

**SOCIALIST REPUBLIC OF VIET NAM
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT**

**THE INITIAL BIENNIAL UPDATED REPORT
OF VIET NAM TO THE UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE**



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THE INITIAL BIENNIAL UPDATED REPORT OF VIET NAM TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE



**VIET NAM PUBLISHING HOUSE OF NATURAL RESOURCES,
ENVIRONMENT AND CARTOGRAPHY**

TABLE OF CONTENTS

FOREWORD	10
EXECUTIVE SUMMARY	11
CHAPTER 1. NATIONAL CIRCUMSTANCES.....	18
1.1. Natural conditions.....	19
1.1.1. Geography	19
1.1.2. Climate conditions and climate change scenarios for Viet Nam.....	19
1.1.3. Water resources.....	20
1.1.4. Environment.....	21
1.2. Social and economic overview	21
1.2.1. Population.....	21
1.2.2. Agriculture	22
1.2.3. Forestry	23
1.2.4. Industry	24
1.2.5. Transportation	25
1.2.6. Energy.....	25
1.2.7. Economic growth	26
1.3. Sustainable development strategy.....	27
1.4. Institutional arrangement for development of Biennial Updated Reports and National Communications of Viet Nam	29
1.4.1. General information	29
1.4.2. Relevant legal documents.....	30
1.4.3. Organizational structure for development of BUR1	30
CHAPTER 2. 2010 NATIONAL GREENHOUSE GAS INVENTORY	32
2.1. Institutional arrangement for National GHG Inventory	32
2.2. Methodology, data source and emission factors	32
2.3. Quality control and quality assurance	34
2.4. Results of 2010 National GHG Inventory	34
2.4.1. Key emission/removal categories	34
2.4.2. GHG inventory by sector.....	36
2.4.3. Total emission sources and sinks in 2010	47
2.4.4. Comparison of GHG emissions in 1994, 2000 and 2010	50
2.5. GHG emission projections for 2020 and 2030.....	52
2.5.1. General information	52
2.5.2. GHG emission projections.....	56

CHAPTER 3. GREENHOUSE GAS EMISSION MITIGATION ACTIVITIES.....	60
3.1. NAMA preparation	60
3.1.1. General information	60
3.1.2. Development of NAMA proposals	61
3.1.3. MRV preparation.....	63
3.2. CDM Implementation	64
3.3. Implementation of JCM and other mechanisms	66
3.4. Development of GHG mitigation options.....	67
3.4.1. GHG mitigation options in energy sector.....	67
3.4.2. GHG mitigation options in agriculture sector.....	70
3.4.3. GHG mitigation options in LULUCF sector	71
CHAPTER 4. FINANCIAL, TECHNOLOGY AND CAPACITY NEEDS AND SUPPORT RECEIVED FOR CLIMATE CHANGE ACTIVITIES.....	73
4.1. Gaps and constraints.....	73
4.1.1. National GHG Inventory	73
4.1.2. NAMA.....	74
4.1.3. Application of climate change response technologies	74
4.2. Financial, technology and capacity needs	75
4.2.1. Financial needs.....	75
4.2.2. Technology needs	76
4.2.3. Capacity needs.....	77
4.3. Support received for climate change activities	78
AFTERWORD	78
REFERENCES.....	79
APPENDICES.....	82
Appendix I: Information on preparations for three NAMAs	82
Appendix II: List of Viet Nam's CDM Projects registered by the EB from October 2010.....	87

LIST OF TABLES

Table 1.1. Temperature increase and rainfall change in the past 50 years in Viet Nam	20
Table 1.2. Some characteristics of Viet Nam's population.....	21
Table 1.3. Planted area and production of cereals	22
Table 1.4. Planted area of some industrial crops.....	22
Table 1.5. Production of some industrial crops	22
Table 1.6. Number of cattle and poultry	23
Table 1.7. Area, production and gross output of fishing.....	23
Table 1.8. Area of forest in Viet Nam in the period of 2008-2012.....	24
Table 1.9. Gross output of forestry at constant 2010 prices by kinds of activity	24
Table 1.10. Gross output of industry at constant 2010 prices by types of ownership.....	24
Table 1.11. Number of passengers carried by types of transport	25
Table 1.12. Volume of goods carried by types of transport	25
Table 1.13. Total end-use energy consumption by types of fuel.....	26
Table 1.14. GDP at constant 2010 prices by economic sector.....	26
Table 1.15. Exports and imports of goods.....	27
Table 2.1. Description of methods and data source	33
Table 2.2. Results of key category analysis excluding LULUCF.....	34
Table 2.3. Results of key category analysis including LULUCF	35
Table 2.4. GHG emissions from fuel combustion in 2010	36
Table 2.5. GHG fugitive emissions in 2010.....	37
Table 2.6. 2010 GHG emissions in energy sector	37
Table 2.7. Irrigated rice area in 2010.....	39
Table 2.8. Number of cattle and poultry in 2010.....	39
Table 2.9. 2010 GHG emissions in agriculture sector.....	39
Table 2.10. Land use and land use change in 2010.....	41
Table 2.11. Forest area of eco-regions.....	42
Table 2.12. 2010 GHG emissions/removals in LULUCF sector	43
Table 2.13. Total volume of municipal solid waste processed in landfills	45
Table 2.14. Average waste composition.....	45
Table 2.15. Production, discharged wastewater volume and COD in wastewater of several important industries in 2010	45

Table 2.16. Amount of hazardous medical waste burned in incinerators.....	46
Table 2.17. 2010 GHG emissions in waste sector.....	46
Table 2.18. Summary of GHG emissions and removals in 2010.....	47
Table 2.19. Total GHG emissions in 1994, 2000 and 2010 by sector.....	50
Table 2.20. Total GHG emissions in 1994, 2000 and 2010 by gas	51
Table 2.21. End-use energy demand forecast to 2030 by types of fuel-energy.....	52
Table 2.22. End-use energy demand forecast to 2030 by sector.....	53
Table 2.23. GDP growth forecast.....	53
Table 2.24. GDP structure forecast at current prices.....	53
Table 2.25. Population growth forecast.....	53
Table 2.26. Area and production of major crops in 2010, 2020 and 2030	54
Table 2.27. Area of irrigated paddy cultivation by region in 2010, 2020 and 2030	54
Table 2.28. Number of cattle and poultry in 2010, 2020 and 2030	54
Table 2.29. Planning for forest and forest land for 2020 and projections for 2030.....	55
Table 2.30. Volume of solid waste processed in landfills in 2010 and projections for 2020 and 2030.....	56
Table 2.31. GHG emission projections for 2020 and 2030 in energy sector.....	56
Table 2.32. GHG emission projections for 2020 and 2030 in agriculture sector.....	57
Table 2.33. GHG emission/removal projections for 2020 and 2030 in LULUCF sector	57
Table 2.34. GHG emission projections for 2020 and 2030 in waste sector	58
Table 2.35. Total GHG emissions in 2010 and projections for 2020 and 2030	58
Table 3.1. Emission factors of national grid for 2008, 2010, 2011 and 2012	65
Table 3.2. Primary energy demand for the period of 2015 - 2030	68
Table 3.3. Potential and cost of GHG mitigation options in energy sector.....	70
Table 3.4. Agricultural production targets for 2010, 2020 and vision to 2030	71
Table 3.5. Potential and cost of GHG mitigation options in agriculture sector.....	71
Table 3.6. Potential and cost of GHG mitigation options in LULUCF sector	72
Table 4.1. Total investment to respond to climate change in Viet Nam (constant 2010 prices)	75
Table 4.2. Priority technologies for GHG mitigation by sector	76
Table 4.3. Priority technologies for adaptation by sector	77

LIST OF FIGURES

Figure 1.1. Institutional arrangement for BUR1 development.....	31
Figure 2.1. Institutional arrangements for 2010 National GHG Inventory	33
Figure 2.2. 2010 GHG emissions in energy sector	38
Figure 2.3. 2010 GHG emissions in agriculture sector.....	41
Figure 2.4. 2010 GHG emissions/removals in LULUCF sector	44
Figure 2.5. 2010 GHG emissions in waste sector.....	47
Figure 2.6. 2010 GHG emissions and removals by sector	49
Figure 2.7. Total GHG emissions in 1994, 2000 and 2010 by sector	50
Figure 2.8. Total GHG emissions including LULUCF in 1994, 2000 and 2010 by gas	51
Figure 2.9. Total GHG emissions in 2010 and projections for 2020 and 2030.....	59
Figure 2.10. Workshop on the 2010 National GHG Inventory.....	59
Figure 3.1. The Fourth Capacity-building Workshop on LCD and NAMAs in Ha Noi.....	62
Figure 3.2. Proposed institutional arrangement for national and sectoral MRV systems	64
Figure 3.3. Distribution of Viet Nam's registered CDM projects by sector	65
Figure 3.4. Photos of several CDM projects in Viet Nam	66

