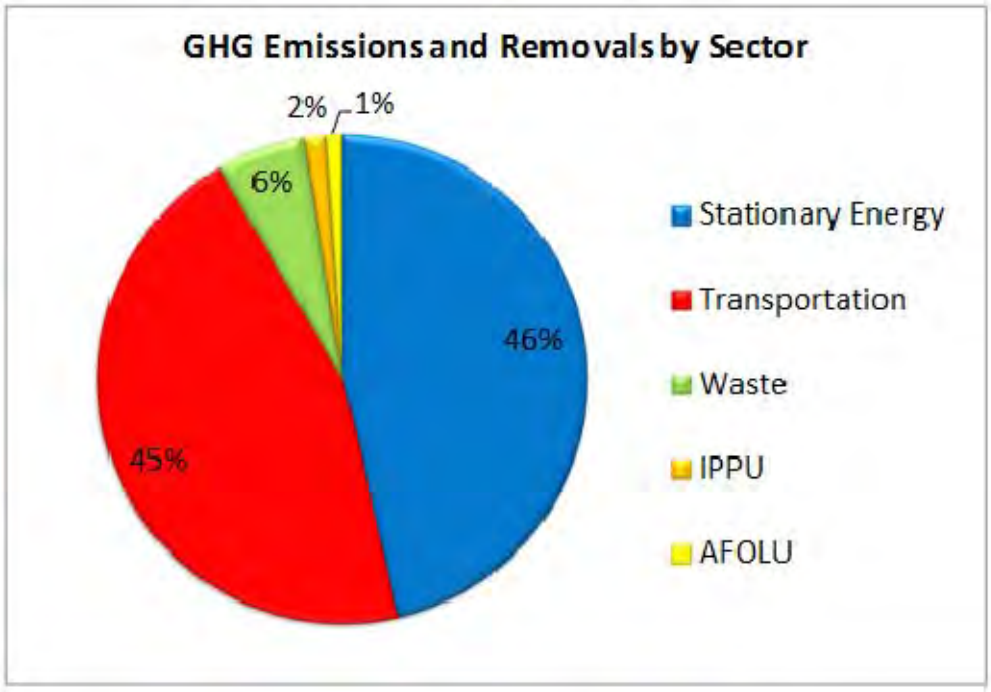


Figure 1 GHG Emissions and Removals by Sector in HCMC

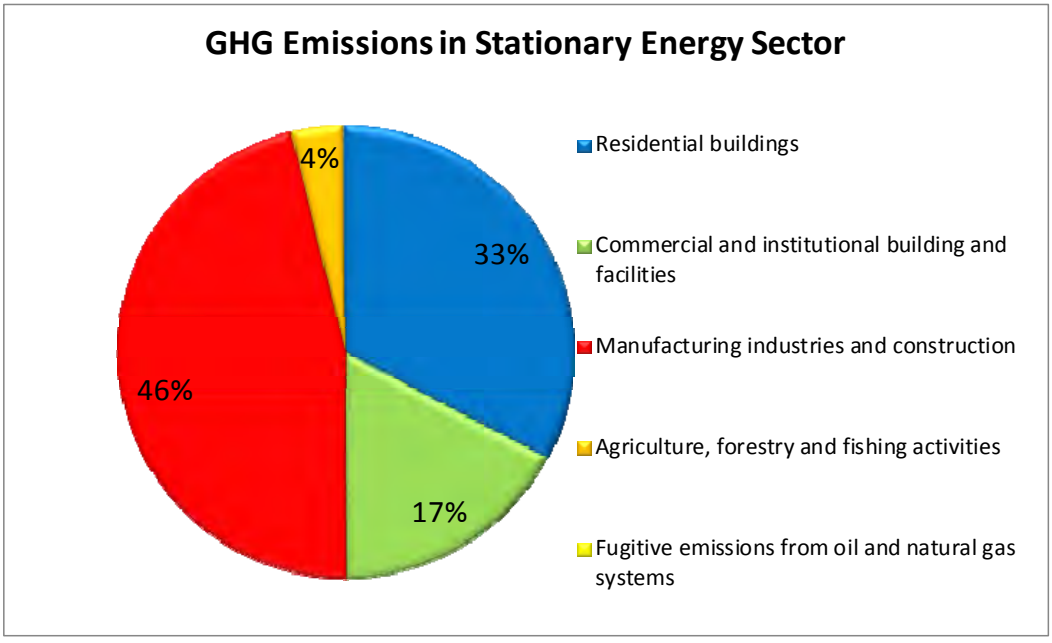


Figure 2 GHG Emissions in Stationary Energy Sector of HCMC

The 2013 GHG inventory of HCMC was reviewed by the experts of the C40 Cities Climate Leadership Group (C40). C40 suggested that the GHG inventory looked very good, containing a lot of very useful detail, with only minor missing information. C40 is a co-developer of the GPC and is promoting the preparation of GHG inventory based on the GPC.

The 2013 GHG inventory of HCMC was presented in the Final Seminar held on 26 October 2017.

In addition, a leaflet on the GHG inventory of HCMC was made and distributed widely through the concerned organizations.

(3) Preparation of GHG inventory based on ten sectors of CCAP

CCB also requested the preparation of GHG inventory based on the ten sectors of the CCAP. At first, CCB put a strong emphasis on preparing the GHG inventory based on the ten sectors of the CCAP so it was planned to be prepared separately from the GHG inventory based on the GPC. However, later on, as a result of further discussions with CCB, and after the data started coming in and the GHG inventory began to take form, CCB decided to prioritize the GPC inventory which is internationally comparable over the ten-sector inventory.

Consequently, the GHG inventory based on the ten sectors of CCAP was produced by reorganizing the GHG inventory based on the GPC. Table 4 shows the relation between the ten sectors of the CCAP and the sectors and sub-sectors of the GPC. Regarding the Water Management, Construction, Health, and Tourism Sectors of the CCAP, the emissions in each sector could not be calculated separately and are included in the other sectors. Table 5 shows the 2013 GHG inventory based on the ten sectors of the CCAP.

Table 4 Correspondence between Ten Sectors of CCAP and Sectors and Sub-sectors of GPC

Ten Sectors of CCAP	Sectors and Sub-sectors of GPC
Urban Planning	Land Sub-sector
Energy	Stationary Energy Sector, excluding Manufacturing Industries and Construction Sub-sector, and Agriculture, Forestry, and Fishing Activities Sub-sector
Transport	Transportation
Industry	Manufacturing Industries and Construction Sub-sector of Stationary Energy Sector IPPU Sector
Water Management	Included elsewhere (mainly Stationary Energy Sector) ++
Waste Management	Waste Sector
Construction	Included elsewhere (mainly Manufacturing Industries and Construction Sub-sector of Stationary Energy Sector) ++
Health	Included elsewhere (mainly Waste Sector) ++
Agriculture, Forestry, and Fishing	Livestock Sub-sector of AFOLU Sector, and Aggregate Sources and Non-CO_2 Emission Sources on Land Sub-sector of AFOLU Sector Agriculture, Forestry, and Fishing Activities Sub-sector of Stationary Energy Sector
Tourism	Included Elsewhere (mainly Stationary Energy Sector) ++

++: Regarding these four sectors of the CCAP, it is not possible to quantify the GHG emissions separately

Table 5 2013 GHG Inventory of HCMC based on Ten Sectors of CCAP

CO_2

Các lĩnh vực ưu tiên/ (10 lĩnh vực)/ Priority Sectors (10 sectors)	Đơn vị/ Unit	Năm 2013 Year 2013
Quy hoạch đô thị/ Urban Planning Sector	$GgCO_2$/năm ($GgCO_2$/year)	*-161.04*
Năng lượng/ Energy Sector	$GgCO_2$/năm ($GgCO_2$/year)	8,522.40
Giao thông/ Transport Sector	$GgCO_2$/năm ($GgCO_2$/year)	14,612.35
Công nghiệp/ Industry Sector	$GgCO_2$/năm ($GgCO_2$/year)	8,531.14
Quản lý nước/ Water Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Quản lý chất thải/ Waste Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	5.48
Xây dựng/ Construction Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Y tế/ Health Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Nông nghiệp/ Agriculture, forestry, and fishing Sector	$GgCO_2$/năm ($GgCO_2$/year)	661.47
Du lịch/ Tourism Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Tổng/ Sub-total	$GgCO_2$/năm ($GgCO_2$/year)	32,171.81

CH_4

Các lĩnh vực ưu tiên/ (10 lĩnh vực)/ Priority Sectors (10 sectors)	Đơn vị/ Unit	Year 2013
Quy hoạch đô thị/ Urban Planning Sector	$GgCO_2$/năm ($GgCO_2$/year)	*0.00*
Năng lượng/ Energy Sector	$GgCO_2$/năm ($GgCO_2$/year)	4.22
Giao thông/ Transport Sector	$GgCO_2$/năm ($GgCO_2$/year)	42.93
Công nghiệp/ Industry Sector	$GgCO_2$/năm ($GgCO_2$/year)	11.39
Quản lý nước/ Water Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Quản lý chất thải/ Waste Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	2,084.35
Xây dựng/ Construction Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Y tế/ Health Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Nông nghiệp/ Agriculture, forestry, and fishing Sector	$GgCO_2$/năm ($GgCO_2$/year)	409.51
Du lịch/ Tourism Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Tổng/ Sub-total	$GgCO_2$/năm ($GgCO_2$/year)	2,552.40

N_2O

Các lĩnh vực ưu tiên/ (10 lĩnh vực)/ Priority Sectors (10 sectors)	Đơn vị/ Unit	Year 2013
Quy hoạch đô thị/ Urban Planning Sector	$GgCO_2$/năm ($GgCO_2$/year)	0.00
Năng lượng/ Energy Sector	$GgCO_2$/năm ($GgCO_2$/year)	14.40
Giao thông/ Transport Sector	$GgCO_2$/năm ($GgCO_2$/year)	38.02
Công nghiệp/ Industry Sector	$GgCO_2$/năm ($GgCO_2$/year)	6.41
Quản lý nước/ Water Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Quản lý chất thải/ Waste Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	159.93
Xây dựng/ Construction Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Y tế/ Health Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Nông nghiệp/ Agriculture, forestry, and fishing Sector	$GgCO_2$/năm ($GgCO_2$/year)	170.99
Du lịch/ Tourism Sector	$GgCO_2$/năm ($GgCO_2$/year)	IE
Tổng/ Sub-total	$GgCO_2$/năm ($GgCO_2$/year)	389.75

Khí khác/ Other Gas

Các lĩnh vực ưu tiên/ (10 lĩnh vực)/ Priority Sectors (10 sectors)	Đơn vị/ Unit	Year 2013
Quy hoạch đô thị/ Urban Planning Sector	$GgCO_2$/năm ($GgCO_2$/year)	NO
Năng lượng/ Energy Sector	$GgCO_2$/năm ($GgCO_2$/year)	0.87
Giao thông/ Transport Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Công nghiệp/ Industry Sector	$GgCO_2$/năm ($GgCO_2$/year)	0.00
Quản lý nước/ Water Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Quản lý chất thải/ Waste Management Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Xây dựng/ Construction Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Y tế/ Health Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Nông nghiệp/ Agriculture, forestry, and fishing Sector	$GgCO_2$/năm ($GgCO_2$/year)	0.00
Du lịch/ Tourism Sector	$GgCO_2$/năm ($GgCO_2$/year)	NE
Tổng/ Sub-total	$GgCO_2$/năm ($GgCO_2$/year)	0.87

2.2.2 Development of GHG Inventory Preparation Manual

In order to enable continuous preparation of GHG inventory in HCMC, the GHG Inventory Preparation Manual was developed. The table of contents of the GHG Inventory Preparation Manual is shown in Table 6.

Table 6 Table of Contents of GHG Inventory Preparation Manual

Title	Outline
Chapter 1. Introduction	Outline of manual, glossary, etc.
Chapter 2. GHG Inventory Preparation Procedures	Roles and responsibilities of concerned organizations, preparation procedures
Chapter 3. Calculation Methods	Calculation methods on emissions and removals
Chapter 4. Data Sources	Data sources and result of data collection
Chapter 5. Calculation	Concrete calculation steps on emissions and removals
Chapter 6. Reporting based on GPC	Method on compiling GHG inventory
Annex I. Data Collection Forms	Set of data collection forms
Annex II. The GHG inventory of HCMC in 2013	2013 GHG inventory of HCMC
Annex III. The GHG Inventory Based on the Priority Sectors in HCMC	Method on compiling GHG inventory based on the priority sectors of HCMC (ten sectors of CCAP)

The manual was developed in parallel with preparing the GHG inventory. In Chapter 1, the outline of the manual, glossary, and so on were described referring to the GPC and National Greenhouse Gas Inventory Report of Japan. In Chapter 2, the roles and responsibilities of the concerned organizations and preparation procedures were described reflecting the results of the activities on collection of basic information on GHG inventory and discussions with CCB. In Chapter 3, the calculation methods on emissions and removals were described referring to the GPC and 2006 IPCC Guidelines. In Chapter 4, the data required for GHG inventory were listed and the data available in HCMC were indicated. In Chapter 5, the concrete calculation steps on emissions and removals were stated. In Chapter 6, the method to compile the GHG inventory using the results of GHG emissions and removals calculated in Chapter 5 was described.

In order to collect opinions regarding the roles and responsibilities of the concerned organizations and preparation procedures on GHG inventory from stakeholders, two consultation meetings were conducted. The first meeting was held on 1 March 2017. Twenty-one HCMC officials and 16 individuals from districts, universities and private companies such as fuel companies took part. A total of nine opinions and questions were raised. The main content of the consultation was the preparation schedule and roles and responsibilities of the concerned organizations. However, there was no major objection.

The second consultation meeting was held on 12 July 2017. Twenty HCMC officials and nine

individuals from universities and private companies participated. A total of 57 opinions and questions were received. Most of them were of technical nature. Topics include double counting of emissions from electricity consumption, emissions from open burning of waste, and using software such as Access instead of Excel for calculation. Regarding the GHG inventory preparation procedures, some suggested to start the preparation process earlier so that there is longer time for preparing the draft GHG inventory. Some questioned whether DONRE had enough resource to prepare GHG inventories.

In addition, in the taskforce meeting of CCSB held on 29 August 2017, the final exchange with the relevant organizations of HCMC was conducted regarding the manual. Opinions in favor of prioritizing the use of existing statistical data and limiting the scope of quality control activities by the Data Providing Organizations were raised amongst a few others.

Based on these processes, successive discussions with CCB, advice from JICA long-term experts, and opinions of MONRE, the manual was completed. The manual was presented during the Final Seminar held on 26 October 2017, and distributed to the relevant organizations through CCB.
The manual primarily describes the steps to prepare the GHG inventory of HCMC. However, a greater portion of the manual is general and common, and can be used in other cities and provinces.

2.2.3 Training on GHG Inventory

In April and July-August 2017, the training for preparing the GHG inventory was conducted using the draft GHG Inventory Preparation Manual. The participants were those who were expected to become responsible for regularly preparing the GHG inventory, belonging to CCB and Division of Meteorology, Hydrology and Climate Change.

In the training, the 2014 GHG inventory of HCMC based on the GPC was prepared using the above-mentioned GHG inventory calculation files and data of 2014 collected in the process of preparing the 2013 GHG inventory. The content of the training is summarized in Table 7.

Table 7 Content of Training on GHG Inventory

Date and Time	Participants	Content
9:00 – 16:00 19 April 2017	8	Lecture on preparing GHG inventory Calculation exercise on preparing GHG inventory on electricity consumption (Stationary Energy Sector)
9:00 – 16:00 20 April 2017	8	Calculation exercise on preparing GHG inventory on fuel combustion (Stationary Energy and Transportation Sectors)
9:00 – 16:00 27 July 2017	6	Calculation exercise on preparing GHG inventory on Land Sub-sector
9:00 – 16:00 1 August 2017	7	Calculation exercise on preparing GHG inventory on Waste Sector
9:00 – 16:00 2 August 2017	5	Calculation exercise on preparing GHG inventory on IPPU Sector and AFOLU Sector excluding Land Sub-sector

The course materials for the training were prepared in Vietnamese. The essential points of the training materials were summarized in presentation slides, and the training was carried out using the presentation, GHG inventory calculation files, and the manual. The participants brought their personal computers and calculated the GHG emissions and removals using the spreadsheets. The participants understood the content of the training very well and active discussions took place. As a result, the participants' understanding on GHG inventory was enhanced and their capacity to prepare inventories was strengthened. The main topics discussed and achievements attained in the training are shown in Table 8.

Table 8 Achievements of Training

Sector	Main Discussion Topics	Achievements
Stationary Energy	Grid emission factor	Understanding of grid emission factors to be used in GHG inventories, and grid emission factors to be used in JCM projects and other projects
Stationary Energy and Transportation	Unit of activity data	Regarding fuels, understanding of the conversion method from unit of data collected to unit of activity data necessary for GHG inventories
	Categorization of sectors and sub-sectors	Understanding of the method to categorize the collected fuel consumption data into sectors and sub-sectors
Waste	Information on municipal solid waste	Understanding of the challenges in estimating the amount of waste open-burned due to insufficient information on waste recycled
	Industrial waste	Understanding of the issue of lack of information on industrial waste
IPPU	Emission sources	Understanding that a wide range of activities are emission sources and the difficulty in collecting data in HCMC
AFOLU	Land use information	Understanding of the current situation of information on land necessary for GHG inventory preparation and priorities of AFOLU Sector

In addition, during the training, all calculation steps were reviewed with the participants. As a result, the GHG inventory calculation files were improved in the area of detailed Vietnamese descriptions, and notations and arrangements of worksheets.

2.3 MRV

2.3.1 Information Gathering and Needs Assessment on NAMA and MRV

Basic information on NAMAs or climate change mitigation measures and MRV in HCMC was collected and analyzed to identify the challenges in MRV implementation and areas requiring capacity development. Existing literature and data was collected and interviews were conducted with relevant entities. Energy, transport and waste are the targeted sectors. The local consultants were engaged for smooth communication with the relevant organizations and information gathering.

(1) Energy sector

1) Organizations, policies and donor support

An analysis of the organizational structure and policies was done through document collection and interviews with the DOIT and EVN HCMC.

a) Energy usage

In order to understand the energy use in HCMC, information on energy use by industry sector, energy supply by source, and policies and initiatives on energy was collected.

b) Roles of organizations in energy sector

The organizations in the energy sector of HCMC was identified and their roles were studied. It was confirmed that DOIT was the main organization that dealt with the plans and measures of the energy sector.

c) Major policies and plans on energy

Information on policies and projects that are ongoing or planed necessary for selection of the MRV trial measures in the energy sector was collected. The information was used as the basis for “2) Information on NAMAs.” The policies and projects which are included in the CCAP were also collected.

2) Information on NAMAs

A longlist containing the candidate mitigation measures for the MRV trials was created. It was confirmed that the scope of the energy sector shall encompass all policies and actions related to renewable energy utilization and energy saving in HCMC. It was also confirmed that the scope encompassed both project- and policy-based mitigation measures. The list contained ongoing measures and the same to be implemented in the near future.

Table 9　Candidate Mitigation Measures for MRV Trial (Longlist) (Energy Sector)

Title of mitigation measure	Implementing body	Outline
Stimulate energy saving in households	DOIT	Pilot projects aimed at stimulating energy saving and CO_2 emission reduction in households will be implemented. 4 billion VND will be secured as city budget to implement projects by 2020.
Development of energy saving business model	DOIT	Project aims to develop energy saving business model which contribute to GHG emission reduction. Study on business models utilizing renewable energy and energy saving equipment will be implemented. 4 billion VND will be secured as city budget to implement project by 2020.
Replacement of existing street lamps with LED	DOIT	Project aims to replace existing street lamps with LED. 17.2 billion VND will be secured from city budget and international support to complete by 2020.
Project for Establishing a training center for energy management	DOIT	Project aims to establish training center that provides training courses on energy management and energy saving diagnosis and implement various training.
Efficiency improvement of electricity generation and distribution	DOIT	Project aims to reduce power loss in distribution network, improve efficiency of power plants and change energy mix (increase ratio of renewable energy), and will be implemented by 2030.
Project to promote introduction of energy saving equipment	DOST ECC	Project aims to promote introduction of energy saving technologies such as co-generation plant and waste heat recovery plant in agriculture and industry sector. Project aims to promote introduction of high efficiency air conditioners, high efficiency water heaters, LED lamps and high efficiency chillers in consumer sector.
Introduction of Solar PV system	DOST	Project aims to promote renewable energy utilization. HCMC set the program named the “Pilot program for supporting mechanisms of Solar PV investment in Ho Chi Minh City” to provide incentives to households and buildings that are willing to install a Solar PV system on their rooftop.

Notes:　DOST: Department of Science and Technology; ECC: Energy Conservation Center

(2) Transport sector

1) Organizations, policies and donor support

The following analyses were done through document collection and interviews with the DOT to consider an MRV framework, structure and procedures.

a) Transport situation

In order to understand the current situation of the transport sector of HCMC, which is the basis for considering the MRV framework, information such as statistics on socio-economy and transportation, and status and plans on public transport development was collected.

b) Roles of organizations in transport sector

Information on the organizations in charge of transport projects was analyzed. Among these organizations, the organizational structure of DOT, which is mainly responsible for managing the plans and measures in the transport sector of HCMC, and roles of each office within DOT were studied.

c) Major policies and plans on transport

Information on ongoing and planned transport measures including those listed in the CCAP was collected. The information was used as the basis for “2) Information on NAMAs” and for selecting the measures for the MRV trials.

2) Information on NAMAs

A longlist containing the mitigation measures which were candidates of the MRV trials was created. The list contained ongoing measures and the same to be implemented in the near future.

Basically, all transport-related measures in HCMC were considered in selecting the measures for the MRV trials. The possibility to pilot MRV was analyzed for both project-based and policy-based mitigation measures. Project-based measures are relatively easy to set up the logic of emission reductions and to obtain the necessary data for monitoring. Policy-based measures include, for example, the introduction of fuel economy standards and subsidies for the introduction of low emission vehicles. However, for these measures, it is relatively difficult to present the logic of emission reductions because the emissions may increase or decrease depending on various factors besides the policy measure in questions. For such reason, project-based mitigation measures were mainly targeted for the MRV trials.

Table 10 Candidate Mitigation Measures for MRV Trial (Longlist) (Transport Sector)

Title of mitigation measure	Implementing body	Outline
Introduction of CNG Bus for Public Bus Fleet	Saigon Bus	HCMC promotes introduction of CNG buses. In Phase 1, 21 CNG buses were introduced to Route 1. In Phase 2, 29 units were introduced to Route 27 and started operation from August 2016.
BRT Line 1 Project	MOCPT	BRT Line 1, with total length of 23 km, between Vo Van Kiet and Mai Chi Tho Boulevard is planned. Project is supported by World Bank and CNG buses will be introduced.
MRT Line 1 Project	MAUR	MRT Line 1, with total length of 19.7 km and 14 stations (2.6 km and 3 stations is underground), is planned to operate between Ben Thanh and Suoi Tien. Estimated passenger demand is 620,000 passenger/day in 2020. Project is supported by JICA.
MRT Line 2 Project	MAUR	MRT Line 2, with total length of 11.3 km and 10 stations (9.3 km and 9 stations is underground), is planned to operate between Ben Thanh and Tham Luong. Project is supported by ADB, KfW and EIB.
Introduction of river bus	Thuong Nhat Co., LTD	Several river bus routes have been planned in rivers/canals in HCMC. Route 1 is from Bach Dang through Thanh Da Canal and Sai Gon River to Linh Dong Ward. Route 2 is from Bach Dang through Ben Nghe Canal to Tau Hu then to Gom Port in District 6.
Nguyen Hue Pedestrian Street Project	-	Pedestrian walkway, 64 m wide and 670 m long, in front of HCMC People's Committee opened in April 2015.

Notes: MOCPT: Management and Operation Center for Public Transport; MAUR: Management Authority for Urban Railways

(3) Waste sector

1) Organizations, policies and donor support

An analysis on the waste sector of HCMC including solid waste and wastewater management was done. The analysis was done through literature review and interviews with DONRE, HCMC Management Board for Solid Waste Treatment Complexes (MBS), HCMC Urban Environment Company Limited (CITENCO), UDC, DARD, and others.

a) Management of waste

In order to understand the waste management in HCMC, information on the waste management including waste generation, final waste treatment, wastewater treatment and operation of the wastewater treatment plants in HCMC was collected.

b) Roles of organizations in waste sector

The organizations in the waste sector of HCMC was identified and studied. The oversight agencies in the waste sector were identified as follows: the Division of Solid Waste Management under DONRE for municipal solid waste management; SCFC for wastewater treatment; and DARD for agricultural and livestock waste.

c) Major policies and plans on waste

Information on policies and projects that are ongoing or planed necessary for selection of the MRV trial measures in the waste sector was collected. The information was used as the basis for "2) Information on NAMAs." The policies and projects which are included in the CCAP were also collected.

2) Collection of information on NAMAs

A longlist that contains the candidate mitigation measures for the MRV trials was created. The scope is all actions related to waste management and wastewater treatment in HCMC including agricultural waste and livestock waste. Both policy-based and project-based measures were considered. Both ongoing and planned measures were considered.

Table 11 Candidate Mitigation Measures for MRV Trial (Longlist) (Waste Sector)

Title of mitigation measure	Implementing body	Outline
Separation and collection of municipal solid waste at source	DONRE	Project aims to promote separation and collection of municipal solid wastes in five districts (Districts 1, 3, 6, 12 and Binh Thanh).
Optimization of solid waste transportation route in District 1	CITENCO	Project aims to reduce fuel consumption of waste transportation trucks through improving collection and transportation routes in District 1.
Electricity Generation at Go Cat Landfill Site	CITENCO	Project aims to avoid emissions of CH_4 from Go Cat Landfill Site through collecting biogas generated by disposed organic waste. Collected biogas is used to generate electricity (2.4MW) to be used on site and supplied to electricity grid.

Title of mitigation measure	Implementing body	Outline
Energy from Waste Project (EfW)	CITENCO	Project aims to reduce volume of municipal solid waste sent to landfill site. Organic contents contained in municipal solid waste will be combusted to generate energy.
Animal Manure Collection and Biogas Recovery at Small Farms	LIFSAP	Project aims to install bio-digesters in 844 livestock farms in Cu Chi District. Biogas from animal manure is collected for cooking by farmers. Project is carried out under World Bank-assisted program.
Bio-digester subsidy scheme for small-sized farmers	HCMC People's Committee	Decree 26/2008 of HCMC set up subsidy program to support small farmers purchase bio-digesters. Program was terminated in 2012.
Recovery of biogas from wastewater treatment plant at brewery	Private company	Project aims to collect biogas from industrial wastewater treatment process and utilize it for energy generation.
Biogas utilization at Binh Dien Market	DONRE	Project aims to reduce volume of waste disposed at landfill site through utilizing organic waste generated at market. Collected waste is used to generate energy, which leads to reduction of fossil fuel consumption at market.
Reuse of treated wastewater at industrial park	Private company	Project aims to recycle wastewater treated at wastewater treatment plant in industrial park and reuse it for industrial processes.

Note: LIFSAP: Livestock Competitiveness and Food Safety Project

2.3.2 Piloting MRV

Mitigation measures to pilot MRV were selected through the following steps.

Step 1 Setting of selection criteria

Set the criteria for selecting the measures to pilot MRV. Set the criteria from perspectives such as consistency with the relevant plans of the target sector, potential of the measure to be replicated, MRV-ability, GHG emission reduction, co-benefits and implementation timing.

Step 2 Selection of candidate measures

Selected the final candidate measures from the longlist using the set criteria.

Step 3 Determination of candidate measures

Determined the target measures through discussions with CCB and relevant organizations (as described herein below).

Step 4 MRV trial

The MRV trials were implemented.

Table 12 Criteria for Selecting Projects to Pilot MRV

Criteria	Description
Consistency with the relevant plans of the target sector	Measures are in line with the policies identified in higher level plans of the target sector
Potential for the measure to be replicated	Measures can be expected to be diffused widely in HCMC in the future
MRV-ability	Implementing body of monitoring and reporting is clearly identified, and MRV implementation is actually feasible
GHG emission reduction	GHG emission is expected to be reduced
Co-benefits	Co-benefits such as air pollution prevention and water contamination prevention are expected
Implementation timing	Measures have already been carried out or are being carrying out.

Table 13 Selected Mitigation Actions to Pilot MRV

Sector	Project title	Implementing body	Relevant organizations
Energy	Replacement of Existing Street Lamp with LED	District 3	DOIT
	Introduction of Solar PV system	ECC	DOST
Transport	Introduction of CNG Bus for Public Bus Fleet	Saigon Bus	DOT, MOCPT
	BRT Line 1 Project	UCCI	-
	MRT Line 1 Project	MAUR	-
Waste	Electricity Generation at Go Cat Landfill Site	CITENCO	DONRE
	Animal Manure Collection and Biogas Recovery at Small Farms	LIFSAP	DARD

Note: UCCI: HCMC Urban-Civil Works Construction Investment Management Authority

(1) Energy sector

Two mitigation measures to pilot MRV were selected from the longlist (see Table 9). The measures were selected by applying the selection criteria (see Table 12) and also through consultation with CCB and other relevant agencies. The selected measures are the “Replacement of Existing Street Lamp with LED” and “Introduction of Solar PV System.” An outline of each measure is shown in Table 14 and Table 15.

For each of the selected measures, an analysis was done on applicable methodologies for GHG emission reduction calculation. Practical methodologies that allow the implementing entity to utilize the available data and existing monitoring and reporting system were chosen. The necessary data to calculate the baseline and project GHG emissions, such as activity data and emission factors, were collected in accordance with the chosen methodologies. Using the data obtained through monitoring by the implementing entity, the GHG emission reduction was calculated.

For the “Replacement of Existing Street Lamp with LED,” monitoring activities to collect information such as data on electricity consumption and lighting time could not be conducted. The calculation of GHG emission reductions was done by using the number and specification of the lamps introduced which are reported in the project report submitted to CCB via DOIT.

For the “Introduction of Solar PV System,” the calculation of GHG emission reductions was done by using the electricity generation data provided by ECC.

The MRV organizational structure and detailed MRV process were analyzed. The roles of the concerned organizations, existing monitoring and reporting system and its applicability to the MRV trials, and involvement of the implementing bodies and oversight departments in MRV trials were studied. A practical MRV framework was then established through consultation with the oversight departments and CCB.

The information on the MRV framework and involved organizations, applied methodologies, results of the GHG emission reduction calculations, and results of the monitoring activities are shown in Annex 1.

Table 14　Outline of Mitigation Measure to Pilot MRV (Replacement of Existing Street Lamp with LED)

Project name	Replacement of Existing Street Lamp with LED
Implementing body	District 3
Oversight organization	DOIT
Outline	Replacement of 18W roadway lightning to LED (9W). 2,100 lamps have been replaced already. All roadway lightning in HCMC will be replaced by 2020 (200,000 lamps will be replaced in total) Part of the replaced LEDs which are connected to an electric meter will be targeted for MRV.

Table 15 Outline of Mitigation Measure to Pilot MRV (Introduction of Solar PV System)

Project name	Introduction of Solar PV System
Implementing body	ECC
Oversight organization	DOST
Outline	A small-scale solar PV system is installed on the rooftops of five buildings and ten households. The power generated will be consumed on-site. In the case of households, the owner covers the installation cost and the implementing body provides cash incentives against the electricity generated by the system, with payments made at a fixed rate per unit of electricity with predetermined intervals. For buildings, the implementing body covers the installation cost, but does not pay for the electricity generated.

(2) Transport sector

Three mitigation measures to pilot MRV were selected from the longlist (see Table 10). The measures were selected by applying the selection criteria (see Table 12) and also through consultation with CCB and other relevant agencies. The selected measures are the “Introduction of CNG Bus for Public Bus Fleet,” “BRT Line 1 Project” and “MRT Line 1 Project.” The BRT and MRT projects are either at the stage of planning or construction, therefore it was not possible to actually pilot MRV. However, these projects are significantly important in the transport sector in HCMC, and CCB and relevant agencies have high expectation toward these projects in reducing GHG emissions. An outline of each measure is shown in Table 16, Table 17, and Table 18.

For each of the selected measures, an analysis was done on applicable methodologies for GHG emission reduction calculation. Practical methodologies that allow the implementing entity to utilize the available data and existing monitoring and reporting system were chosen. The necessary data to calculate the baseline and project GHG emissions, such as activity data and emission factors, was collected in accordance with the chosen methodologies. Using the data obtained through monitoring by the implementing entity, the GHG emission reduction was calculated.

For the “Introduction of CNG Bus for Public Bus Fleet,” the Saigon Bus continuously collected data on driving distances and fuel consumption of buses, and these data were used for emission reduction calculation. For the “BRT Line 1 Project” and “MRT Line 1 Project,” emission reductions were estimated using the planned value, since it was not possible to monitor actual data. Study sessions were held for both UCCI and MAUR in order to enhance their technical skills.

The MRV organizational structure and detailed MRV process were analyzed. The roles of the concerned organizations, existing monitoring and reporting system and its applicability to the MRV trials, and involvement of the implementing bodies and oversight departments in MRV trials were studied. A practical MRV framework was then established through consultation with the oversight

departments and CCB.

The information on the MRV framework and involved organizations, applied methodologies, results of the GHG emission reduction calculations, and result of the monitoring activities are shown in Annex 1.

Table 16 Outline of Mitigation Measure to Pilot MRV (Introduction of CNG Bus for Public Bus Fleet)

Project name	Introduction of CNG Bus for Public Bus Fleet
Implementing body	MOCPT
Oversight organization	DOT
Relevant organization	Bus operator: SaigonBus
Outline	21 CNG buses replaced diesel buses and are operated on Route 27 from August 2016. The CNG buses have a capacity of 68 passengers, engine displacement of 11,149 cc, vehicle weight of 10,780 tons. CNG has low carbon content than conventional gasoline/diesel fuel, thus GHG emission is reduced.

Table 17 Outline of Mitigation Measure to Pilot MRV (BRT Line 1 Project)

Project name	BRT Line 1 Project
Implementing body	MOCPT
Oversight organization	DOT
Relevant organization	BRT operator: Not specified yet Planning and designing: UCCI
Outline	Total length is 23 km (An Lac Turnaround (for turning) - Vo Van Kiet Boulevard - Mai Chi Tho Boulevard - Cat Lai T-junction (Rach Chiec Terminal)). CNG buses will be introduced for the BRT system. GHG emission is reduced through mode shift of passenger transportation from existing means of transportation such as private cars to more efficient BRT.

Table 18 Outline of Mitigation Measure to Pilot MRV (MRT Line 1 Project)

Project name	MRT Line 1 Project
Implementing body	MAUR
Oversight organization	(Not applicable. MAUR is directly under the control of HCMC People's Committee)
Relevant organization	MRT operator: Not specified yet Planning and designing: MAUR
Outline	Total length is 19.7 km with 14 stations (Ben Thanh - Suoi Tien). 2.6 km is underground and 17.1 km is elevated. GHG emission is reduced through mode shift of passenger transportation from existing means of transportation such as private cars and buses to more efficient MRT.

(3) Waste sector

Two mitigation measures to pilot MRV were selected from the longlist (see Table 11). The measures were selected by applying the selection criteria (see Table 12) and also through consultation with CCB and other relevant agencies. The selected measures are the "Electricity Generation at Go Cat Landfill Site" and "Animal Manure Collection and Biogas Recovery at Small Farms." An outline of each measure is shown in Table 19 and Table 20.

For each of the selected measures, an analysis was done on applicable methodologies for GHG emission reduction calculation. Practical methodologies that allow the implementing entity to utilize the available data and existing monitoring and reporting system were chosen. The necessary data to calculate the baseline and project GHG emissions, such as activity data and emission factors, was collected in accordance with the chosen methodologies. Using the data obtained through monitoring by the implementing entity, the GHG emission reduction was calculated.

For the "Electricity Generation at Go Cat Landfill Site," the necessary activity data, including the volume of collected biogas from the landfill site, amount of annual electricity generation, and amount of electricity consumed, was collected and used for emission reduction calculation. For the "Animal Manure Collection and Biogas Recovery at Small Farms," the data on the number of livestock in the target farms, size of the installed bio-digesters, and amount and type of fuel consumed by farmers was collected and used for emission reduction calculation.

Study sessions were held for the implementing entities and oversight departments in order to enhance their understanding on MRV and GHG emission reduction calculation. The MRV organizational structure and detailed MRV process were analyzed. The roles of the concerned organizations, existing monitoring and reporting system and its applicability to the MRV trials, and involvement of the implementing bodies and oversight departments in MRV trials were studied. A practical MRV framework was then established through consultation with the oversight departments and CCB.

The information on the MRV framework and involved organizations, applied methodologies, results of the GHG emission reduction calculations, and results of the monitoring activities are shown in Annex 1.

Table 19 Outline of Mitigation Measure to Pilot MRV (Electricity Generation at Go Cat Landfill Site)

Project name	Electricity Generation at Go Cat Landfill Site
Implementing body	CITENCO
Oversight organization	DONRE
Outline	Go Cat Landfill Site started accepting municipal solid waste in 2001. The waste-to-energy project (output of 2.4MW) started in 2005. Although the landfill site stopped accepting municipal solid waste in 2007, landfill gas (LFG) generated by the landfilled waste is collected for electricity generation. Although the plant used to generate 400 MWh/month at the beginning of the project, the figure dropped to 10 MWh/month in 2016 due to the decreased volume of landfill gas and aging of the power generation unit (only one unit was under operation as of 2016).

Table 20 Outline of Mitigation Measure to Pilot MRV (Animal Manure Collection and Biogas Recovery at Small Farms)

Project name	Animal Manure Collection and Biogas Recovery at Small Farms
Implementing body	LIFSAP
Oversight organization	DARD
Outline	Bio-digesters were installed in 844 livestock farms in Cu Chi District to avoid methane emissions. Collected methane gas is used for cooking by farmers.

2.3.3 Development of MRV Manual

The MRV Manual was developed with the aim to assist HCMC officials, including CCB, and officials of other cities to quantify and report the GHG emission reductions of mitigation measures by themselves continuously into the future. The MRV Manual was developed taking into consideration the outcomes of the MRV trials and analysis of related institutions and framework. The manual was improved through two consultation meetings targeting the relevant organizations of HCMC, and discussions with MONRE, CCB and long-term experts

The first consultation meeting targeting the relevant departments, districts, businesses and universities was held on 1 March 2017 to obtain feedbacks on the MRV framework proposed by the

project team. The participants were divided into two groups after the presentation on the MRV framework in plenary in order to obtain as many comments as possible. Many suggested that a clarification on the background and legal basis for the MRV manual development, motivation to implement MRV such as obligations and incentives, and proper staffing and budget allocation for MRV implementation were necessary.

The second consultation meeting was held on 11 July 2017 to confirm the appropriateness of the information and explanation in the revised MRV Manual, check if the explanation is sufficient and clear, and there are no redundant parts or unnecessary duplication. The relevant departments, districts, businesses, universities and MONRE participated. The full draft of the MRV Manual was dispatched to the concerned organizations before the consultation meeting. Many suggested that a clarification of the purpose and recommended readers of the MRV Manual, an indication of the criteria and principle for selecting the mitigation measures to MRV, and enrichment of the descriptions on GHG emission reduction calculation method were necessary.

Table 21 Table of Contents of MRV Manual

Title	Outline
Chapter 1. Introduction	Introduction of purpose, background, legal basis, and recommended readers of MRV manual and outline of MRV
Chapter 2. Basic MRV Framework 2-1. Defining scope of mitigation actions to MRV in the city 2-2. Setting up MRV framework for the city	Introduction of MRV framework, setting procedures of MRV framework and defining scope of mitigation actions to MRV
Chapter 3. MRV Process 3-1. Determining mitigation actions to MRV 3-2. Implement MRV 3-3. Approve MRV result	Introduction of steps from preparation to implementation and approval of MRV
Annex I Case Studies on MRV	Introduction of case studies on MRV
Annex II Typical Mitigation Actions and Emission Reduction Logic	Introduction of typical mitigation actions and logic of emission reductions
Annex III MRV Plan Form	MRV Plan Form
Annex VI Mitigation Monitoring Report Form	Mitigation Monitoring Report Form

A CCSB taskforce meeting on the GHG Inventory Preparation Manual and MRV Manual was held on 29 August 2017 to confirm the content of the manuals with the relevant organizations. Some suggested that integration with the existing reporting systems and procedures was integral to reduce additional work as much as possible, while others pointed out that a clarification of the procedures for future MRV implementation was necessary.

Subsequently, the MRV Manual was finalized taking into account the feedback from CCB and

MONRE. The MRV Manual was presented during the Final Seminar held on 26 October 2017. The MRV Manual was distributed to the relevant organizations through CCB.

Furthermore, the outline of the MRV manual and lessons learnt from the MRV trials were reported at the study session on MRV held on 14 July 2017 in Hanoi by MONRE. Opinions were exchanged with eight officials from the ministries concerned with the designing of the national MRV framework.

2.4 Training and Seminars

2.4.1 Regular Seminars

A seminar targeting HCMC officials concerned with GHG inventory and MRV trials was held twice as shown in Table 22. The lectures were conducted by the expert team.

Table 22 Record of Regular Seminars

	Date and time	Venue	Participants	Contents
First	9:00-11:00 6 January 2016	Meeting room in DONRE	Six from CCB, one each from DOT, DOIT, MBS, MOCPT and EVN HCMC, and two from CITENCO	Outline of project, progress of project, outline of GHG inventory, outline of NAMA/MRV
Second	9:00-10:30 18 March 2016	Meeting room in rental office	One each from CCB, DOT, DOIT and EVN HCMC, and two from MBS	Outline of NAMA/MRV, outline of NAMA/MRV guidelines for HCMC, candidate NAMAs to pilot MRV, calculation of GHG emissions for MRV

2.4.2 Training in Japan

The training in Japan mainly targeting HCMC officials was conducted twice.

The first training was conducted from 22 to 28 May 2016. The training schedule is shown in Table 23. Lectures were given by the Bureau of Environment of the Tokyo Metropolitan Government (TMG) and Environment Bureau of the City of Osaka. Site visits to a waste treatment plant generating power from waste and an energy efficient building were conducted as well. The participants planned mitigation measures through an exercise in a workshop. The participants are shown in “3.2 Training.”

Table 23　Schedule of First Training in Japan

Date	Time	Contents
Sun 5/22		Arrival
Mon 5/23	9:00-9:30 9:30-10:00 10:00-12:00	・Briefing ・Orientation ・Presentation by trainees (initiatives and challenges on climate change measures in HCMC, expectations on this training etc.)
	13:00-13:50 13:50-15:30 15:30-16:30	・Presentation by trainees (continued) ・Discussions with expert team ・Cooperation with Malaysia (Iskandar Region and Putrajaya City) by Tokyo
Tue 5/24	10:00-12:00	・Lecture on Carbon Reduction Reporting Program in Tokyo ・Lecture on climate change mitigation in the waste sector in Tokyo
	14:30-16:30 17:15-17:45	・Visit to Tokyo Square Garden (initiatives on energy saving of office building) ・Visit to new bas terminal in Shinjuku, Tokyo
Wed 5/25	8:00-12:00	Move to Osaka
	14:15-16:00 16:00-17:00	・Lecture on planning process, progress management and reviewing of Global Warming Action Plan of Osaka City ・Lecture on monitoring of mitigation measures, calculation of GHG emission reductions in Osaka City ・Visit to energy efficient building in Osaka
Thu 5/26	10:00-11:15	・Visit to Hug Museum (smart energy network, energy system in a building and house)
	13:00-15:30 16:15-17:30	・Visit to waste treatment plants ・Lecture on underground city around Osaka Station and site visit
Fri 5/27	9:00-12:00	・Group discussions and preparation for presentation by trainees
	13:00-15:30 15:30-16:00	・Presentation by trainees ・Closing ceremony
Sat 5/28		Departure

The second training was conducted from 21 to 27 May 2017. The training schedule is shown in Table 24. Lectures by the Bureau of Environment of TMG, and site visits to a solid waste treatment plant and a wastewater treatment plant were held. The participants made an MRV plan through an exercise in a workshop. The participants are shown in “3.2 Training.”

Table 24　Schedule of Second Training in Japan

Date	Time	Contents
Sun 5/21		Arrival
Mon 5/22	10:00-11:30	・ Briefing
	11:30-12:00	・ Orientation
	13:00-14:30	・ Presentation by trainees (initiatives on climate change mitigation in HCMC, expectations on this training)
	14:30-16:00	・ Lecture on GHG Inventory Preparation Manual of HCMC
	16:00-17:30	・ Lecture on MRV Manual on HCMC
Tue 5/23	9:30-12:00	・ Lecture on mitigation measures of TMG
	13:30-17:00	・ Lecture on GHG inventory of Tokyo ・ Lecture on Cap-and-Trade Program
Wed 5/24	9:30-12:00	・ Lecture on program to promote energy saving in small and medium -sized private enterprises
	14:00-16:00	・ Site visit to energy efficient building
Thu 5/25	9:30-11:30	・ Site visit to solid waste treatment plant
	14:00-16:00	・ Site visit to wastewater treatment plant
Fri 5/26	9:00-12:00	・ Workshop
	13:00-13:20	・ Presentation by trainees
	13:20-15:00	・ Discussions
	15:00-16:00	・ Closing ceremony
Sat 5/27		Departure

2.4.3　General Training on Climate Change Mitigation

The General Training on Climate Change Mitigation for HCMC Officials was conducted twice.

The first training was conducted on 25, 28, 29 and 30 November 2016. The training program is shown in Table 25. Lectures were given by the expert team, and officials of MONRE and Institute of Meteorology, Hydrology and Environment. In Part A of the training (25 and 28 November), lectures on overview of climate change issues, GHG inventory, and climate change mitigation measures were conducted. In Part B (29 and 30 November), lectures on MRV of mitigation measures and a workshop were conducted. In the workshop, the participants planned mitigation measures applicable to HCMC and calculated their GHG emission reductions. The participants are shown in “3.2 Training.”

Table 25 Program of First General Training on Climate Change Mitigation for HCMC Officials

Module	Topic	Contents
PART A 1. Introduction	1-1. Introduction and ex-ante assessment	· Briefing on objectives, goals and structure of training · Baseline comprehension test and self-assessment on knowledge on climate change
	1-2. Overview of climate change and response of international community	· Basics and key concepts on climate change: science, effect, vulnerability, mitigation and adaptation · Global warming and GHG emissions · Response to climate change of international community and Vietnam
	1-3. Policies of Vietnam on climate change mitigation	· International agreements and response of Vietnam · National Target Program to Respond to Climate Change, and National Strategy on Climate Change · INDC, NAMA, National Communication and GHG inventory
PART A 2. Understanding Country and City-wide Emissions	2-1. National GHG inventory	· Purpose and structure of national GHG inventory · Introduction of National GHG inventory of Japan and Vietnam · Policies on national GHG inventory
	2-2. City/province level GHG inventory	· Purpose and structure of city/province level GHG inventory · Introduction of city/province level GHG inventory of Japan and Vietnam · Policies on city/province level GHG inventory
	2-3. Data collection and emissions calculation in GHG inventory	· Introduction of protocols and guidelines · Data collection and calculation of GHG emissions for preparation of GHG inventory
PART A 3. Understanding Climate Change Mitigation Measures	3-1. Climate change mitigation technologies and initiatives	· Illustration of typical climate change mitigation technologies and initiatives
	3-2. Climate change mitigation policies	· Illustration of typical climate change policies · Climate change mitigation policies at city/province level in Japan · Climate change mitigation policies of TMG
	3-3. Identifying and prioritizing climate change mitigation measures	· Approach to identify and prioritize climate change mitigation measures

Module	Topic	Contents
PART B 4. Planning Climate Change Mitigation Measures and MRV	4-1. Financing climate change mitigation measures	· Tax measures, subsidy and incentives · International financing, market mechanisms
	4-2. Planning MRV-able climate change mitigation measures	· Concept of MRV and NAMAs/climate change mitigation measures · Integrating climate change mitigation into projects and initiatives
	4-3. Monitoring and calculation of GHG emission reductions from mitigation actions	· Methodology to quantify emission reductions
PART B 5. Exercise on Developing Climate Change Mitigation Measures and MRV Planning	5-1. Group exercise	· Planning climate change mitigation measure and its MRV structure · Calculation of GHG emission reductions
	5-2. Presentation by groups	· Presentation, discussions, and feedback from JICA experts
	5-3. Ex-post assessment and closing	· Closing · Terminal comprehension test and self-assessment on knowledge on climate change

Note: INDC: Intended Nationally Determined Contributions

The second training was conducted on 5, 6 and 7 July 2017. The training program is shown in Table 26. Lectures were given by the expert team, an official of MONRE and a C40 staff. In Part A of the training (5 and 6 July), lectures on overview of climate change issues, GHG inventory, and climate change mitigation measures were conducted. In Part B (7 July), as an exercise, the participants drafted MRV plans of mitigation measures. The participants are shown in "3.2 Training."

Table 26 Program of Second General Training on Climate Change Mitigation for HCMC Officials

Module	Topic	Content
PART A 1. Introduction	1-1. Overview of climate change and response of international community	· Basics and key concepts on climate change: science, effect, vulnerability, mitigation and adaptation · Global warming and GHG emissions · Response of international community to climate change
	1-2. Policies of Vietnam on climate change mitigation	· International agreements and response of Vietnam · National Target Program to Respond to Climate Change, and National Strategy on Climate Change · NDC, NAMA, National Communication and GHG inventory

Module	Topic	Content
PART A 2. Understanding Country and City-wide Emissions	2-1. GHG inventory	・ Purpose and structure of national and city/province level GHG inventory ・ Introduction to protocols and guidelines ・ Calculation of emissions and preparation of GHG inventory National inventory of Japan and Vietnam ・ City/province level GHG inventory of Japan and Vietnam ・ GHG Inventory Preparation Manual of HCMC
	2-2. GHG inventory of world cities	・ GPC ・ Approach to GHG inventory preparation ・ Best practices and challenges of GHG inventory preparation ・ Benefit of GHG inventory preparation
PART A 3. Understanding Climate Change Mitigation Measures	3-1. Climate change mitigation technologies and initiatives	・ Illustration of typical climate change mitigation technologies and initiatives
	3-2. Climate change mitigation policies	・ Illustration of typical climate change policies ・ Climate change mitigation policies at city/province level in Japan ・ Climate change mitigation policies of TMG
PART A 4. Planning Climate Change Mitigation Measures and MRV	4-1. Financing climate change mitigation measures	・ Tax measures and cross subsidy ・ International financing ・ Market mechanism (carbon credits)
	4-2. Planning MRV-able Climate Change Mitigation Measures	・ Concept of MRV and NAMAs/climate change mitigation measures
	4-3. Monitoring and calculation of GHG emission reductions from mitigation actions	・ Methodology to quantify emission reductions ・ Calculation of emission reductions
PART B 5. Planning and Implementing MRV in HCMC	5-1. Lecture	・ Introduction to MRV Manual ・ Institutional arrangement and procedures on MRV
	5-2. Exercise, presentation and discussions	・ Develop MRV Plan ・ Exercise for considering the logic of GHG emission reductions ・ Presentation by each group ・ Feedback from JICA experts

Note: NDC: Nationally Determined Contributions

2.4.4 Final Seminar

The Final Seminar aiming to present the achievements of the project was held on 26 October 2017. The seminar program is shown in Table 27. The number of participants was 89. The breakdown is shown in Table 28.

Table 27 Program of Final Seminar

Topic	Contents	Presenter
1. Overview of project	・ Background, objectives, activities, implementation structure and summary of achievements in HCMC	Expert team
2. GHG inventory of HCMC	・ Basics on GHG inventory ・ 2013 GHG inventory of HCMC (emission sources and quantity, comparison with national emissions and other cities)	Expert team
3. GHG Inventory Preparation Manual	・ Objective and composition of manual ・ Procedures and data sources in HCMC	Expert team CCB
4. MRV trials	・ Basics on MRV and objectives of MRV trials ・ Process and outcome of MRV trials (outline of selected project/ measure, monitoring activities implemented, calculation of emission reductions, and challenges and lessons learned through trial)	Expert team Concerned organizations for MRV trials
5. MRV Manual	・ Objective and composition of manual ・ MRV framework and process in HCMC	Expert team CCB
6. Capacity building of HCMC officials	・ Summary of all seminars and training held under SPI-NAMA in HCMC ・ Report on training in Japan	DONRE
7. Developing effective mitigation policies for cities: Learning from Tokyo	・ GHG emission reduction measures in building sector implemented by TMG ・ Possible application of measures implemented by TMG to HCMC	MHIR
8. Building on foundation created by SPI-NAMA	・ Way forward (future direction) ・ Utilization of achievements of SPI-NAMA including the two manuals	CCB

Note: MHIR: Mizuho Information and Research Institute

Table 28 Breakdown of Participants in Final Seminar

Organization	Number
MONRE	2
Departments and districts of HCMC	47
Companies in HCMC	13
Institutes in HCMC	9
International organization	1
JICA Vietnam Office	3
MHIR	1
Local consultants and expert team	13
Total	89

2.5 Collaboration and Publicity

2.5.1 Collaboration

The project collaborated with many organizations. C40, in which HCMC participates as a member city, provided tools and conducted reviews on the GHG inventory of HCMC prepared by the project, and gave useful advice. In the General Training on Climate Change Mitigation organized by the project, C40 explained the relevance of climate change measures at the city level and the utility of GHG inventories by presenting its initiatives. The expert team informed C40 on the project activities in HCMC and cooperated with C40 to ensure a coordinated approach to the capacity enhancement of HCMC.

Osaka City provided an opportunity for the project to be introduced during the seminar organized under its sister city project with HCMC. Later, the city received the participants of the training in Japan and explained the initiatives on climate change mitigation undertaken within the city.

TMG hosted the participants of the training in Japan twice and gave lectures on its climate change mitigation measures and low-carbon initiatives taken in its business. The expert team supported the CCB counterpart to give a presentation during the symposium, which shared experiences on effective climate change measures such as emissions trading, organized by TMG in conjunction with the International Carbon Action Partnership.

The National Institute for Environmental Studies, Institute for Global Environmental Strategies (IGES) and MHIR were working on projecting the GHG emissions in HCMC. The project was given an opportunity to introduce itself during the seminar organized by this group. Later, the project hired a Vietnamese former member of this group as a local consultant to do a study and prepare a report required to institutionalize the GHG Inventory Preparation Manual and MRV Manual, which was basically built on the achievements of this group.

The group of IGES, MHIR and others provided lectures on the climate change mitigation measures of TMG during the General Training on Climate Change Mitigation utilizing the scheme of the

Ministry of the Environment, Japan. The expert team supported this group when it conducted a study in HCMC by introducing the relevant organizations.

2.5.2 Publicity

The project activities were disseminated regularly by updating the website of JICA technical cooperation projects. At first, the activities during the October 2015 to March 2016 period were publicized. Since then, the project activities were reported every three months. The content was made in Japanese, English, and Vietnamese. Newsletters, in English and Vietnamese, were also made every three months and uploaded onto the website (Annex 2). The newsletters were distributed in events such as the General Training on Climate Change Mitigation, consultation meetings, and Final Seminar.

2.6 Contribution to Project Purpose

The Project Purpose is “Capacity of the GoV concerning the planning and implementation of NAMAs is enhanced.” Through this work, taking HCMC as a model, the capacity to monitor climate change mitigation measures at the city level was strengthened. Specifically, two manuals which outline the procedures and implementations structures on GHG inventory and MRV of mitigation measures were established, in consultation with the relevant organizations of HCMC and MONRE. These manuals are later expected to become official documents of HCMC. This in turn will contribute to the attainment of the three indicators of the Project Purpose: 1) Policy framework for mitigation including NAMAs is prepared; 2) Modality for national MRV is prepared; and 3) Modalities on NAMA/MRV for local governments are streamlined into the draft national MRV framework. It is worthy to note that on MRV of mitigation measures, the initiatives in HCMC are moving ahead of the discussions at the national level and they are serving as good test cases for establishing the national MRV framework.

3. Inputs

3.1 Dispatch of Experts

The members of the expert team and roles of each expert are shown in Table 29. The team consisted of a team leader, two experts in GHG inventory, three experts in MRV, and a workshop organizer/ coordinator. One of the experts in MRV was in charge of the training in Japan as well.

Table 29 Members of Expert Team

Name	Organization	Role/Expertise	Task
Hirofumi Ishizaka	Pacific Consultants Co., Ltd.	Team Leader/MRV	1. Project management, liaison and public relations, reporting to JICA 2. Supervision of experts and local consultants 3. Institutionalization of GHG inventory and MRV 4. Development of materials for seminars/ training in HCMC and lecturing 5. Quality control of reports
Fumihiko Kuwahara	Suuri-Keikaku Co., Ltd.	GHG Inventory 1	1. Preparation of GHG inventory of HCMC 2. Development of GHG Inventory Preparation Manual 3. Training on GHG inventory preparation 4. Development of publicity material on GHG inventory 5. Development of materials for seminars/ training in HCMC and lecturing
Wataru Morimoto	Oriental Consultants Global Co., Ltd.	GHG Inventory 2	1. Preparation of GHG inventory of HCMC 2. Development of materials for seminars/ training in HCMC and lecturing
Yoshihiro Mizuno	Pacific Consultants Co., Ltd.	GHG Emission Quantification 1	1. Assistance to team leader 2. Information collection and analyses of NAMA/MRV and challenges 3. Piloting MRV (energy sector) 4. Development of MRV Manual 5. Development of materials for seminars/ training in HCMC and lecturing

Name	Organization	Role/Expertise	Task
Yasuki Shirakawa	Pacific Consultants Co., Ltd.	GHG Emission Quantification 2	1. Information collection and analyses of NAMA/MRV and challenges 2. Piloting MRV (transport sector) 3. Development of MRV Manual 4. Development of materials for seminars/ training in HCMC and lecturing
Tetsuya Yoshida	Oriental Consultants Global Co., Ltd.	GHG Emission Quantification 3	1. Information collection and analyses of NAMA/MRV and challenges 2. Piloting MRV (waste sector) 3. Development of MRV Manual 4. Development of materials for seminars/ training in HCMC and lecturing
Taiki Kuishi	Pacific Consultants Co., Ltd.	Workshop Organization/ Coordinator	1. Organization of seminars/training in HCMC 2. Organization of training in Japan 3. Disseminating project activities and achievements 4. Coordination
Yoshihiro Mizuno	Pacific Consultants Co., Ltd.	Training in Japan	1. Organization of training in Japan

The assignment record of the expert team is shown in Table 30. The number of visits to Vietnam was 21 and number of working days in Vietnam was 773 in total.