ABBREVIATIONS

AFD	French Development Agency
AusAID	Australian Agency for International Development
BAU	Business As Usual
BUR	Biennial Updated Report
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CIDA	Canadian International Development Agency
COD	Chemical Oxygen Demand
COMAP	Comprehensive Mitigation Assessment Process
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change
DANIDA	Danish International Development Agency
DFAT	Department of Foreign Affairs and Trade
DMHCC	Department of Meteorology, Hydrology and Climate Change
DNA	Designated National Authority
DTU	Technical University of Denmark
EB	Executive Board of the Clean Development Mechanism
FAO	Food and Agriculture Organization of the United Nations
FiT	Feed-in-Tariff
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
IMHEN	Institute of Meteorology, Hydrology and Climate Change
IPCC	Intergovernmental Panel on Climate Change
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
LCD	Low-Carbon Development
LEAP	Long-range Energy Alternatives Planning System
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land-Use Change and Forestry
MACC	Marginal Abatement Cost Curve
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transportation

MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NTFP	Non-Timber Forest Product
NTP-RCC	National Target Program to Respond to Climate Change
O&M	Operation & Maintenance
ODA	Official Development Assistance
OECC	Overseas Environmental Cooperation Center of Japan
PDD	Project Design Document
PPP	Public Private Partnership
PoA	Programme of Activities under the Clean Development Mechanism
QA/QC	Quality Assurance / Quality Control
REDF	Renewable Energy Development Fund
SP-RCC	Support Program to Respond to Climate Change
UNDP	United Nations Development Programme
UN-ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US\$	United States dollar
VEA	Viet Nam Environment Administration
VND	Viet Nam Dong
WB	The World Bank

CHEMICAL FORMULA

CH ₄	Methane
CO	Carbon monoxide
CO ₂	Carbon dioxide
HFCs	Hydro fluorocarbons
NO _x	Oxides of nitrogen
N ₂ O	Nitrous oxide
NH ₃	Ammonia
PFCs	Perfluorocarbons
SF ₆	Sulfur hexafluoride

UNIT

kg	Kilogram
mm	Millimeter
cm	Centimeter
m	Meter
km	Kilometer
m ²	Square meter
km ²	Square kilometer
m ³	Cubic meter
t	Tonne
tCO ₂	Tonne of CO ₂
tCO ₂ e	Tonne of CO ₂ equivalent
ktCO ₂ e	Thousand tonne of CO ₂ equivalent
TOE	Tonne of oil equivalent
KTOE	Thousand tonne of oil equivalent
W	Watt
kW	Kilowatt
kWh	Kilowatt-hour
MWh	Megawatt-hour
ha	Hectare
BTU	British thermal unit
°C	Degree Celsius
MW	Megawatt

FOREWORD

Climate change is happening in an unpredictable manner. Without timely responses, climate change presents as one of the most serious threats to humanity.

As one of the countries most affected by climate change, Viet Nam has been actively mobilizing national resources and international support to implement measures to cope with climate change and to develop a low-carbon economy aimed towards green growth and sustainability, and at the same time to contribute to the ultimate goal of the United Nations Framework Convention on Climate Change (UNFCCC) including the achievement of the objective of limiting global average temperature increase to less than 2°C by the end of this century.

In pursuant of Decision No.2/CP.17 dated March 15th, 2012 of the 17th Conference of the Parties to the UNFCCC, the Ministry of Natural Resources and Environment, the National Focal Point of the Government of Viet Nam to implement the UNFCCC and the Kyoto Protocol, the Standing Office of the National Climate Change Committee, in coordination with line ministries, has developed the Initial Biennial Updated Report of Viet Nam to submit to the UNFCCC in December 2014. The development of this Report contributes to carrying out Viet Nam's obligation as a developing Party to the UNFCCC and its commitment to the donors in implementing national priority climate change programs. The main contents of the Report include: National circumstances, 2010 national greenhouse gas inventory, Greenhouse gas emission mitigation activities, Financial, technology and capacity needs and support received for climate change activities in Viet Nam.

The Ministry of Natural Resources and Environment has the honour to present the Initial Biennial Updated Report of Viet Nam to the UNFCCC and requests central and local management agencies to take this as a reference in the process of planning and developing policies and programs to respond to climate change in Viet Nam.



Nguyen Minh Quang
Minister of Natural Resources and Environment

EXECUTIVE SUMMARY



In pursuant of Decision No.2/CP.17 dated March 15th, 2012 of the 17th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and in implementing Decision No.44/QĐ-TTg dated January 8th, 2014 of the Prime Minister, the Ministry of Natural Resources and Environment of Viet Nam, the National Focal Point of the Government of Viet Nam to implement UNFCCC and Kyoto Protocol, Standing Office of the National Climate Change Committee, in coordination with relevant ministries, has developed the Initial Biennial Updated Report of Viet Nam to the UNFCCC. The report consists of four chapters:

- Chapter 1: National circumstances
- Chapter 2: 2010 National greenhouse gas inventory
- Chapter 3: Greenhouse gas emission mitigation activities
- Chapter 4: Financial, technology and capacity needs and support received for climate change activities

NATIONAL CIRCUMSTANCES

Natural conditions

Geography

Viet Nam is situated in Southeast Asia and spans from latitudes 8°27' to 23°23' N, and longitudes 102°08' to 109°30' E. The country borders China to the north, Laos and Cambodia to the west, and the East Sea to the east, south, and southwest. Viet Nam has over one million km² of sea water and two major archipelagos, Hoang Sa and Truong Sa with over 3,000 islands, islets and reefs.

Viet Nam, with its S-shaped coastline, has a land area of approximately 331,051.4 km². Ha Noi is the capital, the centre of politics, culture, science and education.

Climate and climate change scenarios for Viet Nam

Viet Nam has a tropical monsoon climate. The highest annual mean temperature is 27.7°C and the lowest is 12.8°C. Average annual rainfall usually ranges from 1.400 to 2.400 mm.

According to "Climate change and sea level rise scenarios for Viet Nam" published in 2012, in the medium emission scenario, by the end of the 21st century, annual mean temperature would increase by from 2°C to 3°C; annual rainfall would increase by from 2% to 7%; and average sea level would rise by from 57 cm to 73 cm.

Water resources

Viet Nam has more than 2,360 rivers longer than 10 km, including 109 major rivers and 13 large river systems with an area of over 10,000 km². The total volume of surface water in river basins throughout the country is around 830-840 billion m³ per year. Total reserve of accessible underground water in Viet Nam is about 63 billion m³ per year.

Environment

Air, surface water and soil environments are contaminated. Protection of the environment and the response to climate change are given special attention. Many relevant policies and legal documents have been enacted and implemented.

Social and economic overview

Population

In 2010, Viet Nam's population was 86.93 million, average population density was 263 persons/km², population growth rate was 1.05%, and average life expectancy was 72.9.

Agriculture

The total area of agricultural land in 2010 was about 10.1 million ha, accounting for about 31% of total national land area, of which about 7.5 million ha was annual paddy crops. The production of paddy in 2010 reached 40 million tonnes and in 2012 increased to nearly 44 million tonnes. Paddy and maize production not only meets national demand for food consumption and food security but a major part of the excess production also contributes to export.

Forestry

The total national forest area in 2010 was 13.4 million ha, equivalent to 39.5% of forest cover. By 2012, total forest area was nearly 13.9 million ha with forest cover proportion increased to 40.7%.

Industry

From 2009 to 2012, gross output of industry at constant 2010 prices by types of ownership increased.

Transportation

Despite its rapid growth in all aspects, the transportation sector has not met the increasing demands of the society. Road transport is the dominant mode of passenger and goods transportation, followed by waterway.

Energy

Viet Nam has been diversifying its energy sources, promoting energy saving and efficiency, and issuing policies to explore renewable energy with low emission. Total end-use energy consumption by types of fuel increased from 43,202 KTOE in 2008 to 47,873 KTOE in 2012.

Economic growth

During the period of 2008-2012, GDP at constant 2010 prices by economic sector increased gradually, reaching VND 1,923,749 billion in 2008 and VND 2,412,778 billion in 2012. GDP per capita was US\$ 1,168 in 2010 and increased to approximately US\$ 1,200 in 2012.

Sustainable Development Strategy

Sustainable development is required throughout the development process of the country. Viet Nam has made significant achievements in all three areas of sustainable development including socio-economic development and environmental protection. The poverty rate has decreased and the Human Development Index has improved over the years. From the position of a poor country, Viet Nam has thrived to achieve middle income status and has achieved a number of Millennium Development Goals.

2010 NATIONAL GREENHOUSE GAS INVENTORY

In 2010, the total greenhouse gas (GHG) emissions including Land Use, Land-Use Change and Forestry (LULUCF) sector in Viet Nam were 246.8 million tonnes of CO₂ equivalent and 266 million tonnes of CO₂ equivalent without LULUCF. GHG emissions from the energy sector accounted for the largest proportion of 53.05% of total GHG emissions without LULUCF sector, followed by the agriculture sector with 33.20%. GHG emissions from industrial processes and waste sectors were 7.97% and 5.78% respectively.

Summary of 2010 National GHG inventory

Unit: million tonnes of CO₂e

Sector	CO ₂	CH ₄	N ₂ O	Total	Percentage (%)
Energy	124.8	16.0	0.4	141.1	53.05
Industrial Processes	21.2	-	-	21.2	7.97
Agriculture	-	57.9	30.4	88.3	33.20
LULUCF	-20.3	1.0	0.1	-19.2	
Waste	0.07	13.4	1.8	15.4	5.78
Total Emissions (excluding LULUCF)	146.0	87.3	32.7	266.0	100.00
Total Emissions (including LULUCF)	125.7	88.3	32.8	246.8	

In the period of 1994-2010, total GHG emissions in Viet Nam (including LULUCF) increased from 103.8 to 246.8 million tonnes of CO₂ equivalent, including the energy sector with highest increase from 25.6 to 141.1 million tonnes of CO₂ equivalent, which was the largest emission sector in 2010.

Comparison of total GHG emissions in 1994, 2000 and 2010

Unit: million tonnes of CO₂e

Sector	1994	2000	2010
Energy	25.6	52.8	141.1
Industrial Processes	3.8	10.0	21.2
Agriculture	52.4	65.1	88.3
LULUCF	19.4	15.1	-19.2
Waste	2.6	7.9	15.4
Total	103.8	150.9	246.8

Total GHG emissions from energy, agriculture, LULUCF and waste sectors are projected at 466 million tonnes of CO₂ equivalent in 2020, increasing to 760.5 million tonnes of CO₂ equivalent in 2030. The energy sector is projected to remain the largest source of GHG emissions.

GHG emissions in 2010 and projections for 2020 and 2030

Unit: million tonnes of CO₂e

Sector	2010	2020	2030
Energy	141.1	381.1	648.5
Agriculture	88.3	100.8	109.3
LULUCF	-19.2	-42.5	-45.3
Waste	15.4	26.6	48.0
Total	225.6	466.0	760.5

GREENHOUSE GAS EMISSION MITIGATION ACTIVITIES

NAMA Preparation

The Department of Meteorology, Hydrology and Climate Change under the Ministry of Natural Resources and Environment is the National Focal Point for Nationally Appropriate Mitigation Action (NAMA) registration to the UNFCCC Secretariat.

Currently, an institutional arrangement for NAMAs in Viet Nam is under development. Some activities such as capacity building and technical assistance to develop baseline scenarios, mitigation scenarios, and Measurement, Reporting and Verification (MRV) systems are also being carried out.

Some NAMA proposals in energy, industry, construction, agriculture, forestry and waste sectors in Viet Nam have been developed but are still unable to access international support.

Within the project “Facilitating Implementation and Readiness for Mitigation”, two NAMAs are being developed for registration, including (i) Supporting program for wind power development in Viet Nam and (ii) NAMA on biogas for on-site power generation for medium/large pig farms. The Ministry of Industry and Trade has proposed the NAMA entitled “Fund for renewable energy development – Viet Nam GET FIT mechanism” submitted to NAMA Facility for support. Besides, several activities for preparing other NAMA proposals have also been initiated.

MRV preparation

Viet Nam has a plan to establish MRV systems at national and sectoral levels in the near future in order to meet the requirements of national GHG inventory and GHG emission management including development of country-specific emission factors.

CDM Implementation

As of June 2014, Viet Nam had 253 Clean Development Mechanism (CDM) projects, 11 Programmes of Activities under the CDM registered and 10,068,987 Certified Emission Reductions (CERs) issued by the Executive Board of the CDM. At the moment, Viet Nam is ranked 4th in the world for the number of registered CDM projects and 11th for the issued CERs. Total GHG emissions reduced by 253 CDM projects are about 137 million tonnes of CO₂ equivalent during the crediting period.

Implementation of JCM and other mechanisms

Viet Nam is in the process of negotiating with Japan to issue guidelines to implement the Joint Crediting Mechanism (JCM) soon in Viet Nam. The two sides have basically adopted technical guidelines for pilot JCM projects in the country. At this stage, 28 JCM projects (18 energy projects, four transport projects, three waste projects and three forestry projects) are in the feasibility study stage with total GHG emission reduction potential estimated at 10 million tonnes of CO₂ equivalent per year.

Apart from implementation of JCM projects, some enterprises in Viet Nam have participated in carbon crediting projects under the Verified Carbon Standard (VCS) and Gold Standard (GS) to trade on voluntary carbon markets. As of June 15th, 2014, Viet Nam has four projects registered under the GS and 15 projects under the VCS with 419,452 credits issued for these VCS projects.

Development of GHG mitigation options

Eleven mitigation options have been developed for GHG emission reduction in the three largest emission sectors, including six options in the energy sector, two in the agriculture sector and three in the LULUCF sector. Total GHG mitigation potential of the 11 options in these

three sectors is 1,040.9 million tonnes of CO₂ equivalent, of which the energy sector would contribute 237.3 million tonnes, the agriculture sector would contribute 10.8 million tonnes and the LULUCF sector would contribute 792.8 million tonnes.

The GHG mitigation cost is from US\$ -10.9 to 41.1/tCO₂e for the energy sector, from US\$ -59.1 to 76.3/tCO₂e for the agriculture sector and from US\$ 0.9 to 1.6/tCO₂e for the LULUCF sector.

FINANCIAL, TECHNOLOGY AND CAPACITY NEEDS AND SUPPORT RECEIVED FOR CLIMATE CHANGE ACTIVITIES

Financial needs

According to the Climate Public Expenditure and Institutional Review of Viet Nam carried out by the United Nations Development Programme, in recent years, the Government of Viet Nam has spent considerable funds, about 0.1% of GDP, for activities to respond to climate change. Development partners' support from Official Development Assistance to respond to climate change amounted to about 31%, most of which took the form of loans (about 97% in the period of 2004-2013).

Technology needs

Under the framework of the Project "Global Technology Needs Assessment" - First stage (completed in 2012) with financial and technical support from UNEP through UNEP-DTU Partnership (formerly UNEP Risoe Centre), Viet Nam has identified 10 priority technologies to mitigate GHG emissions in energy, agriculture and LULUCF; and 10 priority technologies to adapt to climate change in agriculture, LULUCF, water resources and coastal zone management.

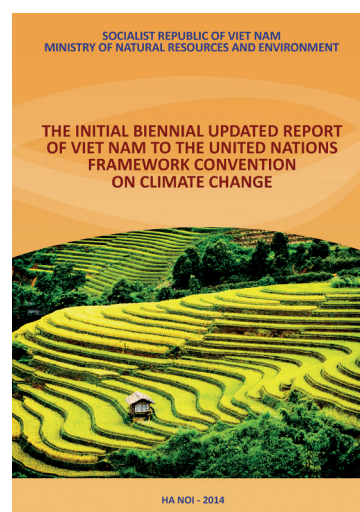
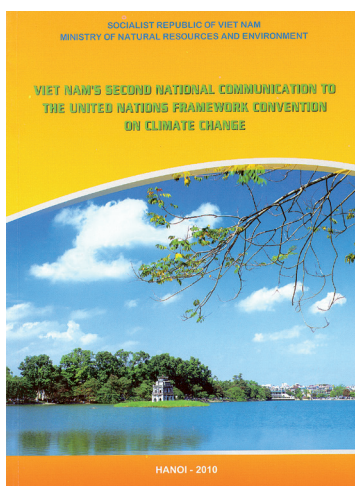
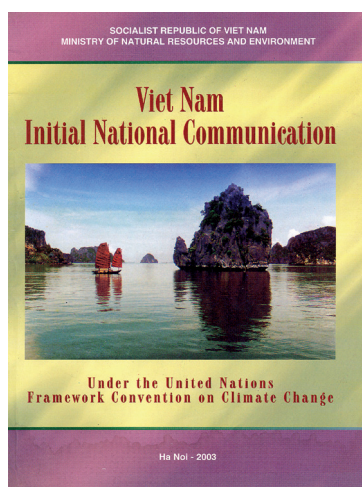
Capacity needs

- Supplementing and completing legal documents for implementation of the UNFCCC and response to climate change in the country to ensure comprehensive and consistent coordination from central to local authorities with participation of the whole society.
- Developing, updating and downscaling climate change scenarios as a basis for assessment of climate change impacts for developing and implementing action plans to respond to climate change at local level.
- Improving capacity and effectiveness of early warning and disaster prevention; research and application of modern technology for meteorological forecasts, warnings, and observations; assessment of water resources, climate resources, climate change and climate change impacts.
- Building capacity for officials who are focal points for climate change and NAMA, MRV, CDM and JCM at line ministries;
- Developing a database system that can be integrated into the General Statistics Office database to meet demands of GHG inventory, climate change response, and national periodic reports on climate change;
- Studying and developing country-specific emission factors for GHG inventory; improving capacity for measurement and quantification of GHG mitigation programs and projects at local and regional levels;
- Improving capacity to develop a low-carbon economy for local authorities at all levels as well as enterprises;
- Researching and developing several climate services and insurance systems.