Table 30 Assignment Record of Expert Team

(As of 9 November 2017)

Name (Role/Expertise)		Visits	2015				2016												2017												Days	M/M
			9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Hirofumi Ishizaka (Team Leader/MRV)	Work in Vietnam	17		7-14 (8)	29-30 (2)	1-2 (2)	4-8 (5)	(0)	(0)	12-16 (5)	(0)	9-16 (8)	(0)	8-12 (5)	25-30 (6)	1,30,31 (3)	1-4,23-30 (12)	1-3 (3)	11-17 (7)	26-28 (3)	1-4 (4)	7-14 (8)	14-19 (6)	(0)	4-15 (12)	1-5,28-31 (9)	1-2 (2)	23-28 (6)			116	3.87
	Domestic Work	0	25 (1)	23 (1)	20 (1)	15 (1)	18 (1)	(0)	29 (1)	22 (1)	13,23 (2)	27 (1)	6 (1)	(0)	15 (1)	7,13 (2)	9,10,11, 18,21 (5)	6-8 (3)	10,18, 20,24 (4)	7,9 (2)	9 (1)	3 (1)	10,24,26 (3)	9,14,22 (3)	25 (1)	8 (1)	22 (1)	10,17 (2)			41	2.05
Fumihiko Kuwahara (GHG Inventory 1)	Work in Vietnam	17		7-14 (8)	29-30 (2)	1-4 (4)	4-9 (6)	(0)	13-19 (7)	(0)	(0)	13-18 (6)	(0)	7-13 (7)	28-30 (3)	1-6,25-31 (13)	1-5,24-30 (12)	1-3 (3)	9-21 (13)	21-28 (8)	1-4,21-31 (15)	1,10-22 (14)	(0)	(0)	3-14,23-31 (21)	1-5,28-31 (9)	1-2 (2)	23-28 (6)			159	5.30
	Domestic Work	0	(0)	1,2,15, 16 (4)	10 20 (2)	(0)	(0)	(0)	(0)	(0)	23 (1)	27 (1)	(0)	2 (1)	(0)	(0)	7,8,9,15, 16,17 (6)	13,28 (2)	24 (1)	17 (1)	16,17 (2)	4,24 (2)	(0)	27 (1)	(0)	(0)	(0)	(0)			24	1.20
Wataru Morimoto (GHG Inventory 2)	Work in Vietnam	4		7-14 (8)	29-30 (2)	1-5 (5)	4-9 (6)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	23-30 (8)	1-3 (3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)			32	1.07
	Domestic Work	0	25,30 (2)	(0)	20 (1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	12, 15 (2)	1,3,5,6,7,1 2 (6)	12-16, 26,27 (7)	10,12 (2)	(0)	(0)	5,6,10 (3)	(0)	(0)	(0)	(0)	(0)	(0)			23	1.15
Yoshihiro Mizuno (GHG Emission Quantification 1)	Work in Vietnam	16		7-16 (10)	4-7,29-30 (6)	1-5 (5)	4-9 (6)	(0)	13-19 (7)	(0)	(0)	19-25 (7)	20-27 (8)	(0)	25-30 (6)	1,30,31 (3)	1-4,24-30 (11)	1-3 (3)	(0)	22-28 (7)	1-4 (4)	10-15 (6)	11-20 (10)	(0)	3-15 (13)	29-31 (3)	1-2 (2)	23-28 (6)			123	4.10
	Domestic Work	0	25 (1)	23 (1)	20 (1)	15,21 (2)	18 (1)	(0)	29 (1)	22 (1)	(0)	27 (1)	6 (1)	(0)	15 (1)	13 (1)	9,10,11, 14,21 (5)	6-8,12 (4)	10,30,31 (3)	3,10 (2)	30 (1)	7 (1)	10 (1)	9,12,13,1 6 (4)	25 (1)	8 (1)	7,22 (2)	17,18 (2)			39	1.95
Yasuki Shirakawa (GHG Emission Quantification 2)	Work in Vietnam	15		7-14 (8)	29-30 (2)	1-5 (5)	4-9 (6)	(0)	14-19 (6)	(0)	(0)	19-25 (7)	20-27 (8)	(0)	25-30 (6)	1,30,31 (3)	1-4,24-30 (11)	1-2 (2)	(0)	22-28 (7)	1-4 (4)	10-15 (6)	14-19 (6)	(0)	3-15 (13)	30-31 (2)	1 (1)	23-28 (6)			109	3.63
	Domestic Work	0	25 (1)	2 (1)	20 (1)	(0)	(0)	19 (1)	8 (1)	1,5 (2)	23 (1)	14 (1)	15 (1)	29 (1)	21 (1)	24 (1)	5,7,9,19 (4)	6 (1)	6 (1)	6,16,20 (3)	21,30, 31 (3)	3,4 (2)	10,12, 23,31 (4)	12,15,16 (3)	25,27 (2)	8 (1)	(0)	(0)			37	1.85
Tetsuya Yoshida (GHG Emission Quantification 3)	Work in Vietnam	14		7-14 (8)	30 (1)	1-5 (5)	4-8 (5)	(0)	13-19 (7)	(0)	(0)	14-22 (9)	20-27 (8)	(0)	25-30 (6)	1,31 (2)	1-4,24-30 (11)	1-2 (2)	(0)	22-28 (7)	1-4 (4)	10-15 (6)	14-19 (6)	(0)	3-15 (13)	(0)	(0)	23-28 (6)			106	3.53
	Domestic Work	0	25 (1)	15 (1)	20 (1)	(0)	(0)	(0)	11 (1)	(0)	(0)	(0)	15 (1)	29 (1)	15,16, 20,21,23 (5)	7, 13, 24 (3)	14,15,16,1 8,22 (5)	8,9,16, 20,26 (5)	10,13, 18,30 (4)	1,2,3, 10 (4)	13,17, 30 (3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)			35	1.75
Taiki Kuishi (Workshop Organization/ Coordinator)	Work in Vietnam	16		7-16 (10)	29-30 (2)	1-5 (5)	4-9 (6)	(0)	13-19 (7)	(0)	(0)	13-25 (13)	(0)	7-13 (7)	25-30 (6)	1,30,31 (3)	1-5,21-30 (15)	1-3 (3)	(0)	26-28 (3)	1-4 (4)	10-15 (6)	14-20 (7)	(0)	3-15 (13)	1-5,28-31 (9)	1-2 (2)	22-28 (7)			128	4.27
	Domestic Work	0	25 (1)	23 (1)	20 (1)	24 (1)	20 (1)	5 (1)	2,25 (2)	20,21 (2)	13,19, 23-27 (7)	28 (1)	7 (1)	16 (1)	15 (1)	13 (1)	9,10,11, 14,18 (5)	6-8,12 (4)	10,11,17 19,31 (5)	8,13 (2)	8,10 (2)	19,20,24 (3)	10,22-26 (6)	9,12,19 (3)	25 (1)	8 (1)	22 (1)	10,16 (2)			57	2.85
Yoshihiro Mizuno (Training in Japan)	Domestic Work	0	(0)	(0)	(0)	(0)	(0)	(0)	25,30 (2)	20,21 (2)	13,19, 23-27 (7)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	8 (1)	21,24 (2)	2,8,9 23-25 (6)	(0)	(0)	(0)	(0)	(0)			20	1.00

Work in Vietnam	773	25.77
Domestic Work	276	13.80
Total		39.57

3.2 Training

3.2.1 Training in Japan

The training in Japan was conducted twice as shown in Table 31. The participants of the first and second training are shown in Table 32 and Table 33 respectively.

Table 31 Summary of Training in Japan

	Date	Place	Participants	Topics
First	22 to 28 May 2017	Tokyo, Osaka	13	・ Mitigation measures of TMG ・ Global Warming Action Plan of Osaka City ・ Measures for energy saving in office building ・ Visit to solid waste treatment plant ・ Workshop
Second	21 to 27 May 2017	Tokyo	10	・ GHG Inventory Preparation Manual and MRV Manual of HCMC ・ Mitigation measures of TMG ・ GHG inventory of Tokyo ・ Measures for energy saving in office building ・ Visit to solid waste treatment plant ・ Visit to wastewater treatment plant ・ Workshop

Table 32 Participants of First Training in Japan

Name	Organization
Nguyen Thi Lệ Thái	HCMC People's Committee
Nguyễn Thị Diễm Hương	Department of Natural Resources and Environment
Trần Hồng Lan	Department of Natural Resources and Environment
Phùng Hoàng Vân	Department of Natural Resources and Environment
Lê Thị Thanh Thảo	Management Board for Solid Waste Treatment Complexes
Phạm Quốc Huy	Department of Transport
Phan Minh Tuan	Department of Industry and Trade
Nguyễn Minh Hoàng	Urban Environment Company Limited
Ha Le An	Management and Operation Center for Public Transport
Nguyễn Tuấn Dũng	Electricity of Vietnam HCMC
Nguyen Van Minh	Ministry of Natural Resources and Environment
Nguyen Thi Thao	Ministry of Industry and Trade
Phung Tien Thanh	Ministry of Transport

Table 33 Participants of Second Training in Japan

Name	Organization
Nguyen Tuyet Phuong	Department of Natural Resources and Environment
Nguyen Huy Phuong	Department of Natural Resources and Environment
Chau Truc Phuong	Department of Natural Resources and Environment
Nguyen Viet Vu	Department of Natural Resources and Environment
Trinh Quoc Binh	Department of Industry and Trade
Nguyen Thi Phuong Thao	Department of Agriculture and Rural Development
Vo Thi Lam	Livestock Competitiveness and Food Safety Project Management Board
Phan Anh Tuan	Steering Center of the Urban Flood Control Program
Ha Quoc Linh	Urban-Civil Works Construction Investment Management Authority
Huynh Van Hung	Statistical Office

3.2.2 General Training on Climate Change Mitigation

The General Training on Climate Change Mitigation was conducted twice as shown in Table 34. The participants of the first and second training are shown in Table 35 and Table 36 respectively.

Table 34 Summary of General Training on Climate Change Mitigation

	Date	Place	Participants	Topics
First	25, 28-30 November 2017	HCMC	90	・ Overview of climate Change ・ Country and city-wide GHG emissions ・ Climate change mitigation measures ・ Planning and MRV of climate change mitigation measures
Second	5-7 July 2017	HCMC	68	・ Overview of climate change ・ Response to climate change of international community ・ Country and city-wide GHG emissions ・ Climate change mitigation measures ・ Planning and MRV of climate change mitigation measures ・ Planning and implementation of MRV in HCMC

Table 35 Participants of First General Training on Climate Change Mitigation

Name	Organization
Huỳnh Quốc Toàn	Department of Natural Resources and Environment
Nguyễn Thị Phương Thảo	Department of Natural Resources and Environment
Võ Thị Làm	Department of Natural Resources and Environment
Đỗ Thị Bưởi	Department of Construction
Phan Minh Tuấn	Department of Industry and Trade
Vũ Thùy Linh	Department of Natural Resources and Environment
Phạm Thị Nguyệt Thanh	Department of Natural Resources and Environment
Hà Minh Châu	Department of Natural Resources and Environment
Lê Nguyễn Quế Hương	Department of Natural Resources and Environment
Nguyễn Huy Phương	Department of Natural Resources and Environment
Cao Hoàn Thanh Trúc	Department of Natural Resources and Environment
Nguyễn Thị Kim Liên	Department of Natural Resources and Environment
Trần Hồng Lan	Department of Natural Resources and Environment
Hồ Thị Kim Thi	Department of Natural Resources and Environment
Phạm Thị Kim Ngân	Department of Natural Resources and Environment
Đỗ Thi Hoàng Oanh	Department of Natural Resources and Environment
Nguyễn Ngọc Nguyễn	Department of Natural Resources and Environment
Huỳnh Lê Khoa	Department of Natural Resources and Environment
Hứa Huỳnh Khoa	Department of Natural Resources and Environment
Nguyễn Thị Lợi	Department of Planning and Architecture
Nguyễn Thị Thanh Vân	Department of Planning and Architecture
Trương Cẩm Tú	Department of Planning and Architecture
Lê Thị Thanh Thảo	Department of Science and Technology
Huỳnh Lưu Trùng Phùng	Electricity of Vietnam HCMC
Đoàn Phạm Tuấn Khanh	Electricity of Vietnam HCMC
Phung Hoang Van	Electricity of Vietnam HCMC
Nguyễn Thị Cẩm Vân	HCMC Institute for Development Studies
Trần Nhật Nguyên	HCMC Institute for Development Studies
Trịnh Thị Minh Châu	HCMC Institute for Development Studies
Lê Đình Trung	HCMC Public Security
Nguyễn Thế Vinh	HCMC Public Security
Huỳnh Hoàng Linh	HCMC Public Security
Đặng Thị Hồng Phượng	Urban Environment Company Limited
Nguyễn Ngọc Huy	Urban Environment Company Limited
Hà Lê Ân	Management and Operation Center for Public Transport
Đồng Thị Hoài Phương	Management and Operation Center for Public Transport
Trương Thị Kim Phương	Urban Drainage Company Limited
Võ Thanh Thủy	HCMC Export Processing Zone Authority

Name	Organization
Nguyễn Thị Ngọc Mai	HCMC Export Processing Zone Authority
Nguyễn Quốc Bảo	HCMC Export Processing Zone Authority
Phạm Thị Ngọc Mai	HCMC Export Processing Zone Authority
Lê Nguyễn Hồng Ân	People’s Committee of Binh Tan District
Phan Thanh Phong	People’s Committee of Binh Tan District
Đào Thúy Vân	People’s Committee of Binh Tan District
Phạm Thanh Tâm	People’s Committee of District 1
Nguyễn Lê Thiên Thanh	People’s Committee of District 1
Nguyễn Thị Kim Cúc	People’s Committee of District 10
Nguyễn Phan Bích Thủy	People’s Committee of District 4
Nguyễn Thị Kim Chi	People’s Committee of District 4
Thái Thủy Tú	People’s Committee of District 6
Hồ Nguyễn Anh Thư	People’s Committee of District 6
Lê Thu Cúc	People’s Committee of District 7
Tôn Nữ Phương Anh	People’s Committee of District 7
Nguyễn Hữu Phú	People’s Committee of District 8
Nguyễn Huỳnh Khải Huấn	People’s Committee of District 8
Võ Thị Như Quỳnh	People’s Committee of District 9
Phạm Thanh Phước	People’s Committee of District 9
Lã Minh Phượng	People’s Committee of Go Vap District
Lê Thanh Tú	People’s Committee of Go Vap District
Phạm Ngọc Hiệu	People’s Committee of Hoc Mon District
Lê Nguyễn Ngọc Tài	People’s Committee of Nha Be District
Tạ Công Tường Huy	People’s Committee of Nha Be District
Dương Thị Hồng Ngọc	People’s Committee of Phu Nhuan District
Nguyễn Huỳnh Nhật Tân	People’s Committee of Phu Nhuan District
Trần Hữu Thức	People’s Committee of Tan Binh District
Nguyễn Mai Thanh Tùng	People’s Committee of Tan Binh District
Nguyễn Khoa	People’s Committee of Tan Phu District
Huỳnh Vũ Thành Thi	People’s Committee of Thu Duc District
Nguyễn Thị Thanh Loan	People’s Committee of Thu Duc District
Nguyễn Thị Ngọc Thảo	Sai Gon University
Nguyễn Huy Hoàng Phi	Sai Gon University
Vũ Thụy Hà Anh	Sai Gon University
Phạm Bá Thủy	Sai Gon Water Corporation
Trần Đình Hòa	Sai Gon Water Corporation
Trần Nguyễn Minh Châu	Sai Gon Water Corporation
Võ Xuân Khanh	Sai Gon Water Corporation
Ngô Kim Hùng	Saigon Public Urban Lighting Company Limited
Nguyễn Văn Hợp	Saigon Public Urban Lighting Company Limited

Name	Organization
Đặng Thị Thùy Trang	Saigon Transportation Mechanical Corporation
Nguyễn Hải Đảo	Saigon Transportation Mechanical Corporation
Hà Thanh Tuấn	Steering Center of the Urban Flood Control Program
Phạm Thị Minh Hiền	Steering Center of the Urban Flood Control Program
Hà Thanh Tuấn	Steering Center of the Urban Flood Control Program
Lê Hữu Quỳnh Anh	University of Natural Resources and Environment
Nguyễn Kim Thiện	Urban Civil Works Construction Investment Management Authority
Trần Quân	Urban Civil Works Construction Investment Management Authority
Nguyễn Thanh Nghị	Urban Civil Works Construction Investment Management Authority
Huỳnh Tấn Lợi	Van Lang University
Lê Thị Kim Oanh	Van Lang University
Ngô Tiến Dũng	Binh Dien Wholesale Market Management and Trading Company

Table 36 Participants of Second General Training on Climate Change Mitigation

Name	Organization
Vũ Thị Hoài Nhơn	Urban Environment Company Limited
Lê Thị Thủy Tiên	Urban Environment Company Limited
Nguyễn Minh Lý	Department of Agriculture and Rural Development
Huỳnh Quốc Toàn	Department of Agriculture and Rural Development
Phạm Tấn Thịnh	Department of Construction
Nguyễn Hoàng Xuân Mai	Department of Construction
Lương Xuân Nhung	Department of Industry and Trade
Lý Thế Bảo	Department of Industry and Trade
Trần Hồng Lan	Department of Natural Resources and Environment
Phạm Thị Kim Ngân	Department of Natural Resources and Environment
Hồ Thị Kim Thi	Department of Natural Resources and Environment
Huỳnh Lê Khoa	Department of Natural Resources and Environment
Châu Trúc Phương	Department of Natural Resources and Environment
Nguyễn Ngọc Nguyễn	Department of Natural Resources and Environment
Cao Lê Uyên Phương	Department of Natural Resources and Environment
Lưu Thị Giang	Department of Natural Resources and Environment
Vũ Thị Đăng Khoa	Department of Natural Resources and Environment
Bùi Hải Thiên Vũ	Department of Natural Resources and Environment
Hà Hương Liên	Department of Natural Resources and Environment
Nguyễn Khánh Tuyên	Department of Natural Resources and Environment
Nguyễn Thị Ý Nhi	Department of Natural Resources and Environment
Phạm Đại Nghĩa	Department of Natural Resources and Environment
Nguyễn Thị Liên	Department of Natural Resources and Environment
Hoàng Phương Lâm	Department of Natural Resources and Environment

Name	Organization
Trần Thanh Sơn	Department of Natural Resources and Environment
Lê Trung Nghĩa	Department of Natural Resources and Environment
Phạm Thị Nguyệt Thanh	Department of Natural Resources and Environment
Vũ Thùy Linh	Department of Natural Resources and Environment
Dương Thị Kiều Trang	Department of Construction
Hoàng Trung Hải	Electricity of Vietnam HCMC
Nguyễn Quốc Bảo	HCMC Export Processing Zone Authority
Nguyễn Hiếu Dân	HCMC Export Processing Zone Authority
Võ Thị Làm	Livestock Competitiveness and Food Safety Project
Hà Lê Ân	Management and Operation Center for Public Transport
Cao Trung Tín	Management and Operation Center for Public Transport
Nguyễn Tấn Đức	Management and Operation Center for Public Transport
Ngô Kim Hùng	Saigon Public Urban Lighting Company Limited
Đặng Tấn Sơn	Saigon Public Urban Lighting Company Limited
Võ Trần Phương	Saigon Public Urban Lighting Company Limited
Nguyễn Đức Ban	Steering Center of the Urban Flood Control Program
Phan Phạm Thanh Trang	Steering Center of the Urban Flood Control Program
Nguyễn Việt Hưng	Steering Center of the Urban Flood Control Program
Nguyễn Thanh Nghị	Urban Civil Works Construction Investment Management Authority
Đoàn Ngọc Khánh Linh	University of Science
Hoàng Thị Thúy Phương	Department of Tourism
Phạm Dương Tùng	Department of Tourism
Lưu Nguyễn Bảo Uyên	University of Technology
Nguyễn Ngọc Phước Đại	Institute for Research and Development
Nguyễn Dương Minh Hoàng	Institute for Research and Development
Nguyễn Thị Ngọc Thảo	Sai Gon University
Nguyễn Huy Hoàng Phi	Sai Gon University
Lâm Thị Hồng Thanh	Sai Gon University
Nguyễn Lê Nhi	Sai Gon University
Nguyễn Thị Tâm Lăng	Sai Gon Hi-Tech Park
Nguyễn Thị Tú Quyên	Sai Gon Hi-Tech Park
Lê Hoàng Bảo Trân	Sai Gon Hi-Tech Park
Võ Mỹ Y	Sai Gon Hi-Tech Park
Huỳnh Minh Hòa	Saigon Bus
Đinh Thị Nga	University of Natural Resources and Environment
Hoàng Thị Kiều Diễm	University of Natural Resources and Environment
Dương Phạm Hùng	Van Lang University
Hà Hoàng Hiếu	Binh Duong University
Vũ Mạnh Quyền	Unknown
Huỳnh Thị Thùy Dương	Police HCMC

Name	Organization
Lê ĐìnhTrung	Police HCMC
Huỳnh Văn Hùng	Statistical Office
Lê Minh Hùng	Statistical Office
Đỗ Huy Lượng	Department of Health

3.3 Budget Execution

A total of 10,369,868 Japanese yen was executed. The breakdown is shown in Table 37.

Table 37 Breakdown of Budget Execution

Expense	Price (JP yen)
General Employment	0
Professional Employment	1,715,131
Vehicle	469,225
Rental	7,598,888
Maintenance	0
Office Supplies	3,847
Travel	133,810
Communication/Transportation	150,552
Printing	298,415
Utility	0
Miscellaneous	0
Total	10,369,868

3.4 Local Consultant Contract

Three local consultant contracts totaling 150,701.10 USD were executed. A summary is shown in Table 38.

Table 38 Local Consultant Contracts

Item	Contractor	Period	Content
1	RCEE-NIRAS Joint Stock Company	25 November 2015 to 30 December 2016	Study on issues on NAMA/MRV in cities of Vietnam, collection of data required to prepare GHG inventory, collection and analysis of documents related to NAMAs in energy, transport and waste sectors, collection of data required to quantify GHG emission reductions of NAMAs, assistance on implementing MRV trails on NAMAs, assistance on organizing seminars, and support including interpretation, translation and scheduling

2	RCEE-NIRAS Joint Stock Company	25 November 2016 to 8 September 2017	Preparation of Vietnamese version GHG inventory, support for organizing training on GHG inventory, support for developing GHG Inventory Preparation Manual, assistance on implementing MRV trails on NAMAs, support for preparing seminar materials and developing MRV Manual, and support including interpretation and translation
3	Tran Thanh Tu and Phan Thu Nga	3 April 2017 to 31 October 2017	Proposing of process to deliberate on regulations on GHG inventory and MRV in People's Committee, proposing of mechanisms to encourage implementation of MRV by HCMC organizations, estimation of GHG emission reduction potentials in HCMC, and preparing of draft of regulations on GHG inventory and MRV

4. Recommendations and Lessons Learned

4.1 Recommendations

4.1.1 GHG Inventory

(1) Recommendation to HCMC

1) The GHG inventory of HCMC for 2014 and 2015 should be prepared referring to the GHG Inventory Preparation Manual, training material, and GHG inventory for 2013. Such an exercise will enable reaffirming of the knowledge and skills obtained during the project, and further enhance the capacity to prepare GHG inventories. The activity data collected from the Data Providing Organization have already been entered into the *Input Data* worksheet of the GHG inventory calculation files.
2) The GHG inventory of HCMC should be prepared for every even-numbered years from 2016 onwards according to the GHG inventory Preparation Manual.
3) A complete fuel consumption data on LPG, Natural Gas and Coal in HCMC should be sought because the information on fuel consumption in HCMC is not sufficient.
4) The information on the amount of municipal solid waste generated, recycled and open-burned within the city boundary should be collected to improve the waste sector inventory.
5) The information on the amount of industrial waste generated, treated, disposed and recycled within the city boundary should be collected to improve the waste sector inventory.
6) The amount of CH_4 recovered at landfill sites should be collected to improve the waste sector inventory.
7) HCMC should continuously update and improve the GHG Inventory Preparation Manual based on the experience and know-hows drawn through the continuous preparation of GHG inventories.
8) To fulfill the reporting requirements of C40, basic information of HCMC including the geographic boundary, heating degree days, population, GDP and etc. need to be provided in the reporting form.
9) The reporting form of C40 not only requires data but also data sources and notation keys in each sub-category, referring to the GHG Inventory Preparation Manual.
10) DOIT under HCMC should provide information from the Energy Intensity Monitoring Sheet of the Annual Report on Energy Conservation and Efficient Use Submitted by the designated enterprises (hereinafter Energy Intensity Monitoring) every year. Coal consumption was reported by only one enterprise. Because it was not clear whether the data reported reflected the actual situation, it was not used in the 2013 GHG inventory. The accuracy of the data should be checked by examining the time-series data and enquiry with the concerned enterprise.
11) The definition of the fuel types stated in the Energy Intensity Monitoring Sheet must be confirmed. For example, now *Gas* is defined as biogas because CNG is separately stated but it is

not clear whether such categorizations are correct.

(2) Recommendation to MONRE

1) MONRE should request Ministry of Industry and Trade (MOIT) to prepare an energy statistical yearbook to improve the stationary energy and transportation sector inventories.
2) Department of Climate Change (DCC) under MONRE should prepare the CH_4 and N_2O emission factor of the grid using the calculation method for CO_2 emission factor of the grid to improve the stationary energy sector inventory.

(3) Recommendation to JICA

1) HCMC will prepare the GHG inventory every two years. DONRE officials including CCB staff have learned from A to Z on the preparation of GHG inventories through the training and etc., but have no experience in completing the GHG inventory on their own. CCB still needs technical advice and support on quality control and review. JICA should consider the support measures to CCB, including the cooperation with C40, and implement.
2) For continued preparation and improvement of the GHG inventory, further support is necessary. For example, the following activities require assistance: reflecting of new emission sources, when they arise, in the GHG inventory; and updating of the GHG inventory calculation files when new information on coal consumption, fuelwood consumption, IPPU Sector, industrial waste disposed, and so on become available. An assistance to enable HCMC to independently make and implement an improvement plan of the GHG inventory each time it prepares an inventory is also necessary.

4.1.2 MRV

(1) Recommendations to HCMC

1) HCMC should continue and expand the MRV trials initiated by the project to establish a sustainable MRV operation by the stakeholders because the project period was not long enough to achieve this. Before moving on to a city-wide operation, DONRE and stakeholders need to gain more experience in selecting target measures, identifying a methodology for each measure and implementing MRV in accordance with the MRV Manual. Moreover, through this process, DONRE should consider if the framework and procedures described in the MRV Manual are in line with the situation of the city, and improve the MRV Manual if there are gaps.
2) Implementation of MRV imposes new and additional challenges to the stakeholders in HCMC, and the motivation to carry out this work is not necessary present. HCMC needs to institutionalize MRV by issuing a decision that officially requires the stakeholders to implement MRV.
3) HCMC should utilize the existing structures and procedures for monitoring and reporting of

regular activities as much as possible so that the implementation of MRV does not cause an excessive burden on the stakeholders.

4) HCMC must secure the budget and develop the human resources for MRV implementation. DONRE should explain the relevance of MRV to HCMC Department of Planning and Investment (DPI) and HCMC Department of Finance (DOF) by referring to the international and national context on climate change, and also by using the results of the MRV trials and MRV Manual. DONRE should demand the allocation of the necessary budget and human resources for implementation of MRV.
5) During the initial stages of MRV operation, HCMC should consider receiving technical support from international/local experts (such as consultants with experience in CDM, JCM or other GHG emission reduction projects) especially on the identification of the methodology for GHG emission reduction calculation and monitoring.
6) DONRE should hold training on climate change mitigation actions, MRV and the MRV Manual periodically to enhance understanding on MRV and promote proactive implementation of MRV.
7) HCMC should share the experience gained and lessons learned through the MRV trials to MONRE and other national agencies responsible for establishing the national MRV system so that a realistic and practical system will be established.
8) HCMC should share its experience and institutions on city-level MRV with cities in Vietnam and other countries to promote good practices on climate change mitigation at the local level.

(2) Recommendations to MONRE

1) MONRE should establish a legal framework on the national MRV system so that HCMC and other cities in Vietnam can institutionalize MRV at the local level.
2) MONRE should consider the lessons and constraints emerging through the MRV trials in HCMC and MRV Manual in establishing the national MRV framework.
3) MONRE should indicate the principle on GHG emission reduction calculations, and monitoring and reporting activities so that there is no doubt in conducting MRV at the city level.

(3) Recommendation to JICA

JICA should consider providing support on the above-mentioned recommendations to HCMC, particularly on 1), 5) and 6) which require expertise. CCB intends to continue and expand MRV activities using the MRV Manual. However, further trial and error is required to establish a sustainable MRV framework. Further assistance towards this end from JICA is appreciated.

4.1.3 Overall

During the Final Seminar organized on 26 October 2017, CCB presented its intentions to utilize the achievements of the project and plans going forward. It explained that the GHG Inventory Preparation

Manual and MRV Manual are expected to be adopted as official documents of HCMC before the end of 2017. It also explained the activity plan from 2018 onwards. The plan is summarized in Table 39. The plan reflects the project activities undertaken and promotes the initiatives on climate change mitigation undertaken by HCMC, and also contributes to enhancing the sustainability of the project achievements.

In the presentation, CCB's expectations towards the continued cooperation with JICA, C40, TMG and Osaka City were expressed. JICA, in consultation with MONRE, should coordinate with these organizations and other donors, and consider assisting HCMC so that it is able to accelerate its activities.

Table 39 Plan from 2018 Onwards

Item	GHG Inventory		MRV	
	Activity	Responsibility	Activity	Responsibility
2018	Prepare 2016 GHG Inventory of HCMC	DONRE	Select pilot mitigation measures to apply MRV process	Major units in MRV procedures
	Formulate and approve plan to develop regulations on GHG inventory in HCMC	DONRE	Formulate and approve plan to develop regulations on MRV in HCMC	DONRE
2019	Assess 2016 GHG Inventory results to adjust process and methodology	DONRE	Implement MRV on selected mitigation measures	Implementing units
	Develop regulations on GHG inventory in HCMC	DONRE, Department of Justice	Develop regulations on MRV in HCMC	DONRE, Department of Justice
2020	Prepare 2018 GHG Inventory of HCMC	DONRE	Continue to implement MRV on selected mitigation measures	Major units in MRV procedures
	Promulgate and issue regulations on GHG inventory in HCMC	HCMC People's Committee	Promulgate and issue regulations on MRV in HCMC	HCMC People's Committee
2020 - 2030	Prepare GHG inventory bi-annually in accordance with promulgated regulations	DONRE	Implement MRV of mitigation actions using MRV procedure in accordance with the issued regulations	Major units in MRV procedures

Source: Presentation in Final Seminar

4.2 Lessons Learned

(1) Institutional arrangement on GHG inventory preparation

The cooperation of many organizations is necessary for preparing the GHG inventory. In this project, the organizations to provide data, data to be used, roles of the concerned organizations, schedule of GHG inventory preparation and etc. were determined through the two consultation meetings and CCSB taskforce meeting.

Initially, the Data Providing Organizations would not agree to the roles and responsibilities, including quality control of data proposed by CCB and expert team because: 1) they had no obligations to report to DONRE; 2) they did not collect data for the purpose of GHG inventory; and 3) they were not in a position to contribute to the quality control of GHG inventory. Under this circumstance, mutual understanding was attained by sharing opinions and discussing on the issues at the consultation meetings in which all stakeholders gathered together. To newly establish a GHG inventory preparation structure or to add new organizations to an existing structure in an effort to improve the GHG inventory, such approach taken in this project would be very much relevant.

(2) Quality control of GHG inventory

From the viewpoint of quality control and quality assurance, preparation of GHG inventories should eliminate black boxes and special setups in the calculation process so that anyone can objectively verify the calculation process. In this project, the GHG inventory was prepared using a spreadsheet (Excel) similarly to the national GHG inventory of Vietnam. The GHG inventory calculation files consist of several worksheets. The data collected every year are entered into one worksheet, and the parameters and emission factors are set in advance in other worksheets. The calculation structure is as follows: 1) the activity data, which is the basic data of GHG emissions and removals, are calculated using the data collected and entered; and 2) the GHG emissions and removals are subsequently calculated using the activity data, parameters and emission factors. It was confirmed that this approach was effective and straightforward through the training on GHG inventory. When preparing a GHG inventory, this approach should continue to be adopted.

(3) Sustainable MRV

For transport projects, data on fuel economy and driving distance of the vehicle are important for MRV. However, in HCMC, it was difficult to know the actual fuel economy of buses because of the prevailing rule. The rule defines a constant fuel economy, for example, 40 liters per 100 km, by vehicle type, which has to be incorporated into the operation reports. In addition, it is difficult to know the actual driving distance, because the total driving distance of buses is calculated by multiplying the distance of the bus route by the number of trips, rather than by monitoring the actual driving distance using the odometer.

In the MRV trial, such existing reporting system was effectively utilized in order not to increase the burden on the bus company. Such an approach is effective for ensuring sustainability of MRV because it can reduce both labor of the company and costs. However, such system is not based on the actual fuel economy or actual driving distance data, unlike in the methodology of CDM or JCM. This may not be compatible with the monitoring approach to be defined in the national MRV system, which is still under consideration. Although it is effective to apply the existing monitoring and reporting system to ensure the sustainability of MRV, it is important to remember such existing system may not always be fully applicable due to the compatibility with the regulations of international/national/sectoral MRV systems.

(4) Promotion of MRV and collaboration between departments

In implementing MRV, cross-departmental collaboration under the administration of DONRE (CCB), including the monitoring activities by each implementing entity to report the results to DONRE (CCB) through the sectoral oversight departments, is essential.

At the beginning of this project, collaboration between DONRE (CCB) and the departments concerned with the implementation of MRV was not sufficient. The expert team tried to promote close collaboration among the relevant departments. For example, the expert team asked CCB officials to attend the meetings, and study sessions on the calculation of GHG emission reductions and monitoring, which were organized for the implementing entities and oversight departments. As a result, the MRV trials were smoothly implemented, and a practical MRV structure and procedures were established. In order to further enhance such cross-departmental collaboration, it is not only important to form official structures such as cross-departmental working groups, but also to enhance cooperation between the relevant departments in routine meetings related to MRV implementation.

(5) Motivation for MRV

A number of study sessions were held for the implementing entities and oversight departments concerned with the MRV trails in order to enhance their understanding on MRV and GHG emission reduction calculation. The participants conducted calculations for the pilot mitigation measures using the tools that have been developed under the project. These sessions resulted in the stakeholders having a better understanding on MRV and enthusiasm to tackle MRV. In order to promote MRV implementation, it is important to enhance the understanding of the stakeholders on MRV and also to make them more interested in the GHG emission reduction logic and the calculation methods.

(6) Networking by training in Japan

The training in Japan contributed greatly to establishing good relationships between CCB and other concerned organizations, and enhancing their awareness on the project.

Not only CCB but also the organizations concerned with GHG inventory preparation and MRV

trials were invited to the training. Site visits and workshops were incorporated in the training program so that participants had opportunities to discuss with each other. This in turn enabled CCB officials to establish good relationships with those in various positions of various other departments, including heads of departments and divisions. The training was a good opportunity also for the expert team to directly discuss with the officials of organizations besides CCB.

After the training, the cooperation among the concerned organizations became stronger as the participants became the contact persons of their own organizations to communicate with CCB and expert team. By requesting for cooperation of the concerned organizations through the training participants, the project activities could be conducted more smoothly than before.

The training in Japan should be utilized to establish good relationships among stakeholders particularly in projects which deal with cross-sectoral issues like climate change and those that require the engagement of many organizations.

(7) Modification of project design

This project started in January 2015 with MONRE as the counterpart organization. HCMC was later selected as the pilot city and the activities in HCMC commenced in October 2015. At that time, this work also commenced and the expert team started to travel to HCMC.

However, when the activities started, because the activities in HCMC was not clearly defined in the overall framework of the project and HCMC was not provided with sufficient explanation on the JICA cooperation, the understanding of the stakeholders on the project was lacking and the activities were delayed. In response, the Project Design Matrix (PDM) was revised to clearly indicate HCMC as the pilot city, in consultation with CCB, MONRE and long-term experts. At the same time, the activities and indicators were revised for consistency. The revised PDM was approved during the JCC held in June 2016.

In addition, during the JICA technical advisory mission’s visit to Vietnam in September 2016, discussions were held on the overall objective and target of the project, and positioning of the activities in HCMC, with all key stakeholders participating. As a result of proactive participation, and the analysis and advice provided by the mission members, the stakeholders were able to share a common understanding on the project. The expectations of MONRE towards the activities in HCMC and targets to be attained in the project became clearer.

In a situation in which the circumstances have changed significantly from the detailed planning stage and more implementing bodies have been added, and project activities are ongoing at multiple sites with many stakeholders involved, it can be concluded that measures such as the revision of the PDM at an appropriate timing and dispatching of a technical advisory mission, through which an objective analysis and advice from those not engaged in the implementation of the project on the ground can be given, are valuable initiatives for the smooth implementation of the project.

(8) Ownership over outputs

Initially, the project experienced delays. However, later, the project produced the expected outputs on time. As seen in the presentation during the Final Seminar, a strong sense of ownership over the project outputs developed among the counterparts.

HCMC, in particular CCB, carefully assessed the roles that it is mandated to play as public administrative bodies and what the project may be able to offer, and to work out how HCMC can integrate the project outputs into its regular activities so that the project does not end up as an one-off event. For example, on GHG inventory, taking into account that the results should be presented to the public and that the results will be used for policy planning later on, CCB carefully decided not to collect the inventory data in an ad-hoc manner relying on personal connections among the staff members but to do it officially and systematically under the instructions of the People's Committee. CCB also decided to have the GHG Inventory Preparation Manual and MRV Manual adopted by the People's Committee as official documents of HCMC rather than leaving them simply as project outputs.

The counterpart organizations of the project carried out internal procedures to ensure that the project outputs are fully utilized and sustained. Although this may have caused the initial delay, it had the effect of enhancing the ownership of the counterpart organizations over the project outputs. In a project, which is usually time bound, lengthy delay is a problem. Nevertheless in the context of sustainability, the importance of respecting the deliberation and decision-making process within the counterpart organization cannot be overstated.

The expert team has been closely communicating with CCB, listening to its requests, sympathizing with its challenges, and consulting on the activity plan and outputs using drafts and examples. Whenever the team proposed something, it always tried to give ample time for consideration and also encouraged deliberation within the wider HCMC administration. The team respected the decision-making process of the counterpart organization. Such approach has led to the high level of ownership by the counterparts and establishment of good trust between the counterparts and the expert team.

ANNEX

Annex 1
MRV Report

Annex The result of GHG emission reduction calculations, the result of monitoring activities

1. Replacement of Existing Street Lamp with LED
2. Introduction of Solar PV system
3. Introduction of CNG buses
4. BRT Line 1 project
5. MRT Line 1 project
6. Electricity Generation at Go Cat Landfill
7. Animal Manure Collection and Biogas Recovery at Small Farms

<Energy Sector>

Project name: Replacement of Existing Street Lamp with LED

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

Electricity consumption of LED is less than CFL. Replacing CFL with LED results in reduction of electricity consumption. That results in CO_2 emission reductions.

2) Methodology to calculate GHG emission reduction

A simple methodology was applied for this project as below, based on a basic emission calculation formula provided in the approved CDM methodology, "AMS-II.L, Demand-side activities for efficient outdoor and street lighting technologies."

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$\boldsymbol{BE_y = \sum_i (R_{BL,i} \times Q_{BL,i,y} \times O_{BL,i,y}) \times EF_{grid}}$$

BE_y	Baseline emissions in year *y* (tCO_2/year)
$R_{BL,i}$	Rated power of the CFL of the group of i lighting devices (kW)
$Q_{BL,I,y}$	Quantity of CFL used in the site (units)
$O_{BL,I,y}$	Annual operating hours for the CFL in year y
EF_{grid}	Emission Factor of the grid (tCO_2/kWh)

$$\boldsymbol{PE_y = \sum_i (R_{PJ,i} \times Q_{PJ,i,y} \times O_{PJ,i,y}) \times EF_{grid}}$$

PE_y	Baseline emissions in year *y* (tCO_2/year)
$R_{PJ,i}$	Rated power of the LED of the group of i lighting devices (kW)
$Q_{PJ,I,y}$	Quantity of LED distributed and installed under the project activity (units)
$O_{PJ,I,y}$	Annual operating hours for the LED in year y
EF_{grid}	Emission Factor of the grid (tCO_2/kWh)

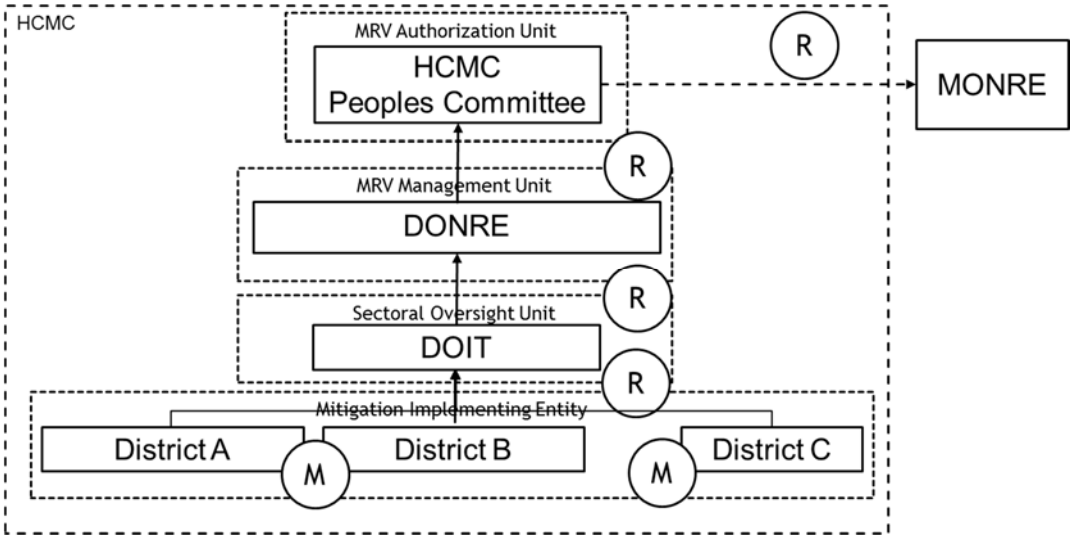
Monitoring Parameter:

EF_{grid}	Emission factor of the grid (tCO_2/kWh)
$Q_{PJ,I,y}$	Quantity of LED distributed and installed under the project activity (units)
$O_{PJ,I,y}$	Annual operating hours for the LED in year y

3) Estimated GHG emission reduction

50 tCO_2/year

4) Organizational structure for monitoring and reporting



5) Monitoring period

from January 1st 2016 until December 31st 2016

6) Monitoring methods

Monitoring parameters

Parameter	Monitoring method	Person/position in charge	Site
$Q_{BL,i}$ Quantity of CFL used in the site (units)	· The staff of the districts counts the quantity of CFL which are used at the site before the project starts.	Staff of the districts	The target small street
$O_{BL,l,y}$ Annual operating hours for CFL in year y (hours)	· A timer is used to count the hours. · The staff of the districts checks and records the setting value before the project starts.	Staff of the districts	Controller of the street lamps
$Q_{PJ,i}$ Quantity of LED distributed and installed under the project activity (units)	· The staff of the districts counts the quantity of installed LED lamps. · These data are recorded for 12 months.	Staff of the districts	The target small street
$O_{PJ,l,y}$ Annual operating hours for the LED in year y (hours)	· A timer is used to count the hours. The staff of the districts checks and records the setting value monthly.	Staff of the districts	Controller of the street lamps
EF_{grid} Emission factor of grid (tCO_2/kWh)	· Default value in official document by the MONRE is applied. · Check updated value every year and apply the latest value where appropriate.	Staff of the districts	N/A

Fixed parameters

Parameter	Source	Value
$R_{BL,i}$ Rated power of the CFL of the group of i lighting devices (W)	This value is provided by the supplier of CFL lamps.	18
$R_{PJ,i}$ Rated power of the LED of the group of i lighting devices (W)	This value is provided by the supplier of LED lamps.	9

(2) Result of monitoring activities

1) Monitoring period

From January 1st 2016 to December 31st 2016 (12 months)

2) Emission reductions of the monitoring period

12 tCO_2/year

3) Processes of the emission reduction calculation

The quantity of LED lamps distributed and installed under the project was counted and recorded monthly. And the setting value for operating hours was checked and recorded monthly.
Grid emission factor of the grid is 0.66 tCO_2/MWh, referred the latest official EF provided by the MONRE in May 2016.

Emission reductions for 12 months are calculated as follows:

$$\boldsymbol{BE_y} = \sum_{\boldsymbol{i}} (\boldsymbol{R_{BL,i,y}} \times \boldsymbol{Q_{BL,i,y}} \times \boldsymbol{O_{BL,i,y}}) \times \boldsymbol{EF_{grid}}$$

$$= \sum_i (18\ (kW) \times 250 \times 4{,}015\ (hous)) \times 0.66\ (\mathrm{tCO2/MWh})$$

$$= 152 \times 0.66\ (\mathrm{tCO2/MWh})$$

= 100 t-CO_2/year

$$\boldsymbol{PE_y} = \sum_{\boldsymbol{i}} (\boldsymbol{R_{PL,i,y}} \times \boldsymbol{Q_{PJ,i,y}} \times \boldsymbol{O_{PJ,i,y}}) \times \boldsymbol{EF_{grid}}$$

$$= \sum_i (9\ (kW) \times 250 \times 4{,}015\ (hous)) \times 0.66\ (\mathrm{tCO2/MWh})$$

$$= 76 \times 0.66\ (\mathrm{tCO2/MWh})$$

= 50 t-CO_2/year

$$\boldsymbol{ER_y} = \boldsymbol{BE_y} - \boldsymbol{PE_y}$$

$$= 100 - 50 = 50\ \mathrm{tCO_2/year}$$

(3) GHG emission reduction calculation sheet

Emission reduction calculation sheet for LED project

Emission Reduction

Description	Parameter	Unit	Emissions
Emission reduction	ER_y	tCO_2/year	**50**
Baseline emission	BE_y	tCO_2/year	100
Project emission	PE_y	tCO_2/year	50

Inputs

Description	Parameter	Unit	value	Data source
Annual operating hours of CFL in the year y	$O_{BL,i,y}$	hours/year	4015	Monitored
Quantity of CFL in year y	$Q_{BL,I,y}$	unit	250	Monitored
Wattage per lamp of CFL category i	$R_{BL,i}$	W	18	Catalog data
Annual operating hours of LED in the year y	$O_{PJ,i,y}$	hours/year	4015	Monitored
Quantity of CFL in year y	$Q_{PJ,I,y}$	unit	250	Monitored
Wattage per lamp of normal lamp category i	$R_{PJ,i}$	W	9	Catalog data
CO2 Emission factor of grid	EF_{grid}	tCO_2/MWh	0.66	

Project name: Introduction of Solar PV system

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

The electricity generated by the solar PV system is used as a substitute for the electricity from the grid. The electricity generated by the solar PV system does not emit any CO_2. On the other hand, thermal power plants connected to the power grid are using fossil fuels and emitting CO_2. Therefore, utilizing the electricity generated by solar PV system results in CO_2 emission reductions.

2) Methodology to calculate GHG emission reduction

A simple methodology was applied for this project as below, based on a basic emission calculation formula provided in the approved CDM methodology, "AMS-I.A: Electricity generation by the user."

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$\boldsymbol{BE_y = EG_{p,y} \times EF_{grid}}$$

BE_y	Baseline emissions in year *y* (tCO_2/year)
$EG_{p,y}$	Annual generated electricity by solar PV system (kWh)
EF_{grid}	Emission Factor of the grid (tCO_2/kWh)

$$\boldsymbol{PE_y = EG_{p,y} \times EF_{PV}} = 0$$

PE_y	Project emissions in year *y* (tCO_2/year)
$EG_{p,y}$	Annual generated electricity by solar PV system (kWh)
EF_{PV}	Emission Factor of the solar PV system (tCO_2/kWh) = 0

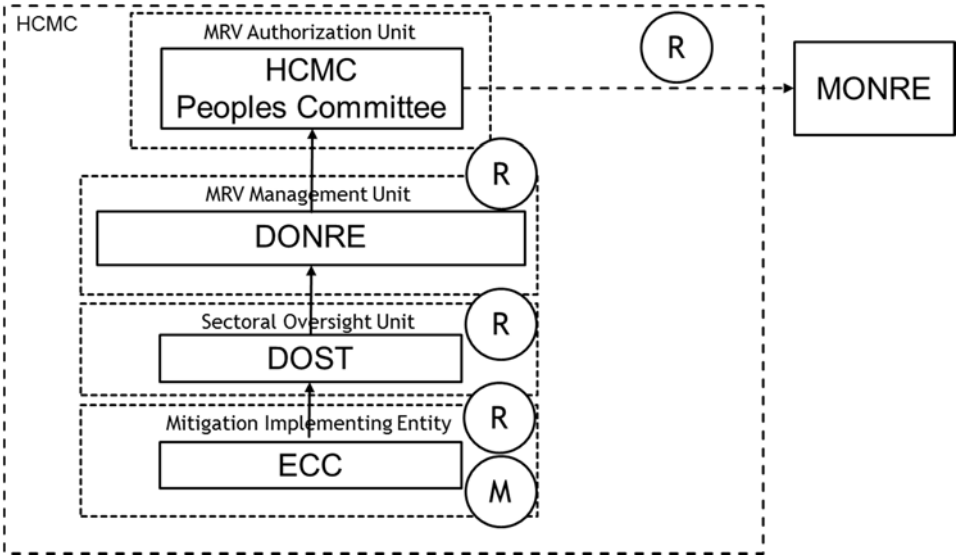
Monitoring parameters are as follows:

EF_{grid}	Emission Factor of the grid (tCO_2/kWh)
$EG_{p,y}$	Annual generated electricity by solar PV system (kWh)

3) Estimated GHG emission reduction

11 tCO_2/year

4) Organizational structure for monitoring and reporting



5) Monitoring period

From January 1st 2016 to December 31st 2016 (12 months)

6) Monitoring methods

Monitoring parameters

Parameter	Monitoring method	Person/position in charge	Site
$EG_{p,y}$ Annual generated electricity by solar PV system (kWh)	· The value of the electric meter is read and recorded monthly. · Recorded data is accumulated for 12 months and used for the GHG emission reduction calculation.	Staff of ECC	DOST's building
EF_{grid} Emission factor of grid (tCO_2/kWh)	· Default value in the official document by the MONRE is applied. · Updated value will be checked every year and the latest value will be applied where appropriate.	Staff of ECC	N/A

(2) Result of monitoring activities

1) Monitoring period

From January 1st 2016 to December 31st 2016 (12 months)

2) Emission reductions of the monitoring period

12 tCO_2/year

3) Processes of the emission reduction calculation

The amount of generated electricity by the solar PV systems was monitored as designated in the MRV Plan. The accumulated electricity generation amount was 20,764.40 (kWh).

Grid emission factor of the grid is 0.66 tCO_2/MWh, referred the latest official EF published by the MONRE in May 2016.

Emission reductions for 12 months are calculated as follows:

$$\boldsymbol{BE_y = EG_{p,y} \times EF_{grid}}$$
$$= 20{,}764.40\ (\text{kWh}) \times 0.66\ (\text{tCO2/MWh})$$
$$= 13.7\ \text{tCO}_2\text{/year}$$

$$\boldsymbol{PE_y = EG_{p,y} \times EF_{PV}}$$
$$= 0\ \text{tCO}_2\text{/year}$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$
$$= 13.7 - 0 = 13.7\ \text{tCO}_2\text{/year}$$

Data for electricity generation provided by ECC

Monitoring period		Monitoring date	Electricity generation indicated by electric meter (kWh)	Accumulated electricity generation amount (kWh)
From	To			
1-Jan-16	31-Jan-16	31-Jan-16	1,810.48	1,810.48
1-Feb-16	29-Feb-16	29-Feb-16	1,812.49	3,622.97
1-Mar-16	31-Mar-16	31-Mar-16	2,016.81	5,639.78
1-Apr-16	30-Apr-16	30-Apr-16	1,821.87	7,461.65
1-May-16	31-May-16	31-May-16	1,757.80	9,219.45
1-Jun-16	30-Jun-16	30-Jun-16	1,512.80	10,732.24
1-Jul-16	31-Jul-16	31-Jul-16	1,786.83	12,519.07
1-Aug-16	31-Aug-16	31-Aug-16	1,701.74	14,220.81
1-Sep-16	30-Sep-16	30-Sep-16	1,570.40	15,791.21
1-Oct-16	31-Oct-16	31-Oct-16	1,621.46	17,412.67
1-Nov-16	30-Nov-16	30-Nov-16	1,887.52	19,300.20
1-Dec-16	31-Dec-16	31-Dec-16	1,464.20	20,764.40

(3) GHG emission reduction calculation sheet

GHG Emission reduction calculation sheet for PV project

Period of monitoring:

Emission Reduction

Description	Parameter	Unit	Emissions
Emission reduction	ER_y	tCO_2/year	**13**
Baseline emission	BE_y	tCO_2/year	13
Project emission	PE_y	tCO_2/year	0

Inputs

Description	Parameter	Unit	Amont of Electric generation	Data source
Amount of electricity generated in the year y	EG_{PJ}	kWh/year	20,764	Measured
CO2 Emission factor of grid	EF_{grid}	tCO_2/MWh	0.66	

<Transport Sector>

Project name: Introduction of CNG buses

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

Main component of CNG is natural gas and it has low carbon content per energy than diesel fuel. Therefore, even though efficiency of the diesel engines is slightly better than that of the CNG engines, CO_2 emission are reduced through replacing diesel buses by CNG buses.

2) Methodology to calculate GHG emission reduction

A simple methodology was developed for this project as below, based on a basic emission calculation formula provided in the IPCC 2006 guidelines.

$$\boldsymbol{BE_y = SFC_{diesel} \times NCV_{diesel} \times EF_{diesel} \times DD_y \times N_{PJ,y}}$$

$$\boldsymbol{PE_y = SFC_{CNG}/CF \times NCV_{CNG} \times EF_{CNG} \times DD_y \times N_{PJ,y}}$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$

BE_y	Baseline emission in year *y* (tCO_2/year)
PE_y	Project emission in year *y* (tCO_2/year)
ER_y	Emission reduction in year *y* (tCO_2/year)

Monitoring Parameters:

DD_y	Annual average distance travelled in year *y* (km/year)
$N_{PJ,y}$	Number of CNG buses in year *y*

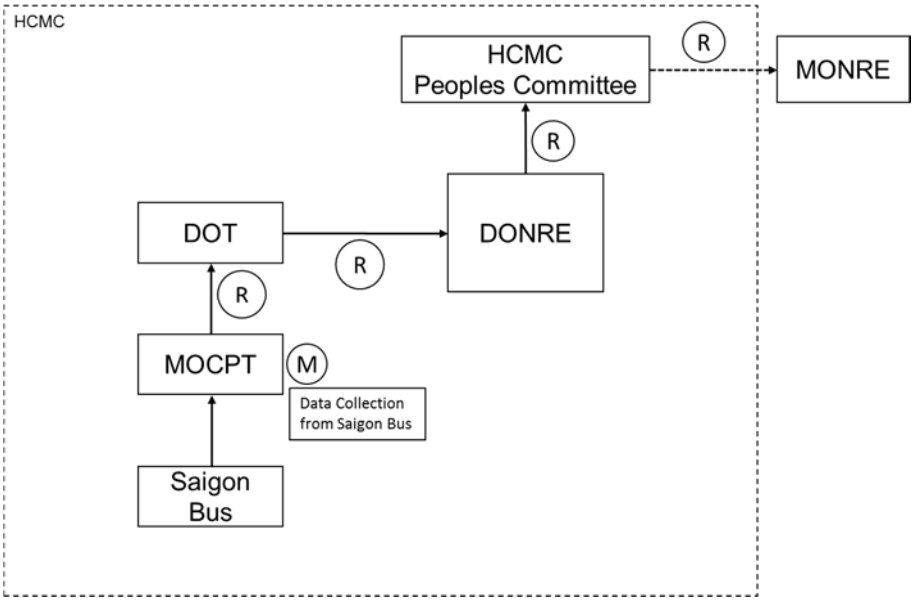
Fixed Parameters:

SFC_{diesel}	Specific fuel consumption of diesel bus (kg/km)
SFC_{CNG}	Specific fuel consumption of CNG bus (kg/km)
NCV_{diesel}	Net calorific value of diesel fuel (MJ/kg)
NCV_{CNG}	Net calorific value of CNG (MJ/kg)
EF_{diesel}	Emission factor of diesel fuel (tCO_2/MJ)
EF_{CNG}	Emission factor of CNG (tCO_2/MJ)
CF	Correction factor for CNG specific fuel consumption

3) Estimated GHG emission reduction

37 tCO_2/year

4) Organizational structure for monitoring and reporting



5) Monitoring period

From August 1st 2016 to December 31st 2016 (The period of the MRV trial)

6) Monitoring methods

Monitoring parameters

Parameter	Monitoring method	Person/position in charge	Site
DD_y Annual average distance travelled in year *y* (km/year)	· The data is provided by SaigonBus. · SaigonBus monitors distances travelled by each bus monthly (This is done as a part of their routine works). · These data are averaged to obtain the monthly average distance of all the buses. · Monthly average distance is calculated for 12 months and sum up these to obtain the annual average distance.	MOCPT receives the data from SaigonBus	N/A
$N_{PJ,y}$ Number of CNG buses in year *y*	· The data is provided by SaigonBus. · SaigonBus checks the number of CNG buses in the bus fleet registry.	MOCPT receives the data from SaigonBus	N/A

Fixed parameter

Parameter	Source	Value
SFC_{diesel} Specific fuel consumption of diesel bus (kg/km)	Determined by SaigonBus.	0.290

SFC_{CNG} Specific fuel consumption of CNG bus (kg/km)	Determined by SaigonBus using the actual driving distance and CNG consumption for all project buses.	0.365
NCV_{diesel} Net calorific value of diesel fuel (MJ/kg)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory"	43.0
NCV_{CNG} Net calorific value of CNG (MJ/kg)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory".	48.0
EF_{diesel} Emission factor of diesel fuel (tCO_2/MJ)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory"	0.0000741
EF_{CNG} Emission factor of CNG (tCO_2/MJ)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory"	0.0000561
CF Correction factor for CNG specific fuel consumption	Factor is set to correct/adjust fuel consumption between different specifications of baseline and project buses: Ratio of vehicle weight of CNG bus (10,780kg) to diesel bus (9,880kg)	1.09

(2) Result of monitoring activities

1) Monitoring period

From August 1st 2016 to December 31st 2016 (the period of the MRV trial)

2) Emission reductions of the monitoring period

10 tCO_2 (for 5 months)

3) Processes of the emission reduction calculation

Annual average distance travelled (DD_y) is 23,225 km for 5 months, determined based on the monitored data of 20 CNG buses from August 2016 to December 2016.

Specific fuel consumption of the diesel bus (SFC_{RF}) is 0.290, determined based on the fuel consumption of B80 diesel buses 34.5 liter/100km and the density of diesel 0.84 kg/liter.

Specific fuel consumption of the CNG bus (SFC_{PJ}) is 0.365, determined based on the monitored data of 20 CNG buses.

Emission reductions for 5 months are calculated as follows:

$$\boldsymbol{BE_y = SFC_{RF} \times NCV_{diesel} \times EF_{diesel} \times DD_y \times N_{PJ,y}}$$
$$= 0.290 \times 43.0 \times 0.0000741 \times 23225 \times 20$$
$$= 429\ \mathrm{tCO_2/year}$$
$$\boldsymbol{PE_y = SFC_{PJ}/CF \times NCV_{CNG} \times EF_{CNG} \times DD_y \times N_{PJ,y}}$$
$$= 0.365/1.09 \times 48.0 \times 0.0000561 \times 23225 \times 20$$
$$= 419\ \mathrm{tCO_2/year}$$
$$\boldsymbol{ER_y = BE_y - PE_y}$$

$= 429 - 419 = 10\ \mathrm{tCO_2/year}$

Data for CNG buses provided by Saigon Bus

August 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	5124.8	2,046.76	11	5103.7	1,924.39
2	5273.2	2,046.96	12	4872.5	2,031.96
3	4932.8	1,899.43	13	5020.9	1,882.21
4	4925.6	2,041.70	14	5314.3	2,126.86
5	4309.7	1,690.80	15	4882.8	1,786.52
6	4915.3	1,867.34	16	4760.8	1,761.72
7	4946.7	1,928.23	17	5079.5	2,152.46
8	5209.8	1,922.84	18	4696.9	1,817.53
9	4974.5	1,993.05	19	5153.7	1,906.62
10	4886.4	1,954.79	20	-	-
Total	49,498	19,391	Total	44,885	17,390

September 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	4851,4	1.792,71	11	5030,6	1.853,31
2	4910,6	1.819,54	12	5023,4	1.976,46
3	5020,3	1.858,79	13	4592,4	1.725,83
4	5454,9	2.123,20	14	4855	1.793,46
5	4679,4	1.684,89	15	4946,7	1.780,63
6	5058,4	1.857,79	16	4812,8	1.722,59
7	5058,4	1.920,28	17	4089,8	1.633,86
8	4964,2	1.771,54	18	4926,1	1.702,20
9	4549,1	1.647,25	19	5044,5	1.740,73
10	1390,4	500,37	20	1046,4	452,02
Total	45,937	16,976	Total	44,367	16,381

October 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	4557,4	1.684,35	11	4476	1.715,92
2	4607,4	1.879,61	12	4820	1.902,06
3	5167,6	1.986,36	13	4599,1	2.010,01
4	4739,7	1.850,54	14	5437,2	1.983,41
5	4838,6	1.775,92	15	4768	1.691,27
6	4795,8	1.844,40	16	4539,9	1.680,74
7	3785,5	1.476,55	17	4178,4	1.673,83
8	4349,3	1.625,09	18	4820	1.741,15
9	4700,5	1.731,80	19	4328,2	1.552,88
10	4543,5	1.762,15	20	5282,9	2.060,70
Total	46,085	17,617	Total	47,249	18,012

November 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	4689,7	1.717,78	11	4542,4	1.710,03
2	4349,3	1.732,40	12	4517,5	1.790,07
3	4556,3	1.725,97	13	4693,3	1.945,26
4	4483,8	1.741,21	14	4592,4	1.697,39
5	4559,9	1.650,96	15	4926,8	1.704,48
6	4448,2	1.669,89	16	3729,9	1.358,46
7	4332,9	1.679,62	17	4524,9	1.808,93
8	4552,7	1.662,96	18	4459,6	1.606,91
9	4489,7	1.633,29	19	4559,9	1.632,87
10	4893,6	1.884,48	20	4870,7	1.859,54
Total	45,356	17,099	Total	45,417	17,114

December 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	4778,3	1.655,87	11	2248,3	839,04
2	4174,8	1.614,95	12	4907,5	1.853,22
3	5044,5	1.853,92	13	4683	1.978,47
4	5237,6	2.008,72	14	4571,3	1.730,52
5	5242,3	1.879,66	15	5016,7	1.745,02
6	5242,5	1.900,76	16	4634,1	1.636,11
7	4718	1.710,06	17	4058,9	1.574,97
8	4809,7	1.658,23	18	5174,8	1.876,49
9	5077	1.819,79	19	5136,7	1.801,54
10	4711,9	1.715,20	20	4907,5	1.819,26
Total	49,036	17,817	Total	45,539	16,855

(3) GHG emission reduction calculation sheet

(Draft) Emission reduction estimation sheet for CNG bus project

Period of monitoring:

Emission Reduction

Description	Parameter	Unit	Value
Emission reduction	ER_y	tCO_2 /year	
Baseline emission	BE_y	tCO_2 /year	
Project emission	PE_y	tCO_2 /year	

Inputs

*Input only orange cell

Description	Parameter	Unit	Value	Data source
Annual average distance travelled in year y (km/year)	DD_y	km/year		Monitored
Number of CNG buses in year y	$N_{PJ,y}$	unit		Monitored
Specific fuel consumption of diesel bus	SFC_{diesel}	kg/km		Monitored
Net calorific value of diesel fuel	NCV_{diesel}	MJ/kg		IPCC2006
Emission factor of diesel fuel	EF_{diesel}	tCO_2 /MJ		IPCC2006
Specific fuel consumption of CNG bus	SFC_{CNG}	kg/km		Estimated
Correction factor for CNG specific fuel consumption	CF	-		
Net calorific value of CNG	NCV_{CNG}	MJ/kg		IPCC2006
Emission factor of CNG	EF_{CNG}	tCO_2 /MJ		IPCC2006

Project name: BRT Line 1 project

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

CO_2 emission is reduced through mode shift of passenger transportation from the existing means of transportation such as private cars and motorcycles to BRT. BRT systems are more efficient than private cars in terms of CO_2 emission per passenger-km.