Supports received for climate change activities

In the period of 2010-2014, the Support Program to Respond to Climate Change of Viet Nam has received more than US\$ 800 million.

The Project “Preparation of Viet Nam’s Initial Biennial Updated Report to UNFCCC” (BUR1) has been considered to receive support from the Global Environment Facility. However, in pursuant of Decision 2/CP.17 dated March 15th, 2012 of the 17th Conference of the Parties to the UNFCCC on submission of BUR1 by December 2014, Viet Nam has decided to develop BUR1 in 2014 using the national budget resources. The 2010 national GHG inventory in this report is one of the results of the Project “Capacity building for national greenhouse gas inventory in Viet Nam” funded by Japan International Cooperation Agency.



Viet Nam's National Communications and Initial Biennial Updated Report submitted to the UNFCCC

CHAPTER 1

NATIONAL CIRCUMSTANCES

THE SOCIALIST REPUBLIC OF VIET NAM



1.1. Natural conditions

1.1.1. Geography

Viet Nam is situated in Southeast Asia and spans from latitudes 8°27' to 23°23' N, and longitudes 102°08' to 109°30' E. The country borders China to the north, Laos and Cambodia to the west, and the East Sea to the east, south, and southwest. Viet Nam has over one million km² of sea water, two major archipelagos, Hoang Sa (Da Nang city) and Truong Sa (Khanh Hoa province), and over 3,000 islands, islets and reefs along the coastline.

Viet Nam, with its S-shaped coastline, extends 1,662 km from north to south with a land area of approximately 331,051.4 km². The territory measures 600 km from east to west at its widest and 50 km at its narrowest sections. Viet Nam has two major deltas, Mekong River Delta and Red River Delta.

Ha Noi is Viet Nam's capital, the centre of politics, culture, science and education with an area of 3,323.6 km² and a population of 6.844 million and population density of 2,059 persons/km² in 2012.

1.1.2. Climate conditions and climate change scenarios for Viet Nam

Climate

Viet Nam is situated at the South-eastern tip of the Eurasian continent and spans over 15 degrees of latitude within the northern hemisphere tropics, closer to the Tropic of Cancer than the Equator and features tropical monsoon climate. As Viet Nam territory spans many longitudes with diverse topography, the differences in climatic conditions between regions are significant.

The highest annual mean temperature is 27.7°C and the lowest is 12.8°C. Mean temperatures of the coolest month vary from 10°C to 16°C in the northern highlands, and from 20°C to 24°C in the southern regions. Summer mean temperatures vary between 25°C and 30°C.

Annual average rainfall varies between regions, ranging from 600 to 5,000 mm, usually from 1,400 to 2,400 mm with 80 to 90% occurring during the rainy season. In Viet Nam, there are from 60 to 200 rainy days each year, differentiated amongst regions.

Solar radiation is an important resource in Viet Nam. The total average solar radiation is about 5 kWh/m²/day in the Southern and Central provinces, and about 4 kWh/m²/day in the Northern provinces. Annual average total sunshine duration is about 1,700 to 2,500 hours, decreasing from the south to the north, from the islands to the mainland and from low to high mountainous areas.

Annual mean relative humidity is generally between 80% and 85%. Annual variability of relative humidity is highly influenced by rainfall regimes.

Climate change scenarios for Viet Nam

During the past 50 years in Viet Nam, the annual mean temperature increased by about 0.5°C over the country while the annual rainfall decreased in the north and increased in the south of Viet Nam. Sea level has risen by more than 20 cm. Table 1.1 shows temperature increase and rainfall change in the past 50 years in Viet Nam.

In recent years, climate change-induced natural disasters, especially typhoons, floods and droughts are increasing in intensity and frequency, causing heavy losses of life and damages to the national economy. On average, six to eight typhoons and tropical cyclones strike the country directly every year. The number of intense typhoons is increasing. Landing area of typhoons and tropical cyclones tends to shift towards the south and typhoon season tends to end later. Typhoon tracks are becoming more complex and abnormal. Drought tends to increase differently amongst climate regions. Extreme weather events are more common. Heat waves are increasing significantly in many regions of the country, particularly in the Central and the South.

Table 1.1. Temperature increase and rainfall change in the past 50 years in Viet Nam

Climate region	Temperature (°C)			Rainfall change (%)		
	Jan	Jul	Year	Nov – Apr	May – Oct	Year
Northwest	1.4	0.5	0.5	6	-6	-2
Northeast	1.5	0.3	0.6	0	-9	-7
North Delta	1.4	0.5	0.6	0	-13	-11
North Central	1.3	0.5	0.5	4	-5	-3
South Central	0.6	0.5	0.3	20	20	20
Central Highlands	0.9	0.4	0.6	19	9	11
South	0.8	0.4	0.6	27	6	9

Source: Climate change and sea level rise scenarios for Viet Nam, Ministry of Natural Resources and Environment, 2012

According to “Climate change and sea level rise scenarios for Viet Nam” published in 2012, under the medium emission scenario, by the end of the 21st century:

- The annual mean temperature is projected to increase by from 2°C to 3°C over large parts of the country. The average minimum temperature would increase by from 2.2°C to 3°C; the average maximum temperature would increase by from 2°C to 3.2°C. The number of days with maximum temperature over 35°C would increase by from 15 to 30 days over most of the country.

- The annual rainfall would increase in most climate regions by from 2% to 7%. The rainfall would decrease in the dry season and increase in the rainy season. The maximum daily rainfall compared to that of the period of 1980-1999 would increase in the North and the North Central and decrease in the South Central, the Central Highlands and the South. However, different areas would have abnormal rainy days with doubled rainfall compared to the current record.

- The average sea level along Viet Nam coast is projected to rise by between 57 cm and 73 cm; the highest would occur in regions from Ca Mau to Kien Giang (62 cm to 82 cm) while the lowest would occur in regions from Mong Cai to Hon Dau (49 cm to 64 cm).

1.1.3. Water resources

Viet Nam has a dense river network with more than 2,360 rivers longer than 10 km with frequently running water, including 109 major rivers and 13 large river systems with an area of over 10,000 km².

According to 2012 statistics, the total amount of surface water in river basins throughout the country is around 830-840 billion m³/year, but only about 310-315 billion m³ (37%) is formed in the territory of Viet Nam; the remaining 520-525 billion m³ (63%) comes from neighboring countries.

Total reserve of accessible underground water in Viet Nam is about 63 billion m³ per year, mainly concentrated in Red River Delta and Mekong River Delta.

As a result of climate change, river flows, evaporation and groundwater level have changed. In the last five years, decreases in the dry season surface water led to water shortages and drought in river basin downstream, hydropower reservoirs and irrigation systems. At some sections of the Red River and Thao River, riverbeds were exposed as water levels dropped too low.

1.1.4. Environment

Socio-economic development, industrialization, urbanization, population growth and climate change have all put great pressure on the environment and natural resources.

Air pollution in urban areas, industrial parks and processing zones is mainly caused by transportation, construction, industrial and residential activities and waste treatment.

Surface water is at risk of organic pollution and quality degradation. The major sources of surface water pollution are wastewater from agriculture, craft villages, industries, mining, residential areas and healthcare facilities. Groundwater quality is still in relatively good condition, meeting the requirements of water use but in some areas, groundwater is at risk of salinity intrusion. Groundwater for domestic water supply services accounted for the largest proportion of the total amount of groundwater exploited annually. The marine environment shows signs of pollution, especially in shallow waters that have been affected by marine operations, oil spills, aquaculture, industrial production and tourism development.

Soil environment is contaminated. In many areas in Viet Nam soils are degraded and polluted due to erosion, washout and salinity intrusion induced by sea-level rise. In addition, some of the land is affected by desertification.

Under such pressures, protection of the environment and response to climate change in Viet Nam has received great attention, as shown in the form of guidelines, policies and legal documents at central and local levels. Especially, on June 23rd, 2014, the National Assembly of the Socialist Republic of Viet Nam passed the Law on Environmental Protection No.55/2014/QH13, which will take effect on January 1st, 2015 (replacing the Law on Environmental Protection No. 52/2005/QH11), in which response to climate change has been integrated in the Law.