2) Methodology to calculate GHG emission reduction

A simple methodology was developed for this project as below, by simplifying the CDM methodology "ACM0016 Mass rapid transit projects."

$$\boldsymbol{BE_y = \sum_i \left(PKM_y \times MS_{i,y} \times EF_{PKM,i} \times 10^{-6} \right)}$$

$$\boldsymbol{PKM_y = P_y \times TD_y}$$

$$\boldsymbol{EF_{PKM,i} = \frac{EF_{KM,i}}{OC_i}}$$

$$\boldsymbol{PE_y = FC_y \times NCV_{CNG} \times EF_{CNG}}$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$

BE_y	Baseline emission in year *y* (tCO_2/year)
PE_y	Project emission in year *y* (tCO_2/year)
ER_y	Emission reduction in year *y* (tCO_2/year)

Monitoring Parameters:

PKM_y	Transported volume by BRT in year y (passenger km/year)
P_y	Number of passenger of BRT in year y (passenger/year)
TD_y	Average trip distance of the passenger of BRT in year y (km)
FC_y	CNG consumption by BRT buses in year y (ton/year)
i	1; Passenger car, 2; Bus, 3; Motorcycle, etc.

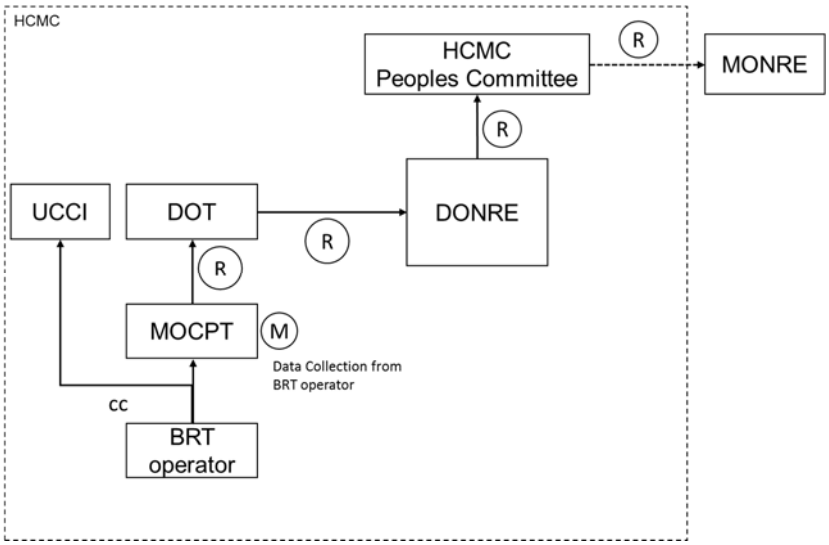
Fixed Parameters:

$MS_{i,y}$	Share of passengers using transport mode i in the baseline in year y
$EF_{PKM,i}$	CO_2 emission factor per passenger kilometer for transport mode i (gCO_2/passenger-km)
$EF_{KM,i}$	CO_2 emission factor of transport mode i (gCO_2/km)
OC_i	Average occupation rate of transport mode i (passenger/vehicle)
NCV_{CNG}	Net calorific value of CNG (MJ/kg)
EF_{CNG}	Emission factor of CNG (tCO_2/MJ)

3) Estimated GHG emission reduction

1,682 tCO_2/year

4) Organizational structure for monitoring and reporting



5) Monitoring period

Starts from January 1st 2021.

6) Monitoring methods

Monitoring parameters

Parameter	Monitoring method	Person/position in charge	Site
PKM_y Transported volume by BRT in year y (passenger km/year)	· The data is provided by the BRT operator. · The operator monitors/analyzes the data daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are compiled to obtain the annual transported volume.	MOCPT receives the data from the BRT operator	N/A
P_y Number of passenger of BRT in year y (passenger/year)	· Use this parameter, if PKM_y is not obtained directly · The data is provided by the BRT operator. · The operator monitors/analyzes the data BRT daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are summed up to obtain the annual number.	MOCPT receives the data from the BRT operator	N/A
TD_y Average trip distance of the passenger of BRT	· Use this parameter, if PKM_y is not obtained directly. · The data is provided by the BRT operator. · The operator monitors/analyzes the data	MOCPT receives the data from the BRT operator	N/A

in year y (km)	BRT daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are averaged to obtain the annual average trip distance.		
FC_y CNG consumption by BRT buses in year y (ton/year)	· The data is provided by the BRT operator. · The operator monitors the consumption through direct measurement (by fuel meter) or invoice from the fuel company monthly. · The monthly data are summed up to obtain the annual consumption.	MOCPT receives the data from the BRT operator	N/A

Fixed parameter

Parameter	Source	Value
$MS_{i,y}$ Share of passengers using transport mode i in the baseline in year y	· Interview survey to passenger of BRT. Necessary number of samples should be taken. For the sample size and questionnaire, the CDM methodology "ACM0016 Mass rapid transit projects[1]" can be referred to. · Interview survey should be carried out once after the project starts. (Motorbike 41.6%, passenger car 7.9%, coach 8.3%, bus 38.7%, taxi 3.0% (Source: BRT FS report))	See "Source"
$EF_{PKM,i}$ CO_2 emission factor per passenger kilometer for transport mode i (gCO_2/passenger-km)	Motorbike 66, passenger car 142, coach 25, bus 25, taxi 82 (Source: New Mechanism Feasibility Study 2011 – Final Report, New Mechanism Feasibility Study for Development of Mass Rapid Transit (MRT) Systems in Jakarta, Indonesia, and Hanoi and Ho Chi Minh, Viet Nam., Mitsubishi Research Institute, Inc.)	See "Source"
$EF_{KM,i}$ CO_2 emission factor of transport mode i (gCO_2/km)	Use national or local values, in case $EF_{PKM,i}$ are not available.	-
OC_i Average occupation rate of transport mode i (passenger/vehicle)	Use national or local values or carry out a survey, in case $EF_{PKM,i}$ are not available.	-
NCV_{CNG} Net calorific value of CNG (MJ/kg)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory"	48.0

[1] https://cdm.unfccc.int/methodologies/DB/FXQBDV16UML49NJN03U1QQTEY9J90E

EF_{CNG} Emission factor of CNG (tCO_2/MJ)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory"	0.0000561

(2) Result of monitoring activities

Note: The following descriptions are based on the hypothetical data for this case study. Actual monitoring will start right after the operation of BRT starts.

1) Monitoring period

The 1st year after the operation starts.

2) Emission reductions of the monitoring period

1,700 tCO_2/year

3) Processes of the emission reduction calculation

Number of the passengers of BRT in the year is 11,026,650 and the average trip distance of the passenger of BRT in the year is 7.5km, thus transported volume by BRT in the year is 82,699,875 passenger-km/year. Share of the passengers using previous transport mode and CNG consumption by BRT buses are same as ex-ante estimation.

Emission reduction is calculated as follows:

$$\boldsymbol{PKM_y = P_y \times TD_y = 1,1026,650 \times 7.5 = 82,699,875}$$

$$\boldsymbol{BE_y = \sum_i \left(PKM_y \times MS_{i,y} \times EF_{PKM,i} \times 10^{-6}\right)}$$

$$= 82{,}699{,}875 \times (0.416 \times 0.000066 + 0.079 \times 0.000412 + 0.083 \times 0.000025 + 0.387 \times 0.000025 + 0.0030 \times 0.000082)$$

$$= \boldsymbol{4,374}$$

$$\boldsymbol{PE_y = FC_y \times NCV_{CNG} \times EF_{CNG}}$$

$$= 993 \times 48{,}000 \times 0.0000561$$

$$= 2{,}674$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$= 1{,}700\ tCO_2/\text{year}$$

(3) GHG emission reduction calculation sheet

(Draft) Emission reduction estimation sheet for BRT project

Emission Reduction

Description	Parameter		Value	Unit
Emission reduction	ER_y			tCO_2 /year
Baseline emission	BE_y			tCO_2 /year
Project emission	PE_y			tCO_2 /year

Inputs

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Description	Parameter		Value	Unit	Data source
Number of passenger of the project activity in year y	P_y			passenger/year	
Average trip distance of the passenger of BRT in year y	TD_y			km	
Use of default value of CO_2 emission factor per passenger-km	-		No		
Number of transportation mode in the baseline	-		5		
CO_2 emission factor per passenger kilometer for transport mode i	$EF_{PKM,i}$	Bike		tCO_2 /passenger-km	
		Passenger car		tCO_2 /passenger-km	
		Minibus		tCO_2 /passenger-km	
		Bus		tCO_2 /passenger-km	
		Other1		tCO_2 /passenger-km	
		Other2		tCO_2 /passenger-km	
Share of passengers by transport mode i in the baseline in year y	$MS_{i,y}$	Bike		%	
		Passenger car		%	
		Minibus		%	
		Bus		%	
		Other1		%	
		Other2		%	
CNG consumption by BRT buses in year y	FC_y			t/year	
CO_2 emission factor of CNG	EF_{CNG}			tCO_2 /MJ	
Net calorific value of CNG	NCV_{CNG}			MJ/t	

Project name: MRT Line 1 project

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

CO_2 emission is reduced through mode shift of passenger transportation from the existing means of transportation such as private cars, local conventional buses and motorcycles to MRT. MRT systems are more efficient than private cars in terms of CO_2 emission per passenger-km.

2) Methodology to calculate GHG emission reduction

A simple methodology was developed for this project as below, by simplifying the CDM methodology "ACM0016 Mass rapid transit projects."

$$\boldsymbol{BE_y = \sum_i \left(PKM_y \times MS_{i,y} \times EF_{PKM,i} \times 10^{-6} \right)}$$

$$\boldsymbol{PKM_y = P_y \times TD_y}$$

$$\boldsymbol{EF_{PKM,i} = \frac{EF_{KM,i}}{OC_i}}$$

$$\boldsymbol{PE_y = EC_y \times EF_{grid}}$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$

BE_y	Baseline emission in year *y* (tCO_2/year)
PE_y	Project emission in year *y* (tCO_2/year)
ER_y	Emission reduction in year *y* (tCO_2/year)

Monitoring Parameter:

PKM_y	Transported volume by MRT in year y (passenger km/year)
$MS_{i,y}$	Share of passengers using transport mode i in the baseline in year y
P_y	Number of passenger of MRT in year y (passenger/year)
TD_y	Average trip distance of the passenger of MRT in year y (km)
EC_y	Grid electricity consumption by MRT in year y (MWh/year)
i	1; Passenger car, 2; Bus, 3; Motorcycle, etc.

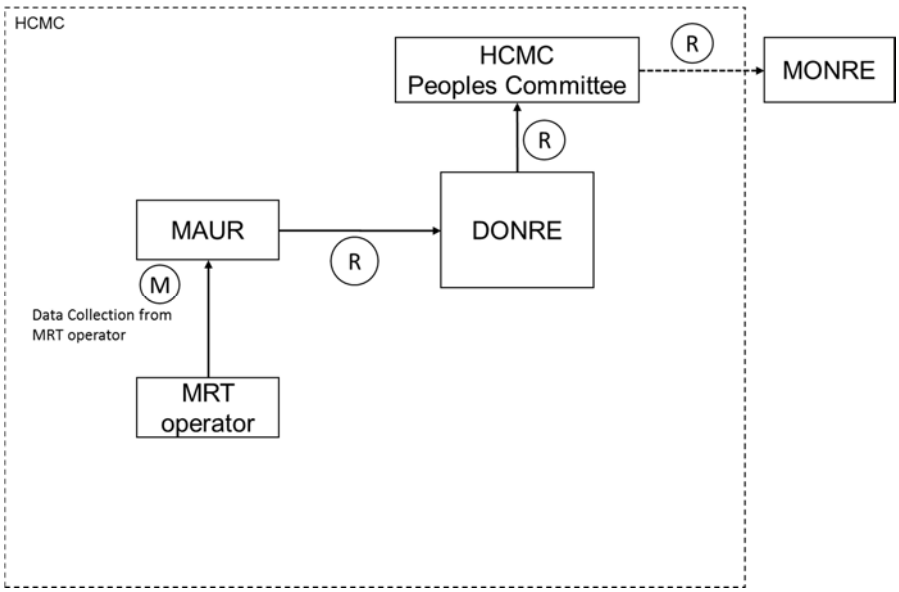
Fixed Parameter:

$EF_{PKM,i}$	CO_2 emission factor per passenger kilometer for transport mode i (gCO_2/passenger-km)
$EF_{KM,i}$	CO_2 emission factor of transport mode i (gCO_2/km)
OC_i	Average occupation rate of transport mode i (passenger/vehicle)
EF_{grid}	CO_2 emission factor of grid electricity (tCO_2/MWh)

3) Estimated GHG emission reduction

110,095 tCO_2/year

4) Organizational structure for monitoring and reporting



5) Monitoring period

Starts from January 1st 2021.

6) Monitoring methods

Monitoring parameters

Parameter	Monitoring method	Person/position in charge	Site
PKM_y Transported volume by MRT in year y (passenger km/year)	· The data is provided by the MRT operator. · The operator monitors/analyzes the data daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are compiled to obtain the annual transported volume.	MAUR receives the data from the MRT operator	N/A
P_y Number of passenger of MRT in year y (passenger/year)	· Use this parameter, if PKM_y is not obtained directly · The data is provided by the MRT operator. · The operator monitors/analyzes the data MRT daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are summed up to obtain the annual number.	MAUR receives the data from the MRT operator	N/A
TD_y Average trip distance of the passenger of MRT in year y (km)	· Use this parameter, if PKM_y is not obtained directly · The data is provided by the MRT operator. · The operator monitors/analyzes the data MRT daily or monthly through ticketing system such as IC card system (This is done as their routine works). · The daily or monthly data are averaged to obtain the annual average trip distance.	MAUR receives the data from the MRT operator	N/A

EC_y Grid electricity consumption by MRT in year y (MWh/year)	· The data is provided by the MRT operator. · The operator monitors the consumption through direct measurement (by electric power meter) or invoice from the power company monthly. · The monthly data are summed up to obtain the annual consumption.	MAUR receives the data from the MRT operator	N/A

Fixed parameter

Parameter	Source	Value
$MS_{i,y}$ Share of passengers using transport mode i in the baseline in year y	· Interview survey to passengers of MRT. Necessary number of samples should be taken. For the sample size and questionnaire, the CDM methodology "ACM0016 Mass rapid transit projects[2]" can be referred to. · Interview survey should be carried out once after the project starts. (Motorbike 89.9%, passenger car 2.8 %, bus 7.3 % (Source: New Mechanism Feasibility Study 2011 – Final Report, New Mechanism Feasibility Study for Development of Mass Rapid Transit (MRT) Systems in Jakarta, Indonesia, and Hanoi and Ho Chi Minh, Viet Nam., Mitsubishi Research Institute, Inc.)	See "Source"
$EF_{PKM,i}$ CO_2 emission factor per passenger kilometer for transport mode i (gCO_2/passenger-km)	Motorbike 66, passenger car 142, coach 25, bus 25, taxi 82 (Source: New Mechanism Feasibility Study 2011 – Final Report, New Mechanism Feasibility Study for Development of Mass Rapid Transit (MRT) Systems in Jakarta, Indonesia, and Hanoi and Ho Chi Minh, Viet Nam., Mitsubishi Research Institute, Inc.)	See "Source"
$EF_{KM,i}$ CO_2 emission factor of transport mode i (gCO_2/km)	Use national or local values, in case $EF_{PKM,i}$ are not available.	-
OC_i Average occupation rate of transport mode i (passenger/vehicle)	Use national or local values or carry out a survey, in case $EF_{PKM,i}$ are not available.	-
EF_{grid} CO_2 emission factor of grid electricity (tCO_2/MWh)	The latest official EF provided by MONRE in May 2016.	0.66

[2] https://cdm.unfccc.int/methodologies/DB/FXQBDV16UML49NJN03U1QQTEY9J90E

(2) Result of monitoring activities

1) Monitoring period

The 1st year after the operation starts.

2) Emission reductions of the monitoring period

121,744 tCO_2/year

3) Processes of the emission reduction calculation

The number of passengers of the MRT in the year is assumed as 116,800,000 and the average trip distance of the passengers of MRT in the year is 20 km, thus transported volume by MRT in the year is 2,336,000,000 passenger-km/year. Share of the passengers using previous transport mode and electricity consumption by MRT are same as the ex-ante estimation.

Emission reduction is calculated as follows:

$$\boldsymbol{PKM_y = P_y \times TD_y = 116,800,000 \times 20 = 2,336,000,000}$$

$$\boldsymbol{BE_y = \sum_i \left(PKM_y \times MS_{i,y} \times EF_{PKM,i} \times 10^{-6}\right)}$$

$$= 2{,}336{,}000{,}000 \times (0.899 \times 0.000066 + 0.028 \times 0.000142 + 0.073 \times 0.000025)$$

$$= 152{,}155$$

$$\boldsymbol{PE_y = EC_y \times EF_{grid}}$$

$$= 46{,}078 \times 0.66$$

$$= 30{,}411$$

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$= 121{,}744\ tCO_2/year$$

(3) GHG emission reduction calculation sheet

(Draft) Emission reduction estimation sheet for MRT project

Emission Reduction

Description	Parameter		Value	Unit
Emission reduction	ER_y			tCO_2/year
Baseline emission	BE_y			tCO_2/year
Project emission	PE_y			tCO_2/year

Inputs

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Description	Parameter		Value	Unit	Data source
Number of passenger of the project activity in year y	P_y			passenger/year	
Average trip distance of the passenger of BRT in year y	TD_y			km	
Use of default value of CO_2 emission factor per passenger-km	-		No		-
Number of transportation mode in the baseline	-		6		-
CO_2 emission factor per passenger kilometer for transport mode i	$EF_{PKM,i}$	Bike		tCO_2/passenger-km	
		Passenger car		tCO_2/passenger-km	
		Minibus		tCO_2/passenger-km	
		Bus		tCO_2/passenger-km	
		Other1		tCO_2/passenger-km	
		Other2		tCO_2/passenger-km	
Share of passengers by transport mode i in the baseline in year y	$MS_{i,y}$	Bike		%	
		Passenger car		%	
		Minibus		%	
		Bus		%	
		Other1		%	
		Other2		%	
Annual electricity consumption associated with the operation of the project activity in year y	$EC_{PJ,y}$			MWh/year	
CO_2 emission factor of the grid electricity	EF_{elec}			tCO_2/MWh	

<Waste sector>

Project name: Electricity Generation at Go Cat Landfill

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

- CH_4 emission is avoided, which would be generated by organic decay in landfill, through collecting such methane gas and utilizing it as energy source.
- CO_2 emission is also reduced through producing electricity by using the collected methane gas from landfill that displaces fossil fuel consumption at grid-connected thermal power plants.

2) Methodology to calculate GHG emission reduction

The following approved CDM methodologies were referred to:

- CDM methodology AMS-III.G "Landfill methane recovery" Version 09.0
- CDM methodology AMS-I.D "Grid connected renewable electricity generation" Version 18.0

The applied methodology estimates the amount of CH_4 emissions avoided by using the expected quantity of electricity generated by the plant, rather than using First Order Decay (FOD) model. Applied equations and description of each parameter is as below.

$$\boldsymbol{ER_y = BE_y - PE_y} \quad \text{(Equation 1)}$$

$$\boldsymbol{BE_y = BE_{1,y} + BE_{2,y}} \quad \text{(Equation 2)}$$

$$\boldsymbol{BE_{1,y} = (1 - OX) \times F_{CH4,PJ,y} \times GWP_{CH4}} \quad \text{(Equation 3)}$$

$$\boldsymbol{BE_{2,y} = EG_{PJ,y} \times EF_{grid,y}} \quad \text{(Equation 4)}$$

$F_{CH4, PJ, y}$	Volume of methane gas collected from landfill (m^3/year)
GWP_{CH4}	Global Warming Potential for methane
$EG_{PJ,y}$	Quantity of electricity generated by the project in year y (MWh/ year)
$EF_{grid,y}$	CO_2 emission factor of electricity grid in year y (t-CO_2/MWh)

$$\boldsymbol{F_{CH4,PJ} = \frac{EG_{PJ,y} \times 3600}{NCV_{CH4} \times EF} \times D_{CH4} \times GWP_{CH4}} \quad \text{(Equation 5)}$$

$EG_{PJ,y}$	Electricity generated by the project in year y (MWh)
D_{CH4}	Density of methane of the landfill gas in year y (ton of methane/m^3 of landfill gas)
GWP_{CH4}	Global Warming Potential (GWP) of methane
NCV_{CH4}	Net calorific value of methane (MJ/Nm^3)
EE_y	Energy Conversion Efficiency

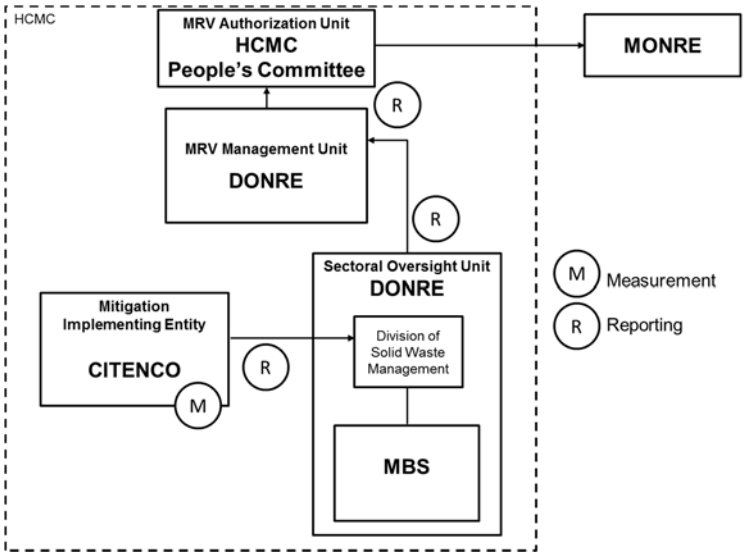
$$\boldsymbol{PE_y = EC_{PJ,y} \times EF_{grid,y}} \quad \text{(Equation 6)}$$

$EC_{PJ,y}$	Quantity of electricity consumed by the project in year y (MWh/year)

3) Estimated GHG emission reduction

462 ton-$CO_{2equivalent}$

4) Organizational structure for monitoring and reporting



5) Monitoring period

From 1 January 2016 to 31 December 2016

6) Monitoring methods

- Monitoring parameters

Parameters listed in the following table will be monitored during the monitoring period.

Monitoring method described below will be applied.

Parameter	Monitoring method	Person/position in charge	Site
$EG_{PJ,y}$ Electricity generated by the project in year y (MWh)	Monitored daily by reading an electricity meter that is equipped at the power plant and records the MWh data on the paper or electronically. Recorded data is shared with head office daily.	Technical staff of the power plant	Onsite (at the project site)
$EC_{PJ,y}$ Quantity of electricity consumed by the project in year y (MWh/yr)	Calculated monthly based on the rated output of all machineries and office equipment that are used for power plant operation. Hours of usage for each equipment are recorded and used for calculation.	Technical staff of the power plant	Onsite (at the project site)

- Fixed parameters

Parameters listed in the following table will not be monitored during the monitoring period. Fixed value will be applied throughout the project timeframe.

Parameter	Source	Value
$EF_{grid,y}$ CO_2 emission factor of electricity	Official data published by MONRE	0.6612 t-CO_2/MWh

grid in year y (t CO_2 /MWh)		
OX Oxidation factor	Default value (CDM methodology)	0.1
NCV_{CH4} Net calorific value of methane	Default value (IPCC Guidelines)	35.9 MJ/Nm^3
EE_y Energy Conversion Efficiency of the project equipment	Default value (CDM methodology)	40 %
D_{CH4} Density of methane in the landfill gas (ton/ m3)	Default value (CDM methodology)	0.716 kg/m^3
GWP_{CH4} Global Warming Potential of methane	Default value (IPCC Guidelines)	25

(2) Result of monitoring activities

1) Monitoring period

1 January 2016 to 30 July 2016

(The power plant did not operate from August 2016 until the end of 2016 due to the work associated with upgrading of EVN transmission line)

2) Emission reductions of the monitoring period

249 tons-$CO_{2\text{-equivalent}}$

3) Processes of the emission reduction calculation

Calculation of the GHG emission reductions was performed as below.

$$F_{CH4,PJ} = \frac{EG_{PJ,y} \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \quad \text{(Equation 5)}$$

= (54.737 × 3,600) / (35.9 × 0.4) × 0.716
= 9.83

$$BE_{1,y} = (1 - OX) \times F_{CH4,PJ,y} \times GWP_{CH4} \quad \text{(Equation 3)}$$

= 0.9 × 9.83 × 25
= 221

$$BE_{2,y} = EG_{PJ,y} \times EF_{grid,y} \quad \text{(Equation 4)}$$

= 54,737 × 0.6612
= 36

$$BE_y = BE_{1,y} + BE_{2,y} \quad \text{(Equation 2)}$$

= 221 + 36
= 257

$$PE_y = EC_{PJ,y} \times EF_{grid,y} \quad \text{(Equation 6)}$$

= 12 × 0.6612

= 8

$$ER_y = BE_y - PE_y$$ (Equation 1)=

= 257 - 8

= 249 ton$CO_{2\text{-equivalent}}$ /year

Data monitored by Mitigation Implementing Entity

	$EG_{PJ,y}$	$EC_{PJ,y}$
Jan	34,974	2.4
Feb	11,314	2.4
Mar	2,906	2.4
Apr	-	-
May	4,370	2.4
Jun	1,173	2.4
Total	54,737	12.0

(3) GHG emission reduction calculation sheet

Emission Reduction

Description	Parameter	Unit	Value
Emission reductions	ER_y	tCO_{2e}/year	**249**
Baseline emissions	BE_y	tCO_{2e}/year	257
Baseline emissions for CH_4	$BE_{1,y}$	tCO_{2e}/year	221
Baseline emissions for CO_2	$BE_{2,y}$	tCO_{2e}/year	36
Project emissions	PE_y	tCO_{2e}/year	8

Inputs

Description	Parameter	Unit	Value	Data source
Electricity generated by the project in year y	$EG_{PJ,y}$	MWh	54.737	Monitored
Quantity of electricity consumed by the project in year y	$EC_{PJ,y}$	MWh/ year	12	Monitored
CO2 emission factor of electricity grid in year y	$EF_{grid,y}$	t-CO2 /MWh	0.661	MONRE
Oxidation factor	OX	-	0.1	Methodology default
Net calorific value of methane	NCV_{CH4}	MJ/Nm3	35.9	IPCC Guidelines
Energy Conversion Efficiency of the project equipment	EE_y	%	40.0	Methodology default
Density of methane in the landfill gas	D_{CH4}	ton/ m3	0.716	Methodology default
Global Warming Potential of methane	GWP_{CH4}	-	25.0	IPCC Guidelines

Project name: Animal Manure Collection and Biogas Recovery at Small Farms

(1) Information on the MRV framework and involved organizations, the applied methodologies

1) Logic of GHG emission reduction

CH_4 emission is avoided through collecting and utilizing organic waste (animal manure) that would be abandoned in the field for organic decay.

CO_2 emission is reduced through avoiding the use of fossil fuels for cooking.

2) Methodology to calculate GHG emission reduction

Following approved CDM methodologies were referred to:

- AMS-III.R "Methane recovery in agricultural activities at household/small farm level"
- AMS-III.D "Methane recovery in animal manure management systems"

$$\boldsymbol{ER_y = BE_y - PE_y} \quad \text{(Equation 1)}$$

ER_y : GHG emissions reduction from the project in year y (ton-CO_{2e}/year)

BE_y : GHG emissions at baseline case without project activity (ton-CO_{2e}/year)

PE_y : GHG emissions from project activity (ton-CO_{2e}/year)

$$\boldsymbol{BE_y = BE_{1,y} + BE_{2,y}} \quad \text{(Equation 2)}$$

$BE_{1,y}$: GHG emissions (CH_4) at baseline case from disposed animal manure (ton-CO_{2e}/year)

$BE_{2,y}$: GHG emissions (CO_2) at baseline case from the consumption of fossil fuels currently used (ton-CO_{2e}/year)

$$\boldsymbol{BE_{1,y} = \sum \frac{(EF_{(T)} \times N_{(T)})}{10^3} \times GWP_{CH4}} \quad \text{(Equation 3)}$$

$EF_{(T)}$: Methane emission factor for livestock (kg CH_4/ head/ year)

$N_{(T)}$: Number of head of livestock (swine)

GWP_{CH4} : Global Warming Potential (GWP) of methane =25

$$\boldsymbol{BE_{2,y} = \sum BG_{PJ,y} \text{x } NCV \times EF_{PJ,y} \times 1/10^6} \quad \text{(Equation 4)}$$

$BG_{PJ,y}$: Quantity of fuel consumed by household without using biogas (kg/year)

NCV : Heating value of fuel (MJ/kg)

$EF_{PJ,y}$: CO_2 emission factor of fossil fuel (t-CO_2/MJ)

$$\boldsymbol{PE_y = 0.1 \times BE_{1,y}} \quad \text{(Equation 5)}$$

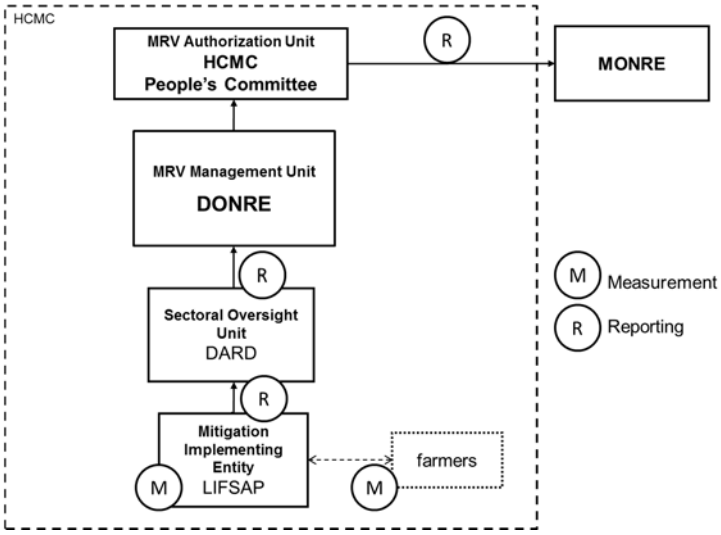
PE_y : GHG emissions from project activity (ton-CO_{2e}/year)

0.1 : Physical leakage of biogas from the animal manure management system to produce, collect and transport the biogas (fraction)

3) Estimated GHG emission reduction

6,862 ton-$CO_{2equivalent}$

4) Organizational structure for monitoring and reporting



5) Monitoring period

From 1 January 2017 to 31 March 2017

6) Monitoring methods

- Monitoring parameters

Parameters listed in the following table will be monitored during the monitoring period.

Parameter	Monitoring method	Person/position in charge	Site
$N_{(T)}$ Number of head of livestock (swine)	Number of head at households is counted by sample livestock farmers to yield average number. Number of samples will be large enough to represent the whole target households. Considering the large size of the target group and difficulty of frequent data collection, above information will be monitored every 3 month	Technical staff of LIFSAP project	Onsite (sample households)
$BG_{PJ,y}$ Quantity of fuel consumed by household instead of using biogas (kg/year)	Calculated based on the average capacity and quantity of cooking device used by target households, and average yearly cooking hours per household. Above information is collected by interview survey from the sufficient number of households that represent the entire target group. Considering the large size of the target group and difficulty of frequent data collection, above information is monitored every 3 month.	Technical staff of LIFSAP project	N/A

- Fixed parameters

Parameters listed in the following table will not be monitored during the monitoring period. Fixed value will be applied throughout the project timeframe.

Parameter	Source	Value
$EF_{(T)}$ Methane emission factor for livestock (kg CH_4/ head/ year)	Default value (IPCC Guidelines) Value for more than 28C average annual temperature is applied.	7 kg CH_4/ head/ year
GWP_{CH4} Global Warming Potential of methane	Default value (IPCC Guidelines)	25
NCV Net calorific value of fuel that would be used for cooking instead of biogas (MJ/ kg)	Default value (IPCC Guidelines) Value of LPG is applied.	47.3 MJ/ kg
$EF_{PJ,y}$ CO_2 emission factor of fuel that would be used for cooking instead of biogas (t-CO_2/MJ)	Default value (CDM methodology) Value of LPG is applied.	63.1 t-CO_2/MJ

(2) Result of monitoring activities

1) Monitoring period

From 1 January 2017 to 31 March 2017

2) Emission reductions of the monitoring period

1,716 tons-$CO_{2\text{-equivalent}}$

3) Processes of the emission reduction calculation

$$\boldsymbol{BE_{1,y}} = \sum_T \frac{(\boldsymbol{EF_{(T)}} \times \boldsymbol{N_{(T)}})}{\boldsymbol{10^3}} \times \boldsymbol{GWP_{CH4}} \quad \text{(Equation 3)}$$

= 844 x 7 x 45 / 10^3 x 25

= 6,647

$$\boldsymbol{BE_{2,y}} = \boldsymbol{BG_{PJ,y}} \text{x } \boldsymbol{NCV} \times \boldsymbol{EF_{PJ,y}} \times \boldsymbol{1/10^6} \quad \text{(Equation 4)}$$

= 844 x 349.7 x 47.3 x 63.1 / 10^6

= 881

$$\boldsymbol{PE_y} = \boldsymbol{0.1} \times \boldsymbol{BE_{1,y}} \quad \text{(Equation 5)}$$

= 0.1 x 6,646.5

= 665

$$BE_y = BE_{1,y} + BE_{2,y}$$ (Equation 2)

= 6,647 + 881.03

= 7,527

$$ER_y = BE_y - PE_y$$ (Equation 1)

= 7,527 – 665

= 6,863 (ton-$CO_{2\text{-equivalent}}$/ year)

= 1,716 (ton-CO_{2e}) (during the 3-month monitoring period)

(3) GHG emission reduction calculation sheet

Emission Reduction

Description	Parameter	Unit	Value
Emission reductions	ER_y	tCO_{2e}/year	**6,863**
Emission reductions (for 3-month monitoring period)	ER_y	tCO_{2e}	**1,716**
Baseline emissions	BE_y	tCO_{2e}/year	**7,527**
Baseline emissions (CH_4) from disposed animal manure	$BE_{1,y}$	tCO_{2e}/year	6,647
Baseline emissions (CO_2) from the consumption of fossil fuels	$BE_{2,y}$	tCO_{2e}/year	881
Project emissions	PE_y	tCO_{2e}/year	**665**

Inputs

Description	Parameter	Unit	Value	Data source
Number of head of livestock (swine)	$N_{(T)}$	head	37,980	Monitored
Quantity of fuel consumed by household instead of using biogas	$BG_{PJ,y}$	kg/year	295,147	Monitored
Methane emission factor for livestock	$EF_{(T)}$	kg CH_4/ head/ year	7	Methodology default
Global Warming Potential of methane	GWP_{CH4}	-	25	IPCC Guidelines
Net calorific value of fuel that would be used for cooking instead of biogas	NCV	MJ/ kg	47.3	IPCC Guidelines
CO_2 emission factor of fuel that would be used for cooking instead of biogas	$EF_{PJ,y}$	t-CO_2/MJ	63.1	IPCC Guidelines (value for LPG)

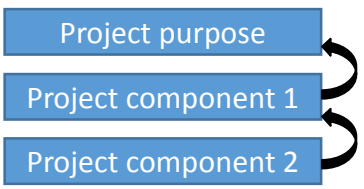
Annex 2
Newsletter

Project to Support the Planning and Implementation of NAMAs in a MRV Manner
Component 2 -Capacity Enhancement of Local Governments-

June 2017

Introduction

According to the National Strategy on Climate Change issued by the Prime Minister of Vietnam in December 2011, Nationally Appropriate Mitigation Actions (NAMAs) will be planned by the Ministry of Natural Resources and Environment (MONRE). In this context, a technical support project for capacity enhancement was requested to JICA. The "Project to Support the Planning and Implementation of NAMAs in a MRV Manner" (SPI-NAMA) started in January 2015. The purpose of SPI-NAMA is to enhance the capacity of the Government of Vietnam concerning the planning and implementing of NAMAs. To attain this goal, SPI-NAMA has two project components.



Project Component 1

The first project component aims to enhance the capacity of MONRE to facilitate the process of development and implementation of NAMAs. It is implemented by MONRE and the JICA Long-Term Experts.

Project Component 2

The second component aims to enhance the capacity of cities in Vietnam to quantify greenhouse gas (GHG) emissions and reductions, taking Ho Chi Minh City (HCMC) as a model city.

This component is implemented by the Climate Change Bureau (CCB), Department of Natural Resources and Environment (DONRE) of HCMC with the support of the JICA Short-Term Experts. The profile of Component 2 is shown below.

Main activities	Piloting MRV of NAMAs Preparing GHG inventory
Executive agency	DONRE-CCB of HCMC
Japanese side input	Seven Short-Term Experts
Project duration	24 months（2015-2017）
Project site	HCMC

Main activities

MRV of NAMAs

Ongoing or planned NAMAs to pilot MRV in HCMC are selected in three focused sectors. They are energy, transport and waste sectors. The baseline GHG emission at the project inception, and anticipated and actual emission reduction of selected NAMAs are quantified. Utilizing the outputs of the activities in HCMC, an MRV manual for HCMC and MRV guidelines for local governments are developed.

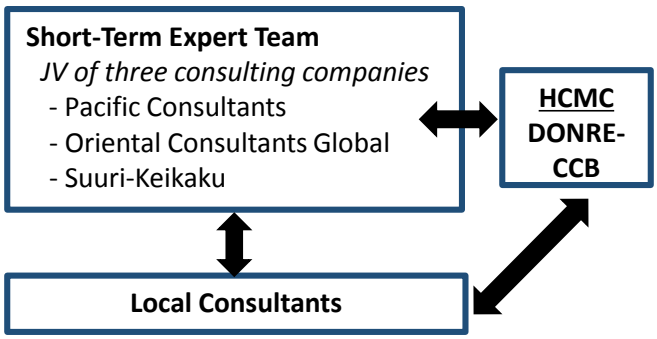
GHG Inventory

The activity data of 2013, 2014, and 2015 are collected. GHG inventory of 2013 and 2014 are developed following the Global Protocol for Community-Scale GHG Emission Inventories (GPC). The GHG inventory of 2013 is also prepared for ten sectors in the Climate Change Action Plan (CCAP) of HCMC.

Year	2013	2014	2015
Inventory format (Excel file)	Same format of excel file		
Data request	Yes	Yes	Yes
Compilation of Inventory (Based on GPC)	Yes	Yes	Optional
Compilation of Inventory (Based on 10 sectors)	Yes	Optional	Optional

Implementation structure

The seven-member JICA Short-Term Expert Team composed of three consulting firms assists the implementation of Component 2. The local consultant team represented by NIRAS-RCEE is also engaged to assist project implementation.



CCB is the main counterpart to the JICA Short-Term Expert Team. CCB was established in DONRE in 2012 to execute practical work related to climate change policy following the decisions of the Climate Change Steering Board of HCMC.

Progress to date

During the April to June 2017 period, the Short-Term Experts made two visits to Vietnam.

- Monitoring reports of the MRV pilot projects were reviewed.
- Final draft of the 2013 GHG inventory based on the GPC was prepared.
- Development of the MRV Manual and GHG Inventory Preparation Manual was continued.

MRV of NAMAs

Monitoring of the MRV pilot projects in energy, transport, and waste sectors was continued. In the meetings with the concerned organizations, the monitoring status and GHG emission reductions were reviewed and contents and procedures on the reporting were discussed. The monitoring report of "Electricity Generation at Go Cat Landfill Site", which is one of the MRV pilot projects, was prepared by the HCMC Urban Environment Company Limited (CITENCO) and reviewed with the DONRE. The monitoring report of "Introduction of CNG Bus for Public Bus Fleet" was also prepared and reviewed with the relevant organizations such as the Department of Transport (DOT), Management and Operation Center for Public Transport (MOCPT), and Saigon Bus.

Preparing GHG Inventory

The 2013 GHG inventory based on GPC was completed in all sectors: Stationary Energy, Transportation, Waste, Industrial Processes and Product Use (IPPU), and Agriculture, Forestry and Other Land Use (AFOLU).

The trial calculation of the GHG inventory based on the ten sectors of CCAP was conducted. However, the GHG emissions could not be calculated for the Water Management, Construction, Health, and Tourism sectors.

The first half of the training on GHG inventory preparation targeting ten officials of DONRE was held on 19 and 20 April. The participants calculated the GHG emissions in the Stationary Energy and Transportation sectors in 2014 in accordance with the GHG Inventory Preparation Manual, which is under development. In the second half of the training, he GHG emissions in the Waste, IPPU, and AFOLU sectors will be calculated and the 2014 GHG inventory based on GPC will be completed.

Second training in Japan

The second training in Japan was held from 21 to 27 May 2017 targeting ten officials of HCMC.

In the first half of the training, lectures on the mitigation measures implemented by the Tokyo Metropolitan Government and policies to promote mitigation actions of private companies were given. A site visit to an energy efficient building was also conducted. Many questions were raised, especially during the lectures on the Reporting Program, and Cap and Trade Program. Keen interests in these programs were shown by the participants.

In the second half of the training, site visits to a solid waste treatment plant and a waste water treatment plant were held to learn the GHG emission reduction efforts in the public sector. In the final day of the training, as an exercise, the participants made a MRV plan of a waste-to-energy project in accordance with the MRV Manual which is been development under the project.

Date	Contents
21 May	• Arrival (Narita)
22 May	• Orientation • Presentation by participants (initiatives on mitigation in HCMC) • Lecture on MRV Manual and GHG Inventory Preparation Manual of HCMC
23 May	• Lecture on mitigation actions of Tokyo Metropolitan Government • Lecture on GHG inventory of Tokyo • Lecture on Reporting Program and Cap & Trade Program
24 May	• Lecture on program to promote energy saving of private sector • Visit to energy efficient building
25 May	• Visit to waste treatment plant • Visit to waste water treatment plant
26 May	• Workshop (MRV planning) • Presentation by participants • Closing
27 May	• Departure (Narita)

Project to Support the Planning and Implementation of NAMAs in a MRV Manner
Component 2 -Capacity Enhancement of Local Governments-

September 2017

Introduction

According to the National Strategy on Climate Change issued by the Prime Minister of Vietnam in December 2011, Nationally Appropriate Mitigation Actions (NAMAs) will be planned by the Ministry of Natural Resources and Environment (MONRE). In this context, a technical support project for capacity enhancement was requested to JICA. The "Project to Support the Planning and Implementation of NAMAs in a MRV Manner" (SPI-NAMA) started in January 2015. The purpose of SPI-NAMA is to enhance the capacity of the Government of Vietnam concerning the planning and implementing of NAMAs. To attain this goal, SPI-NAMA has two project components.

Project purpose

Achieve project purpose

Project component 1

Feedback to component 1

Project component 2

Project Component 1

The first project component aims to enhance the capacity of MONRE to facilitate the process of development and implementation of NAMAs. It is implemented by MONRE and the JICA Long-Term Experts.

Project Component 2

The second component aims to enhance the capacity of cities in Vietnam to quantify greenhouse gas (GHG) emissions and reductions, taking Ho Chi Minh City (HCMC) as a model city.

This component is implemented by the Climate Change Bureau (CCB), Department of Natural Resources and Environment (DONRE) of HCMC with the support of the JICA Short-Term Experts. The profile of Component 2 is shown below.

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GHG Inventory

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Year	2013	2014	2015
Inventory format (Excel file)	Same format of excel file		
Data request	Yes	Yes	Yes
Compilation of Inventory (Based on GPC)	Yes	Yes	Optional
Compilation of Inventory (Based on 10 sectors)	Yes	Optional	Optional

Implementation structure

The seven-member JICA Short-Term Expert Team composed of three consulting firms assists the implementation of Component 2. The local consultant team represented by NIRAS-RCEE is also engaged to assist project implementation.

Short-Term Expert Team
JV of three consulting companies
- Pacific Consultants
- Oriental Consultants Global
- Suuri-Keikaku

HCMC DONRE-CCB

Local Consultants

CCB is the main counterpart to the JICA Short-Term Expert Team. CCB was established in DONRE in 2012 to execute practical work related to climate change policy following the decisions of the Climate Change Steering Board of HCMC.

Progress to date

During the July to September 2017 period, the Short-Term Experts made three visits to Vietnam.

- Training on climate change mitigation for HCMC officials was held.
- Second consultation meeting on the GHG Inventory Preparation Manual and MRV Manual were held.
- Final draft of the manuals has been agreed with CCB. The manuals will be completed after the final check.

MRV of NAMAs

The second consultation meeting on the MRV Manual was held on 11 July 2017 in HCMC. Forty people from departments of HCMC, districts, public companies, and universities participated in the meeting. More than 40 comments and questions were raised. Those included comments on the necessity of incentives or binding rules for MRV implementation, and the importance of consistency with the national MRV institutions.

The outline of the MRV Manual and lessons learned through the MRV trials were presented in a seminar organized by MONRE. Officials of MONRE as well as those of the Ministry of Construction and Ministry of Transport participated in the seminar.

(Consultation meeting)

Preparing GHG Inventory

The second consultation meeting on the GHG Inventory Preparation Manual was held on 12 July 2017. Around 30 people from HCMC departments, districts, public companies, and universities participated in the meeting. Around 60 comments and questions were raised including those on double counting of the GHG emissions, software to calculate the emissions, and preparation process of GHG inventory.

The second half of the training on GHG inventory preparation for officials of DONRE was held on 27 July and 1-2 August. The participants calculated the GHG emissions in the Waste, IPPU, and AFOLU sectors in 2014 in accordance with the GHG Inventory Preparation Manual, which is under finalization. As the emissions in other sectors were calculated in the first half of the training in this April, the calculation for all sectors in the 2014 GHG inventory based on GPC was completed in this training.

Second General Training on Climate Change Mitigation for HCMC Officials

The Second General Training on Climate Change Mitigation for HCMC Officials was held from 5 to 7 July 2017 in HCMC. Around 80 people participated in the training from departments of HCMC, districts, public companies, and universities.

Lectures on climate change mitigation, NAMA, MRV, and GHG inventory were given in the first and second days of the training (Part A). Lectures were given by MONRE and C40 as well.

In the third day (Part B), participants made MRV plans of energy saving project, urban railway project and waste-to-energy project as an group exercise. The participants did the MRV planning in accordance with the MRV Manual which is under finalization. JICA experts and local consultants joined in each group and provided advice. After the exercise, each group presented the MRV plans and discussion was held. Many questions and comments were raised during the lectures and workshop. The participants showed a very positive attitude towards the training.

Taskforce meeting of Climate Change Steering Board (CCSB)

Discussion was held with the concerned organizations on the GHG Inventory Preparation Manual and MRV Manual in the taskforce meeting of CCSB on 29 August 2017. Fourteen people participated in the meeting from ten organizations: DONRE, Department of Agriculture and Rural Development, Department of Planning and Investment, Department of Zoning and Architecture, Department of Science and Technology, Department of Transport, Department of Construction, Steering Committee for Flood Control Program, Department of Industry and Trade, and HCMC Institute for Development Studies.

Project to Support the Planning and Implementation of NAMAs in a MRV Manner
Component 2 -Capacity Enhancement of Local Governments-

November 2017

Introduction

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Local Consultants

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Summary of Project Activities

The final seminar was held on 26 October 2017 in HCMC and all project activities in Vietnam were closed. The seven experts visited Vietnam 21 times and worked for 773 days in total since the project started in September 2015.

Piloting MRV

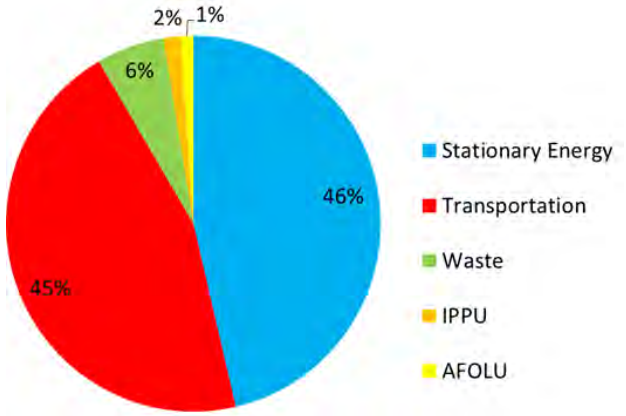
The MRV trials were implemented for three to 12 months targeting seven projects in the energy, transport, and waste sectors. The MRV trials were implemented in collaboration with the implementing body and relevant organizations of those projects

Development of MRV Manual

The MRV Manual was developed with the aim to assist HCMC to conduct MRV of mitigation measures continuously into the future. The manual was completed through successive discussions with CCB and two consultation meetings with the relevant organizations. The outcomes of the MRV trials are reflected in the manual.

Preparation of GHG inventory

The GHG inventory of HCMC for the year 2013 was prepared. The GHG emissions of HCMC in 2013 were calculated to be around 38.5 million tCO2e. The data to prepare GHG inventory was provided by 11 organizations of HCMC.



GHG Emissions and Removals by Sector in HCMC

Development of GHG Inventory Preparation Manual

The GHG Inventory Preparation Manual was developed with the aim to assist HCMC to prepare the GHG inventories continuously into the future. The manual primarily describes the steps to prepare the GHG inventory of HCMC, however, a greater portion of the manual can be also used in other cities and provinces.

Training and Seminars

General Training on Climate Change Mitigation

The General Training on Climate Change Mitigation for HCMC officials was held in 2016 and 2017. The lectures on climate change mitigation measures, MRV, and GHG inventory were given and a workshop was conducted. The first training was held for four days and the second for three days. Around 90 and 70 people participated respectively from departments of HCMC, districts, companies, and institutes.

Training in Japan

The training in Japan was held for one week in 2016 and 2017. Thirteen people participated in the first training and ten in the second. The participants were the officials of the organizations concerned with the project. They visited Tokyo Metropolitan Government and Osaka city to learn the mitigation actions of those cities. The training was good opportunity for CCB and experts to establish a strong relationship with participants who were at various positions of various organizations.

Final Seminar

The final seminar to report the achievements of the project was held on 26 October 2017 in HCMC. The presentations were made by the experts, CCB and relevant organizations, regarding the GHG inventory, two manuals, lessons learned through the MRV trials and experience of the training in Japan. The way forward for climate change mitigation actions in HCMC was also presented by CCB. With this final seminar, all project activities in Vietnam were closed.

Annex 3
Material of Second Consultation Meeting

Project to Support the Planning and Implementation of NAMAs in a MRV Manner

Consultation Meeting on MRV Manual

11 July 2017

SPI-NAMA: Background

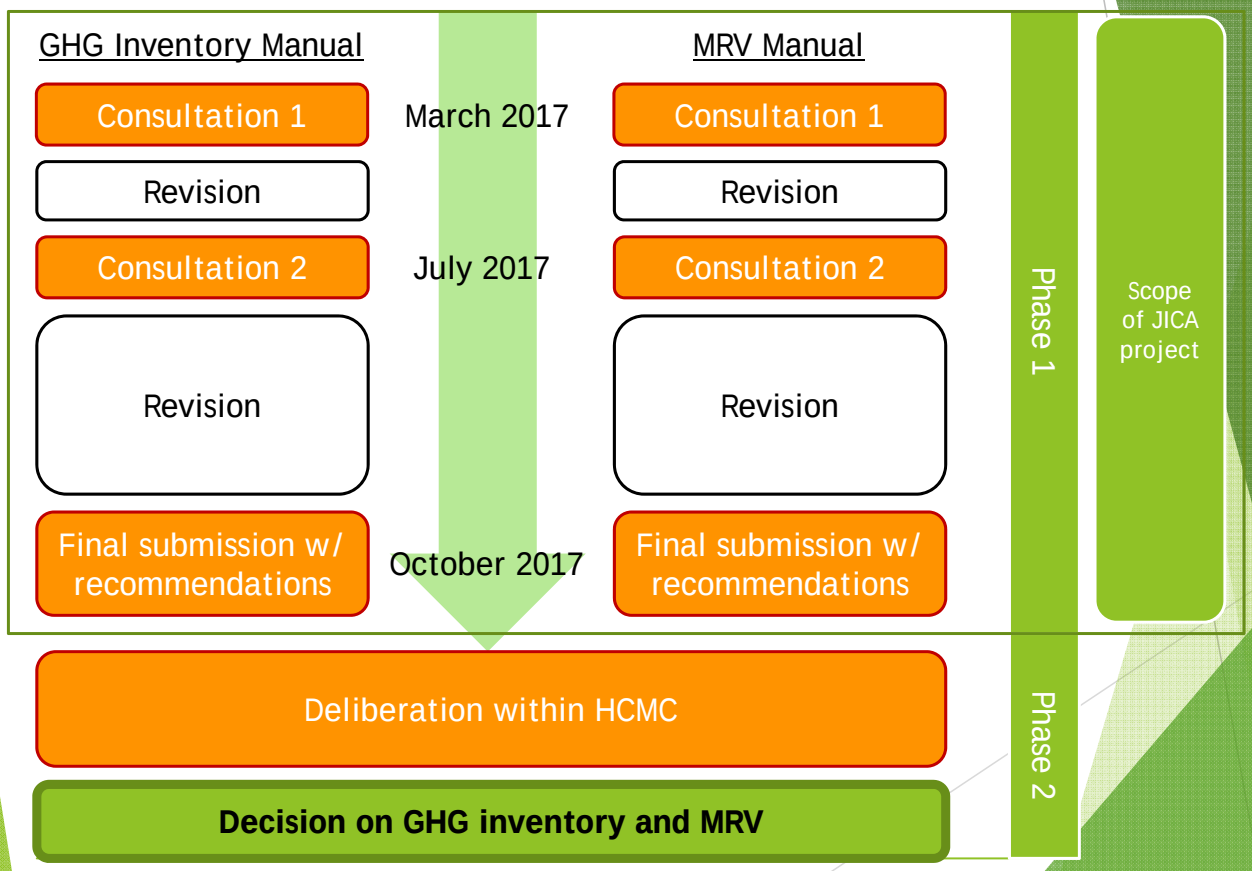
- Project started in January 2015 with MONRE and JICA Long-Term Experts
- HCMC selected as model city of Project and started activities with JICA Short-Term Expert Team from October 2015
  - ✓ Preparation of GHG inventory of HCMC
  - ✓ Piloting of MRV on selected mitigation measures
  - ✓ Drafting of manuals on GHG inventory and MRV
  - ✓ Training in HCMC and Japan

⇩

  - ✓ Institutionalization of GHG inventory and MRV

SPI NAMA: Current Focus in HCMC

Institutionalization of GHG inventory and MRV



Last Consultation (1 March 2017)

- MRV Manual

– morning session –

Discussions on framework and procedures on MRV for HCMC

- GHG Inventory Preparation Manual

– afternoon session –

Discussions on GHG inventory preparation procedures including institutional arrangements and roles of concerned organizations

Consultation Today

- MRV Manual

Second Consultation

- *Confirm appropriateness of information and explanation in MRV Manual, chapter by chapter.*
- *Check if explanation is sufficient and clear, and there are no redundant parts or unnecessary duplication.*

After consultation meeting, MRV Manual will be finalized taking into account feedback from participants and in consultation with CCB and MONRE.

Consultation meeting on Operational Manual for MRV on City-level Climate Change Mitigation Actions (Draft)

11.07.2017

JICA short term experts

Preface

- Purpose of the manual
- Recommended reader
- Structure of manual
- Remarks

Contents of Manual

Chapter 1 – Introduction

Pages: 1 – 14

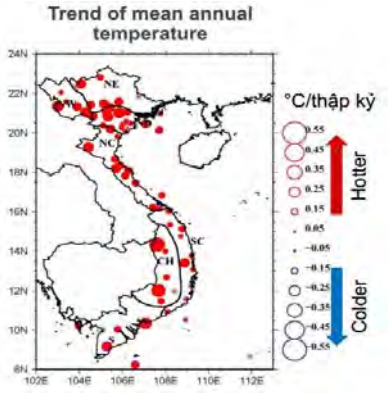
Brief summary of Chapter 1

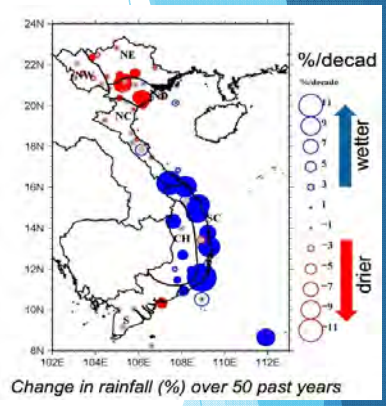
Chapter 1 provides general information such as introduction about climate change, efforts of international organizations and Vietnam in order to address climate changes. Following is the explanation about international and domestic mitigation policies and definitions of MRV.

Chapter 1 – Introduction

1.1. Context

- Global warming: Average temperature rise, ice melt, sea level rise
- Impacts of Climate change to Vietnam: Average temperature rising, rainfall increased, drought, salt intrusion, floods, etc.





Change in rainfall (%) over 50 past years

Trend and breakdown of GHGs emission in Vietnam by gas type

Unit: thousand tonnes of CO_2e

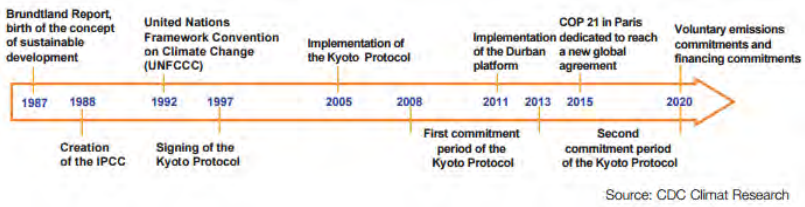
Sector	CO_2			CH_4			N_2O		
	1994	2000	2010	1994	2000	2010	1994	2000	2010
Energy	21,580	45,900	124,799	3,513	6,480	15,959	544	394	413
Industrial Process	3,807	10,006	21,172	0	0	0	0	0	0
Agriculture	0	0	0	43,951	50,059	57,909	8,494	15,032	30,446
LULUCF	15,217	11,860	-20,346	3,777	2,947	1,012	384	298	117
Waste	0	0	65	1,430	6,961	13,449	1,135	964	1,838
Total emissions (without LULUCF)	25,387	55,906	146,037	48,894	63,499	87,316	10,173	16,390	32,696
Total emissions (with LULUCF)	40,604	67,766	125,689	52,671	66,446	88,328	10,557	16,688	32,814

(Sources: National Communication 2003, 2010, National GHG Inventory Report 2010 of Viet Nam, The project "Capacity Building for National GHG Inventory in Viet Nam", 2014)

Chapter 1 – Introduction

1.2. Efforts to address climate changes

- International efforts



Source: CDC Climat Research

- Vietnam efforts

National level: National Strategy on Climate Change, Green Growth, NDC report

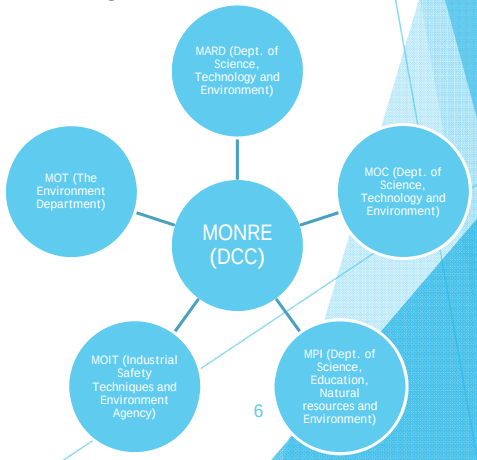
Local level: Climate Change Action Plan,

Green Growth Action Plan

Institutional:

National Committee on Climate Change

Department of Climate Change (DCC)



Chapter 1 – Introduction

1.3 Mitigation Actions to MRV

Definitions

- **Mitigation Actions?**

  Actions (such as policies, programs, measures) to reduce or avoid GHG emission.

  Ex: reduce electricity consumption in buildings, installation PV, use hybrid cars, etc.

Types of mitigation actions

- **Who will implement?**

  Those mitigation actions should be taken by individuals, enterprises and local governments.

  Local authorities:

  Formulate and implement policies, urban trading, cooperate with entities and citizenship

Level of mitigation action	Example
Individual action	Voluntary installation of LED lamps by citizens
Project	Installation of LED lamps in 100 households
Program	Installation of LED lamps in districts X, Y, and Z
Policy	Establishment of subsidy system for purchasing an LED lamp
Strategy/ plan	Development of a city master plan that sets LED lamp installation target of X% by 2020

Type of mitigation action	Examples
Hard measure	• Installation of LED lights • Replacing diesel buses with CNG buses • Construction and operation of a waste-to-energy plant
Soft measure	• Feed-in-tariff system for clean energy generation • Subsidy to purchase low-emission vehicle • Awareness raising to promote waste recycle

Chapter 1 – Introduction

Concept of MRV and its benefits to the city

- **What is MRV?**

  Is a tool to identify and manage GHG emission reduction and process of mitigation actions.

  MRV is Measurement, Reporting and Verification

- MRV is an indispensable component of mitigation actions that allows the check and report in a systematic way.

Measurement (M)	Measure directly using instruments and/or collect information and data that are necessary to calculate GHG emission reductions of the mitigation action.
Reporting (R)	Compile and report data and information that is collected or measured at the Measurement (M) stage.
Verification (V)	Check and confirm the contents that are reported at the Reporting (R) stage from the viewpoint of completeness, accuracy and consistency.