1.2. Social and economic overview

1.2.1. Population

Viet Nam is home to 54 ethnic groups; of these, the Kinh is the largest group, living throughout the territory, mainly in the deltas, near rivers and in urban areas. In 2010, the population of Viet Nam was 86.93 million, average population density was 263 persons/km², population growth rate was 1.05%, and average life expectancy was 72.9. Some characteristics of the population from 2008 to 2012 are shown in Table 1.2.

Table 1.2. Some characteristics of Viet Nam's population

Year	Total population (thousand persons)	Growth rate (%)	Gender (%)		Urban and rural areas (%)	
			Male	Female	Urban	Rural
2008	85,118.7	1.07	49.29	50.71	28.99	71.01
2009	86,025.0	1.06	49.43	50.57	29.74	70.26
2010	86,932.5	1.05	49.45	50.55	30.50	69.50
2011	87,840.0	1.04	49.45	50.55	31.56	68.44
2012	88,772.9	1.06	49.47	50.53	31.84	68.16

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

1.2.2. Agriculture

The total area of agricultural land in 2010 was about 10.1 million ha, accounting for about 31% of the total national land area, of which about 7.5 million ha was annual paddy crops.

The paddy production in 2010 reached 40 million tonnes, an increase of 1.05 million tonnes compared to 2009; and in 2012 reached 43.7 million tonnes, an increase of 1.3 million tonnes compared to 2011 due to increased cropping area and productivity. Paddy and maize production not only meets national demand for food consumption and food security; additionally a major part of the excess production also contributes to export (Table 1.3).

Table 1.3. Planted area and production of cereals

Year	Planted area (thousand ha)		Production (thousand tonnes)	
	Paddy	Maize	Paddy	Maize
2008	7,422.2	1,140.2	38,729.8	4,573.1
2009	7,437.2	1,089.2	38,950.2	4,371.7
2010	7,489.4	1,125.7	40,005.6	4,625.7
2011	7,655.4	1,121.3	42,398.5	4,835.6
2012	7,761.2	1,156.6	43,737.8	4,973.6

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

The plant production sector has been in line with domestic and international markets, focusing on improving product quality. Planted area and production of some industrial crops are tending to increase (Table 1.4 and Table 1.5).

Table 1.4. Planted area of some industrial crops

Unit: thousand ha

Year	Rubber	Coffee	Tea	Sugarcane	Soybean	Cashew	Peanut
2008	631.5	530.9	125.6	270.7	192.1	406.7	255.3
2009	677.7	538.5	127.1	265.6	147.0	391.4	245.0
2010	748.7	554.8	129.9	269.1	197.8	379.3	231.4
2011	801.6	586.2	127.8	282.2	181.1	363.7	223.8
2012	917.9	623.0	128.3	301.9	119.6	335.2	219.2

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

Table 1.5. Production of some industrial crops

Unit: thousand tonnes

Year	Rubber	Coffee	Tea	Sugarcane	Soybean	Cashew	Peanut
2008	660.0	1,055.8	746.2	16,145.5	267.6	308.5	530.2
2009	711.3	1,057.5	771.0	15,608.3	215.2	291.9	510.9
2010	751.7	1,100.5	834.6	16,161.7	298.6	310.5	487.2
2011	789.3	1,276.6	878.9	17,539.6	266.9	309.1	468.7
2012	877.1	1,269.4	909.8	19,015.4	173.5	312.5	468.5

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

Animal husbandry is developing towards large-scale industrial farming. In recent years, diseases, prolonged cold weather and disasters have seriously affected development of cattle and poultry sub-sectors (Table 1.6).

Table 1.6. Number of cattle and poultry

Year	Buffalo	Cow	Pig	Goat, sheep	Poultry
Thousand heads					Million heads
2008	2,897.7	6,337.7	26,701.6	1,483.4	248.3
2009	2,886.6	6,103.3	27,627.7	1,375.1	280.2
2010	2,877.0	5,808.3	27,373.3	3,288.4	300.5
2011	2,712.0	5,436.6	27,056.0	1,267.8	322.6
2012	2,627.8	5,194.2	26,494.0	1,343.6	308.5

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

The area of water surface under aquaculture shows a downward trend in recent years, but the total production and gross output of fishing are increasing (Table 1.7).

Table 1.7. Area, production and gross output of fishing

Year	Area of water surface for aquaculture (thousand ha)	Production of fishing (thousand tonnes)	Gross output of fishing at current prices by kinds of activity (VND billion)
2008	1,052.6	4,602.0	110,510.4
2009	1,044.7	4,870.3	122,666.0
2010	1,052.6	5,142.7	153,169.9
2011	1,040.5	5,447.4	205,866.4
2012	1,038.9	5,820.7	224,263.9

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

1.2.3. Forestry

The total national forest area in 2010 was 13,388,100 ha, equivalent to 39.5% of the land area in Viet Nam under forest cover. Specifically, the total area of natural forests was 10,304,800 ha and of plantation was 3,083,300 ha. In terms of forests classified by function, in 2010, the area of protection forest was 4,846,200 ha, special-use forest was 2,002,300 ha, production forest was 6,373,500 ha and forest areas outside forest land planning was 166,100 ha. In the period of 2008-2012, forest area and forest cover rate gradually increased (Table 1.8).

With effective implementation of forest fire prevention at local level, fire-affected forest area in the country has decreased. Accordingly, the area of fire-affected forest was 6,723 ha in 2010, dropped to about 1,745 ha in 2011 and to about 1,325 ha in 2012.

Table 1.8. Area of forest in Viet Nam in the period of 2008-2012*Unit: thousand ha*

Year	Total forest area	Of which		Forest cover (%)
		Natural forest	Plantation	
2008	13,118.8	10,348.6	2,770.2	38.7
2009	13,258.7	10,338.9	2,919.8	39.1
2010	13,388.1	10,304.8	3,083.3	39.5
2011	13,515.1	10,285.4	3,229.7	39.7
2012	13,862.0	10,423.8	3,438.2	40.7

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

The gross output of forestry at constant 2010 prices by kind of activity is gradually increasing. In particular, the total value increased from VND 17,202.3 billion in 2008 to VND 18,714.7 billion in 2010 and VND 21,136 billion in 2012 (Table 1.9).

Table 1.9. Gross output of forestry at constant 2010 prices by kinds of activity*Unit: VND billion*

Year	Total	Of which			
		Plantation and maintenance	Logging of timber and other forest products	Collection of non-timber and other forest products	Services
2008	17,202.3	2,526.4	12,823.0	898.3	954.6
2009	17,851.8	2,629.1	13,305.1	922.0	995.6
2010	18,714.7	2,711.1	14,011.8	936.2	1,055.6
2011	19,822.6	2,556.0	15,195.8	965.0	1,105.8
2012	21,136.0	2,380.1	16,604.1	998.0	1,153.8

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

1.2.4. Industry

The gross output of industry at constant 2010 prices, across most types of ownership, is gradually increasing (Table 1.10).

Table 1.10. Gross output of industry at constant 2010 prices by types of ownership*Unit: VND billion*

Year	Total	Index (previous year = 100) - %	Of which			
			State		Non-state	Foreign invested sector
			Central	Local		
2009	2,681,900.2	112.5	445,527.7	69,569.8	1,050,172.5	1,116,630.2
2010	2,963,499.7	110.5	497,407.4	69,700.6	1,150,867.3	1,245,524.4
2011	3,233,178.2	109.1	559,828.3	68,279.9	1,238,729.7	1,366,340.3
2012	3,516,651.7	108.8	617,098.7	67,160.1	1,329,276.3	1,503,116.6

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

1.2.5. Transportation

Despite its rapid growth in all aspects, transportation has not met the increasing demands of society. Road transport is the main means of transporting passengers and goods, followed by waterway. The total number of passengers and volume of goods is increasing year by year. The total number of passengers in 2008 was 1,793.5 million, increasing to 2,315.2 million in 2010 and 2,676.5 million in 2012 (Table 1.11). The total volume of goods carried in 2008 was 653.2 million tonnes, increasing to 800.9 million tonnes in 2010 and 961.1 million tonnes in 2012 (Table 1.12).

Table 1.11. Number of passengers carried by types of transport

Unit: million persons

Year	Total	Of which			
		Railway	Road	Waterway	Aviation
2008	1,793.5	11.3	1,629.0	143.0	10.2
2009	2,016.9	11.1	1,843.6	151.3	10.9
2010	2,315.2	11.2	2,132.3	157.5	14.2
2011	2,476.1	11.9	2,306.7	142.4	15.1
2012	2,676.5	12.2	2,504.3	145.0	15.0

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

Table 1.12. Volume of goods carried by types of transport

Unit: thousand tonnes

Year	Total	Of which				
		Railway	Road	River	Marine	Aviation
2008	653,235.3	8,481.1	455,898.4	133,027.9	55,696.5	131.4
2009	715,522.4	8,247.5	513,629.9	137,714.5	55,790.9	139.6
2010	800,886.0	7,861.5	587,014.2	144,227.0	61,593.2	190.1
2011	885,681.5	7,285.1	654,127.1	160,164.5	63,904.5	200.3
2012	961,128.4	6,952.1	717,905.7	174,385.4	61,694.2	191.0

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

1.2.6. Energy

In recent years, Viet Nam has been diversifying its energy sources, promoting energy saving and efficiency, and issuing policies to explore renewable energy with low emission. Viet Nam has promulgated and implemented the Law on Energy Efficiency and Conservation, the National Target Program on Energy Efficiency and Conservation, the National Power Development Plan for the period of 2011-2020 with the vision to 2030 and the National Technical Regulation on Energy Efficiency Buildings.