Type of benefit	Example
Enhanced clarity of project effectiveness and attainment of target	- By performing a well -planned MRV activity, the city can visualize effectiveness and impacts of the project , in terms of its GHG emissions and emission reductions. - Calculated GHG emission reductions are used to check if the mitigation target of Vietnam or a city is met.
Effective policy/ project formulation	- Even more effective policy development or project planning/ evaluation are possible in the future by applying experience of monitoring and evaluating the mitigation action under MRV.
Enhanced opportunity to access to finance	- By conducting MRV activities under specified rules , the mitigation project can have access to various types of climate finance sources , including international finances. MRV is particularly important for mitigation actions that apply to a carbon credit scheme (e.g. Clean Development Mechanism , Joint Crediting Mechanism).

Chapter 2 – Basic MRV framework

Pages: 15 – 22

Brief summary of Chapter 2

Chapter 2 presented the method to identify scope for mitigation actions to MRV and explained basic MRV framework for a city, showed responsibilities of each related agency in this MRV framework

Chapter 2 - Basic MRV framework

2.1 Defining scope of mitigation actions to MRV in a city

- **Approach 1**
  - ✓ If a city ALREADY HAS its own city-wide plan related to climate change, (e.g. climate change master plan, mitigation action plan, green growth strategy or socio-economic development plan), the city can set city-wide plan as the scope of mitigation actions to MRV, as all actions related to GHG emission reductions or prevention included in such a plan or strategy.
- **Approach 2**
  - ✓ If a city DOES NOT HAVE such a plan or strategy yet, the city can define the scope in accordance with its development priority or investment plan. For instance, some cities may want to include all publicly-financed activities in their jurisdictional area in the scope, or other cities may limit to specific sectors, for example scopes that are identified as major GHG emitting sectors in the city.

Box 2-1 Case study: Defining scope of mitigation actions to MRV for HCMC

HCMC chose Approach 1 to define its scope of mitigation actions to MRV.

HCMC has developed Climate Change Action Plan of Ho Chi Minh City (CCAP), which stipulates priority sectors for climate change mitigation. Based on these priority sectors of CCAP, HCMC has set its scope of mitigation actions to MRV as "all mitigation actions stipulated in the CCAP."

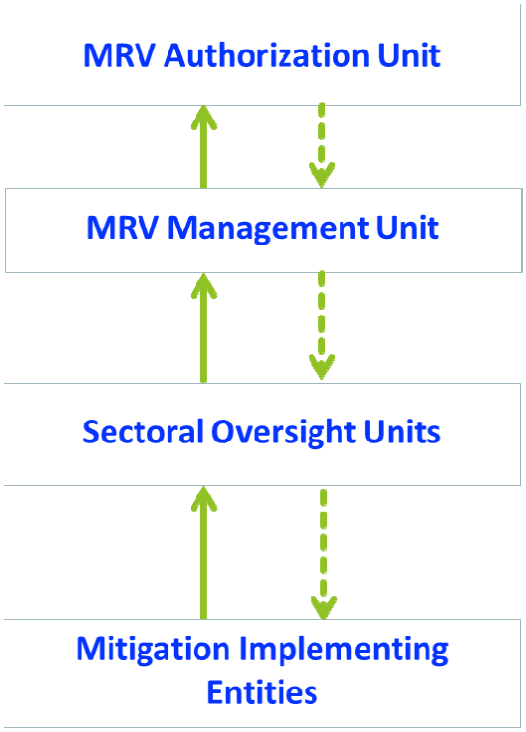
The defined scope of HCMC is characterized as follows:

- The scope contains various levels of mitigation actions from policy-level to project-level actions.
- The scope covers mitigation actions by private sector and individual mitigation actions.

Chapter 2 - Basic MRV framework

2.2. Setting up MRV Framework for the city

Roles of entities



- *Approve Mitigation action list, MRV Plans and MRV reports*

- *Check Mitigation action list, MRV Plans and Sectoral monitoring reports*
- *Submit Mitigation action list, MRV Plans , consolidate Sectoral monitoring reports into MRV Report*

- *Check Mitigation action list and MRV Plans*
- *Check Mitigation monitoring reports*
- *Submit Sectoral Monitoring reports*

- *Define mitigation actions and develop MRV Plans*
- *Submit Mitigation action list and MRV Plans*
- *Implement the mitigation actions' monitoring*
- *Consolidate monitoring results into Mitigation monitoring report*
- *Submit Mitigation monitoring report*

Chapter 2 - Basic MRV framework

Draft MRV framework for HCMC

HCMC People's Committee	**MRV Authorization Unit**
Department of Natural Resources and Environment	**MRV Management Unit**
Various oversight departments in HCMC	**Sectoral Oversight Units**
Various companies and organizations that implement mitigation actions in HCMC	**Mitigation Implementing Entities**

Chapter 2 - Basic MRV Framework

Sectoral Oversight Units

HCMC's Mitigation Sectors (CCAP-based)	Sectoral Oversight Units of HCMC
Urban planning	Department of Architecture and Planning
Energy	Department of Industry and Trade (DOIT)
Transport	Department of Transport (DOT)
Industry	Department of Industry and Trade (DOIT)
Water management	Department of Transport (DOT)
Waste management	Department of Natural Resources and Environment (DONRE)
Construction	Department of Construction (DOC)
Health	Department of Health
Agriculture	Department of Agriculture and Rural Development (DARD)
Tourism	Department of Tourism

Chapter 2 - Basic MRV framework

Mitigation implementation entities

Mitigation implementation entities of HCMC

- District's PCs
- HCMC Energy Conservation Centre (ECC)
- Public Lighting of HCMC (SAPULICO)
- Ho Chi Minh City urban drainage company limited (UDC)
- HCMC Urban Environment Company Limited (CITENCO)
- Vietnam Electricity (EVN)
- Saigon Trading Group (SATRA)
- Saigon Bus Company
- HCMC Saigon water corporation (SAWACO)
- Saigon transportation mechanical corporation limited (SAMCO)
- Others

(These entities was referred to Annex of Draft CCAP of HCMC and pilot activities of project "SPI-NAMA in a MRV manner)

Chapter 3 – MRV process

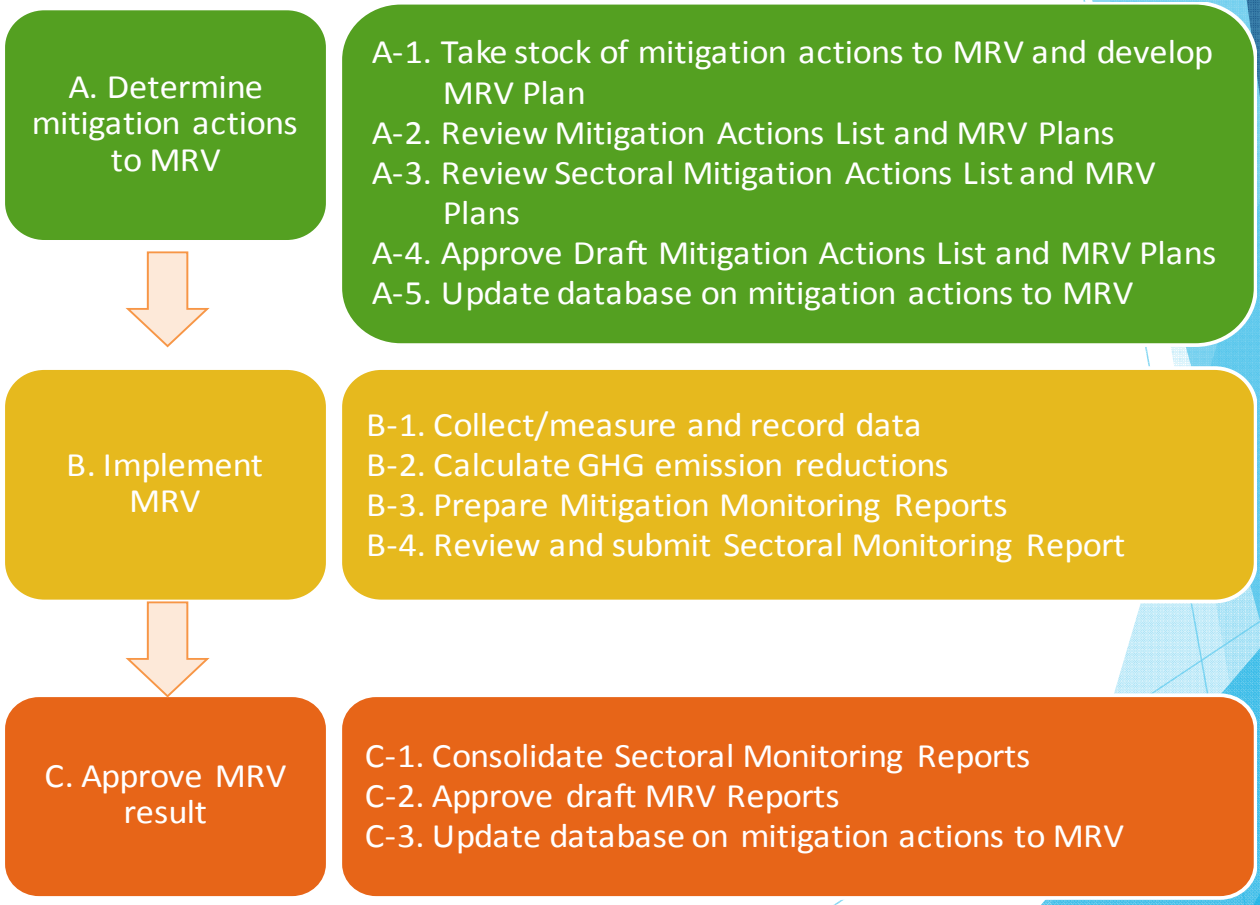
Pages: 23 – 50

Brief summary of Chapter 3

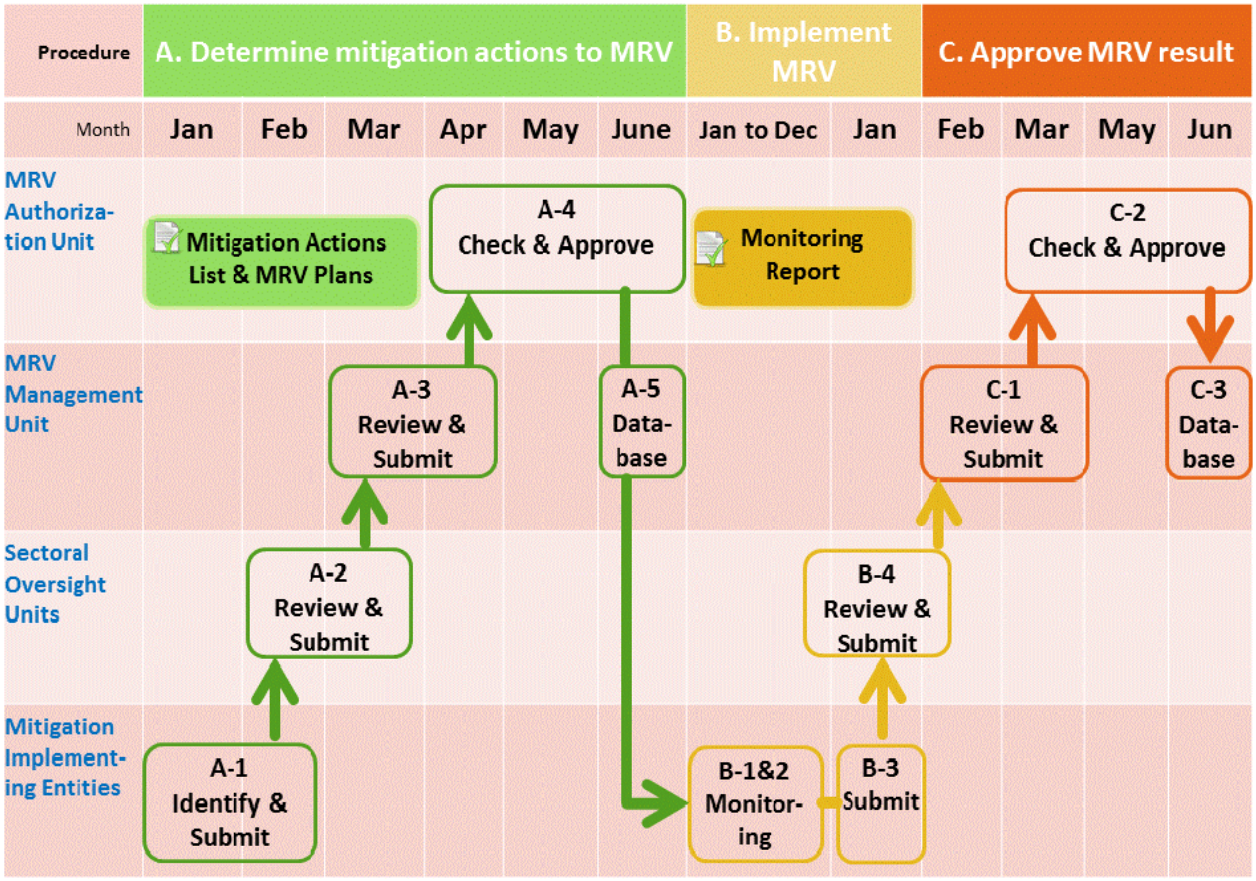
Chapter 3 provides steps by steps to implement MRV.

- Methodology and criteria to identify mitigation actions to MRV
- Implement MRV (Monitoring, Reporting, Verification)

Chapter 3. MRV process



Chapter 3. MRV Process



Chapter 3. MRV process

3-1. Define mitigation actions to MRV

3-1-1. Take stock of mitigation actions to MRV and develop MRV Plan

Pages: 25 – 37

This part instruct implementation entities to develop mitigation action list and MRV Plan

- Step 1 Preparing a long list of actions
- Step 2 Evaluating actions in accordance with the pre-defined criteria
- Step 3 Select actions to MRV and develop Mitigation Actions List

Chapter 3. MRV Process

3.1. Define mitigation actions to MRV

Responsible organization
Mitigation implementing entities

Take stock of mitigation actions to MRV and develop MRV Plan

- Step 1: Prepare a long list of potential mitigation actions
- Step 2: Evaluate/Select mitigation actions in accordance with the pre-defined criteria
  - Criterion 1: Mitigation Potential - Whether the action contributes to reduce GHGs?
  - Criterion 2: Practicability of MRV - Whether the action provides practical ways to MRV?
- Step 3: Select actions and develop Mitigation Actions List

No.	Name of mitigation action	Mitigation Implementing Entity	Location	MRV/Non-MRV
1		Entity A		MRV
2		Entity A		MRV
3		Entity A		Non-MRV
4		Entity A		MRV

Chapter 3. MRV process

3.1. Define mitigation actions to MRV

Responsible organization
Mitigation implementing entities

Prepare MRV plan

I. General information of the mitigation action
  a) Name of the mitigation action
  b) Involved organizations and their roles
  c) Objectives
  d) Technology introduced under the mitigation action
  e) Target GHG type
  f) Location
  g) Timeframe
  h) Cost of mitigation action
  i) Benefits of mitigation action and contribution to sustainable development
  j) Source of funding and supporting financial scheme
  k) Information on international market mechanisms
II. Emission reduction calculation, monitoring and reporting
  a) Logic of GHG emission reduction
  b) Methodology to calculate GHG emission reduction
  c) Estimated GHG emission reduction
  d) Organizational structure for monitoring and reporting
  e) Monitoring period
  f) Monitoring methods

Chapter 3. MRV process

3.1. Define mitigation actions to MRV

Responsible organization
Mitigation implementing entities

Prepare MRV Plan

Table 3-4 Major contents of methodology for GHG emission reduction calculation

Contents	Outline
Applicability	(A methodology contains) description/ explanation of what types of mitigation actions can use the methodology.
Logic of emission reduction	Describe how GHG emission is reduced through the mitigation action.
Formulae of emission reduction calculation	Show calculating formulae of baseline and project emission as well as emission reduction.
Monitoring method of necessary data for emission reduction calculation	Describe method for measurement/collection of each parameter in formulae for calculating baseline/project emission and emission reduction.

Table 3-5 Examples of existing methodologies

Title	Reference
Intergovernmental Panel on Climate Change (IPCC)	http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
Clean Development Mechanism (CDM)	http://cdm.unfccc.int/methodologies/index.html
Greenhouse Gas Protocol: GHG Protocol for Project Accounting	http://www.ghgprotocol.org/standards/project-protocol
International Finance Corporation (IFC) Greenhouse Gas Reduction Accounting Guidance for Climate Related Projects	http://www.ifc.org/
Gold Standard	http://www.goldstandard.org/
Joint Crediting Mechanism (JCM)	http://www.jcm.go.jp
Japan International Cooperation Agency (JICA)	http://www.jica.go.jp/english/our_work/climate_change/mitigation.html
Japan Bank for International Cooperation (JBIC)	http://www.jbic.go.jp/en/efforts/j-mrv

Chapter 3. MRV process

3-1. Define mitigation actions to MRV

3-1-2. Review Mitigation Actions List and MRV Plans

Page: 37

This part presented processes and criteria for Sectoral Oversight Units to review/check the mitigation actions list and MRV Plan

Chapter 3. MRV process

3.1. Define mitigation actions to MRV

Responsible organization:
Sectoral Oversight Units

Review Mitigation Actions List and MRV Plans

- Sectoral Oversight Unit examines Mitigation Actions List and MRV Plans submitted by Mitigation Implementing Entities.
- The example viewpoints of examination are as follows.
  - Whether there is lack in the submitted list/ detailed information
  - Whether the target, procedure and timing for MRV are clearly stated
  - Whether the target project can be expected to have GHG emission reductions
  - Whether the target project compliance with upstream, guiding plans/strategies
  - Whether the target project is MRV-able
- By the end of March, Sectoral Oversight Unit compiles all Mitigation Actions and MRV Plans of the sector as Sectoral Mitigation Actions List and MRV Plans and submits it to MRV Management Unit.

Table 3-6 Image of compiled Sectoral Mitigation Actions List

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	MRV/Non-MRV
1	Energy		Unit AA	Entity A		MRV
2						MRV
3						Non-MRV
4				Entity B		MRV
5						MRV
6						MRV
7						MRV
8						Non-MRV
9				Entity C		MRV
10				Entity D		Non-MRV
...						

Chapter 3. MRV process

3-1. Define mitigation actions to MRV

3-1-3. Review Sectoral Mitigation Actions List and MRV Plans

Page: 38

This part presented process and criterion for MRV Management Unit to check mitigation actions list by sectors and MRV Plans submitted by Sectoral Oversight Units.

Chapter 3. MRV process

3.1. Define mitigation actions to MRV

Review Sectoral Mitigation Actions List and MRV Plans

Responsible Organization:
MRV Management Unit

- MRV Management Unit thoroughly examines the Sectoral Mitigation Actions List and MRV Plans submitted by Sectoral Oversight Units.
- The example viewpoints of examination are as follows.
  - Whether there is lack in the submitted list/ detailed information
  - Whether the target, procedure and timing for MRV are clearly stated
  - Whether the target project can be expected to have GHG emission reductions
  - Whether the target project is MRV-able
- By the end of April, MRV Management Unit compiles all Sectoral Mitigation Actions List and MRV Plans that will be MRV-ed in the next fiscal year, and submits it to MRV Authorization Unit with a recommendation for approval

Table 3-7 Image of Draft Mitigation Actions List

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	Year of addition to the list	MRV/Non-MRV
1	Energy		Unit AA	Entity A		2016	MRV
2						2016	MRV
3						2017	Non-MRV
4				Entity B		2016	MRV
5						2016	MRV
6						2017	MRV
7						2017	MRV
8						2017	Non-MRV
9				Entity C		2016	MRV
10				Entity D		2017	Non-MRV
11	Transport		Unit BB	Entity E			MRV
12							Non-MRV
13				Entity F			MRV
14				Entity G			MRV
15	Waste		Unit CC	Entity H			MRV
...							

Chapter 3. MRV process

3-1. Define mitigation actions to MRV

3-1-4. Approve Draft Mitigation Actions List and MRV Plans

Page: 39

This part presented procedure for MRV Authorization Unit to approve mitigation actions list and MRV Plan submitted by MRV Management Unit.

Chapter 3. MRV process

3-1. Define mitigation actions to MRV

3-1-5. Update database on mitigation actions to MRV

Page: 39

This part presented procedure for MRV Management Unit to update database on mitigation actions to MRV

Responsible Organization :
MRV Authorization Unit

Approve Draft Mitigation Actions List and MRV Plans

- By the end of May, after receiving the Draft Mitigation Actions List and MRV Plans with a recommendation for approval, MRV Authorization Unit approves it as a Mitigation Actions List and MRV Plans.
- By the end of June, MRV Authorization Unit notifies the Mitigation Actions List and MRV Plans through MRV Management Unit to Sectoral Oversight Units

Responsible Organization:
MRV Management Unit

Update database on mitigation actions to MRV

- MRV Management Unit updates the database on mitigation actions to include the Mitigation Actions List and MRV Plans.

Table 3-8 An image of the database

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	Year of addition to the list	MRV/Non-MRV	Emission reduction in year 1	Emission reduction in year 2
...	...	...	...	...	...	...	...	...	...
Total	-	-	-	-	-	-	-	XXXX	XXXX

Chapter 3. MRV process

3-2. Implement MRV

3-2-1. Collect/measure and record data (Monitoring)

Pages: 40-42

This part presented procedure for Mitigation Implementation Entities to conduct monitoring includes instruction to prepare monitoring sheet and calculation sheet and implement monitoring.

Responsible organization:
Mitigation Implementation Entities

Collect/measure and record data (Monitoring)

- Mitigation Implementing Entities conduct monitoring in accordance with respective MRV Plan, and prepare Monitoring Sheet every determined period such as monthly/ quarterly/bi-annually.
- Monitoring activity needs to be carried out at a designated method, procedure and period described in the respective approved MRV plan.
- Mitigation Implementing Entity monitors (through either direct measurement (monitoring) of parameters or data collection from operators such as bus companies) and collects all data (such as CO2 emission factors) that is necessary to calculate GHG emission reductions
- Mitigation Implementing Entity inputs all the collected and measured data and information into a Monitoring Sheet.
- Monitoring Sheet and GHG emission reduction calculation sheet need to be prepared for each mitigation action. Monitored data and its measurement method/ procedure are needed to be determined before implementing Monitoring activity.

Chapter 3. MRV process

3.2 Implement MRV

Prepare monitoring sheet

Table 3-9. Basic contents of Monitoring sheet

I. Information of the mitigation action
a) Name of the mitigation action
b) Sector
c) Mitigation Implementing Entity
d) Sectoral Oversight Unit
e) Name of the site
II. Results of monitoring
a) Monitoring year
b) Monitoring month
c) Creation date
d) Name of the person in charge
e) Monitoring results
f) Monitoring period

Monitoring sheet

Monitoring (Measurement) Sheet for Solr PV project

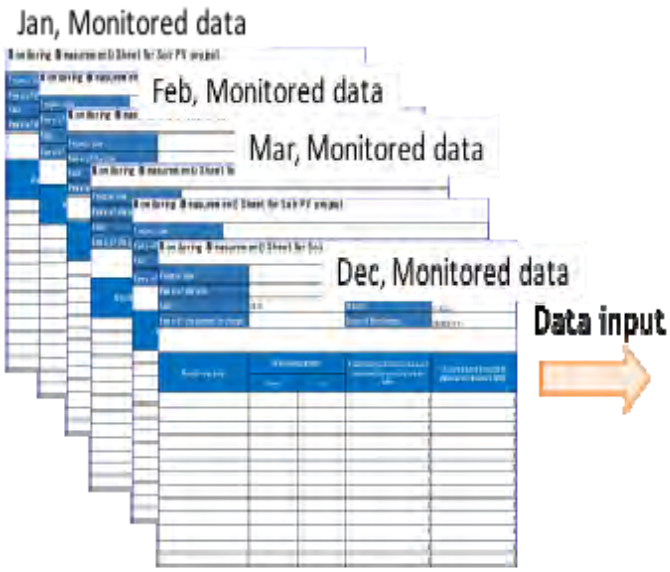
Project title	
Name of the site	
Name/ No. of the Monitoring Meter	
Starting date of Monitoring	
Name of the person in charge	

Monitoring period		Measured date	Electricty generation amount indicated by electric meter (kWh)	Accumulated electricty generation amount (kWh)
From	to			
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0

Chapter 3. MRV process

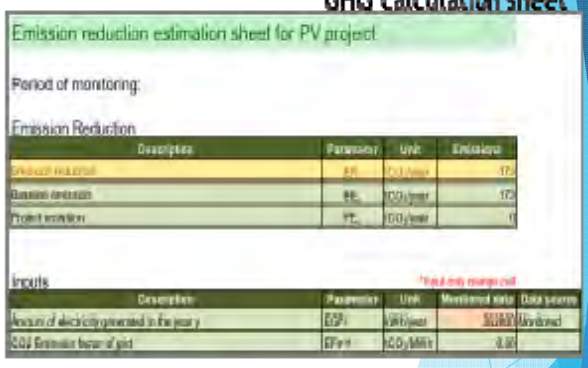
3.2 Implement MRV

Conduct monitoring



Data input

GHG calculation sheet



2017 Total

173 tons-CO_2

Chapter 3. MRV process

3-2. Implement MRV

3-2-2. Prepare and submit Mitigation Monitoring Reports

Pages: 42-43

This part presented the procedure and instruction for Mitigation implementation Entities to prepare and submit mitigation monitoring report

Responsible Organization:
Mitigation Implementation Entities

Prepare and submit Mitigation Monitoring Reports

- Mitigation Implementing Entities prepare Mitigation Monitoring Report using the data of the Monthly Monitoring Sheet and the results of GHG emission reduction calculations.
- The data of Monthly Monitoring Sheet, general information of the mitigation action needs to be included in the Mitigation Monitoring Report.
- Mitigation Implementing Entities conduct the GHG emission reduction calculation once a year by data in Monitoring sheet and GHG emission calculation sheet.
- Mitigation Implementing Entities submit the Mitigation Monitoring Report to Sectoral Oversight Unit by the end of January (once a year).

Table 3-10 Contents of Mitigation Monitoring Report

I. Monitoring period
II. Emission reductions of the monitoring period
III. Processes of the emission reduction calculation

Chapter 3. MRV process

3-2. Implement MRV

3-2-3. Review and submit Sectoral Monitoring Report

Page: 44

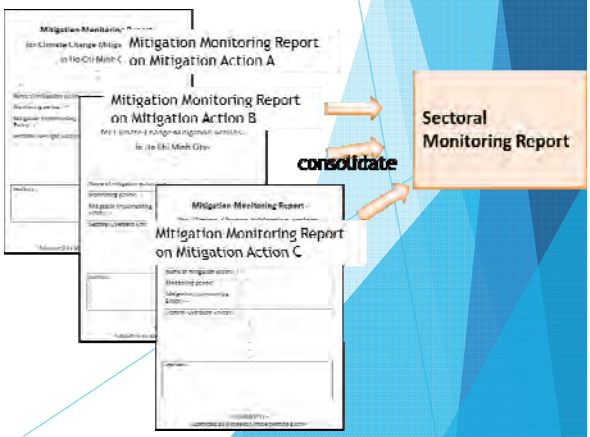
This part presented procedure and instruction for Sectoral Oversight Units to check mitigation monitoring report and consolidate into sectoral monitoring report.

Responsible organization:
Sectoral Oversight Units

Review and submit Sectoral Monitoring Report

- Sectoral Oversight Unit thoroughly reviews the submitted Mitigation Monitoring Reports. Following elements should be considered in examining the reports:
  - Whether there is lack of information in the submitted
  - Whether there is big gap between MRV plan and Mitigation Monitoring Report
- Sectoral Oversight Unit

consolidates the Mitigation Monitoring Reports as Sectoral Monitoring Report and then submits the Sectoral Monitoring Report to MRV Management Unit by the end of February (once a year).



Chapter 3. MRV process

3-3. Approve MRV result

3-3-1. Consolidate Sectoral Monitoring Reports

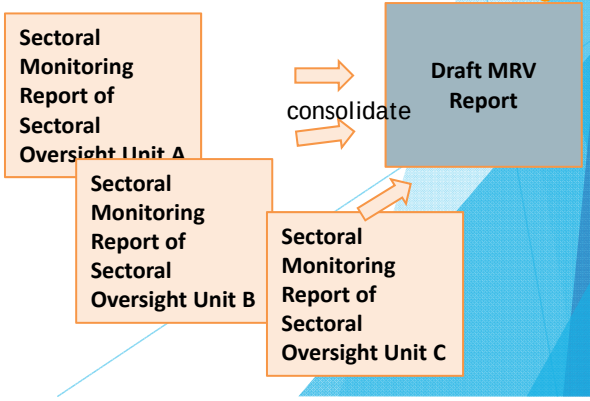
Pages: 45-46

This part presented procedure and instruction for MRV Management Unit to evaluate the Sectoral Monitoring reports and consolidate into Draft MRV Report and submit to MRV Authorization Unit.

Responsible organization:
MRV Management Unit

Consolidation of Sectoral Monitoring Reports

- MRV Management Unit examines Sectoral Monitoring Reports submitted by Sectoral Oversight Units. The example viewpoints of examination are as follows:
  - Whether there is lack of information/data in the submitted Sectoral Monitoring Report.
  - Whether MRV for the mitigation actions have been certainly implemented.
  - Whether GHG emission reduction is calculated accurately like in approved MRV Plan and data has been used is accuracy.
- MRV Management Unit consolidate Sectoral Monitoring Reports submitted by Sectoral Monitoring Reports into a Draft MRV Plan.
- By the end of March, MRV Management Unit submits consolidated Sectoral Monitoring Report to MRV Authorization Unit.



Chapter 3. MRV process

3.3. Approve MRV result

Responsible organization:
MRV Management Unit

Draft MRV Report

- Sector category
- Name of the mitigation action
- Sectoral Oversight Unit(s) and Mitigation Implementing Entity(ies)
- Brief description of the mitigation action
- Financial sources and cost size
- Emission reductions achieved by the mitigation action during the year
- Issues related to implementation of the mitigation action and MRV activity

Example of Draft MRV Report

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	MRV/ Non-MRV	GHG emission reductions (tCO_2e)
1	Energy		Unit AA	Entity A	MRV	
2					MRV	
3					Non-MRV	
4				Entity B	MRV	
5					MRV	
-		Sub-total				
6	Transport		Unit BB	Entity C	MRV	
7					Non-MRV	
8					MRV	
9				Entity D	MRV	
10					Non-MRV	
-		Sub-total				
11	Waste		Unit CC	Entity E	MRV	
12					MRV	
13				Entity F	MRV	
...					Non-MRV	
-		Sub-total				

Chapter 3. MRV process

3-3. Approve MRV result

3-3-2. Approve MRV reports

Page: 47

This part presented procedure for MRV Authorization Unit to approve MRV reports

Chapter 3. MRV process

3-3. Approve MRV result

3-3-3. Update database on mitigation actions to MRV

Page: 47

This part presented procedure for MRV Authorization Unit to update database on mitigation actions with data in approved MRV reports.

Responsible organization:
MRV Authorization Unit

Approve *Draft* MRV report

- By the end of May, MRV Authorization Unit checks the Draft MRV Report and then approve it as a MRV Report
- By the end of June, MRV Report are notified through MRV Management Unit to all concerned entities in HCMC as well as to MONRE.

Responsible organization:
MRV Management Unit

Update database on mitigation actions

- MRV Management Unit update the database of mitigation actions with data provided in approved MRV Report including calculated GHG emission reductions.

Annex

- **Annex 1: MRV Case studies**
  - **MRV Plan**
  - **Monitoring Report**
  - **GHG calculation sheet**

- Solar PV system installation on the roof top of the public building
- Introduction of air conditioning system with inverters to the office
- Replacement CFL to LED of the small street lamps
- Replacement to high energy efficient boilers at a dairy factory
- Introduction of CNG buses
- Eco-driving
- BRT (Bus Rapid Transit)
- Urban railway
- Collection and utilization of landfill gas at final disposal site
- Recycling of municipal solid waste
- Organic fertilizer production
- Animal manure management and biogas use

Annex

- Annex 2: Typical Mitigation Actions and Emission Reduction Logic
  - Generation of electricity
  - Factory
  - Commercial Buildings
  - Households
  - Cars/Motorbikes
  - Buses
  - Railway
  - Ships/vessels
  - Traffic Management
  - Freight transportation
  - Sea ports/Airports
  - Waste treatment/ Wastewater treatment

Annex 3

- Annex 3: Format of MRV Plan

MRV Plan

for Climate Change Mitigation Actions

in Ho Chi Minh City

Name of mitigation action:

Mitigation Implementing Entity:

Sectoral Oversight Unit(s):

Legal basis

DD/MM/YYYY

Submitted by Mitigation Implementing Entity

Table of Contents

Annex

- Annex 4: Format of Monitoring Report

Mitigation Monitoring Report

for Climate Change Mitigation Actions

in Ho Chi Minh City

Name of mitigation action:

Monitoring period:

Mitigation Implementing Entity:

Sectoral Oversight Unit(s):

Legal basis

DD/MM/YYYY

Submitted by Mitigation Implementing Entity

Table of Contents

1

Project to Support the Planning and Implementation of NAMAs in a MRV Manner

Consultation Meeting on GHG Inventory Preparation Manual

12 July 2017

JICA Short-term Experts

Introduce

- GHG inventory experts of JICA short-term expert team
  - Mr. FUMIHIKO KUWAHARA
    - E-mail: kuwahara_fumihiko@sur.co.jp
- Local Consultants (Enerteam)
  - Ms. Tran Thi Yen Phuong
    - E-mail: phuong_tty@enerteam.org
  - Mr. Dang Van Dien
    - E-mail: dien_dv@enerteam.org

Table of Contents

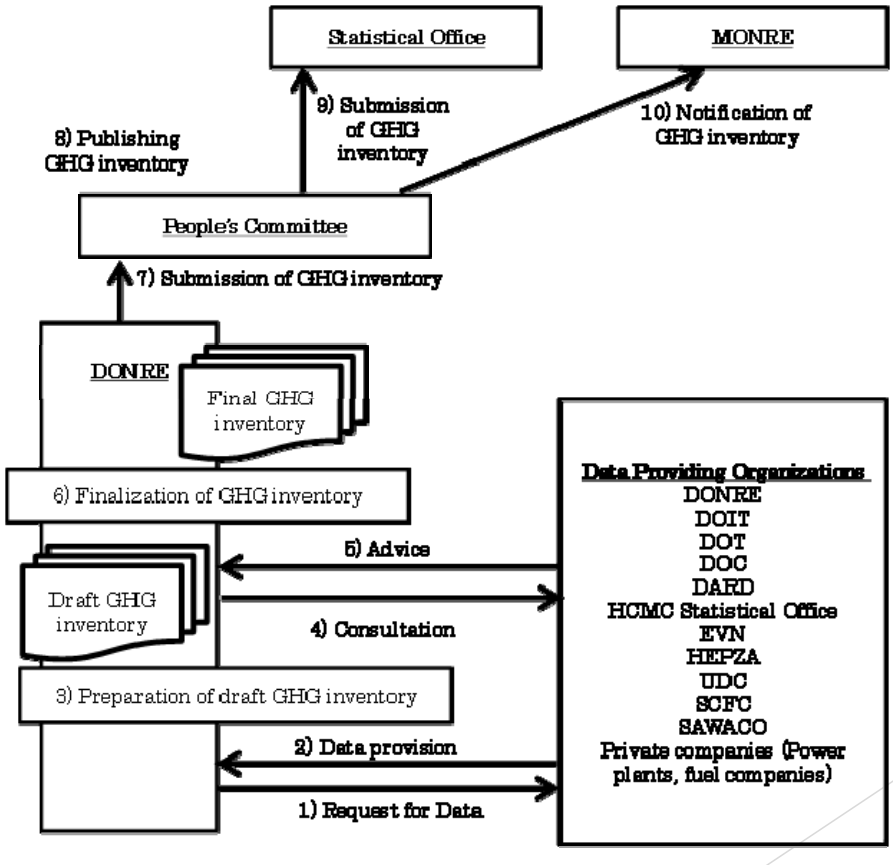
Chapter 1. Introduction

- 1.1 Terms and Definitions
  - GHG, Scope, Notation, Sector, etc.
- 1.2 Sector
  - Stationary Energy, Transportation, Waste
- 1.3 Basic Quantification Method
- 1.4 Calculation Flow
- 1.5 GWP
  - Confirmation of GWP values
- 1.6 QC and QA

Chapter 2. GHG Inventory Preparation Procedures

- 2.1 Overview
  - Institutional Arrangement for the GHG Inventory Preparation in HCMC
  - Preparation Flow of GHG Inventory
  - Roles and Responsibilities
  - Schedule of GHG Inventory Preparation

Chapter 2. GHG Inventory Preparation Procedures



Chapter 2. GHG Inventory Preparation Procedures

	Roles and Responsibilities
PC	Publish GHG inventory Submission of GHG inventory to MONRE
DONRE	Preparation of GHG inventory Preparation, confirmation, and approval of improvement plan on preparation of GHG inventory Performs actual work of GHG inventory compilation. Responsible for inventory calculations, compiling, and archiving and management of all data. Quality control
Data Providing Organizations	Data provision Quality control

Chapter 2. GHG Inventory Preparation Procedures

Preparation Year of GHG inventory: n (even number year) — For example — Preparation Year = 2018

Target Year of GHG inventory: n-2 (two year before) — Target Year = 2016

	Process	Relevant Organizations	Mar.	Apr	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
1	Preparation	DONRE	→	→							
2	Data request	DONRE			→						
3	Data preparation	Data Providing Organizations				→					
4	Data Collection	DONRE				→	→				
5	Preparation of draft GHG inventory	DONRE					→	→			
6	Checking draft GHG inventory	Data Providing Organizations						→	→		
7	Finalizing GHG inventory	DONRE							→		
8	Publishing GHG inventory	PC								→	→

Chapter 2. GHG Inventory Preparation Procedures

- 2.10 QC (add this session)
  - The common and fundamental QC activity on the preparation of GHG inventory is shown
- 2.11 QA
  - QA is review procedure conducted by personnel not directly involved in the inventory preparation process.

General QC (Quality Control), part1

Process of Data Collection and Entry Process of Activity Data Calculation	➢ Check for transcription errors in data entry and referencing ➢ Check the unit, since the persons in charge of data provider change, the new persons in charge might mistake the unit. For example, they might mistake the cubic meter for the liter. ➢ Check the completeness ➢ Check the accuracy of inventory data behavior from one processing step to the next ➢ Check time series consistency ➢ Check the trends on Activity Data
Process of EF and Parameter Setting	➢ Check EFs of past year ➢ Check time series consistency of EFs ➢ Check the local, regional or country-specific EFs ➢ Check the local, regional or country-specific parameters

General QC (Quality Control), part2

Process of Emission Calculation	➢ Check to see that emission units are accurately recorded ➢ Check to ensure that emissions are accurately calculated ➢ Check the connection between worksheets ➢ Check the conformity of files ➢ Check the accuracy of inventory data behavior from one processing step to the next ➢ Check the completeness ➢ Conduct comparisons with the past estimated values by checking the trends of emissions ➢ Check the link to other files
Others	➢ Consider the detailed data from other Data Providing Organizations, along the lines with sub-sector of GPC ➢ Confirm the definition of data collected from other Data Providing Organizations, because the data collected are sometimes not completely equal to the data required for GHG inventory. ➢ Consider the additional information on allocating emissions.

Chapter 4. Data Sources

- 4.1 Stationary Energy Sector
- 4.2 Transportation Sector
- 4.3 Waste Sector
- 4.4 IPPU Sector
- 4.5 AFOLU Sector

Summary of Data Sources

Provider	Sector	Main Provided Data
DOIT	Energy	Fuel Consumption
DOIT	Waste	Main Industrial outputs
EVN	Energy	Electricity Consumption
EVN	IPPU	SF6 of Electricity Equipment
DOC	IPPU	Cement (Kiln), Lime
DOC	Energy	Electricity Consumption
Statistical Office	Energy, Agriculture, Transportation	Agricultural Information
DONRE	Waste	Municipal Solid Waste, Sludge, Other Waste (Clinical Waste)
HEPZA	Waste	Wastewater
UDC	Waste	Sewage Treatment Plants
SCFC	Energy	Electricity Consumption
SAWACO	Energy	Electricity Consumption
DOT	Transportation	Number of Vehicle, Ships
DOT	Land Use	Number of Trees
DARD	Agriculture	Livestock, Rice cultivation, Agricultural Products
DONRE	LULUCF	Land Use and Land Use Change
DARD	LULUCF	Agricultural area

Example of Data Sources
(Residential Sub-sector)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Electricity	✓		EVN(Data Collection Form)	Information on consumption of sub-sector
Charcoal		✓		
Other Kerosene	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Fuel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Gasoline	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Gas		✓		
Coke coal		✓		
Coke gas		✓		
LPG	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Natural Gas	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Waste Oils		✓		
Peat		✓		
Wood/ Wood Waste		✓		
Other Liquid Biofuels		✓		
Other Biogas		✓		
Municipal Waste (biomass fraction)		✓		

Example of Data Sources
(Commercial Sub-sector part1)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Electricity consumption	✓		EVN(Data Collection Form)	Information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Information on consumption of sub-sector
	✓		SAWACO (Data Collection Form)	Information on consumption
	✓		UDC(Data Collection Form)	Information on consumption
	✓		SCFC(Data Collection Form)	Information on consumption
Charcoal	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
Other Kerosene	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Fuel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Gasoline		✓		
Gas		✓		

Example of Data Sources
(Commercial Sub-sector, part2)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Coke coal		✓		
Coke gas	✓		DOIT(Energy Intensity Monitoring Sheet)	Information on consumption of sub-sector
LPG	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Natural Gas	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Other Liquid Biofuels		✓		
Other Biogas		✓		
Municipal Waste (biomass fraction)		✓		

Example of Data Sources
(Manufacturing Sub-sector, part1)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Electricity consumption	✓		EVN(Data Collection Form)	Information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		HEPZA(Data Collection Form)	Information on consumption
Crude Oil		✓		
Orimulsion		✓		
Natural Gas Liquids		✓		
Other Kerosene	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Shale Oil		✓		
Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Fuel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
LPG	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Ethane		✓		
Ethane		✓		
Naphtha		✓		
Bitumen		✓		
Lubricants		✓		
Petroleum Coke		✓		
Refinery Feedstocks		✓		
Refinery Gas		✓		
Paraffin Waxes		✓		
White Spirit and SBP		✓		
Other Petroleum Products		✓		

Example of Data Sources
(Manufacturing Sub-sector, part2)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Anthracite		✓		
Coking Coal	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
Other Bituminous Coal		✓		
Sub-Bituminous Coal		✓		
Lignite		✓		
Oil Shale and Tar Sands		✓		
Brown Coal Briquettes		✓		
Patent Fuel		✓		
Coke Oven Coke and Lignite Coke		✓		
Gas Coke	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
Coal Tar		✓		
Gas Works Gas		✓		
Coke Oven Gas		✓		
Blast Furnace Gas		✓		
Oxygen Steel Furnace Gas		✓		
Natural Gas	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
	✓		World Energy Statistics (IEA)	Whole amounts in Vietname
Municipal Waste (non-biomass fraction)		✓		
Industrial Wastes		✓		
Waste Oils		✓		
Peat		✓		
Wood/ Wood Waste		✓		
Sulphite lyes (Black Liquor)		✓		
Other Primary Soiled Biomass		✓		
Charcoal	✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
Biogasoline		✓		
Biodiesels		✓		
Other Liquid Biofuels		✓		
Landfill Gas		✓		
Sludge Gas		✓		
Other Biogas		✓		
Municipal Waste (biomass fraction)		✓		

Example of Data Sources
(Agriculture Sub-sector)

Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Electricity consumption	✓		EVN(Data Collection Form)	Information on consumption of sub-sector
Charcoal		✓		
Other Kerosene	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Fuel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Gasoline	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Gas		✓		
Coke coal		✓		
Coke gas		✓		
LPG	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Natural Gas	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
	✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Other Liquid Biofuels		✓		
Other Biogas		✓		
Municipal Waste (biomass fraction)		✓		

Data Sources
(Transportation Sector, part1)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
On-road	Electricity		✓		
	Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		SCFC(Data Collection Form)	Information on consumption
		✓		DOT(Data Collection Form)	Information on consumption
		✓		UDC(Data Collection Form)	Information on consumption
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
	Gasoline	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		SCFC(Data Collection Form)	Information on consumption
		✓		DOT(Data Collection Form)	Information on consumption
		✓		UDC(Data Collection Form)	Information on consumption
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
	LPG	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
	Natural Gas	✓		Fuel Company(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		DOT(Data Collection Form)	Information on consumption
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname

Data Sources
(Transportation Sector, part2)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC	Note
Railways	Electricity		✓		
	Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Waterborn navigation	Electricity		✓		
	Diesel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
	Fuel Oil	✓		DOIT(Data Collection Form)	Whole amounts in HCMC and no information on consumption of sub-sector
		✓		DOIT(Energy Intensity Monitoring Sheet)	Sampling survey and Information on consumption of sub-sector
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
Aviation	Electricity		✓		
	Jet fuel	✓		DOIT(Data Collection Form)	Whole amounts in HCMC
		✓		World Energy Statictisc (IEA)	Whole amounts in Vietname
	Aviation Gasoline		✓		
Off-road	Electricity		✓		
	Diesel Oil		✓		
	Gasoline		✓		
	Fuel Oil		✓		

Data Sources
(Waste Sector)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Solid waste disposal	Site Opening and closing year and month	✓		DONRE(Data Collection Form)
	Site opening year, total capacity, and density conversion	✓		DONRE(Data Collection Form)
	Current waste in place and site closure date or capacity	✓		DONRE(Data Collection Form)
	Composition of waste going to solid waste disposal sites	✓		DONRE(Data Collection Form)
	Information on type of landfill site (managed, unmanaged, uncategorized, etc.)	✓		DONRE(Data Collection Form)
	Methane collected and removed in each landfill site		✓	
Biological treatment of waste	Mass of organic waste treated by biological treatment	✓		DONRE(Data Collection Form)
Incineratoin and open burning	Mass of waste incinerated	✓		DONRE(Data Collection Form)
	Information on type of incinerator	✓		DONRE(Data Collection Form)
	Population in HCMC	✓		Statistical Yearbook in HCMC
	Amounts of waste treated	✓		DONRE(Data Collection Form)
	Amounts of waste recycled		✓	
	Per capita waste generation	✓		National Environmental Report
Domestic wastewater treatment	City's population	✓		Statistical Yearbook in HCMC
	Fraction of population in income group i		✓	
	Degree of utilization (ratio) of treatment/ discharge pathway or system	✓		Environemt Survey Report
	Information on methane correction factor		✓	
	Organic componewnt removes as sludge		✓	
	Amount of methane recovered		✓	
Industrial Wastewater treatment	Amount of wastewater	✓		HEPZA(Data Collection Form)
	Information on methane correction factor		✓	
	Organic componewnt removes as sludge		✓	
	Amount of methane recovered		✓	

Data Sources
(IPPU Sector, Industrial Process)

Industrial Process				
Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Mineral Industry	Weight (mass) of clinker produced	✓		DOC(Data Collection Form)
	Weight (mass) of lime produced	✓		DOC(Data Collection Form)
	Mass of melted glass of type i (e.g. float, container, fiber glass, etc.)		✓	
Chemical Industry	Ammonia		✓	
	Nitric acid		✓	
	Adipic acid		✓	
	Caprolactam, glyoxal, and glyoxylic acid		✓	
	Carbide		✓	
	Titanium dioxide		✓	
	Soda ash		✓	
Metal Industry	All coke made onsite at iron and steel production facilities		✓	
	Iron and steel production	✓		Statistical Yearbook in HCMC
	Ferroalloy product type	✓		Statistical Yearbook in HCMC
	Aluminum production		✓	
	Magnesium production		✓	
	Total amount of magnesium casted or handled		✓	
	For HFC and other GHG gases, collect direct measurements or meaningful indirect data		✓	
	Lead products		✓	
	Zinc Production		✓	

Data Sources
(IPPU Sector, Product Use)

Product use				
Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Non-energy products from fuel and solvent use	Lubricants		✓	
	Paraffin waxes		✓	
	Bitumen; road oil and other petroleum diluents		✓	
	White spirit, kerosene, some aromatics		✓	
Emissions from the electrinic industry	Ethcing and CVD cleaning for semiconductors, liquid crystal displays and photovoltaic		✓	
	Heat transfer fluids		✓	
Fluorinated substitutes for ozone	Data on chemical sales by application		✓	
	Data on historic and current equipment sales		✓	
Other Product manufacture and use	Total SF6 consumption by equipment manufactures		✓	
	Total nameplate capacity of new equipment filled on site (not at the factory)		✓	
	Total nameplate capacity of installed equipment	✓		EVN(Data Collection Form)

Data Sources

(AFOLU Sector, Livestock Sub-sector)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Livestock	Dairy Cattle	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Other Cattle	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Buffalo	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Sheep	✓		DARD(Data Collection Form)
	Goats	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Camels		✓	
	Horses	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Mules and Asses		✓	
	Deer		✓	
	Alpacas		✓	
	Swine	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Poultry	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Other Cattle		✓	

Data Sources

(AFOLU Sector, Land Sub-sector)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Land	Forest Land Remaining Forest Land	✓		DONRE(Data Collection Form), DARD(Data Collection Form), Statistical Yearbook in HCMC
	Cropland Remaining Cropland: Paddy Land	✓		DONRE(Data Collection Form), DARD(Data Collection Form), Statistical Yearbook in HCMC
	Cropland Remaining Cropland: Perennial Crop Land	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	Cropland Remaining Cropland: Annual Crop Land	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	Before 2013: Grassland Remaining Grassland	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	After 2014: Grassland Remaining Grassland		✓	
	Wetlands Remaining Wetlands	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	Settlements Remaining Settlements	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	Other Land Remaining Other Land	✓		DONRE(Data Collection Form), Statistical Yearbook in HCMC
	Land Converted to Forest Land	✓		DONRE(Data Collection Form), DARD(Data Collection Form)
	Land Converted to Cropland: Paddy Land	✓ (2005, 2010, 2013)		DONRE(Data Collection Form)
	Land Converted to Cropland: Perennial Crop Land			
	Land Converted to Cropland: Annual Crop Land			
	Before 2013: Land Converted to Grassland			
	Land Converted to Wetlands			
	Land Converted to Settlements			
	Land Converted to Other Land			
	After 2014: Land Converted to Grassland		✓	

Data Sources
(AFOLU Sector, Others Sub-sector)

Sub-Sector	Required data	Data Collected in HCMC	Unavailable Data in HCMC	Data Source in HCMC
Aggregate sources and non-CO2 emission souces on land	Harvested Area of Rice	✓		DARD(Data Collection Form), Statistical Yearbook in HCMC
	Area of burnt land		✓	
	Amount of Calcic Limestone (CaCO3)		✓	
	Amount of Dolomite (CaMg(CO3)2)		✓	
	Amount of Urea Fertilization		✓	
	Amount of Organic N Fertilizer applied to Soil		✓	
	Amount of Managed Manure N applied to Soils		✓	
	Amount of urine and dung N deposited on pasure, range, paddock		✓	
	Amount of total sewage N applied to soils		✓	
	Amount of total compost N applied to soils		✓	
	Amount of other organic amendments usess as fertilizer		✓	
	Area of annual crop	✓		Statistical Yearbook in HCMC
	Annual crop production	✓		Statistical Yearbook in HCMC
	Amount of synthetic fertilizer N applied to soils		✓	
	Amount of animal manure, compost, sewage sludge, and other organic N additions applied to soils		✓	
	Annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock		✓	

Annex Data Collection Forms

- Example of Data Collection Forms
  - Electricity Consumption
  - Fuel Consumption
  - Waste

Data Collection Form (Electricity Consumption part1)

DATA COLLECTION FORM
ENERGY SECTOR
(Attached in the document /DONRE-CCB date / /2016)

Sub-sector: Electricity consumption
Provider: EVN
Inventory Year: 20XX, 20XY

Table 1: Statistics of electricity consumption by the purpose

Sub-sector	Unit	20XX	20XY	Data Source
Residential	MWh /year			
Commercial and public service	MWh /year			
Industry (manufacturing and construction)				
Iron and steel	MWh /year			
Chemical	MWh /year			
Cement and building materials	MWh /year			
Foods and Tobacco	MWh /year			
Textile and Leather	MWh /year			
Paper, pulp and printing	MWh /year			
Construction	MWh /year			
Others	MWh /year			

Data Collection Form (Electricity Consumption part2)

Sub-sector	Unit	20XX	20XY	Data Source
Transport				
Road way	MWh /year			
River and seaway	MWh /year			
Water management				
Water supply station	MWh /year			
Drainage station	MWh /year			
Flood control station	MWh /year			
Waste management Solid waste collection and treatment	MWh /year			
Health				
Public hospital	MWh /year			
Private hospital	MWh /year			
Agriculture (Feedstock/ Farming/ Fishing)	MWh /year			
Tourism				
Restaurants	MWh /year			
Hotels	MWh /year			

Data Collection Form (Fuel Consumption part1)

DATA COLLECTION FORM

ENERGY SECTOR

(Attached in the document /DONRE-CCB date / /2016)

Sub-sector: Fuel consumption

Provider: DOIT

Inventory Year: 20XX, 20XY

Table 1: State of energy consumption by the purpose in year 20XX

	Data	Coal (…/yr)	Gasoline (…/yr)	Kerosene (…/yr)	DO (…/yr)	FO (…/yr)	LPG (…./yr)	Natural gas (…/yr)	Biomass (…/yr)	Biogas (…/yr)	Data Source
1	Residence										
2	Commerce + Public (building)										
3	Manufacture + construction										
3.1	Steel										
3.2	Chemicals										
3.3	Cement + construction materials										

Data Collection Form (Fuel Consumption part2)

	Data	Coal (…/yr)	Gasoline (…/yr)	Kerosene (…/yr)	DO (…/yr)	FO (…/yr)	LPG (…./yr)	Natural gas (…/yr)	Biomass (…/yr)	Biogas (…/yr)	Data Source
3.4	Food + Tobacco										
3.5	Textile + Leather										
3.6	Paper + Printing										
3.7	Construction										
3.8	Other										
4	Transportation										
4.1	Road										
4.2	River and sea way										
5	Water management										
5.1	Water supply station										
5.2	Drainage station										
5.3	Flood control station										
6	Waste management										

Data Collection Form (Fuel Consumption part3)

	Data	Coal (…/yr)	Gasoline (…/yr)	Kerosene (…/yr)	DO (…/yr)	FO (…/yr)	LPG (…./yr)	Natural gas (…/yr)	Biomass (…/yr)	Biogas (…/yr)	Data Source
6.1	Waste collection and treatment										
7	Health										
7.1	Public hospital										
7.2	Private hospital										
8	Agriculture										
8.1	Farming										
8.2	Feedstock										
8.3	Fishing										
9	Tourism										
9.1	Restaurant										
9.2	Hotel										

Data Collection Form (Solid Waste part1)

DATA COLLECTION FORM

WASTE SECTOR

(Attached in the document /DONRE-CCB date / /2016

Sub-sector: Solid waste being landfilled

Provider: Division of Solid Waste Management – DONRE

Inventory year: 20XX, 20XY

Table 1: Information on Solid Waste in HCMC

Type of waste	Unit	20XX	20XY	Data Source
The total amount of solid waste generated				
1) Municipal domestic solid waste	Ton/year			
2) Sludge waste	Ton/year			
- Industry	Ton/year			
- Domestic	Ton/year			
3) Solid waste from industry (non-hazardous waste)	Ton/year			
4) Hazardous waste	Ton/year			
5) Medical waste	Ton/year			
6) Others	Ton/year			

Data Collection Form (Solid Waste part2)

Type of waste	Unit	20XX	20XY	Data Source
The total amount of solid waste treated				
1) Municipal domestic solid waste	Ton/year			
2) Sludge waste	Ton/year			
- Industry	Ton/year			
- Domestic	Ton/year			
3) Solid waste from industry (non-hazardous)	Ton/year			
4) Hazardous waste	Ton/year			
5) Medical waste	Ton/year			
6) Others	Ton/year			

Data Collection Form (Solid Waste part3)

Type of waste	Unit	20XX	20XY	Data Source
The total amount of solid waste recycled and reused				
1) Municipal domestic solid waste	Ton/year			
2) Sludge waste	Ton/year			
- Industry	Ton/year			
- Domestic	Ton/year			
3) Solid waste from industry (non-hazardous)	Ton/year			
4) Hazardous waste	Ton/year			
5) Medical waste	Ton/year			
6) Others	Ton/year			

Chapter 3. Calculation Methods

- 3.1 Stationary Energy Sector
  - Electricity Consumption and Fuel Consumption
- 3.2 Transportation Sector
  - is same as the Stationary Energy Sector
- 3.3 Waste Sector
- 3.4 IPPU Sector
- 3.5 AFOLU Sector

Emissions from Electricity Consumptions

- $Emissions = Activity\ Data \times Emission\ Factor$

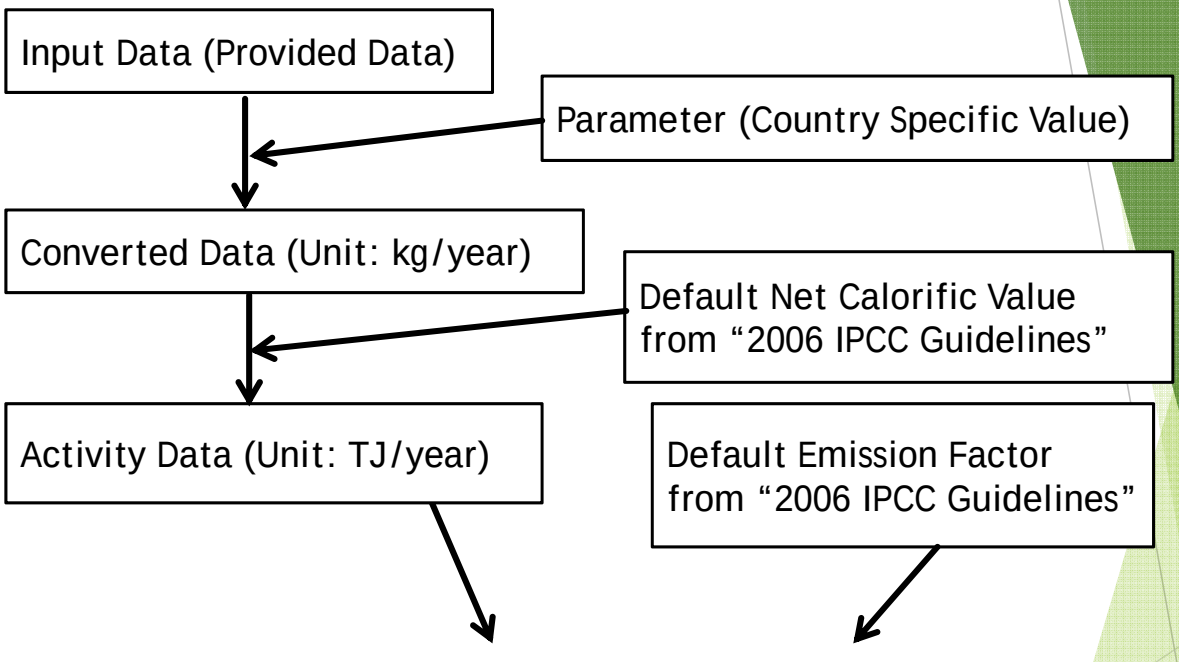
Electricity Consumption of each sub-sector as following
- Agriculture, Fishing and Forestry
- Manufacturing industries and Construction
- Commercial, Restaurant, Hotel
- Residential
- Others

Grid emission factor of electricity

Emission Factor is calculated by using information on the group of existing power plants supplying electricity to the grid in the target year.

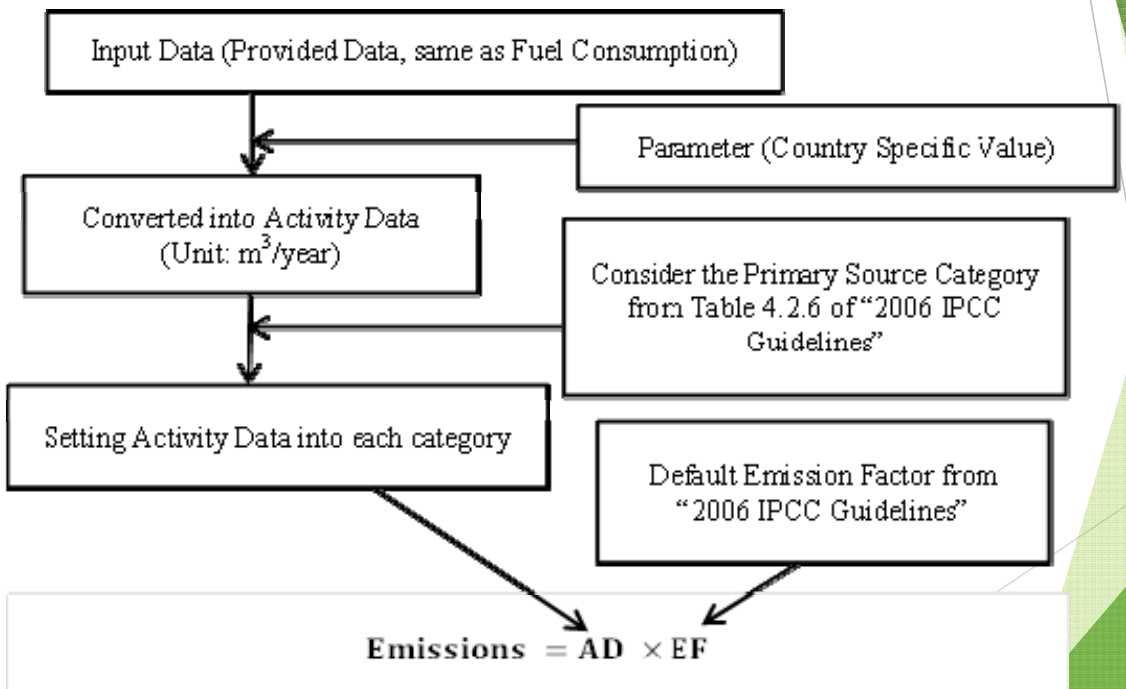
- Data Sources: Activity Data is EVN, Emission Factor is the official document in Vietnam.