Total end-use energy consumption in Viet Nam increased from 43,202 KTOE in 2008 to 47,873 KTOE in 2012. The trend of end-use energy consumption by types of fuel in the period of 2008-2012 is presented in Table 1.13.

Table 1.13. Total end-use energy consumption by types of fuel*Unit: KTOE*

Fuel type	2008	2009	2010	2011	2012
Coal	8,289	8,966	9,893	9,647	8,390
Petroleum	13,819	15,851	17,080	15,297	14,896
Gas	540	639	493	894	1,438
Electricity	5,844	6,615	7,461	8,140	9,063
Non-commercial energy	14,710	14,704	13,875	13,938	14,086
Total	43,202	46,775	48,802	47,916	47,873

*Source: National Power Development Plan VII, 2011
National Target Program on Energy Efficiency and Conservation, 2013*

In mountainous areas, residents mainly use biomass sources such as wood, agricultural residues, rice husk and partly biogas, which account for 80% of energy consumption in these areas. To reduce logging activities in natural forests, the Government has been promoting development and use of energy from biogas. Power produced from renewable energy sources is being connected to the national grid to supplement power supply.

1.2.7. Economic growth

GDP in 2008, 2009, 2010, 2011 and 2012 at constant 2010 prices within three economic sectors – the agriculture, forestry and fishing sector, the industry and construction sector and the services sector – increased gradually (Table 1.14).

Table 1.14. GDP at constant 2010 prices by economic sector*Unit: VND billion*

Year	Total	Of which		
		Agriculture, Forestry and Fishing	Industry and Construction	Services
2008	1,923,749	387,262	726,329	810,158
2009	2,027,591	394,658	769,733	863,200
2010	2,157,828	407,647	824,904	925,277
2011	2,292,483	424,047	879,994	988,442
2012	2,412,778	435,414	930,593	1,046,771

Source: Statistical Yearbook 2011, 2012, the General Statistics Office, 2012, 2013

Export turnover in 2010 reached US\$ 72,236.7 million, increasing to US\$ 114,529.2 million in 2012 while import turnover in 2010 reached US\$ 84,838.6 million and US\$ 113,780.4 million in 2012. Trade surplus reached US\$ 748.8 million in 2012; this was the first time Viet Nam had experienced a surplus in trade since 1993 (Table 1.15).

Table 1.15. Exports and imports of goods

Unit: US\$ million

Year	Total	Of which		
		Exports	Imports	Balance
2008	143,398.9	62,685.1	80,713.8	-18,028.7
2009	127,045.1	57,096.3	69,948.8	-12,852.5
2010	157,075.3	72,236.7	84,838.6	-12,601.9
2011	203,655.5	96,905.7	106,749.8	-9,844.1
2012	228,309.6	114,529.2	113,780.4	748.8

Source: Statistical Yearbook 2012, the General Statistics Office, 2013

GDP per capita increased from US\$ 1,168 in 2010 to about US\$ 1,200 in 2012.

According to the Socio-Economic Development Strategy for 2011-2020, in 2020 Viet Nam will become an industrial country with modern orientation. The contribution of industry and services accounts for about 85% of GDP. The value of high-tech products and products applying advanced technology reaches approximately 45% of total GDP. The value of manufactured products accounts for approximately 40% of total industrial production value. Development of agriculture aims at modern, efficient and sustainable orientation.

1.3. Sustainable development strategy

Viet Nam has made great efforts in the formation and development of the institutional system in accordance with the requirements for sustainable development. Sustainable development has become the strategy and vision of the Party and the Government and has been integrated and reflected in various strategies, plans, programs and projects of ministries, economic sectors and localities for socio-economic development and environmental protection. Many related policies were promulgated to ensure sustainable development goals and the implementation of international agreements to which Viet Nam is a Party.

Viet Nam sustainable development viewpoints are mentioned in the socio-economic development strategy for the period of 2001-2010 and 2011-2020 and Directive No.36-CT/TW in 1998 of the Political Bureau on strengthening environmental protection in the period of industrialization and modernization. Agenda 21 of Viet Nam has been issued by the Government to ensure the country's sustainable development on the basis of close combination and balance between socio-economic development and environmental protection. On that basis, line ministries, sectors and localities develop their action plans to implement Agenda 21.

The Prime Minister issued Decision No.432/QĐ-TTg dated April 12th, 2012 approving the Sustainable Development Strategy in the period of 2011-2020. The Strategy states that humans are central to sustainable development; it further states that sustainable development is required throughout the development process of the country and shall be incorporated in a reasonable and harmonious way into the socio-economic development process and protection of natural resources and the environment to ensure social security.

The National Climate Change Strategy approved by the Prime Minister's Decision 2139/QĐ-TTg dated April 5th, 2011 identifies that responding to climate change in Viet Nam shall be associated with sustainable development towards a low-carbon economy, shall take advantage of opportunities to develop innovative thinking and shall enhance competitiveness and national strength.

The National Green Growth Strategy approved by the Prime Minister's Decision No.1393/QĐ-TTg dated September 25th, 2012 states that the strategy is to restructure and complete economic institutions towards greening the existing sectors and encouraging development of new economic sectors using efficiently energy and resources with high added values. Green growth, low-carbon economy, and enriching natural resources are to become the main thrust in developing a sustainable economy; reducing GHG emissions and increasing capacity to absorb greenhouse gases will gradually become mandatory targets and be the most important criterion in the socio-economic development progress.

The Law on Energy Efficiency and Conservation No.50/2010/QH12 passed by the National Assembly of the Socialist Republic of Viet Nam on June 17th, 2010 states that the principles of energy efficiency and conservation shall be consistent with the strategy and master plan for energy, energy security and environmental protection.

The Law on Environmental Protection No.55/2014/QH13 passed by the National Assembly of the Socialist Republic of Viet Nam on June 23rd, 2014 emphasizes that environmental protection shall be associated with economic development, social security, ensuring children's rights and promoting gender balance, biodiversity conservation and responding to climate change to ensure that people are living in a welcoming environment. This new law added Chapter IV - Responding to climate change, which clearly defines the responsibilities of ministries, ministerial-level agencies, People's Committees at all levels, organizations and individuals in integrating climate change response activities into strategies, planning, plans on socio-economic development, management of GHG emissions, management of substances that deplete the ozone layer, development of renewable energy, production and consumption of environmentally-friendly products, reuse and recycling of waste and recovery of energy from waste, development, transfer and application of science and technology and strengthening international cooperation to respond to climate change and to develop a low-carbon economy and green growth.

In recent years, Viet Nam has taken advantage of favourable opportunities to overcome many challenges and achieved many significant accomplishments in economic, social and environmental

sectors of sustainable development. In terms of economic development, Viet Nam is regarded by the international community as one of the developing countries that have made impressive achievements in economic reform, especially in poverty reduction. From the position of a poor country, Viet Nam has transformed to a middle-income country and has completed some Millennium Development Goals.

In terms of social development, poverty alleviation, population growth control, health care, living environmental improvement, education and training and job creation have all made remarkable achievements. Social security is focused to ensure stable living environments, social welfare and production, especially when there are high inflation rates, natural disasters and adverse impacts of climate change. The unemployment rate within the working age group declined from 4.6% in 2009 to 3.2% in 2012. The national poverty rate also fell sharply and was only 11.1% in 2012. The indicator of gender equality in Viet Nam is quite high compared to other countries with similar levels of development and income. The Human Development Index has improved over the years.

As part of environmental protection, the prevention and control of pollution, GHG emission reduction and biodiversity conservation have all been promoted and have achieved encouraging results. The system of state management on environmental protection from central to local levels is gradually being consolidated and strengthened.

Viet Nam has actively integrated and participated in many international conventions and agreements related to sustainable development.

1.4. Institutional arrangement for development of Biennial Updated Reports and National Communications of Viet Nam

1.4.1. General information

The Government of Viet Nam assigns Ministry of Natural Resources and Environment (MONRE) as the focal agency of the Government, in collaboration with line ministries and agencies, to implement the UNFCCC and the Kyoto Protocol. The Department of Meteorology, Hydrology and Climate Change (DMHCC) under MONRE has the functions and mandates to advise and assist the Minister of MONRE on state management in the field of meteorology, hydrology, climate change and ozone layer protection.