Emissions from Fuel Consumptions



- $Emissions = Activity\ Data \times Emission\ Factor$
  - Activity Data is the fuel consumption in each subsector.
  - Country-specific Emission Factor should be used in the future.

Fugitive Emissions from Fuels



Waste Sector: FOD model (SWDS)

$$CH_4\ emissions = \left\{\sum_x \left[MSW_x \times L_0(x) \times \left(\left(1 - e^{-k}\right) \times e^{-k(t-x)}\right)\right] - R(t)\right\} \times (1 - OX)$$

CH_4	CH_4 emissions (tonne CH_4/year)
x	Landfill opening year or earliest year of historical data available
t	Inventory year
MSW_x	Total municipal solid waste disposed at SWDS in year x (tonnes/year)
R	Methane collected and removed in inventory year (tonnes CH_4/year)
L_0	Methane generation potential
k	Methane generation rate constant, which is related to the time taken for the DOC in waste to decay to half its initial mass (the "half-life") (refer "table 3.4" of 2006 IPCC Guidelines vol.3, chapter 3, p.3.17)
OX	Oxidation factor

Information is provided by DONRE and 2006 IPCC Guidelines.

Waste Sector: FOD model (SWDS)

Methane generation potential

$$L_0 = MCF \times DOC \times DOC_F \times F \times 16/12$$

L_0	Methane generation potential
MCF	Methane correction factor based on type of landfill site for the year of deposition (managed, unmanaged, etc.) (fraction), Managed = 1.0, Unmanaged (≥ 5 m deep) = 0.8, Unmanaged ($<$ 5m deep) = 0.5, Uncategorized = 0.6
DOC	Degradable organic carbon in year of deposition (tonnes C/tonnes waste)
DOC_F	Fraction of DOC that is ultimately degraded (reflects the fact that some organic carbon does not degrade)
F	Fraction of methane in landfill gas
16/12	Stoichiometric ratio between methane and carbon

Information is provided by DONRE and 2006 IPCC Guidelines.

Other Emission Sources on Waste Sector

- Biological Treatment of Solid Waste
  - $Emissions = Activity\ Data \times Emission\ Factor$
  - Activity Data is collected directly.
- Waste Incineration and Open Burning
  - $Emissions = Activity\ Data \times Emission\ Factor$
  - Activity Data is collected directly.
- Wastewater Treatment
  - $Emissions = Activity\ Data \times Emission\ Factor$
  - Activity Data is estimated by using population, information from HEPZA, and other information.

IPPU Sector

- Mineral Industry
- Chemical Industry
- Metal Industry
  - $Emissions = Activity\ Data \times Emission\ Factor$
  - Activity Data is collected directly.
- Product Use
  - SF6 emissions from electrical equipment
  - Equation adapted from 2006 IPCC Guidelines

AFOLU Sector

- Livestock
  - Enteric Fermentation, Manure management
- Aggregate Sources and non-CO2 emissions sources
  - Rice Cultivation, Biomass Burning and Liming Urea, Direct and Indirect N2O Emissions
- Land Use
  - Land Category: Forest land, Cropland, Grassland, Wetlands, Settlements, Other land
  - Carbon stock Changes on Carbon Pool: Biomass, Dead Organic Matter, and Soils
- Equation adapted from 2006 IPCC Guidelines

Chapter 5. Calculation

- 5.1 Stationary Energy Sector
  - 5.1.1 Electricity Consumption
  - 5.1.2 Fuel Consumption
  - 5.1.3 Fugitive Emissions from Fuel
- 5.2 Transportation Sector
  - is same as the Stationary Energy Sector
- 5.3 Waste Sector
  - 5.3.1 Solid Waste Disposal
  - 5.3.2 Biological Treatment of Solid Waste
  - 5.3.3 Incineration and Open Burning
  - 5.3.4 Wastewater Treatment and Discharge
- 5.4 IPPU Sector
- 5.5 AFOLU Sector

5.1.1 Calculation Process (Electricity Consumption)

- Activity Data

Electricity consumption	Unit	Year 2013	Year 2014	Year 2015
Agriculture, Fishing and Forestry sector	MWh/ year	48,520.254	61,811.746	67,128.218
Manufacturing industries and Construction	MWh/ year	7,186,161.416	7,557,369.663	8,094,021.380
Commercial, Restaurant, Hotel.	MWh/ year	2,254,535.866	2,378,573.402	2,622,860.896
Residential	MWh/ year	7,073,622.593	7,452,131.412	8,132,452.777
Others	MWh/ year	1,088,506.184	1,158,480.541	1,265,387.994
Total	MWh/ year	**17,651,346.313**	**18,608,366.764**	**20,181,851.265**

- Emission Factor

Grid Emission Factor	Unit	Year 2013	Year 2014	Year 2015
OM (Operating Margin EF)	ton-CO_2/MWh	0.7495	0.7802	0.7950

- Emissions

Emissions from Electricity consumption of each sector in HCMC	Unit	Year 2013	Year 2014	Year 2015
Agriculture, Fishing and Forestry sector	Gg CO_2/year	33	44	48
Manufacturing industries and Construction	Gg CO_2/year	4892	5425	5811
Commercial, Restaurant, Hotel	Gg CO_2/year	1535	1706	1883
Residential	Gg CO_2/year	4816	5350	5838
Others	Gg CO_2/year	741	832	908
Total	Gg CO_2/year	**12017**	**13357**	**14488**

Sector Specific QC (Electricity Consumption)

- Check the unit (kWh/year, MWh/year, or GWh/year, etc.).
- Confirm the definition of the classification of electricity consumption from the EVN, since the detailed sectors of EVN are not completely equal to the sub-sectors of GHG inventory.
- Generally, the electricity consumption is not so different from the past years, hence, the consistency and the trends of time series should be checked (e.g. mistakes in decimal point may be detected).
- The emission factor on electricity consumption varies every year.

5.1.2 Calculation Process (Fuel Consumption, part1)

- Data collected (Data Providing Organization: DOIT)

Bảng 6: Số lượng nhiên liệu bán ra tại TP.HCM:

STT	Loại nhiên liệu	Đơn vị (m3/năm)	2013	2014	2015	Nguồn số liệu
1	Xăng	m3/năm	3.582.529	3.687.417	4.160.437	
2	Dầu DO	m3/năm	3.328.293	3.909.982	5.002.386	
3	Dầu FO	m3/năm	404.333	418.625	489.335	
4	Dầu lửa	m3/năm	47.204	45.577	53.906	
5	Nhiên liệu bay	m3/năm	1.054.995	1.197.892	1.478.138	
6	Khí hóa lỏng (LPG)		B	B	B	
7	Khí thiên nhiên		B	B	B	
8	Khí nén (CNG)		B	B	B	
9	Than		B	B	B	

- Unit Conversion (m3year) → (ton/year) → (TJ/year)

Fuel type	Average (ton/m3)
Gasoline	0.73
Diesel	0.84
Fuel Oil	0.98
Kerosene	0.81
Jet fuel	0.81

Fuel Type	Unit	Net calorific value
Gasoline	TJ/Gg	44.3
Jet Kerosene	TJ/Gg	44.1
Other Kerosene	TJ/Gg	43.8
Diesel Oil	TJ/Gg	43.0
Fuel Oil	TJ/Gg	40.4
LPG	TJ/Gg	47.3
Natural Gas	TJ/Gg	48.0

5.1.2 Calculation Process (Fuel Consumption, part2)

- Activity Data

Fuel type	Unit	Year 2013	Year 2014	Year 2015
Gasoline	TJ/year	115855	119247	134544
Diesel	TJ/year	120218	141229	180686
Fuel Oil	TJ/year	15976	16540	19334
Kerosene	TJ/year	1664	1607	1901
Jet fuel	TJ/year	37569	42658	52638
LPG	TJ/year	2268	2246	2541
Natural Gas	TJ/year	1463	1441	1567

- Emission Factors

Fuel Type	CO_2 EF ($kg\ CO_2/TJ$)	CH_4 EF ($kg\ CH_4/TJ$)	N_2O EF ($kg\ N_2O/TJ$)
Gasoline	69300	10	0.6
Jet Kerosene	71500	10	0.6
Other Kerosene	71900	10	0.6
Diesel Oil	74100	10	0.6
Fuel Oil	77400	10	0.6
LPG	63100	5	0.1
Natural Gas	56100	5	0.1

5.1.2 Calculation Process (Fuel Consumption, part4)

- Emissions

Fuel type	Unit	Year 2013	Year 2014	Year 2015
Gasoline	Gg-CO2/year	8029	8264	9324
Diesel	Gg-CO2/year	8908	10465	13389
Fuel Oil	Gg-CO2/year	1237	1280	1496
Kerosene	Gg-CO2/year	120	116	137
Jet fuel	Gg-CO2/year	2686	3050	3764
LPG	Gg-CO2/year	143	142	160
Natural Gas	Gg-CO2/year	82	81	88
Total	Gg-CO2/year	20980	23175	28110

Sector Specific QC (Fuel Consumption)

- Check the unit (kg/year, ton/year, liter/year, or m^3/year, etc.).
- Check the conversion factors since these values are country specific values and sometimes change.
- Consider emission factors by collecting the information on the local, regional, or country-specific emission factors.
- Considering these country-specific values by using the information on the lower value and upper value of 2006 IPCC Guidelines.
- Considering the data sources of every type of fuel from departments or surveys such as the energy intensity monitoring, etc.).
- The fuel consumption in HCMC is generally not largely different from the previous year. The compiler should check the consistency and the trends of the time series.
- According to the economic growth, the fuel types consumed in HCMC might change.
- Fuel type collected by Data Providing Organization might change.
- Consider the additional information on allocating emissions.

5.1.3 Calculation Process on Fugitive Emissions from Fuels (part1)

- Considering Emission Sources
- Specific sources include, but are not limited to, equipment leaks, evaporation and flashing losses, venting, flaring, incineration, and accidental releases.
- The detailed activity is shown in 2006 IPCC Guidelines (table 4.2.6 and table 4.2.7, Chapter 4 Volume 2).
- Input Data (Collected Data)
  - Emission sources are gasoline, diesel, jet fuel, LPG, and natural gas. The source of the input data is the same as the fuel consumption

5.1.3 Calculation Process on Fugitive Emissions from Fuels (part2)

- First Step: the activity data on gasoline, diesel, and jet kerosene are set directly from input data by considering the number of digits.
- Second Step: the activity data of LPG (m^3/year) are obtained by dividing input data (ton/year) by conversion factor (kg/m^3).
- Third Step: the activity data of natural gas (m^3/year) are obtained by dividing the activity data of fuel consumption (TJ/year) by net calorific value (TJ/Gg) and conversion factor (kg/m^3).
- Conversion Factor

Natural Gas (CH4)	0.68	(kg/m^3)	:288.8K and 101.3kPa
LPG (C3H8)	2.54	(kg/m^3)	:288.8K and 101.3kPa

5.1.3 Calculation Process on Fugitive Emissions from Fuels (part3)

- Emission Factor

Category	Sub-category	Emission source	CO_2			CH_4			N_2O			Unit of measure
			Average	Lower	Upper	Average	Lower	Upper	Average	Lower	Upper	
Gas Distribution	All	All		5.10E-05	1.40E-04		1.10E-03	2.50E-03	ND	ND	ND	Gg per 10^4 m^3 of utility sales
Natural Gas Liquids Transport	Condensate	All	7.20E-06			1.10E-03			ND	ND	ND	Gg per 10^3 m^3 Condensate and Pentanes Plus
	Liquefied Petroleum Gas	All	4.30E-04			NA	NA		2.20E-09			Gg per 10^3 m^3 LPG
	Liquefied Natural Gas	All	ND	ND	ND	ND	ND	ND	ND	ND	ND	Gg per 10^4 m^3 of marketable gas
Refined Product Distribution	Gasoline	All	NA	NA	NA	NA	NA	NA	NA	NA	NA	Gg per 10^3 m^3 product transported
	Diesel	All	NA	NA	NA	NA	NA	NA	NA	NA	NA	Gg per 10^3 m^3 product transported
	Aviation Fuel	All	NA	NA	NA	NA	NA	NA	NA	NA	NA	Gg per 10^3 m^3 product transported
	Jet Kerosen	All	NA	NA	NA	NA	NA	NA	NA	NA	NA	Gg per 10^3 m^3 product transported

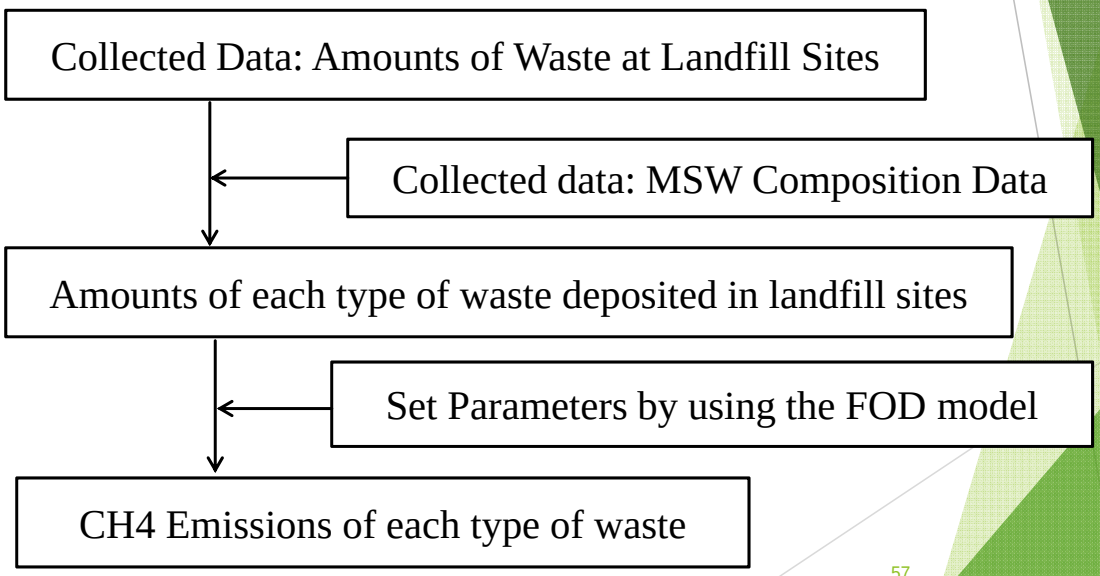
5.1.3 Calculation Process on Fugitive Emissions from Fuels (part3)

- Emissions

Category	Sub-category	Emission source	Unit	Year 2013	Year 2014	Year 2015
Gas Distribution	All	All	Gg CO_2/year	0.0063	0.0062	0.0067
Natural Gas Liquids Transport	Condensate	All	Gg CO_2/year	NO	NO	NO
	Liquefied Petroleum Gas	All	Gg CO_2/year	8.1253	8.0453	9.1031
	Liquefied Natural Gas	All	Gg CO_2/year	NO	NO	NO
Refined Product Distribution	Gasoline	All	Gg CO_2/year	NA	NA	NA
	Diesel	All	Gg CO_2/year	NA	NA	NA
	Aviation Fuel	All	Gg CO_2/year	NA	NA	NA
	Jet Kerosen	All	Gg CO_2/year	NA	NA	NA

5.3.1 Solid Waste Disposal

- The following figure is the outline of GHG emissions from solid waste disposal site.



5.3.1 Input Data on SWDSs

Landfill	Phước Hiệp 1	Phước Hiệp (1A)	Phước Hiệp (2)	Phước Hiệp (3)	Gò Cát	Đông Thạnh	Đa Phước	Data Source
Opening year	1/2003	02/2007	02/2008	10/2013	01/2001	1991	11/2007	DONRE
Closing year	5/2006	02/2008	10/2013		7/2007	2002		DONRE
Characteristic:								DONRE
1) Unmanaged – deep ≥ 5m								DONRE
2) Unmanaged – deep < 5m						x		DONRE
3) Managed – anaerobic	x	x	x	x	x		x	DONRE
4) Managed – semi -aerobic								DONRE
Total area of landfill (m^2)	160,000	97,500	195,000	195,000	250,000	250,000	1,280,000	DONRE
Density burial (mg/m^3)								DONRE
Total capacity (ton)	2,607,704	900,000	2,700,000		5,600,000	10,800,000	24,000,000	DONRE
Operating capacity according years (ton)								DONRE
+ Year 2013	Stop receiving waste	Stop receiving waste	920,432	308,038	Stop receiving waste	Stop receiving waste	1,098,675	DONRE
+ Year 2014			Stop receiving	1,018,319			1,145,913	DONRE
+ Year 2015			Stop receiving	248,189			1,815,490	DONRE

5.3.1 Parameter on MSW Composition Data

MSW Composition	Year 2013	Year 2014	Year 2015
Food waste	60.70%	60.70%	60.70%
Paper/ cardboard	6.87%	6.87%	6.87%
Wood	0.00%	0.00%	0.00%
Textiles	0.69%	0.69%	0.69%
Rubber/leather	0.25%	0.25%	0.25%
Plastic	25.21%	25.21%	25.21%
Metal	0.69%	0.69%	0.69%
Glass	0.00%	0.00%	0.00%
Others	5.59%	5.59%	5.59%
Total	100%	100%	100%

5.3.1 Parameters (part1)

	IPCC default value		Using Value	Country-specific value
	Range	Default value	Value	Reference and remarks
Starting year		1950	1991	
DOC (Degradable organic carbon)	(weight fraction, wet basis)			
Food waste	0.08-0.20	0.15	0.15	
Garden	0.18-0.22	0.2	0.2	=0.17; National Inventory
Paper	0.36-0.45	0.4	0.4	
Wood and straw	0.39-0.46	0.43	0.43	=0.3 ; National Inventory
Textiles	0.20-0.40	0.24	0.24	=0.4 ; National Inventory
Disposable nappies	0.18-0.32	0.24	0.24	
Sewage sludge	0.04-0.05	0.05	0.05	

5.3.1 Parameters (part2)

	IPCC default value		Using Value	Country-specific value
	Range	Default value	Value	Reference and remarks
Industrial waste	0-0.54	0.15	0.15	=0.17; National Inventory
DOCf (fraction of DOC dissimilated)		0.5	0.5	
Methane generation rate constant (k) (years-1)				
Food waste	0.17–0.7	0.4	0.4	=0.2 ; National Inventory
Garden	0.15–0.2	0.17	0.17	=0.03; National Inventory
Paper	0.06–0.085	0.07	0.07	=0.03; National Inventory
Wood and straw	0.03–0.05	0.035	0.035	=0.03; National Inventory
Textiles	0.06–0.085	0.07	0.07	=None; National Inventory
Disposable nappies	0.15–0.2	0.17	0.17	=None; National Inventory
Sewage sludge	0.17–0.7	0.4	0.4	=None; National Inventory

5.3.1 Parameters (part3)

	IPCC default value		Using Value	Country-specific value
	Range	Default value	Value	Reference and remarks
Industrial waste	0.15–0.2	0.17	0.17	=0.13; National Inventory
Delay time (months)		6	6	
Fraction of methane (F) in developed gas		0.5	0.5	
Conversion factor, C to CH4		1.3333	1.3333	
Oxidation factor (OX)		0	0	
Parameters for carbon storage				
% paper in industrial waste		0	0	
% wood in industrial waste		0	0	

5.3.1 CH4 Emissions from SWDSs on Food Waste

Năm/Year	Số lượng thải bỏ/ Amount deposited	MCF	DDOCm được thải bỏ/ Decomposable DOC (DDOCm) deposited	DDOC không phản ứng. Năm thải bỏ/ DDOC not reacted. Deposition year	DDOCm đã phân hủy. Năm thải bỏ/ DDOCm decomposed. Deposition year	DDOCm tích lũy trong bãi chôn lấp ở năm cuối/ DDOCm accumulated in SWDS end of year	DDOCm đã phân hủy/ DDOCm decomposed	CH4 sinh ra/ CH4 generated
	w	MCF	D = w * DOC * DOCf *MCF	B = D * exp2	C = D * (1-exp2)	H = B + ($H_{last\ year}$ * exp1)	E = C + ($H_{last\ year}$ * (1-exp1))	Q = E * 16/12 * F
	Gg	fraction	Gg	Gg	Gg	Gg	Gg	Gg
1991	573.03	0.4	17.19	17.19	0	17.19	0	0
1992	573.03	0.4	17.19	17.19	0	28.71	5.67	3.78
1993	573.03	0.4	17.19	17.19	0	36.43	9.47	6.31
1994	573.03	0.4	17.19	17.19	0	41.61	12.01	8.01
1995	573.03	0.4	17.19	17.19	0	45.08	13.72	9.15
1996	573.03	0.4	17.19	17.19	0	47.41	14.86	9.91
1997	573.03	0.4	17.19	17.19	0	48.97	15.63	10.42
1998	573.03	0.4	17.19	17.19	0	50.01	16.15	10.77
1999	573.03	0.4	17.19	17.19	0	50.71	16.49	10.99
2000	573.03	0.4	17.19	17.19	0	51.18	16.72	11.15
2001	1114.63	0.69154	57.81	57.81	0	92.12	16.87	11.25
2002	1114.63	0.69154	57.81	57.81	0	119.56	30.37	20.25
2003	1027.54	1	77.07	77.07	0	157.21	39.42	26.28
2004	1027.54	1	77.07	77.07	0	182.45	51.83	34.55
2005	1027.54	1	77.07	77.07	0	199.37	60.15	40.1
2006	744.08	1	55.81	55.81	0	189.45	65.73	43.82
2007	917.39	1	68.8	68.8	0	195.79	62.46	41.64
2008	998.93	1	74.92	74.92	0	206.16	64.55	43.03
2009	929.98	1	69.75	69.75	0	207.94	67.97	45.31
2010	929.98	1	69.75	69.75	0	209.13	68.56	45.71
2011	886.6	1	66.5	66.5	0	206.68	68.95	45.97
2012	886.6	1	66.5	66.5	0	205.04	68.14	45.43
2013	1412.58	1	105.94	105.94	0	243.38	67.6	45.07
2014	1313.69	1	98.53	98.53	0	261.67	80.24	53.49
2015	1252.65	1	93.95	93.95	0	269.35	86.27	57.51

5.3.1 Total CH4 Emissions from SWDSs

Năm/ Year	Mêtan phát thải/ Methane generated											Phát thải mêtan/ Methane emissions
	Thực phẩm/ Food	Chất thải vườn/ Garden	Giấy/ Paper	Gỗ/ Wood	Vải/Textile	Tã lót/ Nappies	Bùn thải/ Sludge	Chất thải rắn đô thị/ MSW	Chất thải công nghiệp/ Industrial	Tổng/ Total	Mê tan thu hồi / Methane Recovery	
	A	B	C	D	E	F	Gg	H	J	K	L	M = (K-L) * (1 - OX)
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
1992	3.78	0.00	0.24	0.08	0.06	0.00	0.00		0.00	4.16	0.00	4.16
1993	6.31	0.00	0.46	0.15	0.11	0.00	0.00		0.00	7.03	0.00	7.03
1994	8.01	0.00	0.67	0.23	0.16	0.00	0.00		0.00	9.07	0.00	9.07
1995	9.15	0.00	0.86	0.29	0.21	0.00	0.00		0.00	10.51	0.00	10.51
1996	9.91	0.00	1.04	0.37	0.25	0.00	0.00		0.00	11.57	0.00	11.57
1997	10.42	0.00	1.21	0.43	0.29	0.00	0.00		0.00	12.35	0.00	12.35
1998	10.77	0.00	1.36	0.49	0.33	0.00	0.00		0.00	12.95	0.00	12.95
1999	10.99	0.00	1.51	0.55	0.37	0.00	0.00		0.00	13.42	0.00	13.42
2000	11.15	0.00	1.65	0.61	0.40	0.00	0.00		0.00	13.81	0.00	13.81
2001	11.25	0.00	1.77	0.67	0.43	0.00	0.00		0.00	14.12	0.00	14.12
2002	20.25	0.00	2.45	0.91	0.60	0.00	0.00		0.00	24.21	0.00	24.21
2003	26.28	0.00	3.09	1.14	0.75	0.00	0.00		0.00	31.26	0.11	31.15
2004	34.55	0.00	3.95	1.45	0.97	0.00	0.00		0.00	40.92	0.23	40.69
2005	40.10	0.00	4.75	1.75	1.16	0.00	0.00		0.00	47.76	0.71	47.06
2006	43.82	0.00	5.49	2.04	1.34	0.00	0.00		0.00	52.69	1.10	51.59
2007	41.64	0.00	5.89	2.22	1.44	0.00	0.00		0.00	51.19	0.94	50.25
2008	43.03	0.00	6.45	2.45	1.57	0.00	0.00		0.00	53.50	0.78	52.72
2009	45.31	0.00	7.05	2.71	1.73	0.00	0.00		0.00	56.80	0.25	56.55
2010	45.71	0.00	7.54	2.93	1.84	0.00	0.00		0.00	58.02	0.19	57.83
2011	45.97	0.00	8.00	3.15	1.95	0.00	0.00		0.00	59.07	0.25	58.82
2012	45.43	0.00	8.36	3.04	1.88	1.73	0.00		0.00	60.44	0.15	60.29
2013	45.07	0.00	8.70	2.94	1.81	3.18	0.00		0.00	61.70	0.11	61.59
2014	53.49	0.00	9.55	2.83	1.77	5.43	0.00		0.00	73.07	0.20	72.87
2015	57.51	0.00	10.25	2.74	1.73	7.14	0.00		0.00	79.37	0.16	79.21

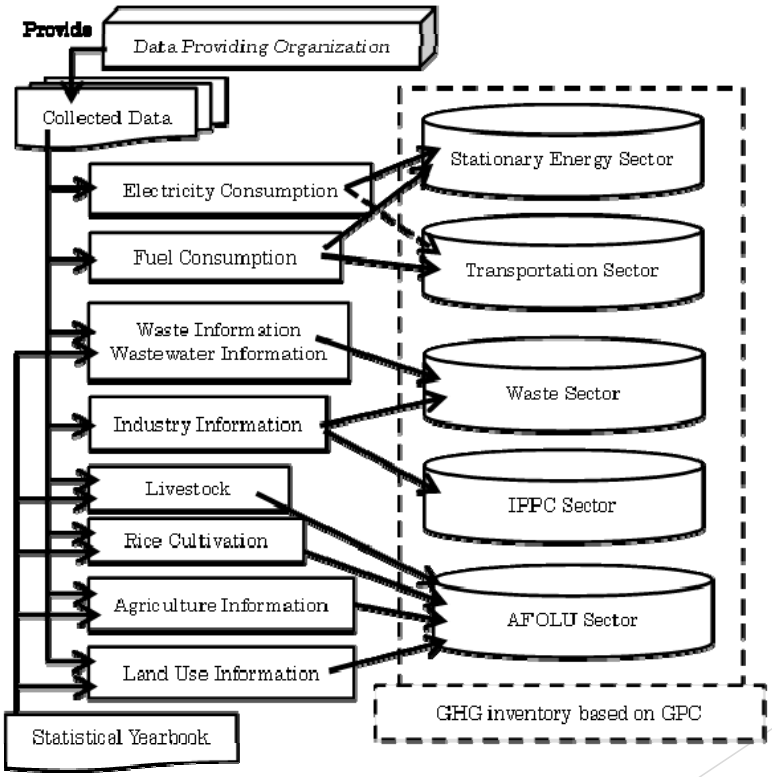
Sector Specific QC (SWDSs)

- Check the unit (kg/year, ton/year, liter/year, or m3/year, etc.)
- The opening and closing information on the disposal sites is important.
- Check and consider the information on the composition of waste going to solid waste disposal sites in each year, since the ratio of the component of solid waste may change over the time.
- Check to see that parameters and emission units are accurately recorded, and that proper conversion factors are used.
- Consider the local, regional or country-specific parameters.
- Check the management situation of each landfill site and value of MCF.
- Check the Oxidation factor and amounts of CH4 collected and removed.
- Consider the waste generated outside of the city boundary and treated within the boundary.
- Consider the waste generated and treated within the city's boundary.
- Consider the waste generated inside the boundary and treated outside of the boundary.

Chapter 6. Reporting based on GPC

- 6.1 Stationary Energy Sector
- 6.2 Transportation Sector
- 6.3 Waste Sector
- 6.4 IPPU Sector
- 6.5 AFOLU Sector

Chapter 6. Reporting based on GPC



6.1.1 Basic Concepts on Emissions Re-categorization Method on Electricity Consumption

Whole Data	Total emissions of each Sub-sector	Detailed information
EVN	Residential Emissions from Residential of EVN	<Unspecified emissions> All
	Commercial Emissions from Commercial, Restaurant, and Hotel of EVN Emissions from Others of EVN	<Specified emissions> Energy Intensity Monitoring Sewage Treatment Plants Infrastructure Equipment such as pump
		<Unspecified emissions> Remainder
	Manufacturing Emissions from Manufacturing industries and Construction of EVN	<Specified emissions> Energy Intensity Monitoring Industrial Zone
		<Unspecified emissions> Remainder
	Agriculture Emissions from Agriculture, Fishing and Forestry of EVN	<Unspecified emissions> All

6.1.1 GHG inventory (Electricity Consumption)

I. Lĩnh vực năng lượng cố định/ Stationary Energy Sector						
GPC ref No.	Phạm vi/ Scope					
I.1		Tòa nhà dân cư/ RESIDENTIAL BUILDINGS	Unit	Year 2013	Year 2014	Year 2015
I.1.1	1		GgCO2/năm (year)			
I.1.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy Consumed (Electricity) within the city boundary	GgCO2/năm (year)	4816	5350	5838
I.1.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and Distribution Loss Emissions from Grid-Supplied Energy Consumed (Electricity)	GgCO2/năm (year)	239	270	295
I.2		Tòa nhà thương mại, tòa nhà hành chính công và cơ sở hạ tầng/ COMMERCIAL and INSTITUTIONAL BUILDINGS and FACILITIES				
I.2.1	1		GgCO2/year			
I.2.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy	GgCO2/năm (year)	1535	1706	1883
I.2.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and	GgCO2/năm (year)	76	86	95
I.3		Sản xuất công nghiệp và xây dựng/ MANUFACTURING INDUSTRIES and CONSTRUCTION				
I.3.1	1		GgCO2/năm (year)			
I.3.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy	GgCO2/năm (year)	4892	5425	5811
I.3.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and	GgCO2/năm (year)	243	274	293
I.4		Công nghiệp năng lượng/ ENERGY INDUSTRIES				
I.4.1	1		GgCO2/năm (year)			
I.4.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy	GgCO2/năm (year)	0	0	0
I.4.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and	GgCO2/năm (year)	0	0	0
I.4.4	1		GgCO2/năm (year)			
I.5		Nông nghiệp, lâm nghiệp và thủy sản/ AGRICULTURE, FORESTRY and FISHING ACTIVITIES				
I.5.1	1		GgCO2/năm (year)			
I.5.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy	GgCO2/năm (year)	33	44	48
I.5.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and	GgCO2/năm (year)	2	2	2
I.6		Những nguồn không cụ thể/ NON-SPECIFIED SOURCES				
I.6.1	1		GgCO2/năm (year)			
I.6.2	2	Phát thải từ tiêu thụ điện lưới trong thành phố/ Emissions from Grid-Supplied Energy	GgCO2/năm (year)	741	832	908
I.6.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện/ Transmission and	GgCO2/năm (year)	37	42	46

6.1.2 IEA Data on Fuel Consumption

	Natural Gas	LPG	Gasoline	Kerosene	Diesel	Fuel Oil
ıtionary Energy Sector						
I.1 Residential Sub-sector	0%	55%	0%	74%	1%	1%
I.2 Commercial Sub-sector	0%	30%	0%	14%	4%	1%
I.3 Manufacturing Sub-sector	100%	15%	0%	12%	16%	86%
I.4 Energy Industries Sub-sector	---	---	---	---	---	---
I.5 Agriculture Sub-sector	0%	0%	2%	0%	5%	1%
I.6 Non-Specified Sources	0%	0%	0%	0%	0%	0%
ansportation Sector						
II.1 On-Road Transportation Sub-sector	0%	0%	98%	0%	74%	0%
II.2 Railways Sub-sector	0%	0%	0%	0%	0%	0%
II.3 Waterborne Navigation Sub-sector	0%	0%	0%	0%	0%	11%
II.4 Aviation Sub-sector	0%	0%	0%	0%	0%	0%
II.5 Off-Road Transportation Sub-sector	0%	0%	0%	0%	0%	0%

6.1.2 Basic Concepts on Emissions Re-categorization Method on Diesel Consumption

Whole Data	Total emissions of each Sub-sector	Detailed information
DOIT	Residential Emissions from DOIT data by using IEA data (refer to Table 6-6)	<Unspecified emissions> All
	Commercial Emissions from DOIT data by using IEA data (refer to Table 6-6)	<Specified emissions> Energy Intensity Monitoring
		<Unspecified emissions> Remainder
	Manufacturing Emissions from DOIT data by using IEA data (refer to Table 6-6)	<Specified emissions> Energy Intensity Monitoring
		<Unspecified emissions> Remainder
	Agriculture Emissions from DOIT data by using IEA data (refer to Table 6-6)	<Unspecified emissions> All
	On-Road Transport Emissions from DOIT data by using IEA data (refer to Table 6-6)	<Specified emissions> Energy Intensity Monitoring MOCPT
		<Unspecified emissions> Remainder
Thermal Power Plants	Energy Industry	<Specified emissions> All

6.1.3 GHG inventory (Fuel Consumption, CO2)

I. Lĩnh vực năng lượng cố định/ Stationary Energy Sector						
GPC ref No.	Phạm vi/ Scope					
I.1		**Tòa nhà dân cư/ RESIDENTIAL BUILDINGS**	Đơn vị/ Unit	Year 2013	Year 2014	Year 2015
I.1.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	268.9	281.39	338.23
I.1.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.1.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			
I.2		**Tòa nhà thương mại, tòa nhà hành chính công và cơ sở hạ tầng/ COMMERCIAL and INSTITUTIONAL BUILDINGS and FACILITIES**	Đơn vị/ Unit			
I.2.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	428.36	500.91	617.67
I.2.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.2.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			
I.3		**Sản xuất công nghiệp và xây dựng/ MANUFACTURING INDUSTRIES and CONSTRUCTION**	Đơn vị/ Unit			
I.3.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	2490.89	41160.18	3440.21
I.3.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.3.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			
I.4		**Công nghiệp năng lượng/ ENERGY INDUSTRIES**	Đơn vị/ Unit			
I.4.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	0	0	0
I.4.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.4.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			
I.4.4	1	Phát thải từ việc phát điện cấp lên lưới/ Emissions from enegry generation supplied to the grid	GgCO2/năm (year)	10263	12323	523
I.5		**Nông nghiệp, lâm nghiệp và thủy sản/ AGRICULTURE, FORESTRY and FISHING**	Đơn vị/ Unit			
I.5.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	605.98	688.53	855.93
I.5.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.5.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			
I.6		**Những nguồn không cụ thể/ NON-SPECIFIED SOURCES**	Đơn vị/ Unit			
I.6.1	1	Phát thải từ đốt cháy nhiên liệu trong thành phố/ Emission from fuel combustion within the city boundary	GgCO2/năm (year)	0	0	0
I.6.2	2	Phát thải từ đốt cháy nhiên liệu ngoài thành phố/ Emission from fuel combustion without the city boundary	GgCO2/năm (year)			
I.6.3	3	Phát thải do thất thoát trong quá trình truyền tải và phân phối điện lưới/ Emission from transmission and distribution losses from grid-supplied energy consumption	GgCO2/năm (year)			

6.1.2 GHG inventory (Fugitive Emissions from Fuels)

I. Lĩnh vực năng lượng cố định dựa trên GPC/ STATIONARY ENERGY Sector based on GPC

Nguồn phát thải CO2: Tiêu thụ nhiên liệu/ CO2 Emission Source: Fuel Consumption

I.7 Phát thải phát tán từ khai khoáng, quá trình, lưu trữ và vận chuyển than/ FUGITIVE EMISSIONS from MINING, PROCESSING, STORAGE and TRSANPORTATION of Coal

GPC ref No.	Phạm vi/	Nguồn phát thải KNK: phát thải CO2/ GHG Emission Sources: CO2 Emissions					
		Hoạt động/ Activity	Mô tả/ Description	Đơn vị/ Unit	Year 2013	Year 2014	Year 2015
I.7.1	**1**	**Sự phát thải từ việc đốt cháy nhiên liệu trong thành phố/ Emissions from Fuel Consumed within the city boundary**		GgCO2/năm (year)			

I.8 Phát thải phát tán từ hệ thống khí tự nhiên và dầu/ FUGITIVE EMISSIONS from OIL and NATURAL GAS SYSTEM

GPC ref No.	Phạm vi/	Nguồn phát thải KNK: phát thải CO2/ GHG Emission Sources: CO2 Emissions					
		Hoạt động/ Activity	Mô tả/ Description	Đơn vị/ Unit	Year 2013	Year 2014	Year 2015
I.8.1	**1**	**Sự phát thải từ việc đốt cháy nhiên liệu trong thành phố/ Emissions from Fuel Consumed within the city boundary**		GgCO2/năm (year)	8.1316	8.0515	9.1098

6.3 GHG inventory (Waste Sector (SWDSs))

Lĩnh vực chất thải theo GPC/ Waste Sector based on GPC

III.1 Thải bỏ chất thải rắn/ SOLID WASTE DISPOSAL

GPC ref No.	Phạm vi/ Scope	Ngồn phát thải KNK/ GHG emission Sources			Đơn vị/ Unit	Năm 2013 Year 2013
		Hoạt động/ Activity	Loại chất thải/ Waste type	Mô tả/ Description		
III.1.1	**1**	**Phát thải do chất thải rắn phát sinh trong thành phố và được thải bỏ vào bãi chôn lấp hoặc bãi rác hở trong thành phố/ Emissions from solid waste generated in the city and disposed in landfills or open dumps within the city**				
III.1.1	1	Bãi chôn lấp/ Landfills	Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	1295.70
III.1.1	1	Bãi chôn lấp/ Landfills	Industrial Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.00
III.1.1	1	Bãi rác hở/ Open Dumps	Municipal Solid Waste	Đang xem xét/ Considering	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	
III.1.1	1	Bãi rác hở/ Open Dumps	Industrial Waste	Đang xem xét/ Considering	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	

6.3 GHG inventory (Waste Sector (Biological Treatment))

Lĩnh vực chất thải theo GPC/ Waste Sector based on GPC

III.2 Xử lý chất thải bằng phương pháp sinh học/ BIOLOGICAL TREATMENT of Waste

GPC ref No.	Phạm vi/ Scope	Nguồn phát thải GHG/ GHG emission Sources			Đơn vị/ Unit	Năm 2013 Year 2013
		Hoạt động/ Activity	Loại rác/ Waste type	Mô tả/ Description		
III.2.1	**1**	**Phát thải do chất thải rắn phát sinh trong thành phố và được xử lý bằng phương pháp sinh học trong thành phố/ Emissions from solid waste generated in the city that is treated biologically in the city**				
III.2.1	1	Composting	Chất thải rắn đô thị/ Municipal Solid Waste	Phát thải CH4/ CH4 Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	11.82
III.2.1	1	Xử lý bằng phương pháp phân hủy kị khí tại các thiết bị công trình khí sinh học/ Anarobic digestion at biogas facilities	Chất thải rắn đô thị/ Municipal Solid Waste	Phát thải CH4/ CH4 Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.00
III.2.1	1	Composting	Chất thải rắn đô thị/ Municipal Solid Waste	Phát thải N2O/ N2O Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	13.083
III.2.1	1	Xử lý bằng phương pháp phân hủy kị khí tại các thiết bị công trình khí sinh học/ Anarobic digestion at biogas facilities	Chất thải rắn đô thị/ Municipal Solid Waste	Phát thải N2O/ N2O Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	NA

6.3 GHG inventory (Waste Sector (Incineration, Open Burning))

Lĩnh vực chất thải theo GPC/ Waste Sector based on GPC

III.3 Lò đốt và đốt lộ thiên/ INCINERATION and OPEN BURNING

GPC ref No.	Phạm vi/ Scope	Nguồn phát thải khí nhà kính/ GHG emission Sources			Đơn vị/ Unit	Năm 2013 Year 2013
		Hoạt động/ Activity	Loại chất thải/ Waste type	Mô tả/ Description		
III.3.1	**1**	**Phát thải do chất thải phát sinh và được xử lý trong thành phố/ Emissions from waste generated and treated within the city**				
III.3.1	1	Lò đốt/ Incinerator	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2/ năm (Gg-CO_2/year)	0.00
III.3.1	1	Lò đốt/ Incinerator	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.00
III.3.1	1	Lò đốt/ Incinerator	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.000
III.3.1	1	Lò đốt/ Incinerator	Chất thải y tế/ Clinical Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	NA
III.3.1	1	Lò đốt/ Incinerator	Chất thải y tế/ Clinical Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.01
III.3.1	1	Lò đốt/ Incinerator	Chất thải y tế/ Clinical Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.116
III.3.1	1	Đốt lộ thiên/ Open burning	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	0.91
III.3.1	1	Đốt lộ thiên/ Open burning	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	30.44
III.3.1	1	Đốt lộ thiên/ Open burning	Chất thải rắn đô thị/ Municipal Solid Waste		Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	10.370

6.3 GHG inventory (Waste Sector (Wastewater Treatment))

Lĩnh vực chất thải dựa trên GPC/ Waste Sector based on GPC

III.4 Xử lý nước thải và thải bỏ/ WASTEWATER TREATMENT and DISCHARGE

GPC ref No.	Phạm vi/ Scope	Nguồn phát thải KNK/ GHG emission Sources			Đơn vị/ Unit	Năm 2013 Year 2013
		Hoạt động/ Activity	Loại chất thải/ Waste type	Mô tả/ Description		
III.4.1	**1**	**Phát sinh do nước thải phát sinh và xử lý trong thành phố/ Emissions from wastewater generated and treated within the city**				
III.4.1	1	Nhà máy xử lý nước thải tập trung bằng công nghệ hiếu khí/ Centralized aerobic wastewater treatment plants	Nước thải sinh hoạt/ Domesitic wastewater	CH4	Gg-CO_2e/ năm (Gg-CO_2e/year)	0.00
III.4.1	1		Nước thải sinh hoạt/ Domesitic wastewater	N2O: Tất cả phát thải N2O từ dò ng nước thải xả vào môi trường/ All indirect N_2O emissions from wastewater effluent	Gg-CO_2e/ năm (Gg-CO_2e/year)	146.196
III.4.1	1	Hầm tự hoại/ Septic tanks	Nước thải sinh hoạt/ Domesitic wastewater	CH4	Gg-CO_2e/ năm (Gg-CO_2e/year)	583.18
III.4.1	1		Nước thải sinh hoạt/ Domesitic wastewater	N2O: "IE" (Được dự đoán ở những nhà máy xử lý tập trung bằng công nghệ hiếu khí)/ estimated in Centralized aerobic wastewater treatment plants)	Gg-CO_2e/ năm (Gg-CO_2e/year)	
III.4.1	1	Không được xử lý/ Untreatment	Nước thải sinh hoạt/ Domesitic wastewater	CH4	Gg-CO_2e/ năm (Gg-CO_2e/year)	1.87
III.4.1	1		Nước thải sinh hoạt/ Domesitic wastewater	N2O: "IE" (Được dự đoán ở những nhà máy xử lý tập trung bằng công nghệ hiếu khí)/ estimated in Centralized aerobic wastewater treatment plants)	Gg-CO_2e/ năm (Gg-CO_2e/year)	
III.4.1	1	Nước thải công nghiệp/ Industrial wastewater	Nước thải công nghiệp/ Industrial wastewater	CH4	Gg-CO_2e/ năm (Gg-CO_2e/year)	1.37

6.4 GHG Inventory (IPPU Sector (SF6 Emissions))

IV.2 Sử dụng sản phẩm/ PRODUCT USE

GPC ref No.	Phạm vi/ Scope	Hoạt động/ Activity	Mô tả/ Description	Đơn vị/ Unit	Năm 2013 Year 2013
IV.2	**1**	**Phát thải từ sử dụng sản phẩm trong thành phố/ Emissions from Product Use Occuring within the City Boundary**			
IV.2	1	Các sản phẩm phi năng lượng từ việc sử dụng dung mô	Phát thải CO_2/ CO_2 Emissions	$GgCO_2$/năm ($GgCO_2$/year)	
IV.2	1	Phát thải từ công nghiệp điện tử/ Emissions from the el	Phát thải HFCs / HFCs Emissions	$GgCO_2$/năm ($GgCO_2$/year)	
IV.2	1		Phát thải PFCs/ PFCs Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1		Phát thải SF_6/ SF_6 Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1		Phát thải NF_3/ NF_3 Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1	Phát thải từ các chất flo thay thế cho các chất làm suy giảm tầng ozone/ Emissions from fluorinated substitues for ozone depleting substances	Phát thải HFCs/ HFCs Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1		Phát thải PFCs/ PFCs Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1	Phát thải từ quá trình sản xuất và sử dụng sản phẩm/ Emissions from other product manufacture and use	Phát thải PFCs/ PFCs Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	
IV.2	1		Phát thải SF_6 / SF_6 Emissions	Gg-CO_2e/ năm (Gg-CO_2e/year)	0.87

6.5 GHG Inventory (AFOLU Sector (Livestock))

V. NÔNG NGHIỆP, LÂM NGHIỆP, VÀ SỬ DỤNG ĐẤT KHÁC/ AFOLU

V.1 VẬT NUÔI/ LIVESTOCK

GPC ref No.	Phạm vi/ Scope	Nguồn phát thải khí nhà kính: phát thải CH_4 và N_2O/			
		Hoạt động/ Activity	Mô tả/ Description	Đơn vị/ Unit	Năm 2013 Year 2013
V.1	**1**	**Phát thải từ vật nuôi/ Emissions from Livestock**			
V.1	1	Quá trình tiêu hóa thức ăn/ Enteric fermentation	Phát thải CH_4/ CH_4 Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	236.67
V.1	1	Quản lý chất thải vật nuôi/ Manure Management	Phát thải CH_4/ CH_4 Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	102.69
V.1	1	Quản lý chất thải vật nuôi/ Manure Management	Phát thải N_2O/ N_2O Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	33.57

6.5 GHG Inventory (AFOLU Sector (Rice Cultivation))

V. NÔNG NGHIỆP, LÂM NGHIỆP, VÀ SỬ DỤNG ĐẤT KHÁC/ AFOLU

V.3 NGUỒN TỔNG HỢP/ AGGREGATE SOURCES

GPC ref No.	Phạm vi/ Scope	Nguồn phát thải khí nhà kính: phát thải CH_4 GHG Emission Sources: CH_4 Emissions			
		Hoạt động/ Activity	Mô tả/ Description	Đơn vị/ Unit	Năm 2013 Year 2013
V.3	**1**	**Phát thải từ nguồn tổng hợp và các nguồn phát thải không phải CO_2 trên đất Emissions from aggregate sources and non-CO2 emission sources on land**			
V.3	1	Canh tác lúa Rice cultivations	Phát thải CH_4/ CH_4 Emissions	Gg-CO_2 tương đương/năm (Gg-CO_2e/year)	65.10

Annex 4
Material of Final Seminar

Project to Support the Planning and Implementation of NAMAs in a MRV Manner

Overview of Activities in HCMC

Final Seminar

26 October 2017

Background and Objectives

Project to Support the Planning and Implementation of NAMAs in a MRV Manner (SPI-NAMA)

- SPI-NAMA started in January 2015 with MONRE and JICA Long-Term Experts
- HCMC selected as model city of Project and started activities with JICA Short-Term Expert Team from October 2015

Project Framework

Project Purpose: Capacity of the Government of Vietnam concerning the planning and implementation of NAMAs is enhanced.
Output 1: Capacity of MONRE to facilitate the process of development and implementation of NAMAs is enhanced.
Output 2: Capacity of the line ministries and *other stakeholders* to plan and implement NAMAs is enhanced.

Feedback

Activities

1. GHG Inventory
   - ✓ Preparation of GHG inventory of HCMC
   - ✓ Training on GHG inventory preparation
   - ✓ Drafting of manual
2. MRV of Mitigation Measures
   - ✓ Piloting of MRV on selected mitigation measures
     Focus: energy, transport and waste sectors
   - ✓ Drafting of manual
3. Capacity Building on Climate Change Mitigation
   - ✓ Training in HCMC and Japan

Institutionalization of GHG inventory and MRV

Implementation Structure

JICA Short-Term Expert Team
JV of three consulting companies
- Pacific Consultants
- Oriental Consultants Global
- Suuri-Keikaku

HCMC
DONRE-CCB

Local Consultants
- RCEE-NIRAS JSC with ENERTEAM
- Private Consultants

Departments and Organizations of HCMC
Statistical Office
Public Companies

Achievements

1. GHG Inventory

(1) Prepared 2013 GHG inventory of HCMC based on:

a.) GPC (Global Protocol for Community-Scale GHG Emission Inventories)

b.) Ten sectors of Climate Change Action Plan

- ✓ *Completed data collection for 2014 and 2015*

(2) Produced publicity material on GHG inventory of HCMC

(3) Completed training on GHG inventory preparation

(4) Completed GHG Inventory Preparation Manual

- ✓ *Two consultation meeting conducted*

Achievements

2. MRV of Mitigation Measures

(1) Completed MRV Piloting

(2) Completed MRV Manual

- ✓ *Two consultation meeting conducted*
- ✓ *Discussions with central level held*

3. Capacity Building on Climate Change Mitigation

(1) Two training trips to Japan

(2) Two training courses in HCMC

(3) Several short seminars

4. Institutionalization of GHG inventory and MRV

Prepared background documents

GHG Inventory of HCMC

Final Seminar

Fumihiko KUWAHARA

Table of Contents

1.1 What is Greenhouse Gases

- Greenhouse gases (GHGs) trap heat in the atmosphere and global warming.
- GHGs consists of CO_2, CH_4, N_2O, HFCs, PFCs, SF6, and NF_3.

Source: http://www.gov-online.go.jp, city.muroran.lg.jp

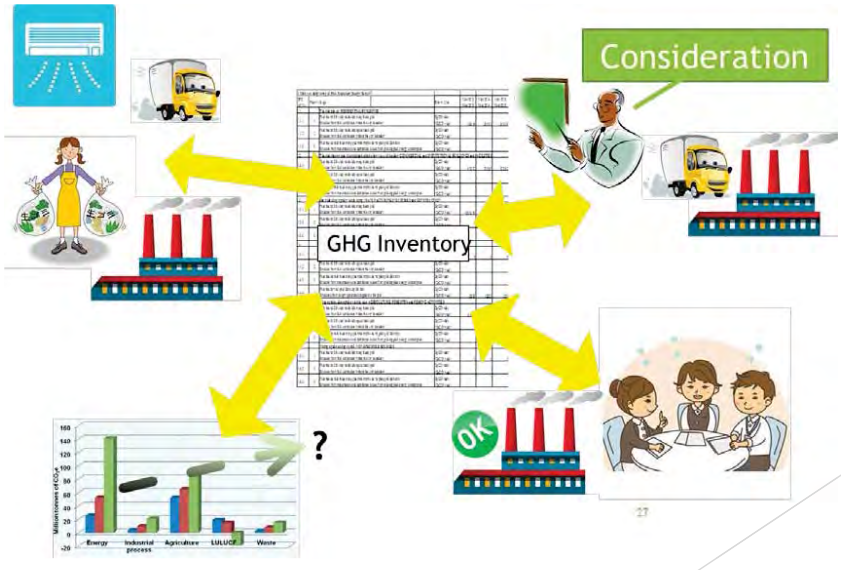
1.2 What is GHG Inventory?

- **Comprehensive List** of GHG emissions and removals
  - Result of Human Activities
  - Within national Territory or city boundary
  - Annual data and time series
- Quantity of GHGs by each Source.
- Policy-makers can use GHG inventory for planning climate change mitigation actions.

1.3 How to Use GHG Inventory?

- GHG inventory enables cities to:
  - understand the amount of GHG emitted in the city;
  - understand the emissions contribution of various activities in the city;
  - compare GHG emissions over time;
  - compare GHG emissions across cities;
  - project future GHG emissions;
  - set GHG emission reduction targets;

- identify the sectors and sub-sectors to focus emission reduction efforts;
- track the impact of mitigation measures; and
- provide solid proof of GHG development for carbon financing.



1.4 How to Calculate GHG Emissions

- Basically, GHG emissions are calculated in each emission sources category using following basic equitation.

- Activity Data are amounts of human activities resulting in emissions, such as gasoline consumption, electricity consumption, amounts of waste disposed, and etc.
- Emission Factor are the average rate of emissions of GHG per unit of activity data, for example: 0.75 tCO_2/MWh in 2013 for electricity.

2. Commentary on 2013 GHG inventory of HCMC

- 2.1 Summary of GHG Inventory in HCMC
- 2.2 Comparison with Countries and Cities
- 2.3 Recommendations
- 2.4 Future Improvement Idea

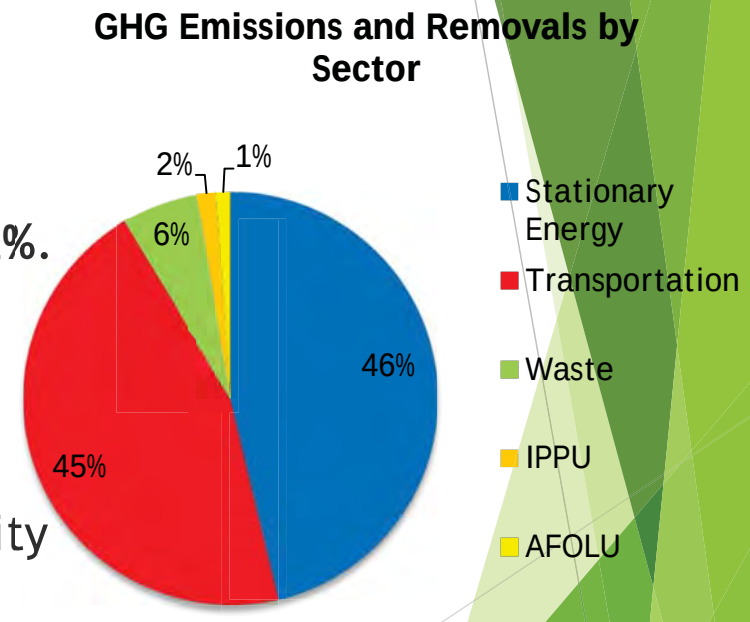
2.1 Summary of GHG Inventory in HCMC

GPC ref No.	GHG Emissions and Removals GHG Emissions Sources (By Sector and Sub-sector)	Total GHG (metric ton CO2e/year) in 2013			
		Scope 1	Scope 2	Scope 3	Total
I	**STATIONARY ENERGY**				
I.1	Residential buildings	269,780	5,301,680	262,963	5,834,424
I.2	Commercial and institutional building and facilities	440,575	2,505,610	124,278	3,070,463
I.3	Manufacturing industries and construction	2,597,202	5,386,028	267,147	8,250,377
I.4.1/2/3	Energy industries	0	0	0	0
I.4.4	Energy generation supplied to the grid	10,316			
I.5	Agriculture, forestry and fishing activities	621,570	36,366	1,804	659,740
I.6	Non-specified sources	0	0	0	0
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	0			0
1.8	Fugitive emissions from oil and natural gas systems	23,378			23,378
	SUB-TOTAL	**3,952,505**	**13,229,684**	**656,192**	**17,838,381**
II	**TRANSPORTATION**				
II.1	On-road transportation	14,544,176	NO	NE	14,544,176
II.2	Railways	IE	IE	NE	0
II.3	Waterborne navigation	149,134	NO	NE	149,134
II.4	Aviation	IE	NO	2,701,073	2,701,073
II.5	Off-road transportation	IE	IE	NE	0
	SUB-TOTAL	**14,693,310**		**2,701,073**	**17,394,382**
III	**WASTE**				
III.1.1/2	Solid waste generated in the city	1,293,241			1,293,241
III.2.1/2	Biological waste generated in the city	24,900			24,900
III.3.1/2	Incinerated and burned waste generated in the city	5,606			5,606
III.4.1/2	Wastewater generated in the city	926,142			926,142
III.1.3	Solid waste generated outside the city	NE			0
III.2.3	Biological waste generated outside the city	NE			0
III.3.3	Incinerated and burned waste generated outside the city	NE			0
III.4.3	Wastewater generated outside the city	NE			0
	SUB-TOTAL	**2,249,889**			**2,249,889**
IV	**INDUSTRIAL PROCESSES and PRODUCT USES (IPPU)**				
IV.1	Emissions from industrial processes occurring within the city boundary	565,704			565,704
IV.2	Emissions from product uses occurring within the city boundary	873			873
	SUB-TOTAL	**566,577**			**566,577**
V	**AGRICULTURE, FORESTRY and OTHER LAND USE (AFOLU)**				
V.1	Emissions from livestock	372,891			372,891
V.2	Emissions from land	-161,037			-161,037
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	211,508			211,508
	SUB-TOTAL	**423,362**			**423,362**
Total	**GHG Emissions and Removals**	**21,885,641**	**13,229,684**	**3,357,265**	**38,472,590**

Scope 1 emissions are the emissions from sources located within the city boundary.
Scope 2 emissions are mainly the emissions from electricity consumption.
Scope 3 emissions are mainly the emissions of transmission and distribution losses from the use of electricity consumption.
NE is Not Estimated, IE is Included Elsewhere, NO is Not Occurring.

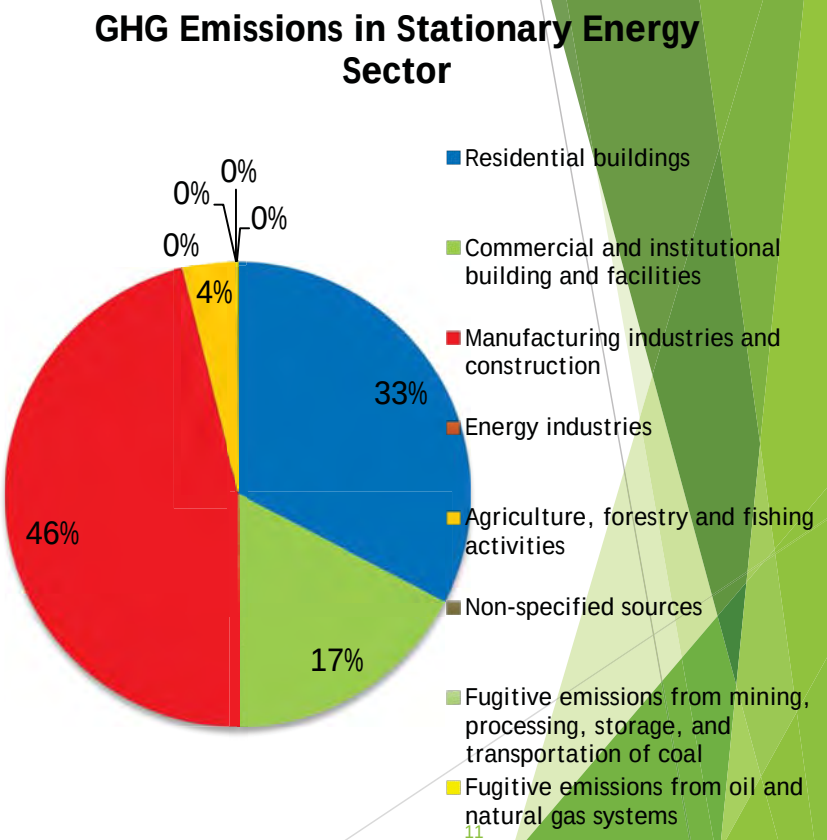
GHG Emissions and Removals by Sector in HCMC

- Stationary Energy: 46%
- Transportation: 45%
- Stationary Energy + Transportation Sectors = 91%.
- Waste: 6%
- IPPU: 2%
- AFOLU: 1%
- Stationary Energy: Electricity Consumption.
- Transportation: Gasoline Combustion and Diesel Combustion.



GHG Emissions in Stationary Energy Sector

- Residential Buildings: 33%
- Commercial and Institutional Building and Facilities: 17%
- Manufacturing Industries and Construction: 46%
- Agriculture, Forestry and Fishing Activities: 4%
- Fugitive Emissions from Oil and Natural Gas Systems: very small
- Others: Not Occurring



2.2 Comparing with Countries and Cities

- Comparison with GHG Inventory of Vietnam and HCMC
- Emission Composition of Cities (Stationary Energy, Transportation, and Waste)
- GHG Emissions per Capita
- GHG Inventory from Stationary Energy and Transportation

Comparison with GHG Inventory of Vietnam and HCMC

- 246.8 million ton CO_2e (Vietnam, Year 2010)
- 38.5 million ton CO_2e (HCMC, Year 2013)
- Although the calculation year differs, the **population** of HCMC is around **9%** of Vietnam, but the **GHG emissions** occupy around **15%** or more.

HCMC is suggested to be the large emission sources in Vietnam.