MONRE, in cooperation with line ministries and agencies, has completed and submitted to the UNFCCC Secretariat the Initial National Communication (November, 2003), the Second National Communication (December, 2010) and is assigned to continue developing the Biennial Updated Reports (BURs) and National Communications to the UNFCCC in the future.

Currently, Viet Nam is working with the United Nations Environment Programme (UNEP) to develop the project document "Viet Nam: Preparation of the Third National Communication to the UNFCCC" (TNC). As planned, this project will be implemented in 36 months, commencing in 2015 and the TNC will be completed and submitted to the UNFCCC Secretariat in 2018.

1.4.2. Relevant legal documents

The legal documents related to the institutional arrangement to develop the BURs and National Communications are:

- Directive No.35/2005/CT-TTg dated October 17th, 2005 of the Prime Minister on implementation of the Kyoto Protocol of the UNFCCC, in which MONRE was assigned as the Focal Point of the Government of Viet Nam to participate in and implement the Kyoto Protocol of the UNFCCC;
- Decision No.47/2007/QD-TTg dated April 6th, 2007 of the Prime Minister approving the Plan for implementing the Kyoto Protocol of the UNFCCC, in which MONRE was assigned to establish the National Steering Committee for the UNFCCC and the Kyoto Protocol. DMHCC was assigned as the Standing Office of the Steering Committee and the CDM Designated National Authority;
- Decision No.43/QD-TTg dated January 9th, 2012 of the Prime Minister on establishment of the National Climate Change Committee chaired by the Prime Minister, in which MONRE was assigned as the Standing Office of the Committee;
- Decision No.1775/QD-TTg dated November 21st, 2012 of the Prime Minister approving the Plan of GHG emission management; management of carbon trading activities to the world market, in which MONRE is assigned to coordinate with line ministries and agencies to implement the Plan to establish national GHG inventory and measurement, reporting and verification (MRV) systems, to conduct national GHG inventories periodically and to develop a program framework for nationally appropriate mitigation actions (NAMAs) of Viet Nam;
- Decree No.21/2013/ND-CP dated March 4th, 2013 of the Government defining the functions, tasks, mandates and organizational structure of MONRE.

1.4.3. Organizational structure for development of BUR1

Basis

In pursuant of Decision No.2/CP.17 dated March 15th, 2012 of the 17th Conference of the Parties to the UNFCCC (COP 17), the non-Annex I countries of the UNFCCC are obliged to develop and submit biennial updated reports to the UNFCCC. The Initial Biennial Updated Report (BUR1) shall be submitted by December 2014.

In Decision No. 44/QD-TTg dated January 8th, 2014 of the Prime Minister approving the 2014 Policy Matrix of the Support Program to Respond to Climate Change, MONRE is assigned to coordinate with other relevant ministries and agencies to develop BUR1 of Viet Nam to the UNFCCC.

Implementing the BUR1 preparation plan as in Decision No.1112/QD-BTNMT dated June 12th, 2014 of MONRE, DMHCC is assigned to coordinate with relevant agencies to develop and complete BUR1 by late 2014.

Institutional arrangement

The National Steering Committee for the UNFCCC and the Kyoto Protocol comprising representatives of line ministries and agencies and relevant organizations develops and completes BUR1 of Viet Nam to the UNFCCC.

The DMHCC coordinates with other relevant agencies and organizations to carry out the following tasks:

- Identifying stakeholders involved in development of BUR1;
- Establishing technical working groups consisting of scientists, experts in relevant sectors and representatives from relevant ministries, agencies, research institutions and centers, governmental and non-governmental organizations;
- Preparing a work plan, organizing and coordinating development of BUR1;

During the process of developing BUR1 using national budget resources, DMHCC coordinates closely with other relevant agencies and organizations to ensure that BUR1 is developed in accordance with current regulations and submitted to the UNFCCC Secretariat by December 2014.

The institutional arrangement for development of BUR1 in Viet Nam is shown in Figure 1.1.

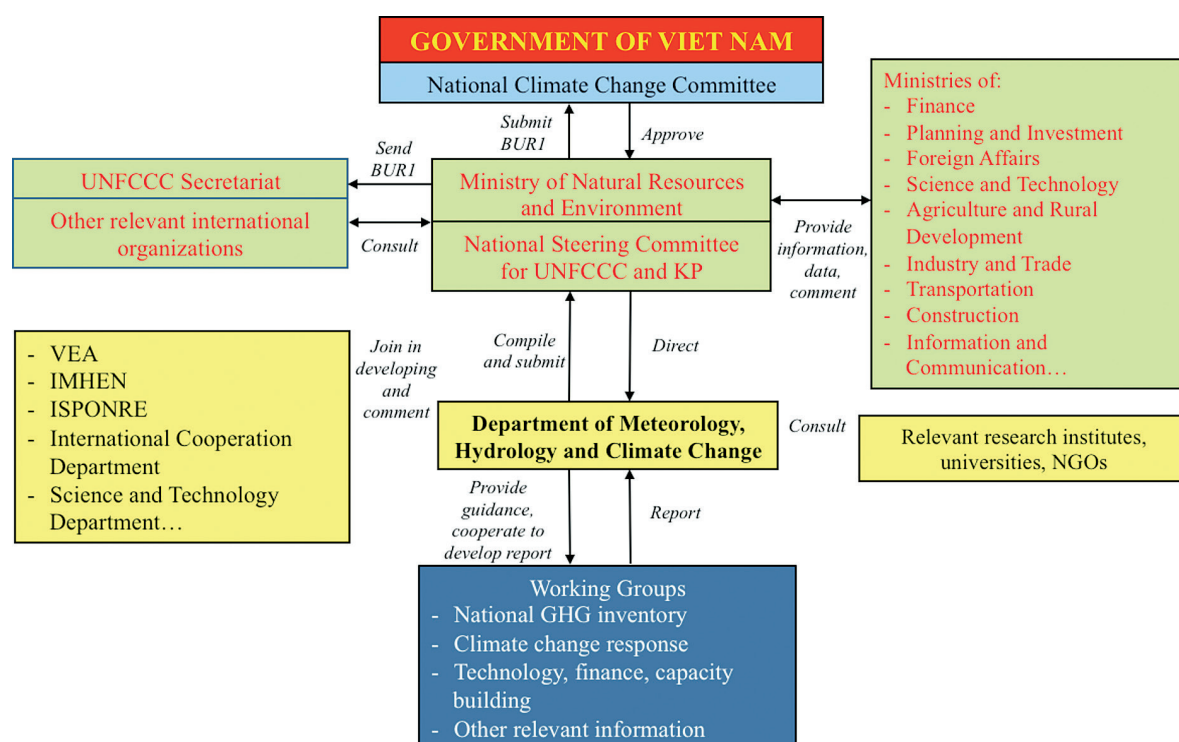


Figure 1.1. Institutional arrangement for BUR1 development

CHAPTER 2

2010 NATIONAL GREENHOUSE GAS INVENTORY

2.1. Institutional arrangement for National GHG Inventory

Currently, Viet Nam is doing research on establishment of a national GHG inventory system. It is expected that this system will be established and fully operational in 2016.

As one of the main activities of the project “Capacity Building for National Greenhouse Gas Inventory in Viet Nam” (2010-2014) funded by the Japan International Cooperation Agency (JICA), 2010 National GHG Inventory was conducted during 2013-2014. MONRE is the governing body of the project. DMHCC - the project implementing agency, in collaboration with other agencies and with assistance from JICA experts, conducts the inventory. The institutional arrangement for 2010 National GHG Inventory is presented in Figure 2.1.

To implement the inventory, DMHCC is responsible for general coordination and supervision.

The Institute of Meteorology, Hydrology and Climate Change (IMHEN) conducts GHG inventory for energy, industrial processes and land use and land use change and forestry (LULUCF) sectors; the Viet Nam Environment Administration (VEA) is responsible for agriculture and waste sectors. Two agencies coordinate with JICA experts to select and approve methodologies, carry out 2010 national GHG inventory and prepare the inventory reports for these sectors.

The Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE) is responsible for research and proposal to develop a national system for national GHG inventory and for recommending a quality control (QC) system for GHG inventory.

The Technical and Scientific Advisory Group of the project (TSAG) collaborates with JICA experts to provide technical advice to IMHEN and VEA during the process of implementing the GHG inventory, including QC for final inventory results.

National consultants collaborate with JICA short-term experts to collect activity data for GHG inventory.

2.2. Methodology, data source and emission factors

Methodologies for 2010 national GHG inventory are selected from the Guidelines of the Intergovernmental Panel on Climate Change (IPCC):

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories;
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000);
- Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF 2003).