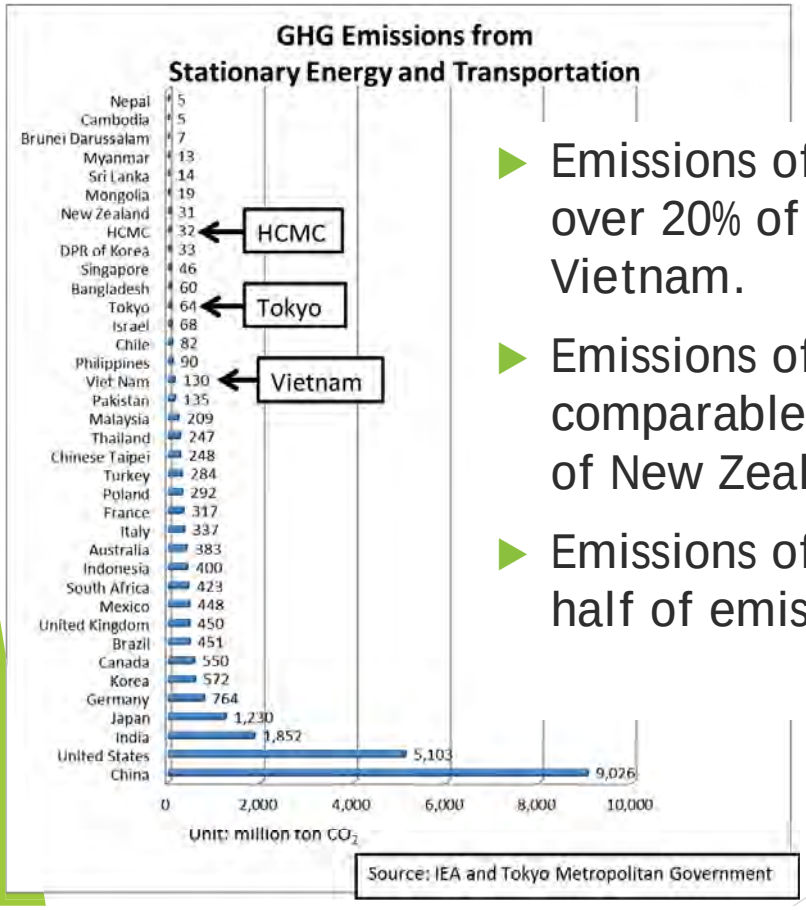
GHG Emissions per Capita

- The **per capita emissions** of HCMC is at the same level of Seoul, London, and Buenos Aires despite HCMC being much less economically developed than its counterparts.

City	GHG emissions per capita ($tonCO_2e$/year/capita)	GHG inventory per GDP ($kgCO_2e$/year/GDP)	GDP/capita (USD/capita)
Seoul	4.638		
London	4.732	82.786	57,157
Los Angeles	7.458	33.422	223,138
Durban	6.588		
Yokohama	5.662	165.596	34,195
Toronto	7.064	123.341	57,273
Buenos Aires	4.395	170.454	25,782
Austin	11.599	121.534	95,437
Madrid	2.869	89.118	32,196
Auckland	5.890	139.831	42,125
Washington DC	12.730	72.891	174,642
Portland	10.064	47.102	213,659
Boston	9.346	54.861	170,355
Salvador de Bahia	1.332	154.384	8,628
Oslo	2.148	24.590	87,361
HCMC	**4.157**	**915.311**	**4,542**

The importance of making policy on GHG emission reduction is suggested.

GHG Inventory from Stationary Energy and Transportation



- Emissions of HCMC occupy over 20% of total emissions in Vietnam.
- Emissions of HCMC are comparable to the emissions of New Zealand.
- Emissions of HCMC are around half of emissions of Tokyo.

2.3 Recommendations

- GHG Inventory of HCMC in 2014 and 2015
- A Complete Fuel Consumption on LGP, Natural Gas, Coal, etc.
- Amount of Municipal Solid Waste Generated, Recycled, and Open-burned
- Amount of industrial waste Generated, Treated, Disposed, and Recycled
- Amount of CH_4 Recovered at Landfill Sites
- Continuously Update and Improve GHG Inventory Preparation Manual

- CH_4 and N_2O Emission Factor of the Grid
- Fulfilling the reporting requirement of C40:
  - Geographic boundary, heating and cooling degree days, population, GDP, and etc.
- Requirement on reporting form of C40:
  - Data, data sources, notation keys in each sub-category
- DOIT under HCMC provides information from the Energy Intensity Monitoring Sheet
- Definition of the fuel type stated in the Energy Intensity Monitoring Sheet

2.4 Future Improvement Idea

- Availability of Emission Factor on Iron and steel industry and Ferroalloy industry in IPPU sector by considering the industrial process of each factory in HCMC
- Vietnamese Energy Statistical Yearbook should be developed by MOIT every year.

Example of Tokyo Case (more detailed information)

- How should the GHG inventory be improved into the future?
- The GHG inventory needs to be improved continuously year by year.
- All fuel types should be collected.
- More detailed information on electricity consumption such as commercial building application, and etc.
- If more detailed information are collected, the GHG inventory using this information can be used for planning of policy and measures and their follow-up.

Example of GHG Emission in Tokyo Metropolitan Government

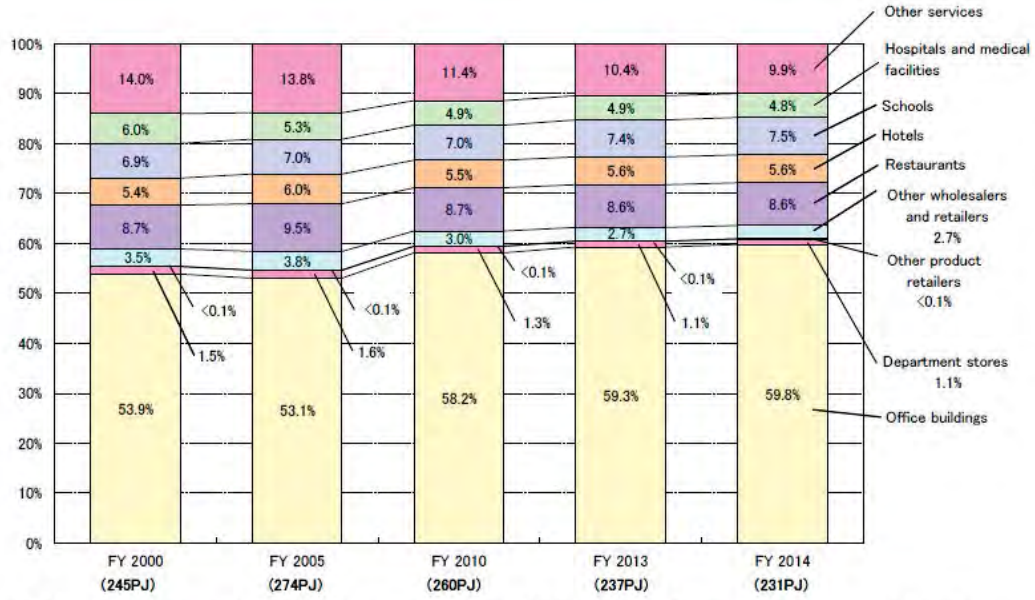


Figure 2-14 Composition ratios in final energy consumption by building application in the commercial sector

Source: Final Energy Consumption and Greenhouse Gas Emissions in Tokyo (FY 2014)
March 2017 Bureau of Environment Tokyo Metropolitan Government

Thank you very much

- Climate Change Bureau in Department of Natural Resources and Environment (DoNRE)
  - Mr. Hà Minh Châu
  - Mr. Nguyễn Huy Phương
  - Ms. Phạm Thị Kim Ngân
  - Ms. Trần Hồng Lan
- GHG inventory experts of JICA short-term expert team
  - Mr. FUMIHIKO KUWAHARA
    - E-mail: kuwahara_fumihiko@sur.co.jp

GHG Inventory Preparation Manual

Final Seminar

Ms. Phạm Thị Kim Ngân

Mr. FUMIHIKO KUWAHARA

Table of Contents

1.1 Objective

- Method of preparation of the GHG inventory of HCMC
- Reference document for the person related with the preparation of GHG inventory

- Based on Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines).

1.2 Composition

Chapter	Notes
Chapter 1: Introduction	Basic Information, such as outlines, terms, etc.
Chapter 2: GHG Inventory Preparation Procedure	Preparation Procedure, such as schedule, roles and responsibility, Institutional Arrangement, etc.
Chapter 3: Calculation Methods	Basic Calculation Formula, including data collection methods
Chapter 4: Data Sources	All data sources necessary for preparing GHG inventory
Chapter 5: Calculation	The concrete calculation steps in HCMC.
Chapter 6: Reporting Based on GPC	The reporting form referring to the GPC.
Annex I: Data Collection Forms	Data collection forms
Annex II: GHG inventory of HCMC in 2013	GHG inventory based on GPC
Annex III: GHG inventory based on the Priority Sectors in HCMC	GHG inventory based on sectors of CCAP

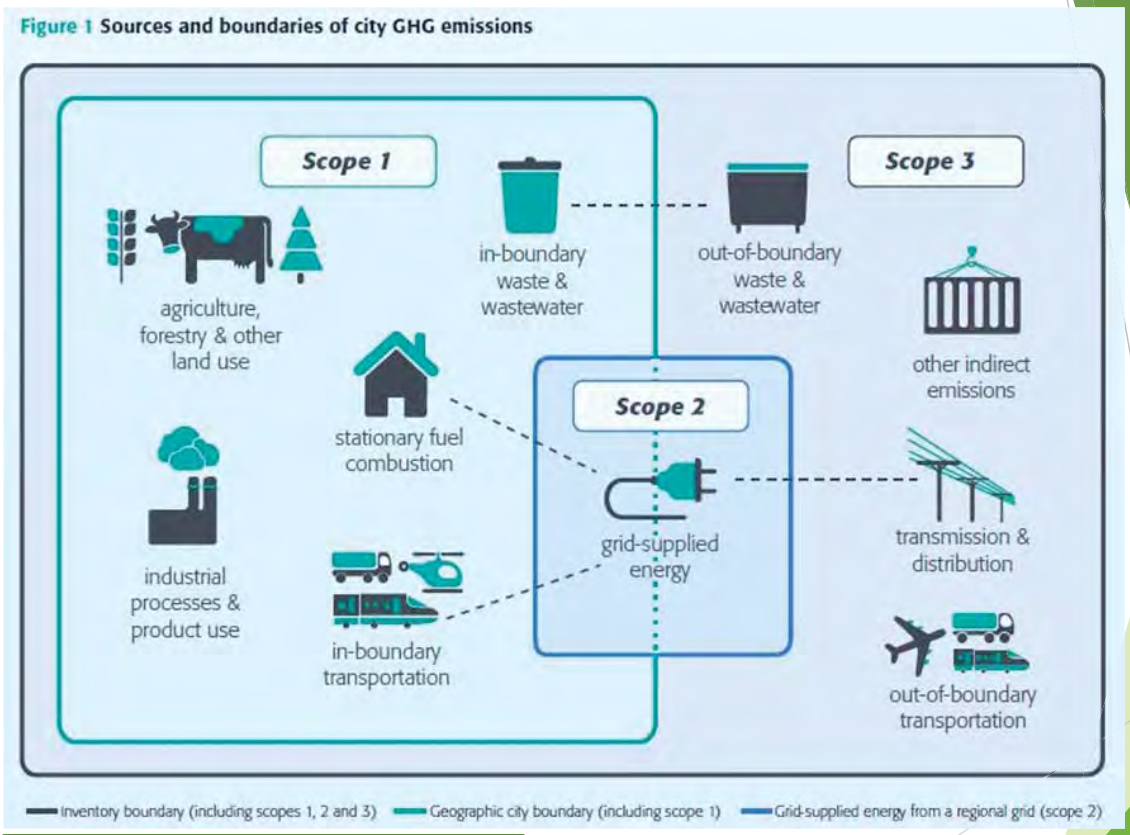
1.3 Sector

Sector	Based on GPC. 1) Stationary energy Sector 2) Transportation Sector 3) Waste Sector 4) Industrial process and product use (IPPU) Sector 5) Agriculture, forestry, and other land use (AFOLU) Sector
Sub-Sector	Divisions that make up a sector
Sub-categories	An additional level of categorization, such as vehicle type, building type, and etc. Sub-categories provide opportunities to use disaggregated data, improve inventory detail, and help identify mitigation actions and policies.

1.4 Scope

- GHG inventory of city level shall consider the Geographic Boundary. This tool is “Scope”
- Emissions are categorized by Scope as following.
- Scopes definitions for city inventories (only city level)

Scope 1	GHG emissions from sources located within the city boundary
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

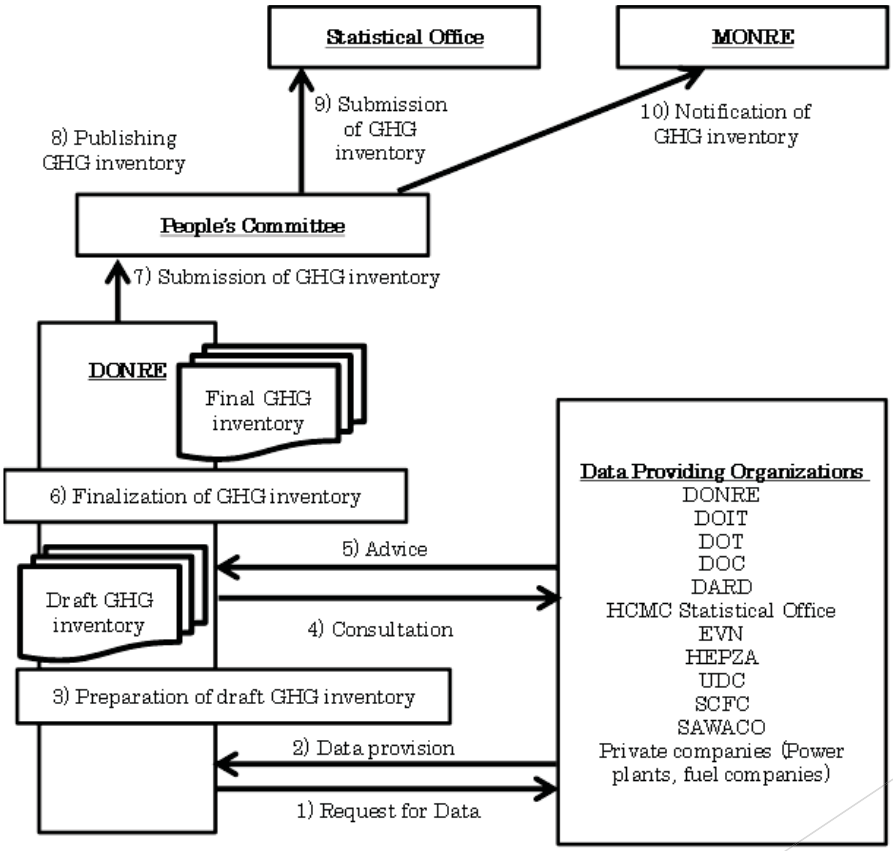


Source: GPC

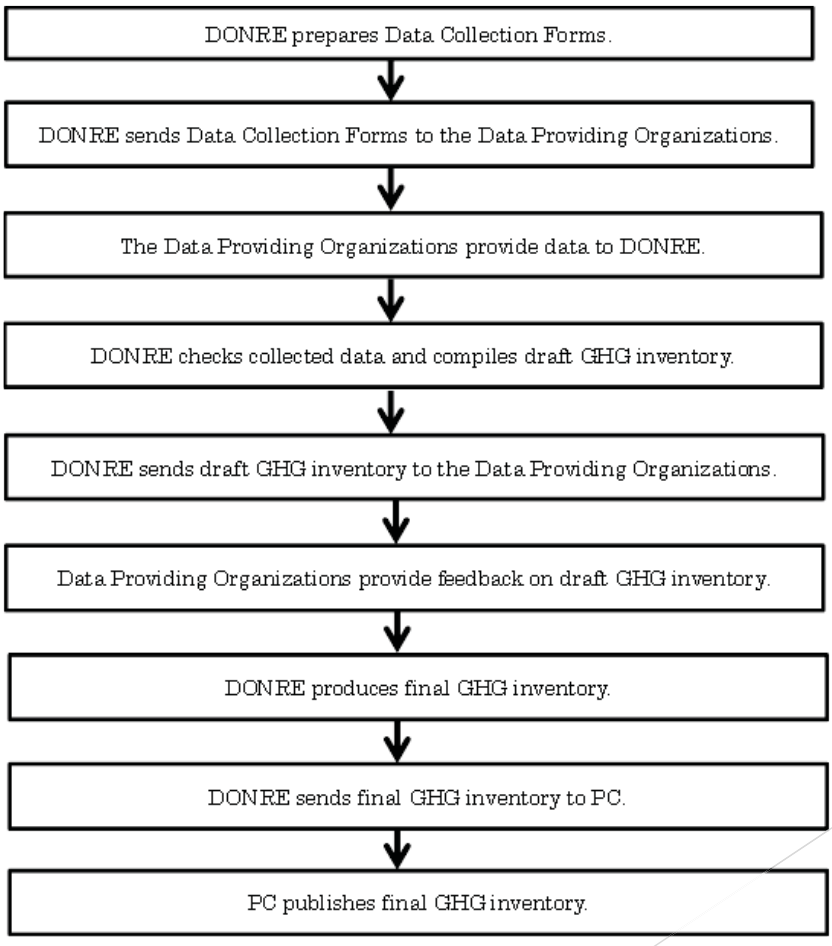
2.1 Procedures (Chapter 2 of Manual)

- 2.1 Overview
- 2.2 Preparation
- 2.3 Data Request
- 2.4 Data Preparation
- 2.5 Data Collection
- 2.6 Preparation of GHG Inventory
- 2.7 Feedback on Draft GHG Inventory
- 2.8 Finalizing GHG Inventory
- 2.9 Publishing GHG Inventory
- 2.10 QC
- 2.11 QA

Institutional Arrangement for the GHG Inventory Preparation in HCMC



Preparation Flow of GHG Inventory



Roles and Responsibilities

	Roles and Responsibilities
PC	Publish GHG inventory Submission of GHG inventory to MONRE
DONRE	Preparation of GHG inventory Preparation, confirmation, and approval of improvement plan on preparation of GHG inventory Performs actual work of GHG inventory compilation. Responsible for inventory calculations, compiling, and archiving and management of all data. Quality control
Data Providing Organizations	Data provision The following quality control ➢ Confirmation of data provided for the preparation of the inventory. ➢ Responding to inquiries regarding data it has provided.

Schedule of GHG Inventory Preparation

Preparation Year of GHG Inventory: n (even number year) For example Preparation Year = 2018

Target Year of GHG Inventory: n-2 (two year before) Target Year = 2016

	Process	Relevant Organizations	Jan.	Feb.	Mar.	Apr	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
1	Preparation	DONRE	→	→									
2	Data request	DONRE			→								
3	Data preparation	Data Providing Organizations				→							
4	Data Collection	DONRE				→	→						
5	Preparation of draft GHG inventory	DONRE					→	→	→	→			
6	Feedback on draft GHG inventory	Data Providing Organizations								→	→		
7	Finalizing GHG inventory	DONRE									→	→	
8	Publishing GHG inventory	PC										→	→

QC (Quality Control)

- Manual includes QC method.
- QC is a system of routine technical activities to assess and maintain the quality of the GHG inventory as it is being compiled.
- QC is performed by personnel compiling the GHG inventory.
- The common and fundamental QC activity on the preparation of GHG inventory is shown in following tables.

QA (Quality Assurance)

- Manual includes QA method.
- QA is review procedure conducted by personnel not directly involved in the inventory preparation process.
- Good Candidates to perform QA:
  - An academic organization
  - C40 Cities Climate Leadership Group
  - ICLEI-Local Governments for Sustainability
  - MONRE, etc.

2.2 Data Sources (Chapter 4 of Manual)

- In Manual, all required data based on GPC are shown.
  - 4.1 Stationary Energy Sector
  - 4.2 Transportation Sector
  - 4.3 Waste Sector
  - 4.4 IPPU Sector
  - 4.5 AFOLU Sector
- The data related in HCMC are shown in following pages.

Summary of Data Sources

Provider	Sector	Main Provided Data
DOIT	Stationary Energy and Transportation	Fuel consumption
EVN	EnergyStationary Energy	Electricity consumption
EVN	IPPU	SF_6 of electricity equipment
DOC	IPPU	Cement (Kiln), Lime
Statistical Office	Waste, AFOLU, IPPU	Population (Domestic wastewater) Agricultural information Products of manufacturing industry
DONRE	Waste	Municipal solid waste, Sludge, Other waste (Clinical waste)
HEPZA	Waste	Wastewater
UDC	Waste, Stationary Energy, and Transportation	Sewage treatment plants Electricity consumption
SCFC	Stationary Energy and Transportation	Electricity and fuel consumption
SAWACO	Stationary Energy	Electricity consumption
DOT	Transportation	Number of vehicle, Ships
DARD	AFOLU	Livestock, Rice cultivation, Agricultural information
DONRE	AFOLU	Land use and land use change

Example of Data Sources
Stationary Energy

Required Data	Data Providing Organization	Notes
Electricity consumption for 5 sub - sector	EVN	Data Collection Form
Kerosene	DOIT	Data Collection Form
Fuel oil	DOIT	Data Collection Form Energy Intensity Monitoring Sheet
Diesel oil	DOIT	Data Collection Form Energy Intensity Monitoring Sheet
LPG	Fuel Companies DOIT	Data Collection Form Energy Intensity Monitoring Sheet
Natural Gas	Fuel Companies DOIT	Data Collection Form Energy Intensity Monitoring Sheet

Example of Data Sources
Transportation

Required Data	Data Providing Organization	Notes
Diesel oil	DOIT DOIT SCFC DOT UDC	Data Collection Form Energy Intensity Monitoring Sheet Data Collection Form Data Collection Form Data Collection Form
Gasoline	DOIT DOIT SCFC DOT UDC	Data Collection Form Energy Intensity Monitoring Sheet Data Collection Form Data Collection Form Data Collection Form

Example of Data Sources
Waste

Required Data	Data Providing Organization	Notes
Amount of solid waste generated, treated, recycled, and reused	DONRE	Data Collection Form
Composition of waste going to solid waste disposal sites	DONRE	Data Collection Form
Mass of organic waste treated by biological treatment	DONRE	Data Collection Form
Mass of waste incinerated	DONRE	Data Collection Form
Degree of utilization ratio of treatment and discharge pathway or system on domestic wastewater	National Environment Report	
Amount of industrial waste water	HEPZA	Data Collection Form

Example of Data Sources
IPPU

Required Data	Data Providing Organization	Notes
Iron and steel production	Statistical Yearbook	
Ferroalloy production	Statistical Yearbook	
Total nameplate capacity of installed equipment (circuit breaker with SF6)	EVN	Data Collection Form

Example of Data Sources
AFOLU

Required Data	Data Providing Organization	Notes
Dairy Cattle	Statistical Yearbook	
Other Cattle	Statistical Yearbook	
Buffalo	Statistical Yearbook	
Fraction of total annual nitrogen excretion managed in manure management system for livestock	Result of the Viet Nam Household Living Standard Survey 2014	
Information on land	DONRE	Data Collection Form
Harvested Area of Rice	Statistical Yearbook	
Area of annual crop	Statistical Yearbook	
Annual crop production	Statistical Yearbook	

Thank you very much

Basics on MRV and objectives of MRV trial

26 October, 2017

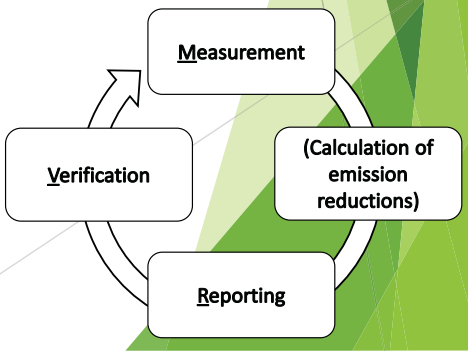
Mr. Yoshihiro Mizuno, JICA Expert Team

1. Basis on MRV

- **Measurement, Reporting and Verification (MRV):**
  - An indispensable component of mitigation actions that allows check and report in a systematic way.
- **Measurement ("M"):**
  - Direct measurement using instruments and/or collection of information and data that are necessary to calculate GHG emission reductions of the mitigation action.
- **Reporting ("R"):**
  - Compilation and reporting of data and information that is collected or measured at the Measurement (M) stage.
- **Verification ("V"):**
  - Checking and confirming the contents that are reported at the Reporting (R) stage from the viewpoint of completeness, accuracy and consistency.

2. Benefits of MRV to the city

- **Enhanced clarity of project effectiveness**
  - The city can visualize the effectiveness and impacts of the project, in terms of its GHG emissions and emission reductions
- **Enhanced opportunity to access finance**
  - The mitigation project may have access to various types of climate finance sources, including international finance
- **Improved policy/ project formulation**
  - policy development or project planning/ evaluation can be improved in the future

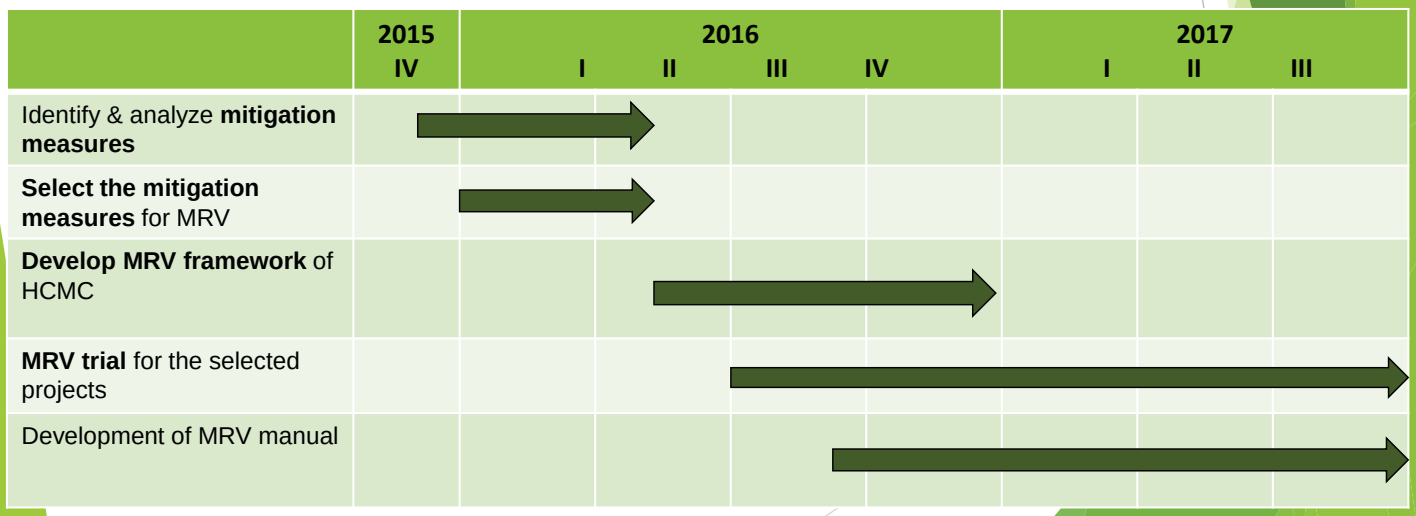


3. Objectives of MRV trial

- To develop and recommend an MRV framework applicable at the city level in Vietnam
- To assist the capacity enhancement of the officials in HCMC on the monitoring, calculation and reporting of GHG emission reductions of mitigation actions
- To develop MRV manual for cities in Vietnam

4. Outline of MRV trial

- Energy, transport and waste sectors were the target sectors
  - Solar PV system (20kW) installation on the roof top of the public building (Energy sector)
  - Introduction of CNG Bus for Public Bus Fleet by SaigonBus (Transport sector)
  - Animal manure collection and biogas recovery at small farms (Waste sector)



Outcomes and Experiences from MRV Trial Activity (Energy sector)

October 26, 2017

Name of presenter (Mr. Cuong)
Energy Conservation Center

Contents of the presentation

1. Outline of the mitigation project for MRV trial
2. Organization structure for MRV trial
3. MRV process of the MRV trial
4. Experiences and lessons learnt through MRV trial activity

1. Outline of the mitigation project for MRV trial

Outline of the mitigation project, including its objective, brief description of low-carbon technology, location, schedule (when the mitigation project started) will be explained. 1 page.

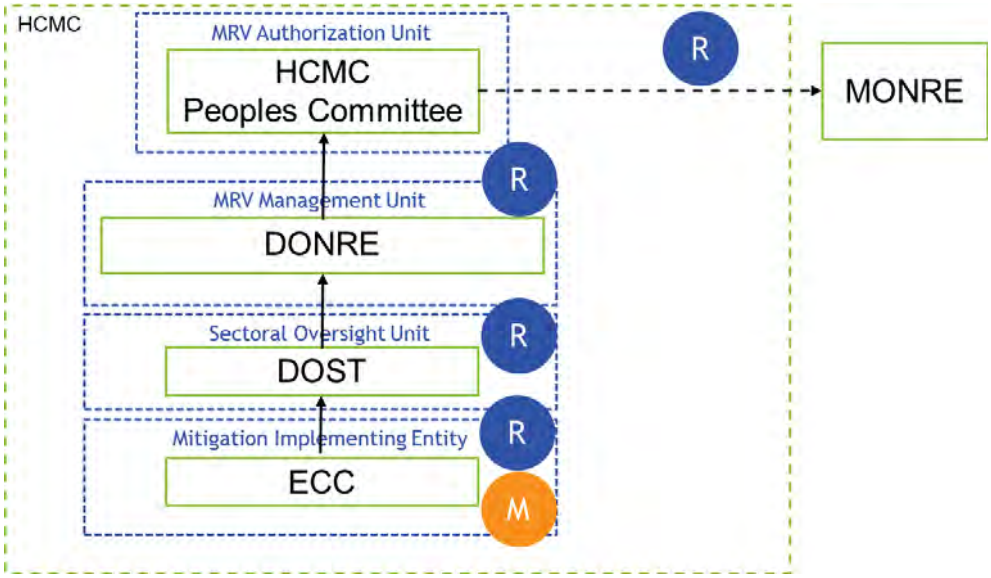
- **Name of the mitigation action**
  Solar PV system (20kW) installation on the roof top of the public building

- **Objective**
  HCMC has a plan to achieve the target of having 1.74% of energy use coming from renewable energy. In order to promote renewable energy generation, HCMC set the program named “Pilot program for Supporting mechanisms of solar PV investment in Ho Chi Minh city” to provide incentives to households and buildings that are willing to install the solar PV system on their rooftop. Solar PV system (20kW) are installed on the roof top of the DOST’s building.

- **Technology introduced under the mitigation action**
  Solar PV system is an electricity generation system which converts sunlight into electricity by the use of photovoltaic (PV) modules. In general, the system also includes ancillary equipment such as inverters in order to change the electrical current from direct current (DC) to alternating current (AC).

2. Organization structure for MRV trial

Organization structure of MRV trial, and roles of each organizations involved in MRV trial will be presented. 1 page.



DOST	Examine monitoring reports submitted by ECC and submit it to DONRE. (Sectoral Oversight Unit)
ECC	Operate solar PV systems and monitor/provide necessary data for GHG emission reduction calculations to DOST.

3. MRV process of the MRV trial (1)

Define mitigation actions to MRV;
How the selected project meets the selection criteria

Criterion 1: Mitigation Potential - Whether the action contributes to reduce GHGs

The electricity generated by the solar PV system is used as a substitute for the electricity from the grid. The electricity generated by the solar PV system does not emit any CO2 because CO2 emission factor of the electricity is zero.

Criterion 2: Practicability of MRV - Whether the action has practical ways to MRV

The MRV of Solar PV project requires only two parameters to be monitored, generated electricity by solar PV system and emission factor of the grid. The monitoring for generated electricity by solar PV system is using a electricity meter. That is daily or monthly routine operation for the owner to know the amount of generated electricity.

Besides the above criteria, in the MRV trial, for the purpose of the SPI-NAMA project, the important point of selecting mitigation actions was that the action is on-going (under operation).

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

Following contents of MRV plan will be explained. Less than 5 pages.

I. General information of the mitigation action

** Information on a) to d), f), g): Described in "1. Outline of the mitigation project for MRV trial"*

e) Target GHG type

CO_2

i) Benefits of mitigation action and contribution to sustainable development

Social benefits: Stimulate the utilization of renewable energy,

Economic benefits: Reduce electricity cost;

Environmental benefits: Reduce air pollutants from the electric generation plant using fossil fuel:

j) Source of funding and supporting financial scheme

HCMC support the investment cost including equipment costs and installation cost. The name of the program is "Pilot program for Supporting mechanisms of solar PV investment in Ho Chi Minh city"

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

II. Emission reduction calculation, monitoring and reporting

a) Logic of GHG emission reduction

The electricity generated by the solar PV system is used as a substitute for the electricity from the grid.

The electricity generated by the solar PV system does not emit any CO2 because CO2 emission factor of the electricity is zero.

The emission factor of the grid electricity is 0.66 t-CO2/MWh.

Utilizing the electricity generated by solar PV system results in CO2 emission reductions.

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

b) Methodology to calculate GHG emission reduction

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$\boldsymbol{BE_y = EG_{p,y} \times EF_{grid}}$$

BE_y Baseline emissions in year y (tCO_2/year)

$EG_{p,y}$ Annual generated electricity by solar PV system (kWh)

EF_{grid} Emission Factor of the grid (tCO_2/kWh)

$$\boldsymbol{PE_y = EG_{p,y} \times EF_{PV}} = 0$$

PE_y Project emissions in year y (tCO_2/year)

$EG_{p,y}$ Annual generated electricity by solar PV system (kWh)

EF_{PV} Emission Factor of the solar PV system (tCO_2/kWh) = 0

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

c) Estimated GHG emission reduction

11 tCO_2/year

e) Monitoring period

From January 1st 2016 to December 31st 2016

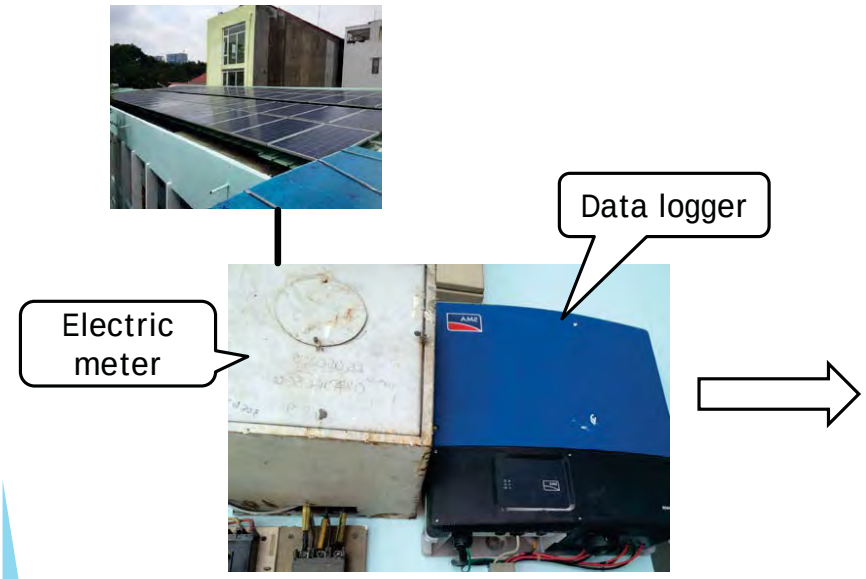
f) Monitoring methods

Monitoring parameter: parameters which should be collected every year after the project starts

Parameter	Method	Person/position in charge
$EG_{p,y}$ Annual generated electricity by solar PV system (kWh)	· The value of the electric meter is read and recorded monthly. · Recorded data is accumulated for 12 month and used for the GHG emission reduction calculation.	Staff of Energy Conservation Center
EF_{grid} Emission factor of grid (tCO_2/kWh)	· Default value in official document by MONRE is applied. · Check updated value every year and apply the latest value where appropriate.	Staff of Energy Conservation Center

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions



The generated electricity measured by the electricity meter in daily and recorded in the data logger.

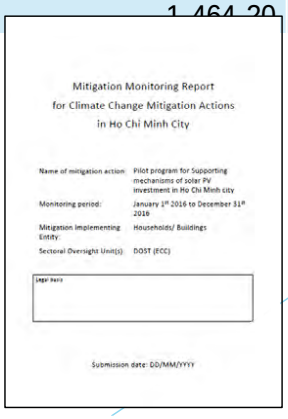
The recorded data was taken by the staff of ECC monthly from the data logger.

	SN: 1900718424 STP 20000TL-30 1900718424	SN: 1900718424 STP 20000TL-30 1900718424
	Total yield	Day yield
	Counter	Analog
dd/MM/yyyy	kWh	kWh
01/01/2016	7017.576	61.232
02/01/2016	7068.068	50.492
03/01/2016	7104.198	36.13
04/01/2016	7158.687	54.489
05/01/2016	7205.871	47.184
06/01/2016	7254.135	48.264
07/01/2016	7313.291	59.156
08/01/2016	7361.273	47.982
09/01/2016	7428.632	67.359
10/01/2016	7497.371	68.739
11/01/2016	7554.396	57.025
12/01/2016	7613.699	59.303
13/01/2016	7673.509	59.81
14/01/2016	7739.291	65.782
15/01/2016	7798.547	59.256
16/01/2016	7851.31	52.763
17/01/2016	7911.386	60.076
18/01/2016	7971.64	60.254
19/01/2016	8026.837	55.197
20/01/2016	8097.736	70.899
21/01/2016	8156.276	58.54
22/01/2016	8224.137	67.861
23/01/2016	8291.175	67.038
24/01/2016	8344.411	53.236
25/01/2016	8419.009	74.598
26/01/2016	8478.836	59.827
27/01/2016	8523.856	45.02
28/01/2016	8573.971	50.115
29/01/2016	8640.601	66.63
30/01/2016	8696.473	55.872
31/01/2016	8766.822	70.349

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

Monitoring period		Monitoring date	Electricity generation indicated by electric meter (kWh)	Accumulated electricity generation amount (kWh)
From	To			
1-Jan-16	31-Jan-16	31-Jan-16	1,810.48	1,810.48
1-Feb-16	29-Feb-16	29-Feb-16	1,812.49	3,622.97
1-Mar-16	31-Mar-16	31-Mar-16	2,016.81	5,639.78
1-Apr-16	30-Apr-16	30-Apr-16	1,821.87	7,461.65
1-May-16	31-May-16	31-May-16	1,757.80	9,219.45
1-Jun-16	30-Jun-16	30-Jun-16	1,512.80	10,732.24
1-Jul-16	31-Jul-16	31-Jul-16	1,786.83	12,519.07
1-Aug-16	31-Aug-16	31-Aug-16	1,701.74	14,220.81
1-Sep-16	30-Sep-16	30-Sep-16	1,570.40	15,791.21
1-Oct-16	31-Oct-16	31-Oct-16	1,621.46	17,412.67
1-Nov-16	30-Nov-16	30-Nov-16	1,887.52	19,300.20
1-Dec-16	31-Dec-16	31-Dec-16	1,464.20	20,764.40


Mitigation Monitoring Report
for Climate Change Mitigation Actions
in Ho Chi Minh City

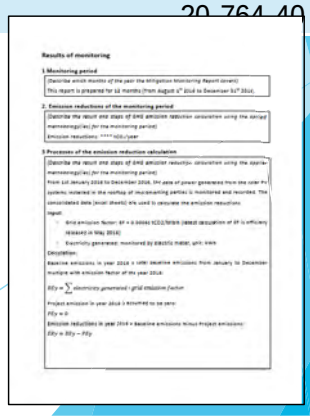
Name of mitigation action: Pilot program for Supporting mechanisms of solar PV investment in Ho Chi Minh city

Monitoring period: January 1st 2016 to December 31st 2016

Mitigation Implementing Entity: Households/ Buildings

Sectoral Oversight Unit(s): DOST (ECC)

Submission date: DD/MM/YYYY



3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

a) Monitoring period

12 months (from January 1st 2016 to December 31st 2016)

b) Emission reductions achieved during the monitoring period

12 tCO_2/5months

c) Process of emission reduction calculation

From 1st January 2016 to December 2016, the amount of generated electricity by the solar PV systems has been monitored. The accumulated electricity generation amount is 20,764.40 (kWh).

Grid emission factor of the grid is 0.66 tCO2/MWh, referred the latest official EF provided by MONRE in May 2016.

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

$$BE_y = EG_{p,y} \times EF_{grid}$$

$$= 20{,}764.40\ (\text{kWh}) \times 0.66\ (\text{tCO2/MWh})$$

$$= 13.7\ \text{tCO}_2/\text{year}$$

$$PE_y = EG_{p,y} \times EF_{PV}$$

$$= 0\ \text{tCO}_2/\text{year}$$

$$ER_y = BE_y - PE_y$$

$$= 13.7 - 0 = 13.7\ \text{tCO}_2/\text{year}$$

GHG Emission reduction calculation sheet for PV project

Period of monitoring:

Emission Reduction

Description	Parameter	Unit	Emissions
Emission reduction	ER_y	tCO_2/year	0
Baseline emission	BE_y	tCO_2/year	0
Project emission	PE_y	tCO_2/year	0

Inputs

*Input only orange cell

Description	Parameter	Unit	Amont of Electric generation	Data source
Amount of electricity generated in the year y	EG_{PJ}	kWh/year	0	Measured
CO2 Emission factor of grid	EF_{grid}	tCO_2/MWh	0.66	

3. MRV process of the MRV trial (5)

Implement MRV and Approve MRV result

How the Monitoring Report should be reviewed and which department should be responsible for the review. How the Monitoring Report should be submitted to MRV Management Unit. 1-2 pages.

In the actual MRV, ECC should submit the monitoring report to DOST. DOST should check the following elements.

- whether there is lack of information in the submitted Mitigation Monitoring Report;
- whether there is big gap between the MRV plan and Mitigation Monitoring Report.

After checking the monitoring report, DOST consolidates the monitoring reports of the solar PV installation project and other mitigation actions into Sectoral Monitoring Report and submits it to DONRE.

DONRE should examine the report in following elements;

- whether there is a lack of information/ data in the submitted Sectoral Monitoring Report;
- whether MRV for the approved mitigation actions has been adequately implemented in accordance with the approved MRV plan;
- whether GHG emission reduction is accurately calculated in accordance with the approved MRV plan and whether appropriate data is applied for calculation.

DONRE submits the report to PC with a recommendation for approval.

4. Experiences and lessons learnt through MRV trial activity

Experiences and lessons learnt through MRV trial activity

- If the project itself has already put in place their monitoring system for the project purpose (beside climate objective), the MRV process will be very much facilitated. Otherwise, investing a whole system for data collection and monitoring (just for MRV purpose) will be a burden for the project developer without any incentives.
- The definition of baseline and how to determine the baseline should be very clear from the beginning (For example: which default values, which grid emission factor should be used, what is the boundary of the project emissions, etc.)
- Official request from PC under the form of a policy document is a must so that relevant stakeholders take responsibility to allocate resources to implement MRV for selected mitigation actions.
-

Outcomes and Experiences from MRV Trial Activity (Transport sector)

October 26, 2017

Mr. Cao Trung Tin
Management and Operation Center for Public Transport

Contents of the presentation

1. Outline of the mitigation project for MRV trial
2. Organization structure for MRV trial
3. MRV process of the MRV trial
4. Experiences and lessons learnt through MRV trial activity

1. Outline of the mitigation project for MRV trial

Outline of the mitigation project, including its objective, brief description of low-carbon technology, location, schedule (when the mitigation project started) will be explained. 1 page.

- **Name of the mitigation action**
  Introduction of CNG Bus for Public Bus Fleet by SaigonBus.

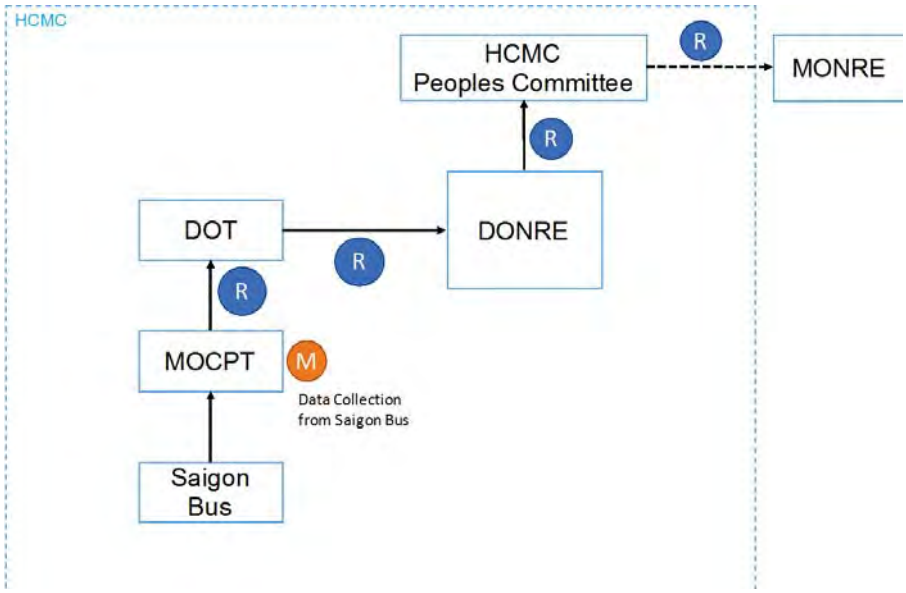
- **Objective**
  HCMC invested new 21 CNG buses to operate for bus route number 27 on August 2016. Those CNG buses promote to reduce GHG emissions and local air pollutants such as PM (Particulate Matters).

- **Technology introduced under the mitigation action**
  The diesel buses used for bus route number 27 were Mercedes buses, with 48 seats and 36 standing, engine is 5,958cc, vehicle weight is 9,880 tons. The CNG buses used now are Hyundai buses, with 40 seats and 28 standing, engine is 11,149cc, vehicle weight is 10,780 tons.

Source: Isuzu Web site

2. Organization structure for MRV trial

Organization structure of MRV trial, and roles of each organizations involved in MRV trial will be presented. 1 page.



DOT	Examine monitoring reports submitted by MOCPT and submit it to DONRE. (Sectoral Oversight Unit)
MOCPT	Receive the monitoring data from SaigonBus, calculate GHG emission reductions, and prepare monitoring reports. The monitoring reports are sent to DOT. (Mitigation Implementing Entity)
SaigonBus	Operate CNG buses and monitor/provide necessary data for GHG emission reduction calculations to MOCPT.

3. MRV process of the MRV trial (1)

Define mitigation actions to MRV

How the selected project meets the selection criteria will be explained.

Criterion 1: Mitigation Potential - Whether the action contributes to reduce GHGs

Main component of CNG is natural gas and it has low carbon content per energy than diesel fuel. Therefore, even though efficiency of diesel engines is slightly better than that of CNG engines, CO_2 emission are reduced through replacing diesel buses by CNG buses.

Criterion 2: Practicability of MRV - Whether the action has practical ways to MRV

The MRV of CNG bus project requires only two parameters to be monitored. The calculation formula is also simple and easy to calculate with less parameters which are collected routinely in daily operation of bus services.

Besides the above criteria, in the MRV trial, for the purpose of the SPI-NAMA project, the important point of selecting mitigation actions was that the action is on-going (under operation).

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

Following contents of MRV plan will be explained. Less than 5 pages.

I. General information of the mitigation action

** Information on a) to d), f), g): Described in "1. Outline of the mitigation project for MRV trial"*

e) Target GHG type

CO_2

i) Benefits of mitigation action and contribution to sustainable development

Social benefits: Local people might see cleaner and safety buses then use those buses more and more;

Economic benefits: Reduce fossil fuel (diesel), increase clean fuel (CNG), reduce fuel cost, improve energy condition and technology transfer;

Environmental benefits: Reduce noise, air pollutants: PM, CO.

j) Source of funding and supporting financial scheme

Transport operators invest in CNG fleet with tax incentives from HCMC.

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

II. Emission reduction calculation, monitoring and reporting

a) Logic of GHG emission reduction

Main component of CNG is natural gas and it has low carbon content per energy than diesel fuel. Therefore, even though efficiency of diesel engines is slightly better than that of CNG engines, CO_2 emission are reduced through replacing diesel buses by CNG buses.

b) Methodology to calculate GHG emission reduction

A simple methodology was developed for this project as below, based on a basic emission calculation formula provided in the IPCC2006 guideline.

$$ER_y = BE_y - PE_y$$
$$BE_y = SFC_{diesel} \times NCV_{diesel} \times EF_{diesel} \times DD_y \times N_{PJ,y}$$
$$PE_y = SFC_{CNG}/CF \times NCV_{CNG} \times EF_{CNG} \times DD_y \times N_{PJ,y}$$

BE_y Baseline emission in year *y* (tCO_2/year)
PE_y Project emission in year *y* (tCO_2/year)
ER_y Emission reduction in year *y* (tCO_2/year)

Monitoring Parameter:
DD_y *:* Annual average distance travelled in year *y* (km/year)
$N_{PJ,y}$ *:* Number of CNG buses in year *y*
Fixed Parameter:
SFC_{diesel}, SFC_{CNG}: Specific fuel consumption of diesel bus and CNG bus, respectively (kg/km)
NCV_{diesel}, NCV_{CNG}: Net calorific value of diesel fuel and CNG, respectively (MJ/kg)
EF_{diesel}, EF_{CNG}: Emission factor of diesel fuel and CNG (tCO_2/MJ)
CF : Correction factor for CNG specific fuel consumption

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

c) Estimated GHG emission reduction

37 tCO_2/year

e) Monitoring period

From August 1st 2016 to December 31st 2016 (The period of the MRV trial.)

f) Monitoring methods

Monitoring parameter: parameters which should be collected every year after the project starts

Parameter	Method	Notes
DD_y Annual average distance travelled in year y (km/year)	· The data is provided by SaigonBus. · SaigonBus monitors distances travelled by each bus monthly (This is done as their routine works). · These data are averaged to obtain the monthly average distance of all the buses. · Monthly average distance is calculated for 12 month and sum up these to obtain the annual average distance.	MOCPT receives the data from SaigonBus
$N_{PJ,y}$ Number of CNG buses in year y	· The data is provided by SaigonBus. · SaigonBus check the number of CNG buses in the bus fleet registry.	

3. MRV process of the MRV trial (2)

Develop MRV plan for a mitigation actions

Fixed parameter: parameters which should be fixed before the 1st emission reduction calculation (one year after the project starts)

Parameter	Source	Value
SFC_{diesel} Specific fuel consumption of diesel bus (kg/km)	Determined by SaigonBus.	0.290
SFC_{CNG} Specific fuel consumption of CNG bus (kg/km)	Determined by SaigonBus using actual driving distance and CNG consumption for all project buses.	0.365
NCV_{diesel} Net calorific value of diesel fuel (MJ/kg)	Default value of "2006 IPCC Guidelines for National Greenhouse Gas Inventory".	43.0
NCV_{CNG} Net calorific value of CNG (MJ/kg)		48.0
EF_{diesel} Emission factor of diesel fuel (tCO_2/MJ)		0.0000741
EF_{CNG} Emission factor of CNG (tCO_2/MJ)		0.0000561
CF Correction factor for CNG specific fuel consumption	Set factor to correct/adjust fuel consumption between different specifications of baseline and project buses.: Ratio of vehicle weight of CNG bus (10,780kg) to diesel bus (9,880kg)	1.09

3. MRV process of the MRV trial (3)

Collect/measure and record data (Monitoring)

Contents of monitoring activity will be explained in detail (how the monitoring data was obtained). Photo of monitoring activity should be shown if possible. 1 or 2 pages.

Number of parameters to be monitored are only two as described in slide 8.

1. Annual average distance travelled in year y (km/year)
2. Number of CNG buses in year y

These data are secondary data and not newly monitored for this project. These are routinely monitored and recorded in the bus fleet datasets for the purpose of daily operation of buses.

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

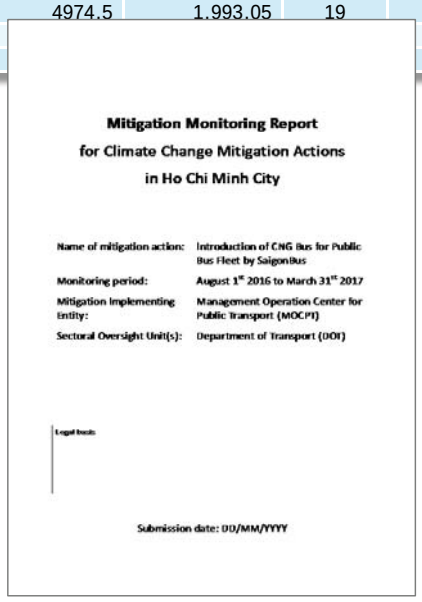
Completed monitoring sheet that shows the actually monitored data will be shown in 1 page.
Also, the following contents of Monitoring Report will be explained within 2 pages.
a) Monitoring period
b) Emission reductions achieved during the monitoring period
c) Process of emission reduction calculation

Images of the monitoring sheet

August 2016

No.	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Travel distance (km/month)	Fuel consumption (kg /month)
1	5124.8	2,046.76	11	5103.7	1,924.39
2	5273.2	2,046.96	12	4872.5	2,031.96
3	4932.8	1,899.43	13	5020.9	1,882.21
4	4925.6	2,041.70	14	5314.3	2,126.86
5	4309.7	1,690.80	15	4882.8	1,786.52
6	4915.3	1,867.34	16	4760.8	1,761.72
7	4946.7	1,928.23	17	5079.5	2,152.46
8	5209.8	1,922.84	18	4696.9	1,817.53
9	4974.5	1,993.05	19	5153.7	1,906.62
10					
Total					

Images of the monitoring report



Mitigation Monitoring Report

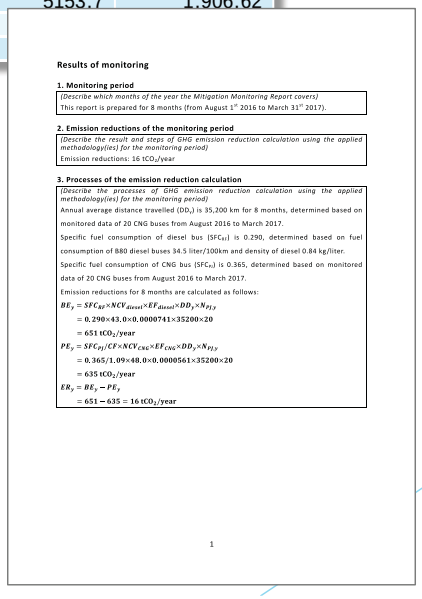
for Climate Change Mitigation Actions

in Ho Chi Minh City

Name of mitigation action:	Introduction of CNG Bus for Public Bus Fleet by SaigonBus
Monitoring period:	August 1st 2016 to March 31st 2017
Mitigation Implementing Entity:	Management Operation Center for Public Transport (MOCPT)
Sectoral Oversight Unit(s):	Department of Transport (DOT)

Legal basis

Submission date: DD/MM/YYYY



Results of monitoring

1. Monitoring period

(Describe which months of the year the Mitigation Monitoring Report covers)
This report is prepared for 8 months (from August 1st 2016 to March 31st 2017).

2. Emission reductions of the monitoring period

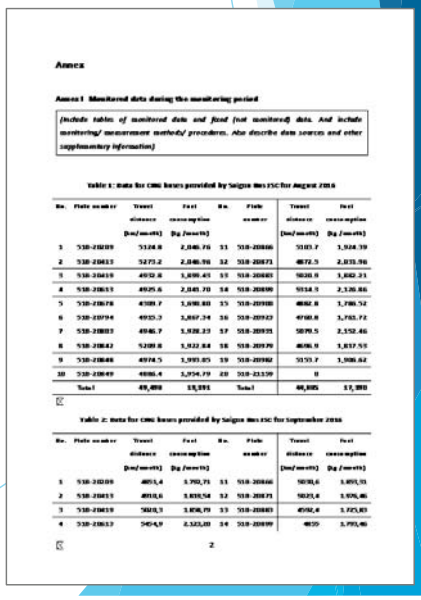
(Describe the result and steps of GHG emission reduction calculation using the applied methodology(ies) for the monitoring period)
Emission reductions: 16 tCO_2/year

3. Processes of the emission reduction calculation

(Describe the processes of GHG emission reduction calculation using the applied methodology(ies) for the monitoring period)
Annual average distance travelled (DD_y) is 35,200 km for 8 months, determined based on monitored data of 20 CNG buses from August 2016 to March 2017.
Specific fuel consumption of diesel bus (SFC_{RF}) is 0.290, determined based on fuel consumption of B80 diesel buses 34.5 liter/100km and density of diesel 0.84 kg/liter.
Specific fuel consumption of CNG bus (SFC_{PJ}) is 0.365, determined based on monitored data of 20 CNG buses from August 2016 to March 2017.
Emission reductions for 8 months are calculated as follows:

$$BE_y = SFC_{RF} \times NCV_{diesel} \times EF_{diesel} \times DD_y \times N_{PJ,y}$$
$$= 0.290 \times 43.0 \times 0.0000741 \times 35200 \times 20$$
$$= 651\ tCO_2/year$$
$$PE_y = SFC_{PJ}/CF \times NCV_{CNG} \times EF_{CNG} \times DD_y \times N_{PJ,y}$$
$$= 0.365/1.09 \times 48.0 \times 0.0000561 \times 35200 \times 20$$
$$= 635\ tCO_2/year$$
$$ER_y = BE_y - PE_y$$
$$= 651 - 635 = 16\ tCO_2/year$$

1



Annex

Annex I Monitored data during the monitoring period

(Include tables of monitored data and fixed (not monitored) data. And include monitoring/ measurement methods/ procedures. Also describe data sources and other supplementary information)

Table 1: data for CNG buses provided by Saigon Bus JSC for August 2016

No.	Plate number	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Plate number	Travel distance (km/month)	Fuel consumption (kg /month)
1	51B-20899	5124.8	2,046.76	11	51B-20866	5103.7	1,924.39
2	51B-20813	5273.2	2,046.96	12	51B-20871	4872.5	2,031.96
3	51B-20819	4932.8	1,899.43	13	51B-20885	5020.9	1,882.21
4	51B-20853	4925.6	2,041.70	14	51B-20890	5314.3	2,126.86
5	51B-20878	4309.7	1,690.80	15	51B-20908	4882.8	1,786.52
6	51B-20894	4915.3	1,867.34	16	51B-20923	4760.8	1,761.72
7	51B-20883	4946.7	1,928.23	17	51B-20935	5079.5	2,152.46
8	51B-20842	5209.8	1,922.84	18	51B-20970	4696.9	1,817.53
9	51B-20848	4974.5	1,993.05	19	51B-20982	5153.7	1,906.62
10	51B-20949	4986.4	1,954.79	20	51B-23339	0	0
	Total	49,898	19,391		Total	48,885	17,903

Table 2: data for CNG buses provided by Saigon Bus JSC for September 2016

No.	Plate number	Travel distance (km/month)	Fuel consumption (kg /month)	No.	Plate number	Travel distance (km/month)	Fuel consumption (kg /month)
1	51B-20899	4853.4	1,792.71	11	51B-20866	5030.6	1,855.55
2	51B-20813	4918.6	1,819.54	12	51B-20871	5023.4	1,976.46
3	51B-20819	5028.3	1,858.79	13	51B-20885	4592.4	1,725.83
4	51B-20853	5454.9	2,323.00	14	51B-20899	4859	1,793.46

2

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

a) Monitoring period

From August 1st 2016 to December 31st 2016. (The period of the MRV trial)

b) Emission reductions achieved during the monitoring period

10 tCO_2/5months

c) Process of emission reduction calculation

Annual average distance travelled (DD_y) is 23,225 km for 5 months, determined based on monitored data of 20 CNG buses from August 2016 to December 2016.

Specific fuel consumption of diesel bus (SFC_{RF}) is 0.290, determined based on fuel consumption of B80 diesel buses 34.5 liter/100km and density of diesel 0.84 kg/liter.

Specific fuel consumption of CNG bus (SFC_{PJ}) is 0.365, determined based on monitored data of 20 CNG buses.

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Monitoring report

Emission reductions for 5 months are calculated as follows:

$$BE_y = SFC_{RF} \times NCV_{diesel} \times EF_{diesel} \times DD_y \times N_{PJ,y}$$
$$= 0.290 \times 43.0 \times 0.0000741 \times 23225 \times 20$$
$$= 429\ tCO_2/year$$

$$PE_y = SFC_{PJ}/CF \times NCV_{CNG} \times EF_{CNG} \times DD_y \times N_{PJ,y}$$
$$= 0.365/1.09 \times 48.0 \times 0.0000561 \times 23225 \times 20$$
$$= 419\ tCO_2/year$$

$$ER_y = BE_y - PE_y$$
$$= 429 - 419 = 10\ tCO_2/year$$

(Draft) Emission reduction estimation sheet for CNG bus project

Period of monitoring:

Emission Reduction

Description	Parameter	Unit	Value
Emission reduction	ER_y	tCO_2/year	
Baseline emission	BE_y	tCO_2/year	
Project emission	PE_y	tCO_2/year	

Inputs

*Input only orange cell

Description	Parameter	Unit	Value	Datasource
Annual average distance travelled in year y (km/year)	DD_y	km/year		Monitored
Number of CNG buses in year y	$N_{PJ,y}$	unit		Monitored
Specific fuel consumption of diesel bus	SFC_{diesel}	kg/km		Monitored
Net calorific value of diesel fuel	NCV_{diesel}	MJ/kg		IPCC2006
Emission factor of diesel fuel	EF_{diesel}	tCO_2/MJ		IPCC2006
Specific fuel consumption of CNG bus	SFC_{CNG}	kg/km		Estimated
Correction factor for CNG specific fuel consumption	CF	-		
Net calorific value of CNG	NCV_{CNG}	MJ/kg		IPCC2006
Emission factor of CNG	EF_{CNG}	tCO_2/MJ		IPCC2006

3. MRV process of the MRV trial (5)

Implement MRV and Approve MRV result

How the Monitoring Report should be reviewed and which department should be responsible for the review. How the Monitoring Report should be submitted to MRV Management Unit. 1-2 pages.

In the actual MRV, MOCPT should submit the monitoring report to DOT. DOT should check the following elements.

- whether there is lack of information in the submitted Mitigation Monitoring Report;
- whether there is big gap between the MRV plan and Mitigation Monitoring Report.

After checking the monitoring report, DOT consolidates the monitoring reports of the CNG project and other mitigation actions into Sectoral Monitoring Report and submits it to DONRE.

DONRE should examine the report in following elements;

- whether there is a lack of information/ data in the submitted Sectoral Monitoring Report;
- whether MRV for the approved mitigation actions has been adequately implemented in accordance with the approved MRV plan;
- whether GHG emission reduction is accurately calculated in accordance with the approved MRV plan and whether appropriate data is applied for calculation.

DONRE submits the report to PC with a recommendation for approval.

4. Experiences and lessons learnt through MRV trial activity

Advantages and disadvantages through MRV trial activity

- Advantages:

- Saigon Bus is implementing entity, necessary data is daily monitoring data, support management activity of the company.

- Technical staff of Saigon Bus was trained all skills in collecting, assessing data and calculating the emission.

- Disadvantages:

- MRV trial for 20 CNG buses if want to multiple should have sufficient resources.

- In order to multiply MRV activities in transport sector, technical staffs should have training to know how to develop methodology and model to calculate GHG emission reduction.

4. Experiences and lessons learnt through MRV trial activity

Experiences and lessons learnt through MRV trial activity

- Operator:

Needs to monitor and collect specific data for each vehicle in order to prepare for next steps.

- MRV implementing entity:

- Check data submitted by Operator.

- Consolidat, assess data → Calucate the GHG emission, Propose and submit Mitigation Monitoring Report.

- Sub-sectoral Oversight Unit and MRV Management Unit:

Needs to have knowledge about transport sector in order to check and approve reports submitted by implementing entity.

Outcomes and Experiences from MRV Trial Activity (waste sector)

October 26, 2017

Mr. Huynh Quoc Toan
Department of Agriculture and Rural Development

Contents of the presentation

1. Outline of the mitigation project for MRV trial
2. Organization structure for MRV trial
3. MRV process of the MRV trial
4. Experiences and lessons learnt through MRV trial activity

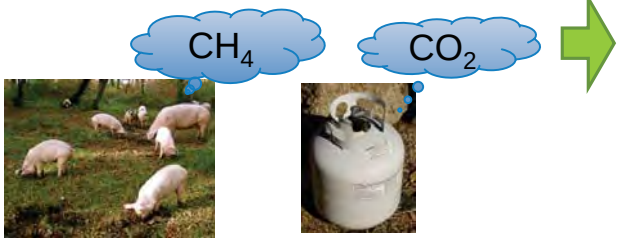
1. Outline of the mitigation project for MRV trial

- **Name of the mitigation project**
  Animal manure collection and biogas recovery at small farms

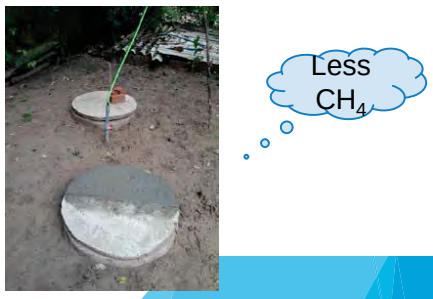
- **Objective**
  To increase the production efficiency of household-based livestock producers and to reduce the environmental impact of livestock production such as on local water and air pollution by installing bio-digesters at small farms.

- **Technology introduced under the mitigation action**
  Bio-digesters installed at livestock farms have the capacity of 7 m^3 or 9 m^3 and they collect animal manure to generate biogas. Collected biogas is used by farmers for cooking purpose (3 hours usage per day on average). Total number of biodigesters installed is 844. Average number of livestock (swine) per household is 45.

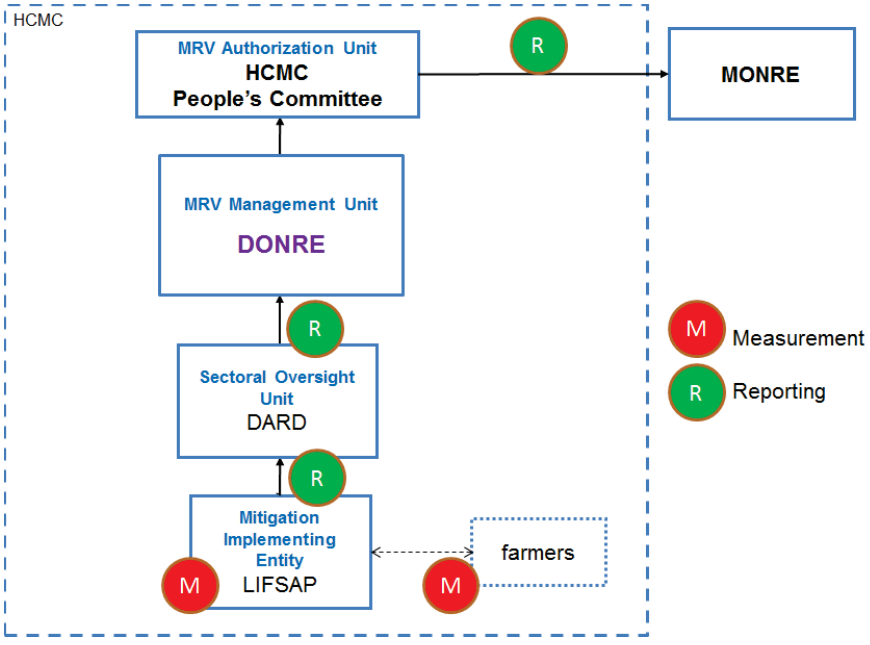
Baseline GHG emissions:
- CH_4 from animal manure
- CO_2 from combustion of LPG



Project GHG emissions:
- CH_4 leakage from bio-digester



2. Organization structure for MRV trial



DARD *Sectoral Oversight Unit* of MRV
Examine monitoring report submitted by LIFSAP and submit it to DONRE.

LIFSAP* *Mitigation Implementing Entity* of MRV
Perform monitoring activity, GHG emission reduction calculation, coordination with data holders (farmers), preparation and submission of Mitigation Monitoring Report.

* LIFSAP: Livestock Competitiveness and Food Safety Project

3. MRV process of the MRV trial (1)

Define mitigation actions to MRV

The mitigation project meets the project selection criterion as follows.

Criterion 1: Mitigation Potential (Whether the action reduces GHGs)

- The project reduces GHGs by recovering and utilizing biogas for heat generation at small farms.
- CH_4 is reduced by stopping disposal of animal manure on the field.
- CO_2 is reduced by displacing LPG consumption by bio-digesters.

Criterion 2: Practicability of MRV
(Whether the action has practical ways to MRV)

- Similar projects (animal manure collection and biogas use) are taking place in many countries and MRV-ed.
- Methodologies that specify necessary parameters to be monitored and formulas to calculate GHG emission reductions are widely used.
- Project implementer is able to obtain necessary data through the existing monitoring system set up by LIFSAP.

3. MRV process of the MRV trial (2)

Develop MRV plan for mitigation actions

MRV Plan of the mitigation project was established as follows.

I. General information of the mitigation action

Target GHG type

- CO_2 and CH_4

Benefits of mitigation action and contribution to sustainable development

- Social benefits: improve environmental awareness by local farmers
- Economic benefits: improved production of livestock, fuel cost saving by farmers
- Environmental benefits: improved local air and water condition

Source of funding and supporting financial scheme

- Part of the cost for purchasing and installing biodigesters was supported by World Bank.

3. MRV process of the MRV trial (2)

Develop MRV plan for mitigation actions (cont'd)

II. Emission reduction calculation, monitoring and reporting

a) Logic of GHG emission reduction

- CH_4 emission is avoided through collecting and utilizing animal manure that would be disposed of at the field and decomposed.
- CO_2 emission is reduced through displacing the use of fossil fuels (LPG) for household cooking with biogas.

b) Methodology to calculate GHG emission reduction

- Internationally acknowledged and widely used methodologies were referred to (CDM methodologies).

$$ER_y = BE_y - PE_y$$

$$BE_{1,y} = \sum \frac{(EF_{(T)} \times N_{(T)})}{10^3} \times GWP_{CH4}$$

$$BE_{2,y} = \sum BG_{PJ,y} \times NCV \times EF_{PJ,y} \times 1/10^6$$

$$PE_y = 0.1 \times BE_{1,y}$$

ER_y	Emission reduction in year *y* (ton-$CO_{2equivalent}$/year)
BE_y	Baseline emission in year *y* (tCO_{2e}/year)
$BE_{1,y}$	CH_4 emission at baseline case from disposed animal manure (tCO_{2e}/year)
$BE_{2,y}$	CO_2 emission at baseline case from the consumption of LPG (tCO_{2e}/year)
PE_y	Project emission in year *y* (tCO_{2e}/year)

3. MRV process of the MRV trial (2)

Develop MRV plan for mitigation actions (cont'd)

c) Estimated GHG emission reduction

6,862 tCO_{2e}/year

d) Monitoring period

1 January 2017 to 31 March 2017 (period of the MRV trial)

e) Monitoring methods

Monitoring parameters: parameters which will be collected every quarter

Parameter	Monitoring method
$N_{(T)}$ Number of head of livestock (swine)	• Data will be provided by sample livestock farmers that yields average number of livestock head per household. • Collected data will be compiled by technical staff of LIFSAP. • Number of samples should be large enough to represent the whole target households. Considering the large size of the target group and difficulty of frequent data collection, this data will be monitored every 3 month.
$BG_{PJ,y}$ Quantity of fuel consumed by household instead of using biogas (kg/year)	• Data will be calculated based on the average capacity and quantity of cooking device used by target households, and average daily cooking hours per household. • Above information should be collected by interview survey from the sample households. Sample size should be large enough to represent the entire target group.

3. MRV process of the MRV trial (2)

Develop MRV plan for mitigation actions (cont'd)

Fixed parameters: parameters which will not be monitored or collected

Parameter	Data source	Applied value
$EF_{(T)}$ Methane emission factor for livestock	Default value (IPCC Guidelines): value for more than 28ºC average annual temperature is applied.	7 kg CH_4/ head/ year
GWP_{CH4} Global Warming Potential of methane	Default value (IPCC Guidelines)	25
NCV Net calorific value of fuel that would be used for cooking instead of biogas	Default value (IPCC Guidelines): value for LPG is applied.	47.3 MJ/ kg
$EF_{PJ,y}$ CO_2 emission factor of fuel that would be used for cooking instead of biogas	Default value (CDM methodology): value for LPG is applied.	63.1 t-CO_2/MJ

3. MRV process of the MRV trial (3)

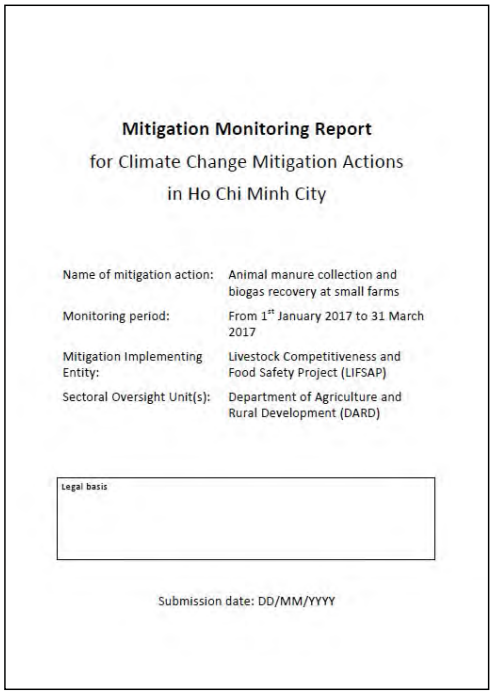
Collect/measure and record data (Monitoring)

- In accordance with the methodology, trial monitoring was conducted where necessary data for GHG calculation was collected.
- Parameters that need be monitored are the followings as specified in the methodology:
  - *Number of head of livestock (swine) (head)*
  - *Quantity of fuel consumed by household instead of using biogas (kg/year)*
- Above data was collected from sample livestock farmers (GAP households) by technical staff of LIFSAP.
- Data collection was conducted using the existing monitoring work under LIFSAP project to minimize the work and cost for monitoring.

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Mitigation Monitoring Report

Result of monitoring including GHG emission reduction information was compiled into a designated format of Mitigation Monitoring Report.



Mitigation Monitoring Report

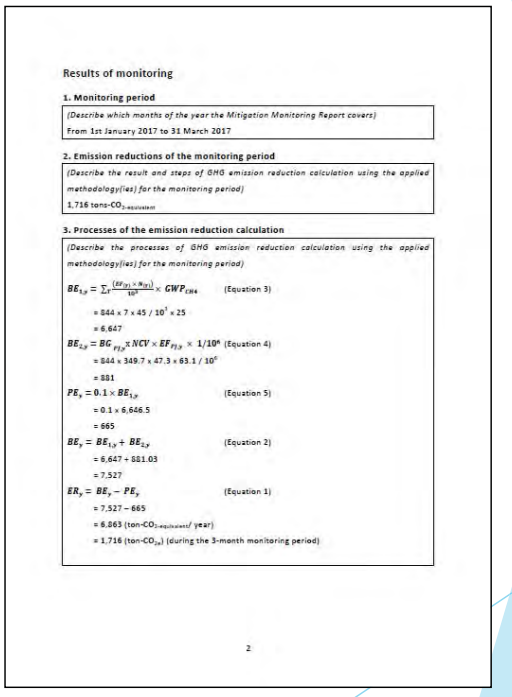
for Climate Change Mitigation Actions

in Ho Chi Minh City

Name of mitigation action:	Animal manure collection and biogas recovery at small farms
Monitoring period:	From 1st January 2017 to 31 March 2017
Mitigation Implementing Entity:	Livestock Competitiveness and Food Safety Project (LIFSAP)
Sectoral Oversight Unit(s):	Department of Agriculture and Rural Development (DARD)

Legal basis

Submission date: DD/MM/YYYY



Results of monitoring

1. Monitoring period

(Describe which months of the year the Mitigation Monitoring Report covers)

From 1st January 2017 to 31 March 2017

2. Emission reductions of the monitoring period

(Describe the result and steps of GHG emission reduction calculation using the applied methodology(ies) for the monitoring period)

1,716 tons-$CO_{2\text{-equivalent}}$

3. Processes of the emission reduction calculation

(Describe the processes of GHG emission reduction calculation using the applied methodology(ies) for the monitoring period)

$BE_{CH_4,y} = \sum_t \frac{(AP_{ty} \times N_{ty})}{10^3} \times GWP_{CH4}$ (Equation 3)

= 844 x 7 x 45 / 10^3 x 25

= 6,647

$BE_{EC,y} = BG_{PJ,y} \times NCV \times EF_{PJ,y} \times 1/10^6$ (Equation 4)

= 844 x 349.7 x 47.3 x 63.1 / 10^6

= 881

$PE_y = 0.1 \times BE_{CH_4,y}$ (Equation 5)

= 0.1 x 6,646.5

= 665

$BE_y = BE_{CH_4,y} + BE_{EC,y}$ (Equation 2)

= 6,647 + 881.03

= 7,527

$ER_y = BE_y - PE_y$ (Equation 1)

= 7,527 – 665

= 6,863 (ton-$CO_{2\text{-equivalent}}$/ year)

= 1,716 (ton-CO_{2e}) (during the 3-month monitoring period)

2

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Mitigation Monitoring Report (cont'd)

a) Monitoring period

From 1st January 2017 to 31 March 2017

b) Emission reductions achieved during the monitoring period

1,716 tons-$CO_{2\text{-equivalent}}$ (for the above 3-month monitoring period)

c) Process of emission reduction calculation

- Total number of livestock (swine) was estimated by determining the average number of livestock per household (45 heads for the 3-month monitoring period). Average number was determined based on monitored data of sample households from January to March 2017.
- Quantity of LPG that was displaced by household by using biogas was estimated based on the survey of sample households on the daily hours of cooking using biogas.

3. MRV process of the MRV trial (4)

Prepare monitoring sheet and Mitigation Monitoring Report (cont'd)

Emission reductions for 3 months are calculated as follows:

$$BE_{1,y} = \sum_T \frac{(EF_{(T)} \times N_{(T)})}{10^3} \times GWP_{CH4} = 844 \times 7 \times 45 / 10^3 \times 25 = 6{,}647$$

$$BE_{2,y} = BG_{PJ,y} \times NCV \times EF_{PJ,y} \times 1/10^6 = 844 \times 349.7 \times 47.3 \times 63.1 / 10^6 = 881$$

$$PE_y = 0.1 \times BE_{1,y} = 0.1 \times 6{,}646.5 = 665$$

$$BE_y = BE_{1,y} + BE_{2,y} = 6{,}647 + 881.03 = 7{,}527$$

$$ER_y = BE_y - PE_y$$

$$= 7{,}527 - 665$$

$$= 6{,}863 \ (tCO_{2\text{-}e}/\text{ year})$$

$$= 1{,}716 \ (tCO_{2e}/\text{ 3-months})$$

Emission Reduction

Description	Parameter	Unit	Value
Emission reductions	ER_y	tCO_{2e}/year	**6,863**
Emission reductions (for 3-month monitoring period)	ER_y	tCO_{2e}	**1,716**
Baseline emissions	BE_y	tCO_{2e}/year	**7,527**
Baseline emissions (CH_4) from disposed animal manure	$BE_{1,y}$	tCO_{2e}/year	6,647
Baseline emissions (CO_2) from the consumption of fossil fuels	$BE_{2,y}$	tCO_{2e}/year	881
Project emissions	PE_y	tCO_{2e}/year	**665**

Inputs

*Input only orange cell

Description	Parameter	Unit	Value	Data source
Number of head of livestock (swine)	$N_{(T)}$	head	37,980	Monitored
Quantity of fuel consumed by household instead of using biogas	$BG_{PJ,y}$	kg/year	295,147	Monitored
Methane emission factor for livestock	$EF_{(T)}$	kg CH_4/ head/ year	7	Methodology default
Global Warming Potential of methane	GWP_{CH4}	-	25	IPCC Guidelines
Net calorific value of fuel that would be used for cooking instead of biogas	NCV	MJ/ kg	47.3	IPCC Guidelines
CO_2 emission factor of fuel that would be used for cooking instead of biogas	$EF_{PJ,y}$	t-CO_2/MJ	63.1	IPCC Guidelines (value for LPG)

3. MRV process of the MRV trial (5)

Approve MRV result

- In the actual MRV, LIFSAP will submit the completed Mitigation Monitoring Report to DARD for review and check.
- DARD will then check the following elements.
  - whether there is a lack of information in the submitted Mitigation Monitoring Report;
  - whether there is a significant gap between the approved MRV Plan and the submitted Mitigation Monitoring Report.
- After checking the Mitigation Monitoring Report, DARD will consolidate the monitoring reports of the LIFSAP project and other mitigation actions in the concerned sector into the Sectoral Monitoring Report and submits it to DONRE.
- DONRE will then examine the Sectoral Monitoring Report from the following perspectives;
  - whether there is a lack of information/ data in the submitted Sectoral Monitoring Report;
  - whether MRV for the approved mitigation action has been adequately implemented in accordance with the approved MRV Plan;
  - whether GHG emission reduction is accurately calculated in accordance with the approved MRV Plan and whether appropriate data is applied for calculation.
- DONRE then submits the report to PC with a recommendation for approval.

4. Experiences and lessons learnt through MRV trial activity

Advantages and disadvantages of MRV trial activity

Advantages

Enthusiastic support of GAP -group leaders

Full support of JICA short-term experts and Vietnamese experts during the implementation of MRV trial

In the calculation process, the parameters were selected by the experts so the data collection and calculation were more easier.

Disadvantages

There should be expense for GAP-group leaders during the survey.

Parameters and equations for calculation were still complicated. If not simplify some parameters, the investigation and calculation process will be very difficult and MRV can not be implemented successfully in state agencies/organizations.

4. Experiences and lessons learnt through MRV trial activity

Experiences and lessons learnt through MRV trial activity

MRV implementing entity:

- Identify clearly baseline emissions and project emissions

- Apply methodologies that have been widely applied around the world to indicate the parameters to be monitored and the formulas for calculating GHG emission reduction.

- Do calculation

Sectoral oversight unit and MRV management unit:

It is necessary to have knowledge of the relevant fields in order to verify the reports issued by the implementing entities.

Operational Manual for MRV on City-level Climate Change Mitigation Actions

26.10.2017

Mr. Yoshihiro Mizuno, JICA short term experts

Mr. Phuong Nguyen, Climate Change Bureau

Purpose of this manual and Recommended readers

(1) Purpose of this manual

- guide local governments (provinces and municipalities) in Vietnam to initiate Measurement, Reporting and Verification (MRV) of climate change mitigation actions. It describes the methods and procedures to implement MRV.
- provides formats that can be used for effective MRV and case studies on MRV for several mitigation actions.
- This manual was developed based on the experiences from the MRV trials in Ho Chi Minh City (HCMC) conducted under the Project to Support the Planning and Implementation of NAMAs in a MRV Manner (SPI-NAMA) in which six mitigation actions from energy, transport and waste sectors were MRV-ed.

(2) Recommended readers

- The officials of HCMC who are involved in planning, implementation and evaluation of climate change mitigation actions.
- The officials of other local governments intending to initiate MRV

Basis of this manual

- Law on Environmental Protection No: 55/2014/QH13;
- Resolution 24/NQ-TW: Active response to climate change, improvement of natural resource management and environmental protection;
- Decision No. 2139/QD-TTg of December 5, 2011: Approving the national strategy for climate change;
- Decision No. 1393/QD-TTg of September 25, 2012: Approving the national strategy on green growth;
- Decision No. 1474/QD-TTg of October 5, 2012: Issuance of the national action plan on climate change period 2012 – 2020;
- Decision No. 2053/QD-TTg of October 28, 2016: Promulgating the plan to implement the Paris Agreement on Climate Change; and
- Decision No. 1775/QD-TTg of November 21, 2012: Approval of the project of greenhouse gas emission management

Contents of this manual

Chapter 2 – Basic MRV framework

Pages: 4 – 10

Brief summary of Chapter 2

Chapter 2 presented the method to identify scope for mitigation actions to MRV and explained basic MRV framework for a city, showed responsibilities of each related agency in this MRV framework

Chapter 2. Basic MRV Framework

2.1 Defining scope of mitigation actions to MRV in the city

- **Approach 1**
  - ✓ If a city ALREADY HAS its own city-wide plan related to climate change, (e.g. climate change master plan, mitigation action plan), the city can employ that plan. Because such a plan usually contains major actions related to GHG emission reduction or prevention in the city.

- **Approach 2**
  - ✓ If a city DOES NOT HAVE such a plan or strategy yet, a plan yet, the city can set the sectors that are identified as major GHG emission sources in the city as the scope of mitigation actions to MRV.

Box 2-1 Case study: Defining scope of mitigation actions to MRV for HCMC

HCMC chose Approach 1 to define its scope of mitigation actions to MRV.

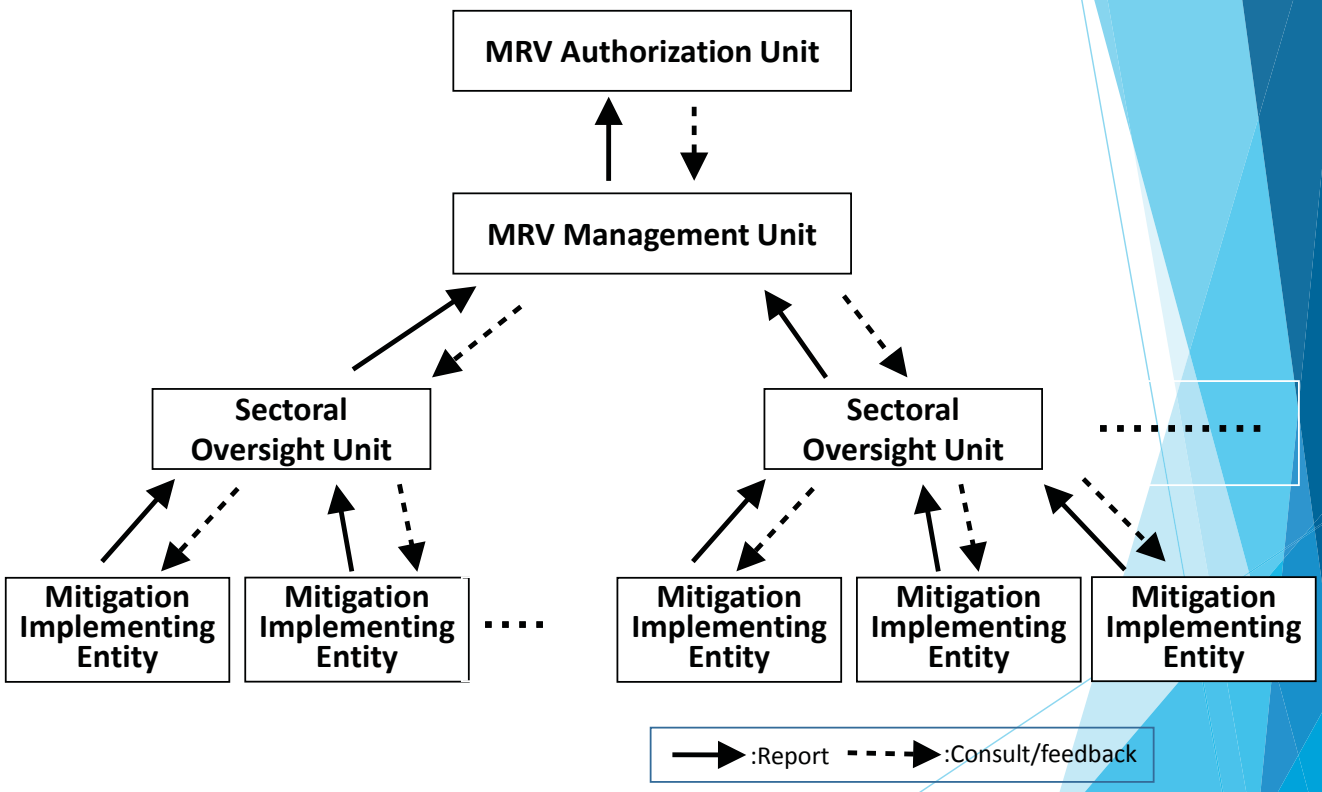
HCMC has developed Climate Change Action Plan of Ho Chi Minh City (CCAP), which stipulates priority sectors for climate change mitigation. Based on these priority sectors of CCAP, HCMC has set its scope of mitigation actions to MRV as "all mitigation actions stipulated in the CCAP."

The defined scope of HCMC is characterized as follows:

- The scope contains various levels of mitigation actions from policy-level to project -level actions.
- The scope covers mitigation actions by private sector and individual mitigation actions.

Chapter 2 - Basic MRV framework

2.2. Setting up MRV Framework for the city



Chapter 2 - Basic MRV framework

Draft MRV framework for HCMC

HCMC People's Committee	MRV Authorization Unit
Department of Natural Resources and Environment	MRV Management Unit
Various oversight departments in HCMC	Sectoral Oversight Units
Various companies and organizations that implement mitigation actions in HCMC	Mitigation Implementing Entities

Chapter 2 - Basic MRV Framework

Sectoral Oversight Units

HCMC's Mitigation Sectors (CCAP-based)	Sectoral Oversight Units of HCMC
Urban planning	Department of Architecture and Planning
Energy	Department of Industry and Trade (DOIT)
Transport	Department of Transport (DOT)
Industry	Department of Industry and Trade (DOIT)
Water management	Department of Transport (DOT)
Waste management	Department of Natural Resources and Environment (DONRE)
Construction	Department of Construction (DOC)
Health	Department of Health
Agriculture	Department of Agriculture and Rural Development (DARD)
Tourism	Department of Tourism

Chapter 3 – MRV process

Pages: 11 – 35

Brief summary of Chapter 3

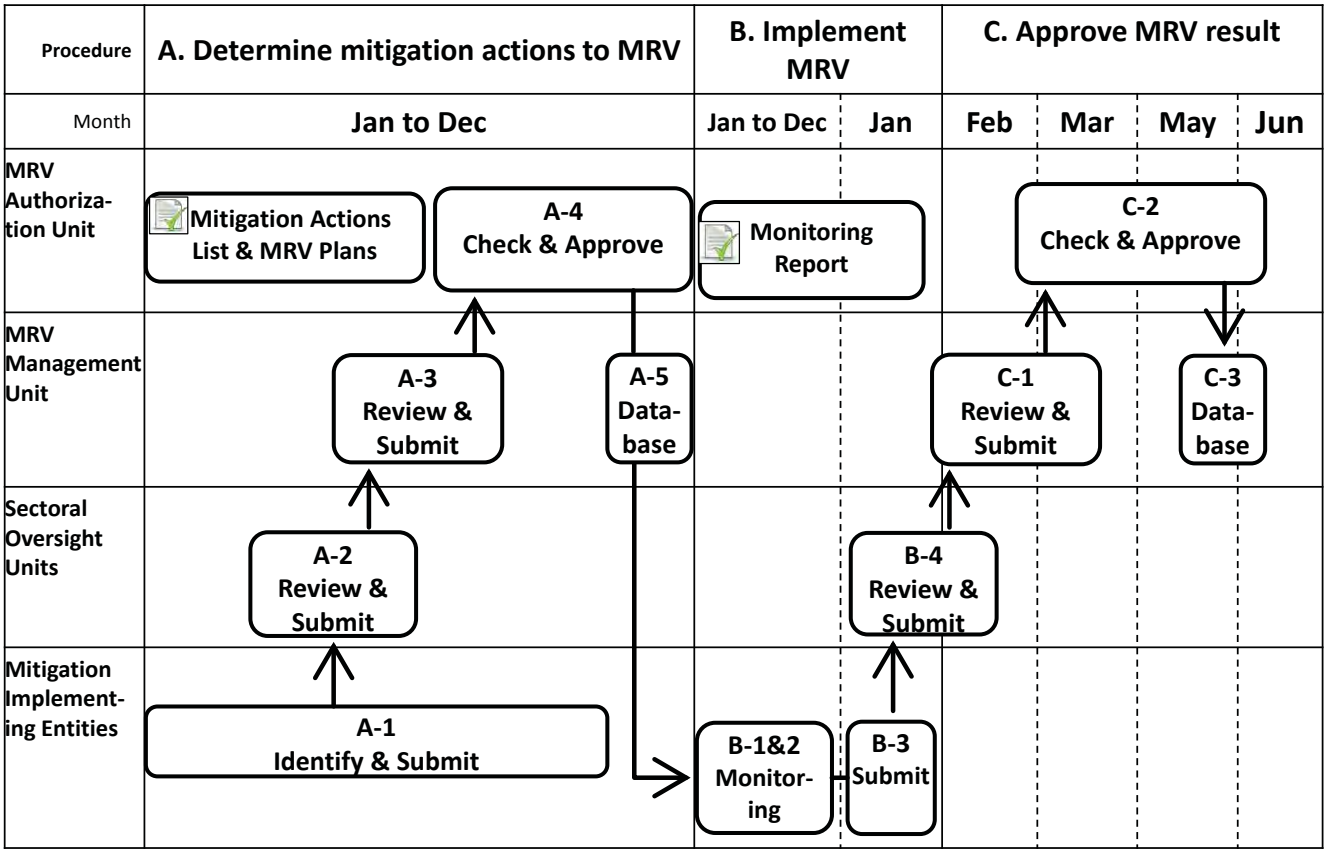
Chapter 3 provides steps by steps to implement MRV.

- Methodology and criteria to identify mitigation actions to MRV
- Implement MRV (Monitoring, Reporting, Verification)

Chapter 3. MRV process

A. Determine mitigation actions to MRV (Section 3-1)	A-1. Take stock of mitigation actions to MRV and develop MRV Plan (3-1-1) A-2. Review Mitigation Actions List and MRV Plans (3-1-2) A-3. Review Sectoral Mitigation Actions List and MRV Plans (3-1-3) A-4. Approve Draft Mitigation Actions List and MRV Plans (3-1-4) A-5. Update database on mitigation actions to MRV (3-1-5)
B. Implement MRV (Section 3-2)	B-1. Collect/measure and record data (3-2-1) B-2. Calculate GHG emission reductions (3-2-2) B-3. Prepare Mitigation Monitoring Reports (3-2-2) B-4. Review and submit Sectoral Monitoring Report (3-2-3)
C. Approve MRV result (Section 3-3)	C-1. Consolidate Sectoral Monitoring Reports (3-3-1) C-2. Approve MRV Reports (3-3-2) C-3. Update database on mitigation actions to MRV (3-3-3)

Chapter 3. MRV Process



Chapter 3. MRV process

3-1. Determining mitigation actions to MRV

3-1-1. Take stock of mitigation actions to MRV and develop MRV Plan

Pages: 13 – 26

This part instruct implementation entities to develop mitigation action list and MRV Plan

- Step 1 Preparing a long list of mitigation actions
- Step 2 Asses actions in accordance with the pre-defined criteria
- Step 3 Select the actions to MRV and develop the Mitigation Actions List

Responsible organization
Mitigation Implementing Entities

Take stock of mitigation actions to MRV and develop MRV Plan

- Step 1: Prepare a long list of potential mitigation actions
- Step 2: Assess mitigation actions in accordance with the pre-defined criteria
  - Criterion 1: Mitigation Potential - Whether the action contributes to reduce GHGs
  - Criterion 2: Practicability of MRV - Whether the action provides practical ways to MRV
- Step 3: Select the actions and develop the Mitigation Actions List

No.	Name of mitigation action	Mitigation Implementing Entity	Location	MRV/Non-MRV
1		Entity A		MRV
2		Entity A		MRV
3		Entity A		Non-MRV
4		Entity A		MRV

Chapter 3. MRV process

3.1. Determining mitigation actions to MRV

Responsible organization
Mitigation Implementing Entities

Prepare MRV plan

I. General information on the mitigation action
- a) Name of the mitigation action
- b) Involved organizations and their roles
- c) Objectives
- d) Technology introduced under the mitigation action
- e) Target GHG type
- f) Location
- g) Timeframe
- h) Cost of mitigation action
- i) Benefits of mitigation action and contribution to sustainable development
- j) Source of funding and supporting financial scheme
- k) Information on international market mechanisms

II. Emission reduction calculation, monitoring and reporting
- a) Logic of GHG emission reduction
- b) Methodology to calculate GHG emission reduction
- c) Estimated GHG emission reduction
- d) Organizational structure for monitoring and reporting
- e) Monitoring period
- f) Monitoring methods

Chapter 3. MRV process

3.1. Define mitigation actions to MRV

Responsible organization
Mitigation Implementing Entities

Prepare MRV Plan

Table 3-3 Major contents of methodology for GHG emission reduction calculation

Contents	Outline
Applicability	A methodology contains description/ explanation on what types of mitigation actions can use the methodology.
Logic of emission reduction	Description on how GHG emission is reduced through the mitigation action.
Formulae of emission reduction calculation	Description on calculation formulae for the baseline and project emissions as well as emission reductions.
Monitoring method of necessary data for emission reduction calculation	Description on the method for measurement/collection of each parameter in the formulae for calculating the baseline/project emissions and emission reductions.

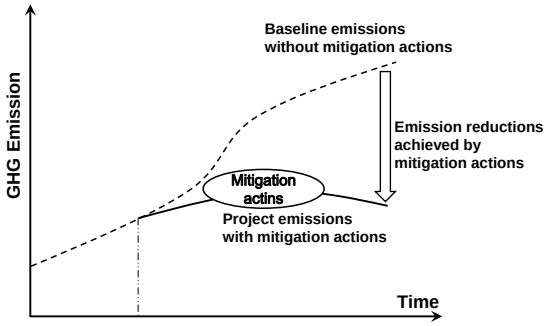


Table 3-4 Sources of existing methodologies

Title	Reference
Intergovernmental Panel on Climate Change (IPCC)	http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
Clean Development Mechanism (CDM)	http://cdm.unfccc.int/methodologies/index.html
Greenhouse Gas Protocol: GHG Protocol for Project Accounting	http://www.ghgprotocol.org/standards/project-protocol
International Finance Corporation (IFC) Greenhouse Gas Reduction Accounting Guidance for Climate Related Projects	http://www.ifc.org/
Gold Standard	http://www.goldstandard.org/
Joint Crediting Mechanism (JCM)	http://www.jcm.go.jp
Japan International Cooperation Agency (JICA)	http://www.jica.go.jp/english/our_work/climate_change/mitigation.html
Japan Bank for International Cooperation (JBIC)	http://www.jbic.go.jp/en/efforts/j-mrv

Chapter 3. MRV process

3-1. Determining mitigation actions to MRV

3-1-2. Review Mitigation Actions List and MRV Plans

Page: 24

This part presented processes and criteria for Sectoral Oversight Units to review/check the mitigation actions list and MRV Plan

Responsible organization:
Sectoral Oversight Unit

Review Mitigation Actions List and MRV Plans

- Sectoral Oversight Unit examines Mitigation Actions List and MRV Plans submitted by Mitigation Implementing Entities.
- The example viewpoints of examination are as follows.
  - Whether there is lack in the submitted list/ detailed information
  - Whether the target, procedure and timing for MRV are clearly stated
  - Whether the target project can be expected to have GHG emission reductions
  - Whether the target project compliance with upstream, guiding plans/strategies
  - Whether the target project is MRV-able
- Sectoral Oversight Unit compiles all Mitigation Actions and MRV Plans of the sector as Sectoral Mitigation Actions List and MRV Plans and submits it to MRV Management Unit anytime throughout year.

Table 3-5 Image of compiled Sectoral Mitigation Actions List

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	MRV/ Non-MRV
1	Energy		Unit AA	Entity A		MRV
2						MRV
3						Non-MRV
4				Entity B		MRV
5						MRV
6						MRV
7						MRV
8						Non-MRV
9				Entity C		MRV
10				Entity D		Non-MRV
...						

Chapter 3. MRV process

3-1. Determining mitigation actions to MRV

3-1-3. Review Sectoral Mitigation Actions List and MRV Plans

Page: 25

This part presented process and criterion for MRV Management Unit to check mitigation actions list by sectors and MRV Plans submitted by Sectoral Oversight Units.

Chapter 3. MRV process

Responsible Organization:
MRV Management Unit

3.1. Determining mitigation actions to MRV

Review Sectoral Mitigation Actions List and MRV Plans

- MRV Management Unit thoroughly examines the Sectoral Mitigation Actions List and MRV Plans submitted by Sectoral Oversight Units.
- The example viewpoints of examination are as follows.
  - Whether there is lack in the submitted list/ detailed information
  - Whether the target, procedure and timing for MRV are clearly stated
  - Whether the target project can be expected to have GHG emission reductions
  - Whether the target project is MRV-able
- By the end of April, MRV Management Unit compiles all Sectoral Mitigation Actions List and MRV Plans that will be MRV-ed in the next fiscal year, and submits it to MRV Authorization Unit with a recommendation for approval

Table 3-6 Image of Mitigation Actions List

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	Year of addition to the list	MRV/ Non-MRV
1	Energy		Unit AA	Entity A		2016	MRV
2						2016	MRV
3						2017	Non-MRV
4				Entity B		2016	MRV
5						2016	MRV
6						2017	MRV
7						2017	Non-MRV
8				Entity C		2016	MRV
9				Entity D		2017	Non-MRV
10	Transport		Unit BB	Entity E			MRV
11							Non-MRV
12				Entity F			MRV
13				Entity G			MRV
14	Waste		Unit CC	Entity H			MRV
...							

Chapter 3. MRV process

3-1. Determining mitigation actions to MRV

3-1-4. Approve Mitigation Actions List and MRV Plans

Page: 26

This part presented procedure for the MRV Authorization Unit to approve the mitigation actions list and MRV Plan submitted by the MRV Management Unit.

Chapter 3. MRV process

3-1. Determining mitigation actions to MRV

3-1-5. Update database on mitigation actions to MRV

Page: 26

This part presented procedure for the MRV Management Unit to update database on mitigation actions to MRV

Chapter 3. MRV process
3.1. Determining mitigation actions to MRV

Responsible Organization :
MRV Authorization Unit

Approve Mitigation Actions List and MRV Plans

- By the end of May, after receiving the Draft Mitigation Actions List and MRV Plans with a recommendation for approval, MRV Authorization Unit approves it as a Mitigation Actions List and MRV Plans.
- By the end of June, MRV Authorization Unit notifies the Mitigation Actions List and MRV Plans through MRV Management Unit to Sectoral Oversight Units

Responsible Organization:
MRV Management Unit

Update database on mitigation actions to MRV

- MRV Management Unit updates the database on mitigation actions to include the Mitigation Actions List and MRV Plans.

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	Location	Year of addition to the list	MRV/ Non-MRV	Emission reduction in year 1	Emission reduction in year 2
...	...	...	...	...	...	...	...	...	...
Total	-	-	-	-	-	-	-	XXXX	XXXX

Chapter 3. MRV process
3-2. Implement MRV
3-2-1. Collect/measure and record data (Monitoring)
Pages: 27-32

This part presented procedure for the Mitigation Implementation Entities to conduct monitoring includes instruction to prepare monitoring sheet and calculation sheet and implement monitoring.

Chapter 3. MRV process

3.2 Implement MRV

Responsible organization:
Mitigation Implementation Entities

Collect/measure and record data (Monitoring)

- The Mitigation Implementing Entities conduct monitoring in accordance with respective MRV Plan, and prepare Monitoring Sheet every determined period such as monthly/ quarterly/bi-annually.
- Monitoring activity needs to be carried out using the designated method, procedure and period described in the respective approved MRV plan.
- The Mitigation Implementing Entity monitors (through either direct measurement (monitoring) of parameters or data collection from operators such as bus companies) and collects all data (such as CO2 emission factors) that is necessary to calculate GHG emission reductions
- The Mitigation Implementing Entity inputs all the collected and measured data and information into the Monitoring Sheet.
- The Monitoring Sheet and GHG emission reduction calculation sheet need to be prepared for each mitigation action. The monitored data and its measurement method/ procedure are needed to be determined before implementing the monitoring activity.

Chapter 3. MRV process

3.2 Implement MRV

Prepare monitoring sheet

Table 3-8 Basic contents of Monitoring sheet

I. Information on the mitigation action
a) Name of the mitigation action
b) Sector
c) Mitigation Implementing Entity
d) Sectoral Oversight Unit
e) Name of the site
II. Results of monitoring
a) Monitoring year
b) Monitoring month
c) Creation date
d) Name of the person in charge
e) Monitoring results
f) Monitoring period

Monitoring sheet

Monitoring (Measurement) Sheet for Solar PV project

Project title	
Name of the site	
Name/ No. of the Monitoring Meter	
Starting date of Monitoring	
Name of the person in charge	

Monitoring period		Measured date	Electricity generation amount indicated by electric meter (kWh)	Accumulated electricity generation amount (kWh)
From	to			
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0

Conduct monitoring

Jan, Monitoring data

Feb, Monitoring data

Dec, Monitoring data

Monitoring (Measurement) Sheet for Solar PV project

Project title	
Name of the site	
Name/ No. of the Monitoring Meter	
Starting date of Monitoring	
Name of the person in charge	

Monitoring period		Measured date	Electricity generation amount indicated by electric meter (kWh)	Accumulated electricity generation amount (kWh)
From	to			
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0

Data input

GHG calculation sheet

GHG Emission reduction calculation sheet for PV project

Period of monitoring:

Emission Reduction

Description	Parameter	Unit	Emissions
Emission reduction	ER_y	tCO_2/year	12
Baseline emission	BE_y	tCO_2/year	12
Project emission	PE_y	tCO_2/year	0

Inputs

*Input only orange cell

Description	Parameter	Unit	Amont of Electric generation	Data source
Amount of electricity generated in the year y	EG_{PJ}	kWh/year	18,000	Measured
CO2 Emission factor of grid	EF_{grid}	tCO_2/MWh	0.66	

Chapter 3. MRV process

3-2. Implement MRV

3-2-2. Prepare and submit Mitigation Monitoring Reports

Pages: 30-32

This part presented the procedure and instruction for the Mitigation implementation Entities to prepare and submit Mitigation Monitoring Report

Responsible Organization:
Mitigation Implementation Entities

Prepare and submit Mitigation Monitoring Reports

- The Mitigation Implementing Entities prepare the Mitigation Monitoring Report using the data of the Monitoring Sheet and the results of GHG emission reduction calculations.
- General information of the mitigation action are also described in the Mitigation Monitoring Report.
- The Mitigation Implementing Entities calculates the GHG emission reduction for the mitigation action to MRV once a year using the data contained in the Monitoring sheets and GHG emission calculation sheet.
- The Mitigation Implementing Entities submit the Mitigation Monitoring Report to the Sectoral Oversight Unit by the end of January (once a year).

Table 3-9 Contents of Mitigation Monitoring Report

I. Monitoring period
II. Emission reductions of the monitoring period
III. Processes of the emission reduction calculation

Chapter 3. MRV process

3-2. Implement MRV

3-2-3. Review and submit Sectoral Monitoring Report

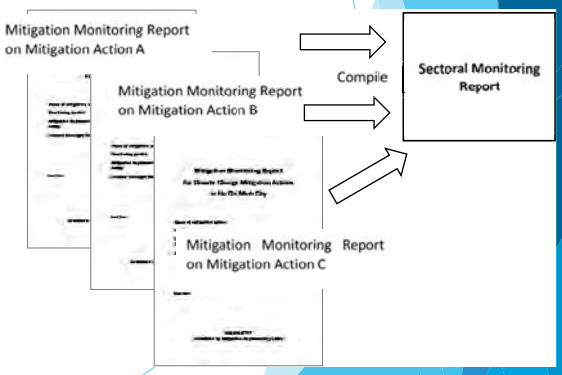
Page: 31

This part presented procedure and instruction for the Sectoral Oversight Unit to check mitigation monitoring report and consolidate into sectoral monitoring report.

Responsible organization:
Sectoral Oversight Unit

Review and submit Sectoral Monitoring Report

- The Sectoral Oversight Unit thoroughly reviews the submitted Mitigation Monitoring Reports. Following elements should be considered in examining the reports:
  - Whether there is lack of information in the submitted
  - Whether there is big gap between MRV plan and Mitigation Monitoring Report
- The Sectoral Oversight Unit compiles the Mitigation Monitoring Reports to develop the Sectoral Monitoring Report and the submits it to the MRV Management Unit by the end of February (once a year).



Chapter 3. MRV process

3-3. Approve MRV result

3-3-1. Compile Sectoral Monitoring Reports

Pages: 33-35

This part presented procedure and instruction for the MRV Management Unit to evaluate the Sectoral Monitoring reports and compile into MRV Report and submit to MRV Authorization Unit.

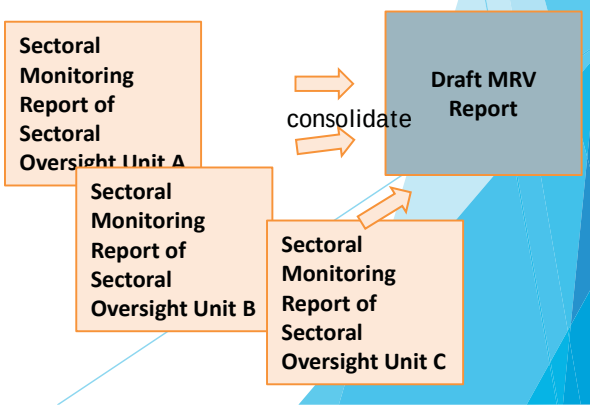
Chapter 3. MRV process

3.3. Approve MRV result

Responsible organization:
MRV Management Unit

Compile Sectoral Monitoring Reports

- The MRV Management Unit examines Sectoral Monitoring Reports submitted by Sectoral Oversight Units. The example viewpoints of examination are as follows:
  - Whether there is lack of information/data in the submitted Sectoral Monitoring Report.
  - Whether the MRV for the approved mitigation actions has been adequately implemented in accordance with the approved MRV Plan.
  - Whether GHG emission reduction is accurately calculated in accordance with the approved MRV Plan and whether appropriate data is applied for the calculation.
- The MRV Management Unit compile the Sectoral Monitoring Reports of the year submitted by all Sectoral Monitoring Reports into the MRV Plan.
- By the end of March, the MRV Management Unit submits the MRV Report to the MRV Authorization Unit.



Chapter 3. MRV process

3.3. Approve MRV result

Responsible organization:
MRV Management Unit

MRV Report

- Sector category
- Name of the mitigation action
- Sectoral Oversight Unit(s) and Mitigation Implementing Entity(ies)
- Classification of MRV or Non-MRV
- Emission reductions achieved by the mitigation action during the year

Table 3-10 Example of MRV Report

No.	Sector	Name of mitigation action	Sectoral Oversight Unit	Mitigation Implementing Entity	MRV/ Non-MRV	GHG emission reductions (tCO_2e)
1	Energy		Unit AA	Entity A	MRV	
2					MRV	
3					Non-MRV	
4				Entity B	MRV	
5					MRV	
-		Sub-total				
6	Transport		Unit BB	Entity C	MRV	
7					Non-MRV	
8				Entity D	MRV	
9					Non-MRV	
-		Sub-total				
10	Waste		Unit CC	Entity E	MRV	
11					MRV	
12				Entity F	MRV	
...					Non-MRV	
-		Sub-total				

Chapter 3. MRV process

3-3. Approve MRV result

3-3-2. Approve MRV reports

Page: 35

This part presented procedure for the MRV Authorization Unit to approve the MRV reports.

Chapter 3. MRV process

3-3. Approve MRV result

3-3-3. Update database on mitigation actions to MRV

Page: 35

This part presented procedure for the MRV Authorization Unit to update database on mitigation actions with data in the approved MRV reports.

Chapter 3. MRV process

3.3. Approve MRV result

Responsible organization:
MRV Authorization Unit

Approve MRV report

- By the end of May, the MRV Authorization Unit checks the MRV Report and then approve the MRV Report
- By the end of June, MRV Report are notified through the MRV Management Unit to relevant entities in the city as well as to the MONRE.

Responsible organization:
MRV Management Unit

Update database on mitigation actions

- The MRV Management Unit update the database on mitigation actions with information contained in the approved MRV Report including attached GHG emission reductions.

Annex

- **Annex 1: MRV Case studies on MRV**

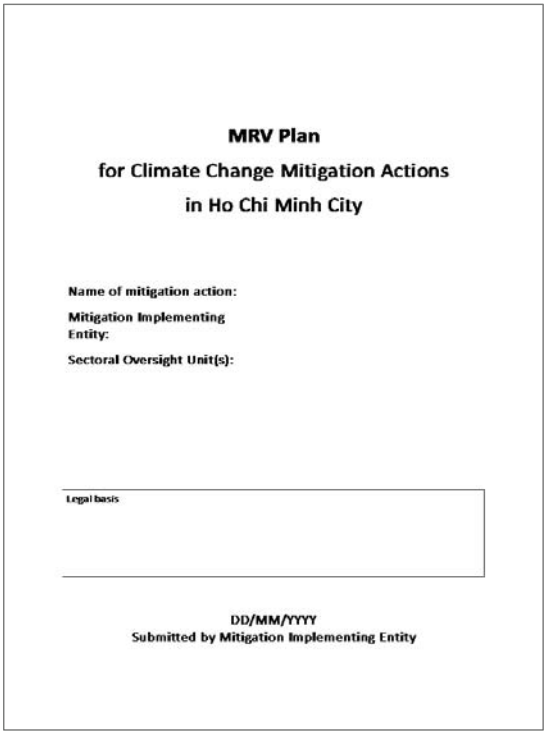
1. Installation of solar PV system on the roof top of the public buildings
2. Introduction of air conditioning system with inverters to the offices
3. Replacement CFL with LED for the small street lamps
4. Replacement to high energy efficient boilers at a dairy factory
5. Introduction of CNG buses
6. Promotion of eco-driving
7. Introduction of Bus Rapid Transit (BRT)
8. Introduction of urban railway
9. Collection and utilization of landfill gas at final disposal site
10. Recycling of municipal solid waste
11. Production of organic fertilizer
12. Collection of animal manure for biogas generation

Annex

- Annex 2: Typical Mitigation Actions and Emission Reduction Logic
  - Generation of electricity
  - Factory
  - Commercial building (hotel, shopping mall, market, etc.)
  - Household
  - Car/motorcycle
  - Bus
  - Railway
  - Ship/vessel
  - Traffic management
  - Freight transportation
  - Port/airport
  - Waste treatment
  - Wastewater treatment

Annex 3

- Annex 3: Format of MRV Plan



MRV Plan

for Climate Change Mitigation Actions

in Ho Chi Minh City

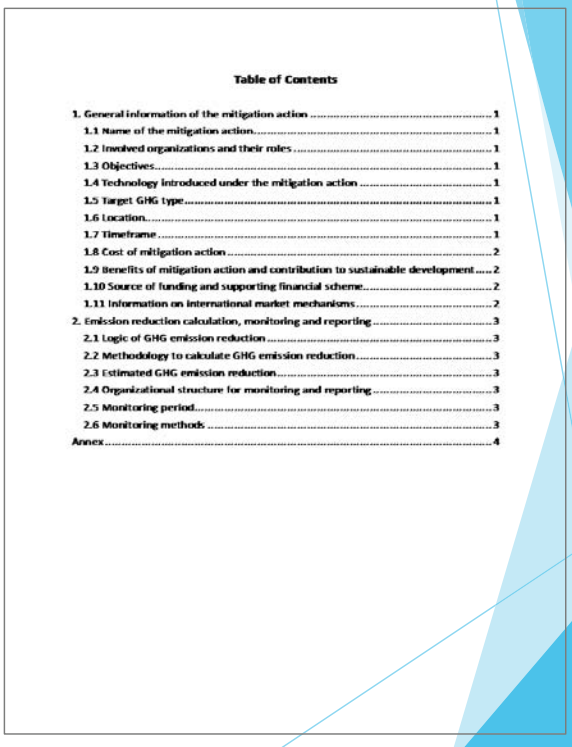
Name of mitigation action:

Mitigation Implementing Entity:

Sectoral Oversight Unit(s):

Legal basis

DD/MM/YYYY
Submitted by Mitigation Implementing Entity



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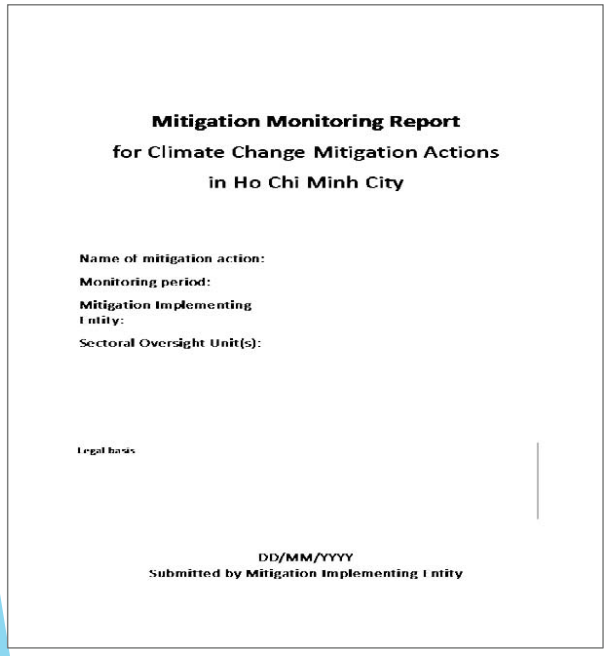
Annex

- Annex 4: Format of Monitoring Report



Mitigation Monitoring Report
for Climate Change Mitigation Actions
in Ho Chi Minh City

Name of mitigation action:

Monitoring period:

Mitigation Implementing Entity:

Sectoral Oversight Unit(s):

Legal basis

DD/MM/YYYY
Submitted by Mitigation Implementing Entity

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1

Project to Support the Planning and Implementation of NAMAs

in a MRV Manner

Capacity building of HCMC officials

Sở Tài nguyên và Môi trường TP.HCM

26 tháng 10 năm 2017

Introduction

- **Legal basis:**
- Decision No. 1911/QĐ-BTNMT of July, 29,2015 : Approving Project document "Project to Support the Planning and Implementation of NAMAs (SPI-NAMA)"
- The policy of the People's Committee in Official Letter No. 5128 / UBND-DT of September,19,2016: Implementation of the SPI-NAMA project in Ho Chi Minh City, (Assigned DONRE in collaboration with the Japan International Cooperation Agency (JICA) to organize training courses, to enhance the capacity of HCMC officials on climate change response and management of GHG reduction activities within the framework of the project in 2016 and 2017.
- **Training sessions within the framework of the project :** 04 sessions in HCMC and 3 sessions in Japan.

Table of Contents

Part 1: Summary of capacity buildings

Part 2: Experience of training in Japan

Summary of capacity buildings

Jan 2016	Seminar on Climate Change Mitigation for HCMC Officials (1st)
Mar 2016	Seminar on Climate Change Mitigation for HCMC Officials (2nd)
May 2016	Training in Japan (1st)
Sept 2016	Training in Japan (organized by Hanoi-side)
Nov 2016	General Training on Climate Change Mitigation for HCMC Officials (1st)
May 2017	Training in Japan (2nd)
July 2017	General Training on Climate Change Mitigation for HCMC Officials (2nd)

1. Seminar on Climate Change Mitigation for HCMC Officials

Objective: Understand outline of SPI-NAMA and basics of GHG inventory and NAMA/MRV

	Date	Participants	Contents
First	6 Jan 2016	13 people (DONRE, DOT, DOIT, MBS, MOCPT, EVN, CITENCO)	➢ Introduction to SPI-NAMA ➢ Basics on GHG inventory ➢ Basics on NAMA/MRV
Second	18 Mar 2016	6 people (DONRE, DOT, DOIT, EVN, MBS)	➢ Outline of NAMA/MRV guidelines for HCMC ➢ Candidate NAMAs to pilot MRV ➢ Calculation of GHG emissions for MRV

2. General Training on Climate Change Mitigation for HCMC Officials

Objective: Enhance capacity of HCMC officials to plan and monitor climate change mitigation measures

	Date	Participants	Contents
First	25 and 28 to 30 Nov 2016 (4 days)	80 in Part A and 49 in Part B	➢ Part A: Lecture on climate change mitigation, GHG inventory, and MRV ➢ Part B: Exercise on planning mitigation measures / planning MRV procedure
Second	5 to 7 July 2017 (3 days)	56 in Part A and 39 in Part B	

3. Training in Japan

Objective: Understand climate change mitigation measures of Japan at local government level

	Date	Participants	Contents
First	22 to 28 May 2016	10 from HCMC (PC, DONRE, MBS, DOT, DOIT, CITENCO, MOCPT, EVN) 3 from Ministries	➢ Mitigation actions of Tokyo Metropolitan Government and Osaka City ➢ Site visit to solid waste treatment plant
Second	21 to 27 May 2017	10 from HCMC (DONRE, DOT, DARD, SCFC, UCCI, Statistical Office)	➢ Mitigation actions of Tokyo Metropolitan Government ➢ Site visits to solid waste treatment plant, waste water treatment plant, and energy-efficient building

4. Training in Japan (Organized by Hanoi-side)

Objective: Learn national and local actions on climate change mitigation in Japan

Date: 6 to 12 September 2016

Participants: Director of DONRE, Vice-Director of CCB, MONRE, MPI, MOIT, MOC, MOT, Da Nang Hai Phong

Visited: Ministries, Business (Keidanren), Tokyo Metropolitan Government, Public thinktanks, Private energy efficient building

Part 1: Summary of capacity buildings

Part 2: Experience of training in Japan

Schedule of the training

Date		Contents
Sun 21 May		*Arrival (Narita)*
Mon 22 May	AM	• Orientation
	PM	• Presentation by trainees (mitigation actions in HCMC) • Lecture by JICA experts
Tue 23 May	AM	• Lecture by Bureau of Environment Tokyo Metropolitan Government (TMG)
	PM	• Lecture by Bureau of Environment TMG
Wed 24 May	AM	• Lecture by Bureau of Environment TMG
	PM	• Site visit to energy efficient building
Thu 25 May	AM	• Site visit to solid waste treatment plant
	PM	• Site visit to waste water treatment plant
Fri 26 May	AM	• Workshop (planning of MRV structure of mitigation measures)
	PM	• Presentation by trainees • Closing ceremony
Sat 27 May		*Departure (Narita)*

1. Detail of the training sessions

Presentation by trainees :

- Overview of mitigation action plans and policies in HCMC, Contents of the works that their organization is planning or implementing.
- Objectives and issues
- Expectations from the training session

Lecture by experts

- Introduction of GHG inventory
- Introduction of Mesuerement- Reporting- Verification (MRV) process

Lecture by Bureau of Environment Tokyo Metropolitan Government (TMG)

* **Tokyo Metropolitan Government's strategy to respond to climate change**
- Overview of CO_2 emission in Tokyo
- Target: (By 2020: Cut 25% of GHG emission in Tokyo compared to 2000, by 2030: 38%)

Lecture by Bureau of Environment Tokyo Metropolitan Government (TMG)

* **Tokyo Metropolitan Government's strategy to respond to climate change**

- **Basic environmental plan of Tokyo**
  - Build a energy smart city:

✓Energy efficiency and energy management activities

✓Extension of using renewable energy

✓ Build a low carbon society , bear and prevent from disaster, use Hydrogen energy

Lecture by Bureau of Environment Tokyo Metropolitan Government (TMG)

* Diagnosis of energy efficiency in Tokyo Metropolitan project

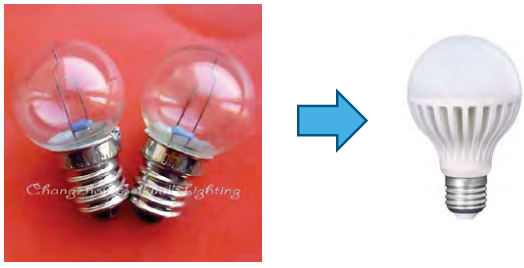
✓Definition

✓ Energy efficiency diagnostic process

✓ Diagnostic achievements

✓Diagnostic efficiency

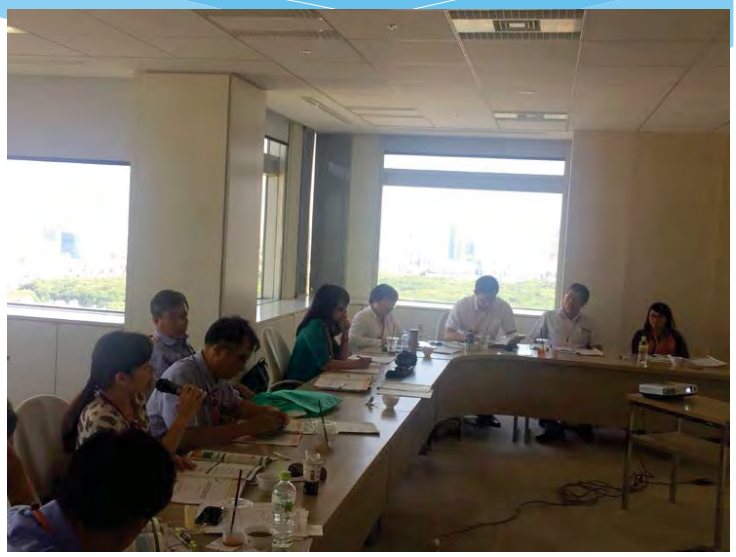
✓Example on energy efficiency and introduction of the project



Lecture by Bureau of Environment Tokyo Metropolitan Government (TMG)

* Cap-and-Trade

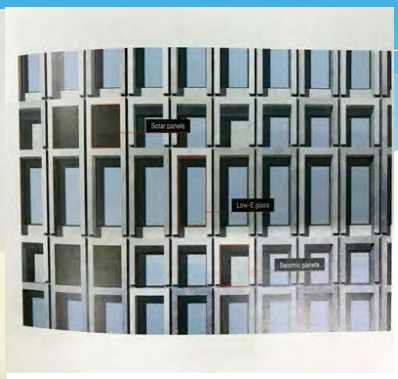
* Energy efficiency promotion program of small and medium private companies and Credit creation project



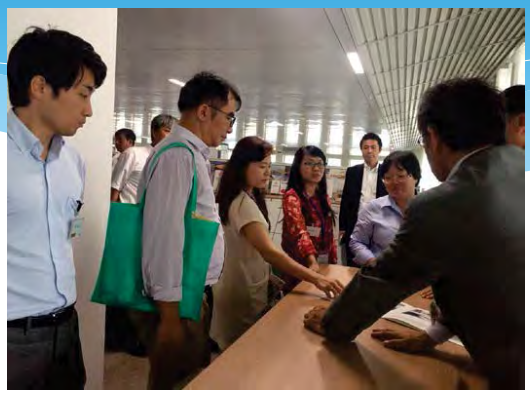
Site visit to energy efficient building - Office of Tokyo public environment company

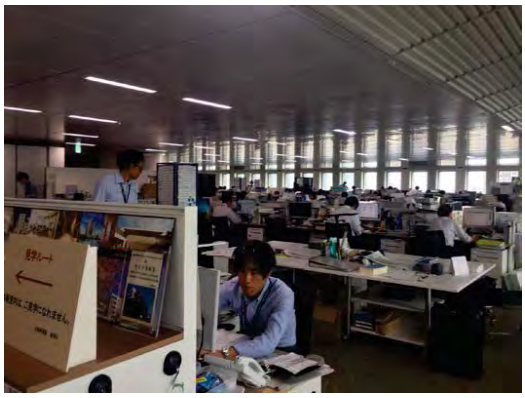
*Visit headquater of Shimizu Group:

Typical building for energy efficiency – Breakthrough solutions in design, lighting and air conditioning.

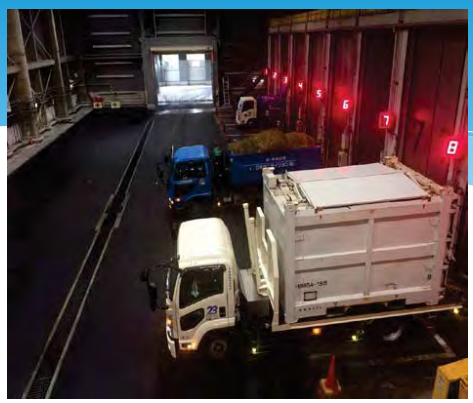


Site visit to energy efficient building
- Office of Tokyo public environment company





Site visit to solid waste treatment plant Ota



Garbage truck to transport the center

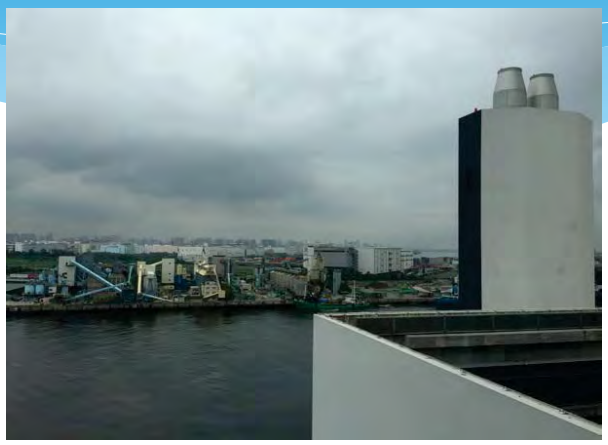
Garbage

Control room

Garbage burning model

Site visit to solid waste treatment plant Ota

Model of turbine generator



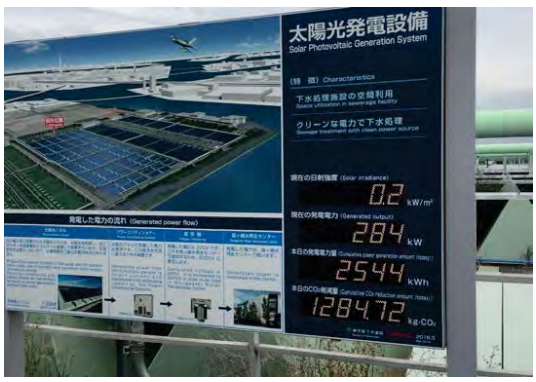
Chimney after the burning process

Site visit to waste water treatment plant Morigasaki

Diagram of using the sludge decomposition process to generate electricity

Solar panels cover reaction tanks

Sedimentation tanks



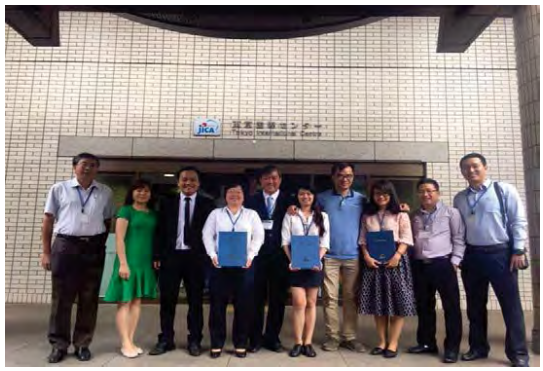
Parameters of the solar panels

Site visit to waste water treatment plant Morigasaki

Utilization of wastewater after treatment for hydropower

Group working on planning of MRV

Presentation – Evaluation– Conclusion



2. Gained Knowledge

Climate change mitigation policies of Tokyo Metropolitan Government

For large scale industrial and commercial manufacturing enterprises (anual energy consumption > 1.500 kL crude oil equivalent)	For medium small scale industrial and commercial manufacturing enterprises	For households
Cap-and-trade: - Purchase the GHG emission reduction credit - Purchase renewable energy credits - Purchase GHG emission reduction outside	Diagnosis of energy efficiency for enterprises that registered technical assistance on improved operation, on introduction of energy efficiency equipment	Partial support (free 2 incandescent bulbs with 1 LED bulb) Scoring system for energy efficiency buildings

2. Gained Knowledge

Manual for Mesuerement- Reporting- Verification (MRV) process

Through an exercise to implement an basic MRV framework for specific project, the knowledge gained:

- MRV is an indispensable component of each mitigation actions that allows check and report in a systematic way.
- MRV is an effective tool to quantify mitigation of each activities
- The works for each stage M, R, V
- Logic of Emission reduction
- Responsibilities of relevant organizations in MRV process
- Benefits and meanings of MRV implementation

Introduce the basic MRV framework(scale, , compulsory or encouraging, financial support, calculation methodologies)

3. How to apply the gained knowledges through training sessions in HCMC

- GHG inventory : Enhance the coordination between organizations and departments
- Submit Manual for MRV to People Committee HCMC to issue : MRV trials for state enterprises, large scale enterprises, large scale wastewater treatment plant, landfill
- Study and develop policies to encourage organizations and individuals in HCMC to participate in energy efficiency, policies on energy use
- Study and introduce the model of garbage collection - incineration - energy generation
- Study and propose efficient using of water resources – energy generation from waste water treatment process
- Propaganda to community .

4. Comments for future training sessions

- *Seminar : target groups*
- *Competitions (test, examination)*
- *Discussion session*
- *Site visit / Introduce the practical model*

Conclusion

* The training sessions had remarkable results
* To apply it needs more research on real situation in HCMC
* When implementing, it is necessary to consult and coordinate with relevant parties
* Cooperate and exchange experience in implementing process
* Community consultation
* Propaganda to community
* Financial resources : sponsorship, JCM mechanism ...

Developing Effective Mitigation Policies for Cities:

Learning from Tokyo

26 OCTOBER 2017 @ Caravelle Saigon

Kazuya FUJIWARA
Mizuho Information & Research Institute Inc.,

Outline

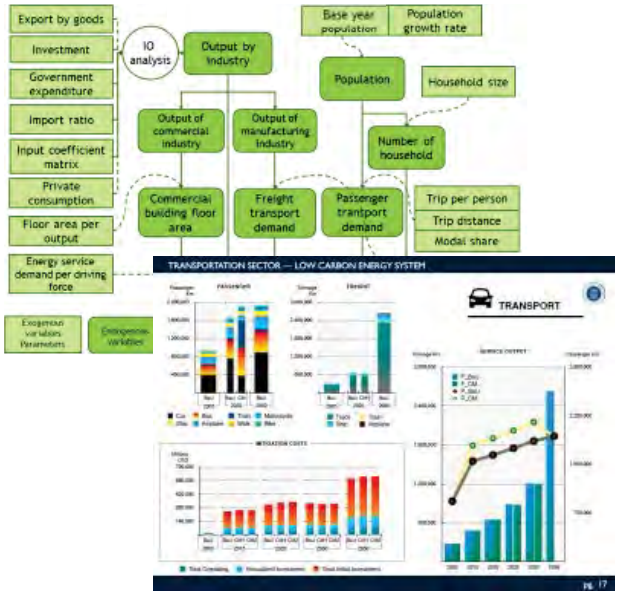
- Introduction of AIM
- Mitigation Policies in Tokyo
- Activities for Knowledge Sharing
- Possible activity in Ho Chi Minh City

Introduction of AIM

What is AIM?

- Asia-Pacific Integrated Model (AIM) is a family of analytical models which are developed by research institutes in Japan. AIM contributes IPCC reports, discussion on climate change mitigation actions in Japan and Asian countries.
- AIM can be regarded as **"researchers network"**, because AIM is developed and applied through collaboration with researchers in various countries.

Model



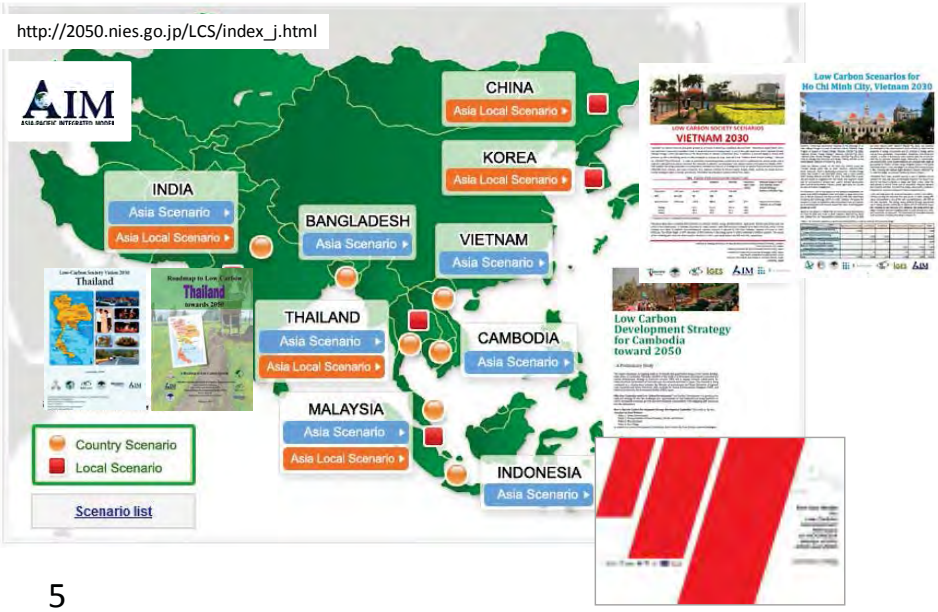
Example of AIM's structure and output

Researchers Network

21th AIM International Workshop

AIM activities in Asia

- AIM has contributed processes to formulate climate policy in Japan, and the activities are expanded to Asia. AIM has been involved in formulation processes of low carbon policies through collaboration with Asian researchers.
- Since FY2014, "Asia Low Carbon Society Research (LCSR) Project" which is funded by MoEJ is launched. The project includes not only making low carbon scenarios but also designing practical programs to realize LCS in target regions.

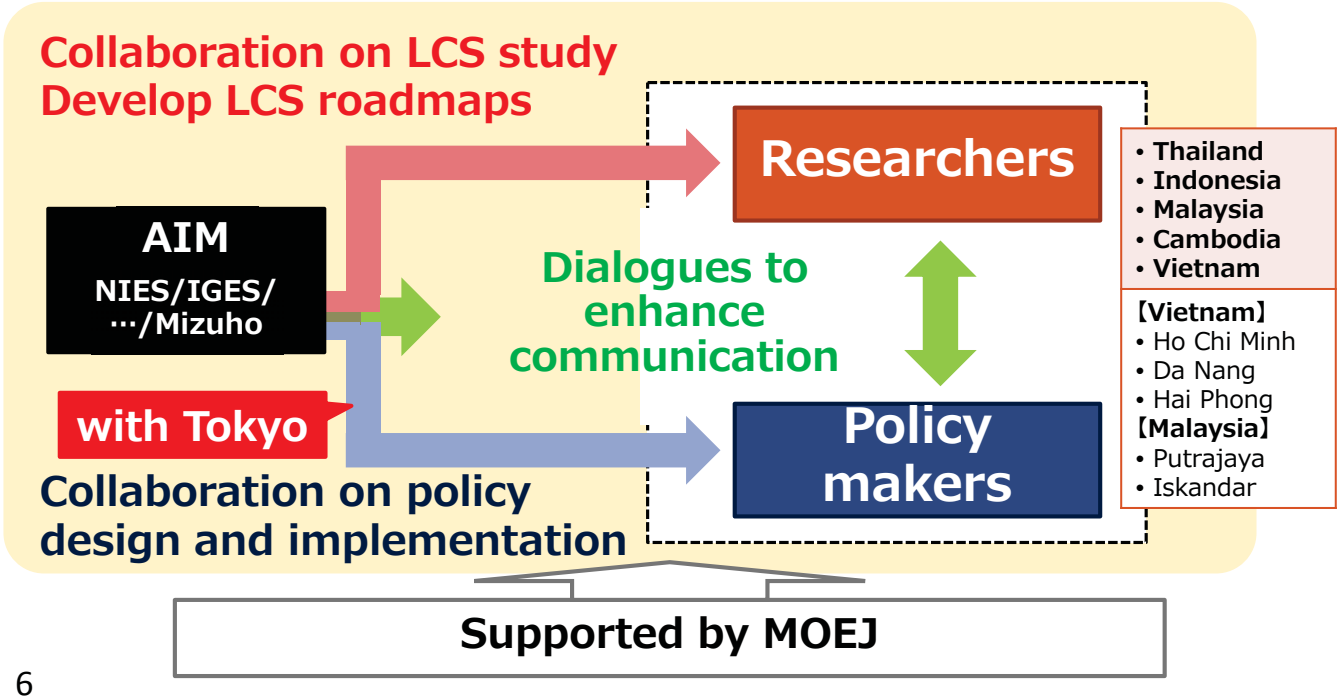


Target Regions
FY2014 -

National	**• Thailand** **• Indonesia** **• Malaysia** **• Cambodia** **• Vietnam**
City	**【Vietnam】** • Ho Chi Minh • Da Nang • Hai Phong **【Malaysia】** • Putrajaya • Iskandar

Asia Low Carbon Society Research Project (MOEJ)

- AIM team has conducted Asia Low Carbon Research Project which is supported by MOEJ.
- The project aims to support developing LCS plans and designing policy instruments to enhance mitigation actions in target regions through collaborative works with Asian researchers and policy makers.



Steps to develop LCS scenarios

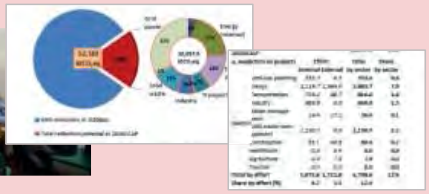
- Components of activities of LCSR project are shown below. Scope and target area of the activities vary year by year.

1 Relation building

a. Find counterparts
b. Relation building
⇐ **Dialogues, WS**

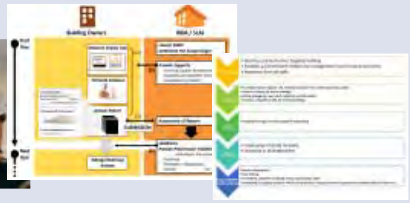

2 Develop LCS plan

a. CB of researchers
b. Quantitative analysis
⇐ **Training, collaboration**

2+ Design program

a. CB of policy makers
b. Design practical program
⇐ **Training, collaboration**

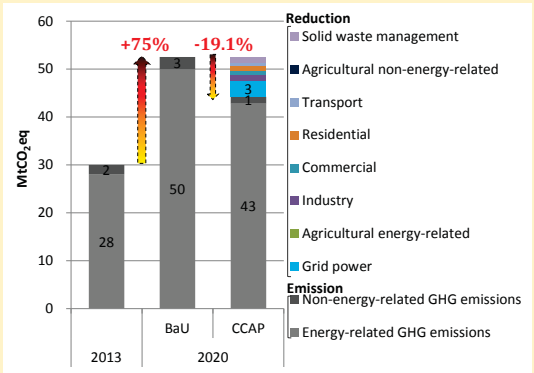
3 Policy dialogue

a. Input to local authorities
b. Appeal to various parties
⇐ **International events**

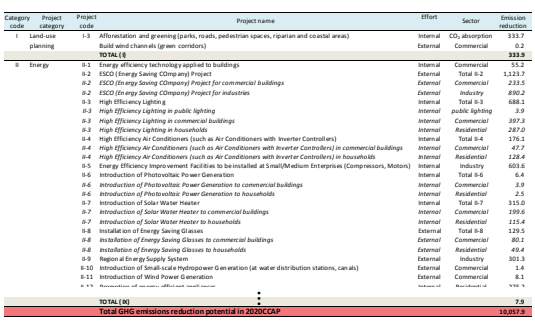

LCS Studies in Vietnamese Cities

- AIM has supported to develop LCS plans in Ho Chi Minh, Da Nang and Hai Phong cities. GHG reduction potential and possible countermeasures towards 2030 are identified based on quantitative analysis by AIM/ExSS.
- LCS plans were developed through collaborative works and discussions with counterparts.

GHG Emission & Reduction



GHG Reduction by Projects

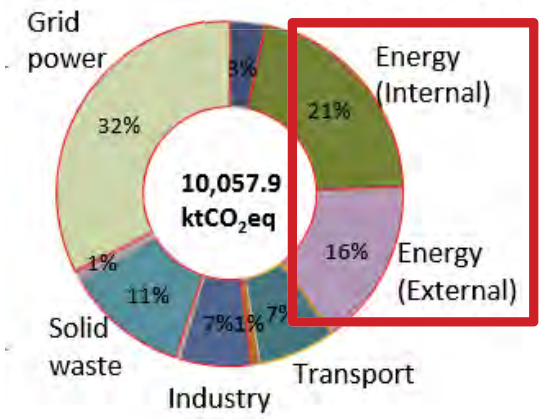


Category code	Project category	Project code	Project name	Effort	Sector	Emission reduction
I	Land-use planning	I-3	Afforestation and greening (parks, roads, pedestrian spaces, riparian and coastal areas)	Internal	CO_2 absorption	333.7
			Build wind channels (green corridors)	External	Commercial	0.2
			TOTAL (I)			333.9
II	Energy	II-1	Energy efficiency technology applied to buildings	Internal	Commercial	55.2
		II-2	ESCO (Energy Saving COmpany) Project	External	Total II-2	1,123.7
		II-2	*ESCO (En ergy Saving COmpany) Project for commercial buildings*	External	Commercial	233.5
		II-2	*ESCO (En ergy Saving COmpany) Project for industries*	External	Industry	890.2
		II-3	High Efficiency Lighting	Internal	Total II-3	688.1
		II-3	*High Efficiency Lighting in public lighting*	Internal	public lighting	3.9
		II-3	*High Efficiency Lighting in commercial buildings*	Internal	Commercial	397.3
		II-3	*High efficiency Lighting in households*	Internal	Residential	287.0
		II-4	High Efficiency Air Conditioners (such as Air Conditioners with Inverter Controllers)	Internal	Total II-4	176.1
		II-4	*High Efficiency Air Conditioners (such as Air Conditioners with Inverter Controllers) in commercial buildings*	Internal	Commercial	47.7
		II-4	*High Efficiency Air Conditioners (such as Air Conditioners with Inverter Controllers) in households*	Internal	Residential	128.4
		II-5	Energy Efficiency Improvement Facilities to be installed at Small/Medium Enterprises (Compressors, Motors)	Internal	Industry	603.6
		II-6	Introduction of Photovoltaic Power Generation	Internal	Total II-6	6.4
		II-6	*Introduction of Photovoltaic Power Generation to commercial buildings*	Internal	Commercial	3.9
		II-6	*Introduction of Photovoltaic Power Generation to households*	Internal	Residential	2.5
		II-7	Introduction of Solar Water Heater	Internal	Total II-7	315.0
		II-7	*Introduction of Solar Water Heater to commercial buildings*	Internal	Commercial	199.6
		II-7	*Introduction of Solar Water Heater to households*	Internal	Residential	115.4
		II-8	Installation of Energy Saving Glasses	External	Total II-8	129.5
		II-8	*Installation of Energy Saving Glasses to commercial buildings*	External	Commercial	80.1
		II-8	*Installation of Energy Saving Glasses to households*	External	Residential	49.4
		II-9	Region al Energy Supply System	External	Industry	301.3
		II-10	Introduction of Small-scale Hydropower Generation (at water distribution stations, canals)	External	Commercial	1.4
		II-11	Introduction of Wind Power Generation	External	Commercial	8.1
			TOTAL (II)			7.9
			Total GHG emissions reduction potential in 2020CCAP			10,057.3

Reduction Potential in HCMC

- HCMC already developed CCAP2016-2020 in which projects for mitigation are grouped into 10 fields.
- AIM team analyzed the reduction potential in project level through collaborative work with HCCB. According to the analysis, projects belonging to “Energy” filed have the largest reduction potential.

Reduction in “Energy”



The largest reduction potential exists in “Energy” field.

Reduction Potential in HCMC

- According to the analysis, ESCO and diffusion of energy efficient devices have large reductions.
- In order to realize actual reductions, a strategic approach is required to expand individual mitigation projects to whole city.

Project List in Field of "Energy"

Project code	Project Group	Sector	Reduction (ktCO2eq)
II-01	**Energy efficiency technology applied to buildings**	Commercial	**55.2**
II-02	**ESCO (Energy Saving COmpany) Project**		
	- for commercial buildings	Commercial	**233.5**
	- for industries	Industry	**890.2**
II-03	**High Efficiency Lighting**		
	- in public lighting	Commercial	**3.9**
	- in commercial buildings	Commercial	**397.3**
	- in households	Residential	**287.0**
II-04	**High Efficiency Air Conditioners (such as Air Conditioners with Inverter Controllers)**		
	- in commercial buildings	Commercial	**47.7**
	- in households	Residential	**128.4**
II-05	**Energy Efficiency Improvement Facilities to be installed at Small/Medium Enterprises**	Industry	**603.6**
II-06	Introduction of Photovoltaic Power Generation		
	- to commercial buildings	Commercial	3.9
	- to households	Residential	2.5
II-07	Introduction of Solar Water Heater		
	- to commercial buildings	Commercial	199.6
	- to households	Residential	115.4
II-08	Installation of Energy Saving Glasses		
	- to commercial buildings	Commercial	80.1
	- to households	Residential	49.4
II-09	Regional Energy Supply System	Industry	301.3
II-10	Introduction of Small-scale Hydropower Generation (at water distribution stations, canals)	Commercial	1.4
II-11	Introduction of Wind Power Generation	Commercial	8.1
II-12	Promotion of energy-efficient appliances	Residential	275.2
Grid	Improvement of generation efficiency, Reduction of transmission loss	Grid	3,259.3
		Total	6,943.0

Reduction by ESCO & Diffusion of Energy Efficient Devices

= 2,650 ktCO2

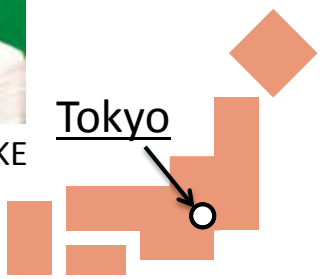
Strategic approach is required.

Mitigation Policies in Tokyo

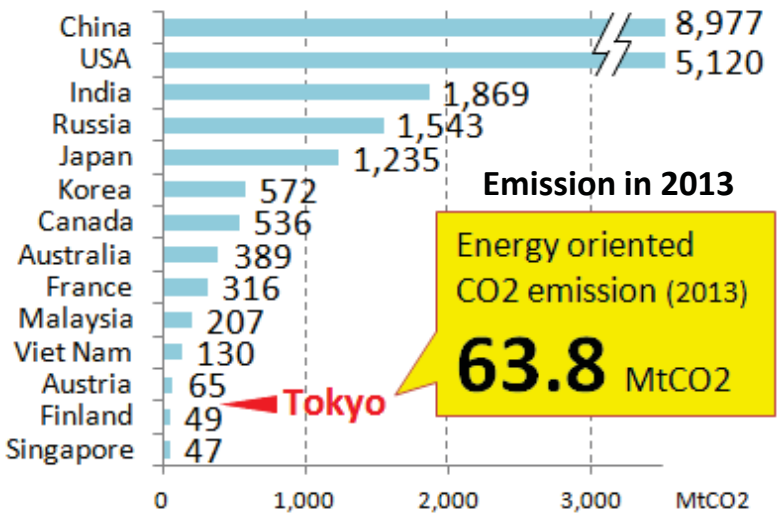
Overview of Tokyo

- Energy-oriented CO2 emission from Tokyo is around 64 MtCO2 in 2013, which corresponds to "a nation level" emission.
- Tokyo Metropolitan Government (TMG) has implemented various policy instruments to develop sustainable city in which both of energy saving and economic growth are realized.

Governor KOIKE



Population	14 million (6,200persons/km2)
Economy	GRDP: 0.8 trillion USD (20% of JP's GDP)



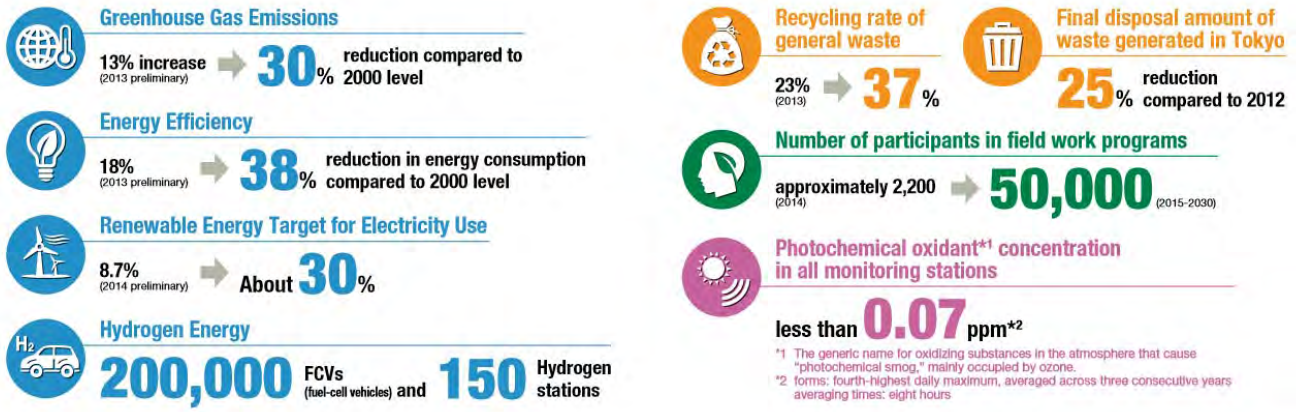
Source: IEA CO2 Emissions from Fuel Combustion [2015 Edition]

Climate Change Policy in Tokyo

- TMG determined the Environmental Master Plan that showcases the environmental policies to be implemented by 2030.
- Climate change policy is included in the Master Plan with quantitative target towards 2030.

Tokyo's Challenges declared in the Master Plan

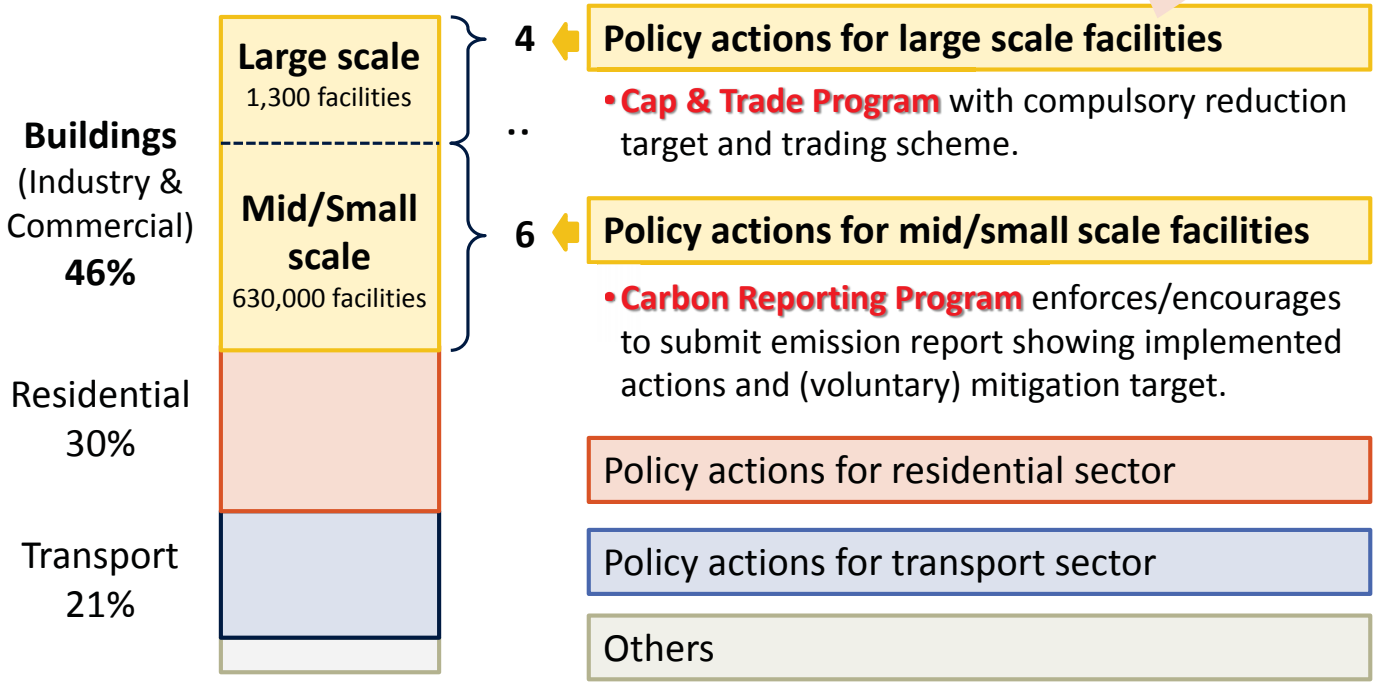
1. **Climate Change** and Urban Energy
2. Sustainable Materials and Waste Management
3. Clean and comfortable air, water, and soil
4. Urban Biodiversity and Greenery



Policies for Energy Saving in Building Sector

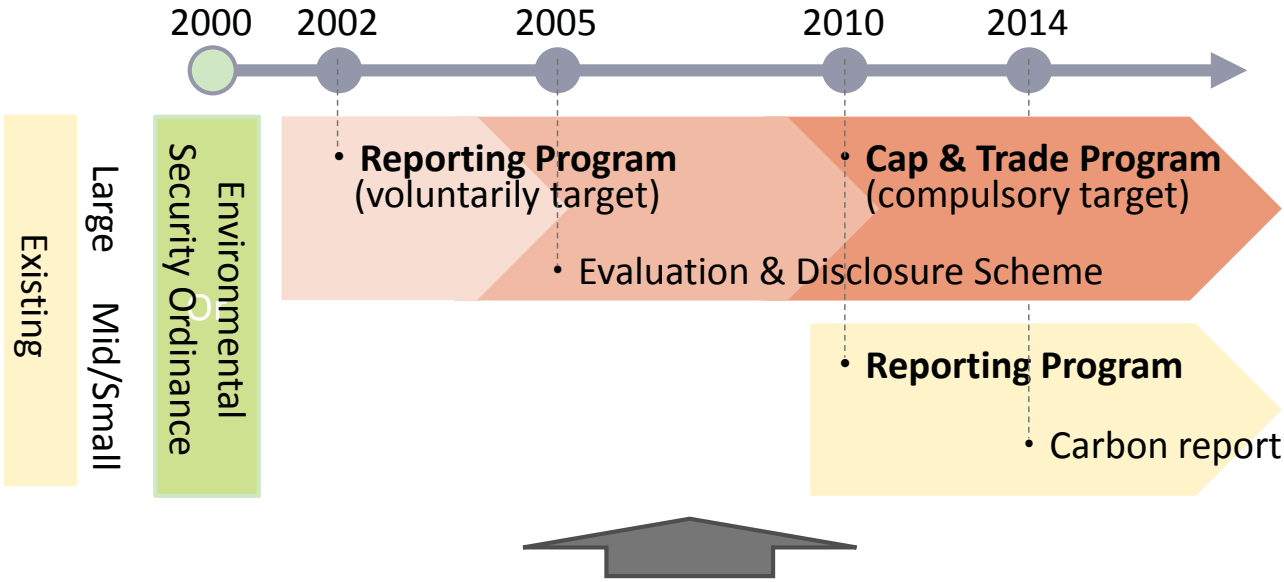
- Emission from building in industrial facilities and commercial sector covers half of Tokyo's emission.
- TMG implemented several policy actions to enhance mitigation activities in building sector.

CO2 Emission in Tokyo



Regulations for Saving Energy in Buildings

- TMG has gradually strengthened policy actions for building sector rafter enactment of the Environmental Security Ordinance in 2000.
- Introducing and implementing the actions have contributed to enhance capacity of TMG staffs and accumulation of data to enhance mitigation actions in Tokyo.



Implementation of those programs has enhanced capacity of TMG staffs and to accumulate data for taking mitigation actions

Impact of Reporting Program

Actual Reduction ← Identification of **countermeasures** enables to take mitigation actions and reduce emission.

Countermeasures ← Identification of **current status** and considera-tion of **reduction target** enables to identify countermeasures to realize mitigation potential.

Current Status & Reduction Target ← **Monitoring** enables to indentify current status of CO2 emission and mitigation potential, which contributes to consider emission reduction.

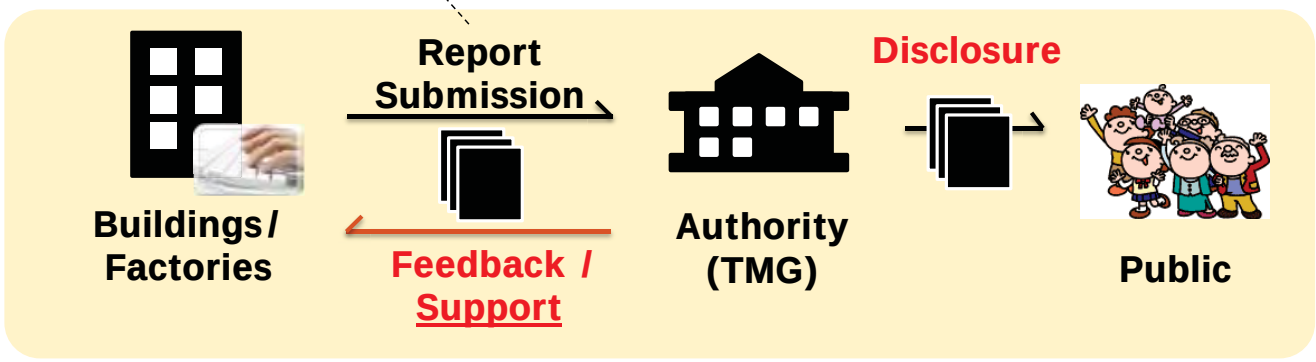
Monitoring ← **Reporting Program** enforces or encourages buildings owners and users to monitor CO2 emission.

Reporting Pg

Carbon Reporting Program in Tokyo

- TMG has operated the reporting program which encourages facilities (enforces large consumers) to monitor and report energy use, CO2 emission and mitigation actions which they take.
- Facilities which submit the report can receive feedbacks and supports to promote mitigation actions.

1. Energy Consumption and CO2 Emission in Previous FY
2. Mitigation Actions which are Taken in Previous FY



For example, free access to **energy saving assessment** services, providing **recommended actions**, tax break, preferential treatments, etc.

Free Access to Energy Saving Assessment

- Energy saving assessment enables to identify status of energy use and equipment and suggest measures to improve energy efficiency.
- TMG provides free access to energy saving assessment to enhance taking actions by mid/small scale facilities.

Experts visit facility.

Conduct an interview and on site inspection on energy consuming features.

Simple advices are provided on-site and detailed report including possible measures to save energy, its impact on utility cost reduction, information of subsidies, etc.

The report will be utilized by facilities to take actions.

Recommended Actions

- TMG identified 255 (recommended) actions from which buildings select actions they did and report TMG.
- Actions can be categorized into prioritized actions and others.

	Prioritized (Lv 1~3)	Others
Institutional Arrangement	Measures relating to institutional arrangement to tackle mitigation actions.	
Monitoring Energy Use	Monitoring consumption of electricity, gas, fuels, water and sewage to grasp CO2 emission.	
Operational Measures	Measures relating to improving operation of equipment without investment.	
Maintenance	Measures relating to maintaining performance of equipment and devices.	
Retrofit / Replacement	Retrofit/replacement requires large investment cost, however they have large impact on emission reduction.	

Example

Actions to improve operation of equipment
[Measure No. 51] Display lighting map

Benefits of Carbon Reporting Program

- The program provides building owners and/or users (tenants) an opportunity to understand the status of energy use and reduction potential, which contributes actual energy cost savings.
- Disclosure of energy performance contributes to obtain good reputation, which may invite (green) investment.

Buildings

1. Energy saving
- enables reduction of energy cost.

2. Good reputation
- contributes to invite green investment

3. Incentives
- tax break
- subsidy
- free access to consultation by experts

Local Authority

1. Green growth/Low carbon city
- contributes to achieve policy goal

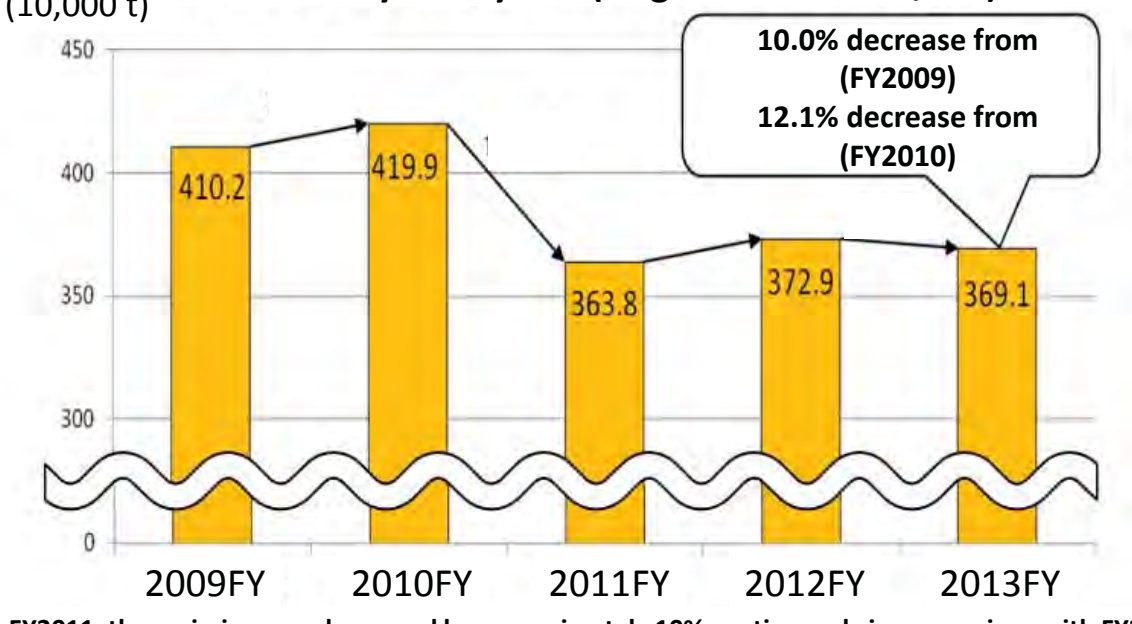
2. Good reputation
- contributes to invite green investment

3. Data accumulation
- energy use/GHG emission
- actions taken in jurisdiction
- other relating information

Impact of Carbon Reporting Program

- The reporting program contributed to reduce CO2 emission in 2013FY by 12% compared to 2010.

Total CO_2 emissions of facilities which have submitted the report continuously for 5 years (target facilities: 23,069)



After FY2011, the emission was decreased by approximately 10% continuously in comparison with FY2009.

* Calculated by fixing the electricity emission coefficient at 0.382t-CO_2/thousand kWh.

Analysis of Tokyo Carbon Reduction Reports
http://www8.kankyo.metro.tokyo.jp/ondanka/news/20150312/index.html

Activities for Knowledge Sharing

Case in Malaysia

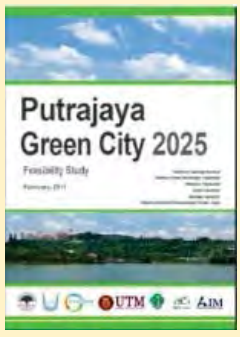
- AIM team has collaborated with local authorities in Malaysia (Putrajaya and Iskandar) to create LCS plans, and completed.
- Both of the cities are now moving on to implementation of the LCS plans to realize low carbon society.

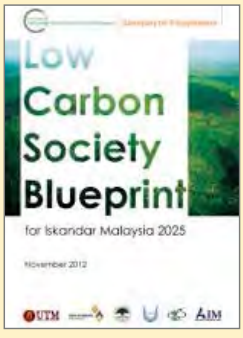
LCS Planning

through quantitative approach

GHG Emission & Reduction

LCS Policies & Actions





City level LCS Plans

COMPLETED!!

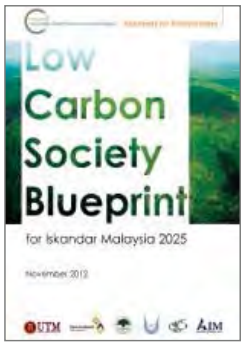
Next Stage

Implementation

Case in Malaysia

- For example, Iskandara Malaysia developed LCS plan which is approved by national government too.
- The plan includes description of development monitoring system.

LCS Blueprint IM 2025



12 actions
281 programs

	Action Names	Themes
1	Integrated Green Transportation	GREEN ECONOMY
2	Green Industry	
3	**Low Carbon Urban Governance**	
4	**Green Buildings & Construction**	
5	Green Energy System & Renewable Energy	
6	Low Carbon Lifestyle	GREEN COMMUNITY
7	Community Engagement & Consensus Building	
8	Walkable, Safe, Livable City Design	GREEN ENVIRONMENT
9	Smart Growth	
10	Green and Blue Infrastructure & Rural Resources	
11	Sustainable Waste Management	
12	Clean Air Environment	

The blueprint said that
*" An effective **monitoring, assessment and publication system** on the progress and achievement of carbon reduction targets and low carbon society is **indispensable** ".*

BEMRS

Case in Malaysia

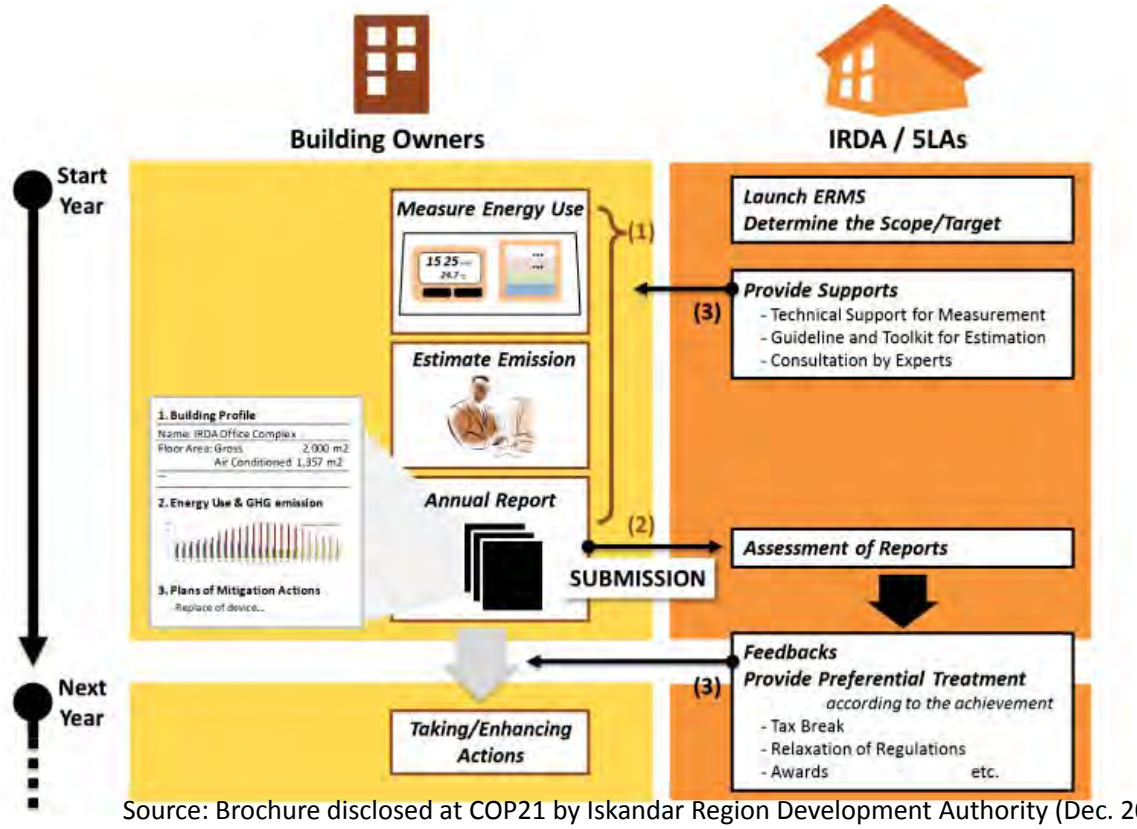
- AIM team has collaborated with both cities (Putrajaya and Iskandar) to design monitoring and reporting program since 2014.
- Trainings, workshops and intensive discussions among city staffs, TMG staffs and AIM experts have been conducted for many times.

2014	2015	2016	2017
Dialogues & training workshops for knowledge sharing	Draft new scheme & disclose it at COP21	Workshop for program design in details	Policy dialogue & collaborative works for program design in details

The scheme will be implemented from 2018FY

Case in Malaysia

- For example, Iskandar authority has drafted the Building Energy Monitoring and Reporting System: BEMRS by referring policy action implemented in Tokyo.



Source: Brochure disclosed at COP21 by Iskandar Region Development Authority (Dec. 2015)

Case in Malaysia

- Iskandar authority is now conducting energy audit program as pilot phase of BEMRS implementation.
- The program will be started in next year targeting governmental buildings.

Source: Presentation by Mr Boyd who is Head of Environment Office of IRDA at MoEJ (Jan. 2017)

Trial in HCMC in 2016

- Simplified training on TMG's reporting program was delivered in Ho Chi Minh City. City officers show interest in TMG's program.
- Some surveys on existing regulations in HCMC. It is revealed that regulations on energy saving exist in Vietnam, but strategy for utilizing existing framework may be required to be re-considered.

Possible Activities in Ho Chi Minh City

Possible Activities in HCMC

■ **Knowledge sharing on policy actions relating to mitigation**

- In this fiscal year (FY2017), AIM team would like to organize a 1-2 day(s) training course on TMG's policy actions, especially reporting program on energy use in buildings.
- The experiences in Tokyo will be shared with city staffs through lectures, exercise and discussions.
- Expected participants are city officers in charge of CCAP implementation in building sector.

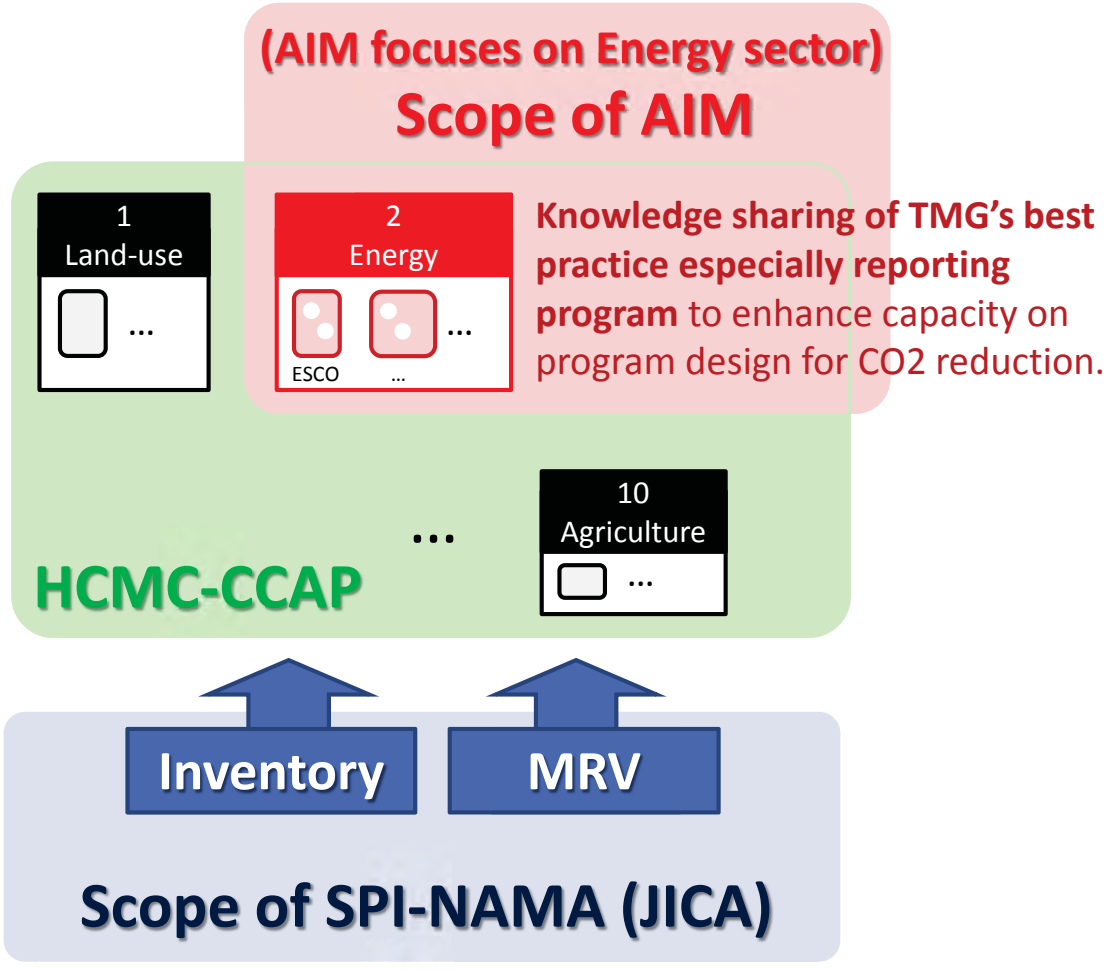
FY2017 (this activity is supported by MOEJ by MAR 2018)

- **Training course** for sharing information and experiences in Tokyo.
- Trial on **drafting possible practical programs** by referring case in Tokyo.

FY2018 ~ (if MOEJ continues the project after FY2017)

- **Complete program design** according to requirements in HCMC.
- **Preparatory activities to implement the program** actually in HCMC.

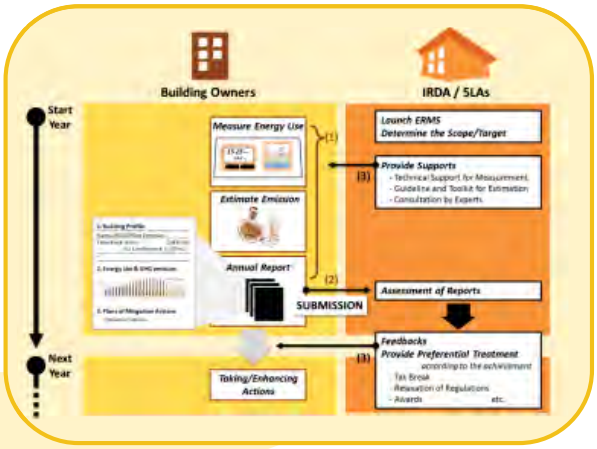
Scope of AIM activities



Expected Outcomes

Enhanced Capacity

Actual Practical Program

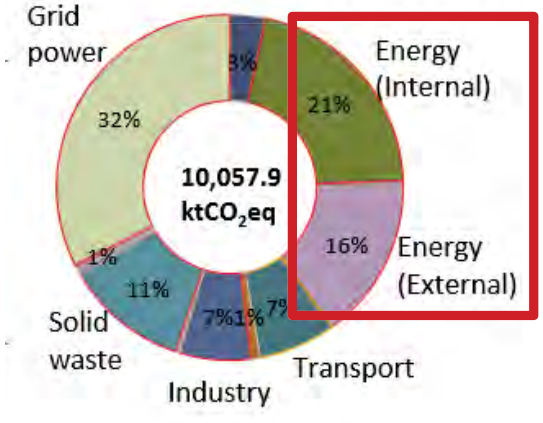


Practical program designed and implemented by trained city staffs enables to reduce CO2 emission in HCMC, which contributes Vietnam's NDC.

LCS Study in HCMC (again)

- HCMC already developed CCAP2016-2020 in which projects for mitigation are grouped into 10 fields.
- AIM team analyzed the reduction potential in project level through collaborative work with HCCB. According to the analysis, projects belonging to "Energy" filed have the largest reduction potential.

Reduction in "Energy"



The largest reduction potential exists in "Energy" field.

LCS Study in HCMC (again)

- According to the analysis, ESCO and diffusion of energy efficient devices have large reductions.
- In order to realize actual reductions, a strategic approach is required to expand individual mitigation projects to whole city.

Project List in Field of "Energy"

Project code	Project Group	Sector	Reduction (ktCO2eq)
II-01	**Energy efficiency technology applied to buildings**	Commercial	**55.2**
II-02	**ESCO (Energy Saving COmpany) Project**		
	- for commercial buildings	Commercial	**233.5**
	- for industries	Industry	**890.2**
II-03	**High Efficiency Lighting**		
	- in public lighting	Commercial	**3.9**
	- in commercial buildings	Commercial	**397.3**
	- in households	Residential	**287.0**
II-04	**High Efficiency Air Conditioners (such as Air Conditioners with Inverter Controllers)**		
	- in commercial buildings	Commercial	**47.7**
	- in households	Residential	**128.4**
II-05	**Energy Efficiency Improvement Facilities to be installed at Small/Medium Enterprises**	Industry	**603.6**
II-06	Introduction of Photovoltaic Power Generation		
	- to commercial buildings	Commercial	3.9
	- to households	Residential	2.5
II-07	Introduction of Solar Water Heater		
	- to commercial buildings	Commercial	199.6
	- to households	Residential	115.4
II-08	Installation of Energy Saving Glasses		
	- to commercial buildings	Commercial	80.1
	- to households	Residential	49.4
II-09	Regional Energy Supply System	Industry	301.3
II-10	Introduction of Small-scale Hydropower Generation (at water distribution stations, canals)	Commercial	1.4
II-11	Introduction of Wind Power Generation	Commercial	8.1
II-12	Promotion of energy-efficient appliances	Residential	275.2
Grid	Improvement of generation efficiency, Reduction of transmission loss	Grid	3,259.3
		Total	6,943.0

Reduction by ESCO & Diffusion of Energy Efficient Devices

= 2,650 ktCO2

How to expand individual projects to whole city?

Impact of Reporting Program (again)

Actual Reduction ← Identification of **countermeasures** enables to take mitigation actions and reduce emission.

Countermeasures ← Identification of **current status** and considera-tion of **reduction target** enables to identify countermeasures to realize mitigation potential.

Current Status & Reduction Target ← **Monitoring** enables to indentify current status of CO2 emission and mitigation potential, which contributes to consider emission reduction.

Monitoring ← **Reporting Program** enforces or encourages buildings owners and users to monitor CO2 emission.

Reporting Pg

Xin cảm ơn!

Thank you for your attention!

PROJECT TO SUPPORT THE PLANNING AND IMPLEMMENTATION OF NAMA IN A MRV MANNER

(SPI-NAMA)

COMPOSITION IN HO CHI MINH CITY

ORIENTATION OF FOLLOW-UP ACTIVITIES AFTER THE PROJECT SPI-NAMA

HCMC , October 2017

CONTENTS

1. The main achievements of the project

- Results of GHG Inventory
- GHG Inventory Manual
- Manual for MRV
- Proposed policy framework for NAMA implementation.
- Capacity Building of CBCC, VC staff

2. The tasks of 2018

- Issuing GHG Inventory Manual and Manual for MRV
- GHG Inventory for 2016 and after every two years in even year (Guidelines are available from the People's Committee).
- Planning to implement Paris Agreement on Climate Change to 2030 (Applying for the City People's Committee).

3. The tasks up to 2020

- Develop regulation on GHG inventory and MRV *(depend on Decree of Government):* Expected to complete in 2019.
- Implement MRV pilot projects
  - 7 projects of 3 sectors have been implemented in SPI-NAMA *(Energy 2 projects , Transportation 3 projects, Waste 2 projects).*
  - Collaborative projects with Osaka *(if possible)*: Frequency converter project and Solar power project
  - Other projects in CCAP 2017-2020, in Implementation plan of Green Growth Program, Implementation plan of Paris Agreement to 2030

MRV for cooperation projects with Japanese partners in the period of 2018-2020

3. The tasks up to 2020

- Proposed policies to support NAMA and development of carbon market: Proposed cooperation with Tokyo
- Continue marketing communication activities in the country
  - Documentation
  - Media
  - Training course, seminar
- Capacity Building: Proposed cooperation with JICA, C40, Tokyo, Osaka.
- Proposed data collection process *(process, time , form, additional data survey, provision, publish data on each sector)*

Study of Tokyo Model

Proposed contents:

- Identifying target group (key enterprises using energy, commercial buildings, etc.…)
- Encouraging each group to report the current state of energy use
- Looking for support to carry out appropriate mitigation activities for enterprises
- Reviewing, evaluating

3. Proposed plan to 2020

	GHG Inventory		MRV	
Time	Contents	Responsible organization	Contents	Responsible organization
2018	GHG inventory of HCMC 2016	DONRE	Choose projects and mitigation activities for MRV pilots	Main Units in MRV process
	Plan and approve the regulation of GHG inventory in HCMC	DONRE	Plan and approve the regulation of MRV process for mitigation activities	DONRE
2019	Evaluation of GHG inventory 2016 to improve the process and methodology	DONRE	Implement selected mitigation MRV pilot projects	Mitigation Implementing Entity
	Regulation on GHG inventory in HCMC	DONRE DOJ	Regulation on MRV process for mitigation activities in HCMC	DONRE DOJ
2020	GHG inventory in HCMC 2018	DONRE	Continue to implement MRV Pilot projects	Main Units in MRV process
	Issue regulation on GHG inventory in HCMC	HCMC People's Committee	Issue regulation on MRV process for mitigation activities in HCMC	HCMC People's Committee
2020-2030	GHG inventory every 2 years according to issued regulation	DONRE	Implement mitigation projects to MRV according to issued regulation	Main Units in MRV process

4. Orientation after 2020

- Standardizing the data collection process.
- Continuing to standardize GHG inventory process (update, addition).
- Continuing to standardize MRV process (update, addition).
- Developing, monitoring, reporting process procedures of Paris Agreement on climate change implementation
- Proposing the polices (if any)
- Sharing experience with other local

** Note : The above issues depend on the Decree of the Government.*

Thank you very much