Activity data are collected from government agencies such as the General Statistics Office, line ministries, departments and agencies of local governments. In case of lack of information, activity data from factories, enterprises and research results are considered for use for the 2010 national GHG inventory. Most of the emission factors used for the inventory are default values provided in the inventory guidelines of the IPCC. Particularly, the emission factor from continuously flooded paddy fields without organic amendments is derived from a research of the Centre for Climate Change Research and Sustainable Development. Table 2.1 briefly describes the methodologies and data used for each major sector.

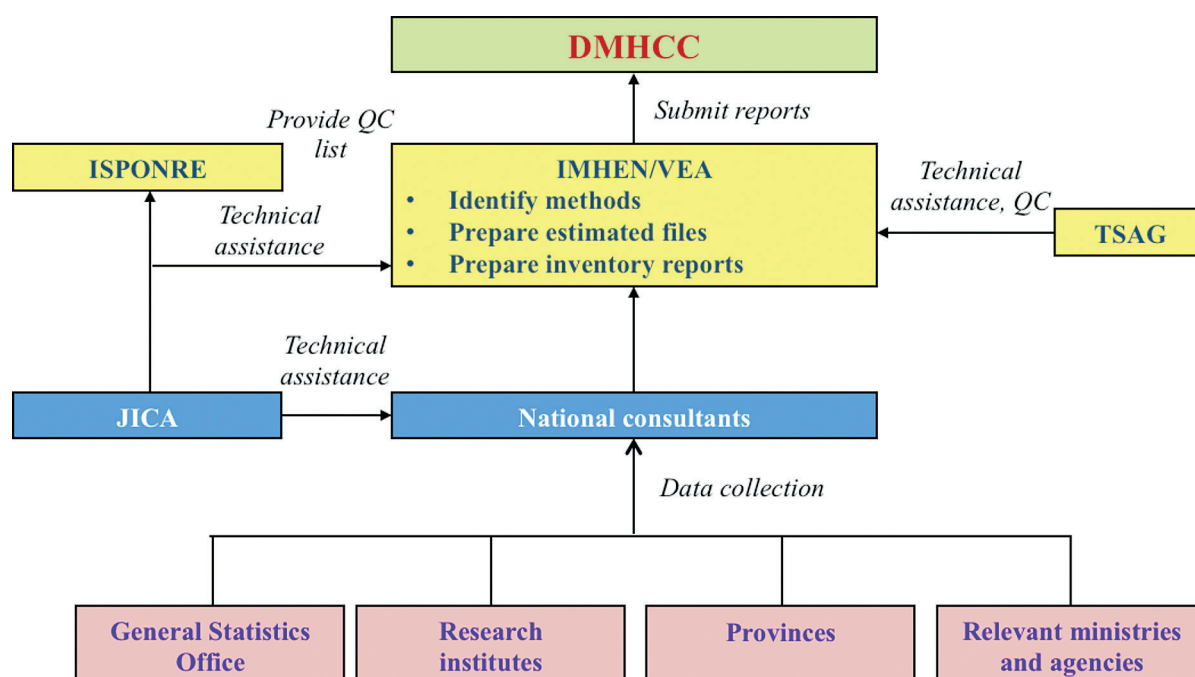


Figure 2.1. Institutional arrangements for 2010 National GHG Inventory

Table 2.1. Description of methods and data source

Sector	Method	Data source		
		Activity data	Emission factor	Other parameter
Energy	Tier 1	National statistics (the National Energy Balance)	Mostly IPCC default values, some country-specific data	Country-specific calorific values for solid fuels
Industrial Processes	Tier 1	National statistics	IPCC default values	None
Agriculture	Mostly Tier 1, some Tier 2	National statistics, data provided from industry/government institutions	Mostly IPCC default values, some country-specific data	IPCC default values
LULUCF	Combination of Tier 1 and Tier 2	National statistics, data from government and provinces, data from research papers	IPCC default values, data from research papers	Data from research papers also used
Waste	Mostly Tier 1, some Tier 2	National statistics, data from government and provinces, data from research papers	Mostly IPCC default values, data from research papers also used	Data from research papers also used

Source: National GHG Inventory Report 2010 of Viet Nam, The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

2.3. Quality control and quality assurance

When conducting the national GHG inventory under the Second National Communication, Viet Nam implemented QC activities by national GHG inventory experts.

Within the framework of the project funded by JICA, research methods for quality assurance and quality control (QA/QC) are developed. Planning and implementation of QA/QC activities and development of guidelines for documentation of the national GHG inventory and QA/QC processes are also conducted. DMHCC carries out QC through consultation with relevant ministries such as Ministry of Industry and Trade (MOIT) and Ministry of Transportation (MOT) for energy, industrial processes and transportation, Ministry of Agriculture and Rural Development (MARD) for agriculture and LULUCF. QA activities will be implemented by agencies not involved in the GHG inventory in the future.

2.4. Results of 2010 National GHG Inventory

2.4.1. Key emission/removal categories

In the 2010 national GHG inventory, a Tier 1 is used for key category analysis and assessment. Key category analysis is performed for both results including and excluding LULUCF in accordance with GPG 2000 and GPG-LULUCF 2003 guidelines.

28 categories have been identified as key in the analysis without LULUCF and 33 categories with LULUCF. The results of key category analysis excluding and including LULUCF are shown in Table 2.2 and Table 2.3.

Table 2.2. Results of key category analysis excluding LULUCF

No	Category	Gas	Emission (ktCO ₂ e)	Percentage (%)	Cumulative percentage (%)
1	4.C.1. Irrigated	CH ₄	41,310.27	15.5	15.5
2	1.A.1.a. Public Electricity and Heat Production	CO ₂	39,234.50	14.7	30.3
3	1.A.2.f. Other	CO ₂	29,786.60	11.2	41.5
4	1.A.3.b. Road Transportation	CO ₂	28,028.97	10.5	52.0
5	2.A.1. Cement Production	CO ₂	20,077.37	7.5	59.6
6	4.D.1. Direct Soil Emissions	N ₂ O	12,914.56	4.9	64.4
7	4.D.3. Indirect Emissions	N ₂ O	9,902.41	3.7	68.1
8	1.B.2.a. Oil	CH ₄	7,070.67	2.7	70.8
9	6.B2. Domestic and Commercial Waste Water	CH ₄	6,826.79	2.6	73.4
10	1.A.4.b. Residential	CO ₂	6,773.17	2.5	75.9
11	4.B.14. Other AWMS ¹	N ₂ O	6,191.24	2.3	78.2
12	4.A1. Cattle	CH ₄	5,399.23	2.0	80.3
13	6.A. Solid Waste Disposal on Land	CH ₄	5,004.79	1.9	82.1
14	1.B.2.c.i. Venting	CH ₄	3,733.74	1.4	83.5
15	1.A.2.e. Food Processing, Beverages and Tobacco	CO ₂	3,661.12	1.4	84.9
16	4.A.2. Buffalo	CH ₄	3,322.94	1.2	86.2

¹ AWMS - Animal waste management system

No	Category	Gas	Emission (ktCO ₂ e)	Percentage (%)	Cumulative percentage (%)
17	4.C.2. Rain fed	CH ₄	3,303.95	1.2	87.4
18	1.A.4.a. Commercial/Institutional	CO ₂	3,293.71	1.2	88.6
19	1.A.3.d. Navigation	CO ₂	2,500.07	0.9	89.6
20	1.B.2.b. Natural Gas	CH ₄	2,388.95	0.9	90.5
21	1.B.1.a. Coal Mining and Handling	CH ₄	2,243.07	0.8	91.3
22	6.B2. Domestic and Commercial Waste Water	N ₂ O	1,837.55	0.7	92.0
23	1.A.2.a. Iron and Steel	CO ₂	1,631.65	0.6	92.6
24	1.A.4.c. Agriculture/Forestry/Fisheries	CO ₂	1,617.32	0.6	93.2
25	6.B.1. Industrial Wastewater	CH ₄	1,617.10	0.6	93.8
26	1.A.2.c. Chemicals	CO ₂	1,450.50	0.5	94.4
27	4.F.1 . Cereals	CH ₄	1,431.42	0.5	94.9
28	1.A.1.b. Petroleum Refining	CO ₂	1,406.39	0.5	95.5

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Table 2.3. Results of key category analysis including LULUCF

No	Category	Gas	Emission/ removal (ktCO ₂ e)	Percentage (%)	Cumulative percentage (%)
1	4.C.1. Irrigated	CH ₄	41,310.27	13.5	13.5
2	1.A.1.a. Public Electricity and Heat Production	CO ₂	39,234.50	12.8	26.3
3	1.A.2.f. Other	CO ₂	29,786.60	9.7	36.1
4	1.A.3.b. Road Transportation	CO ₂	28,028.97	9.2	45.2
5	5.A.1. Forest Land remaining Forest Land	CO ₂	22,593.17	7.4	52.6
6	2.A.1. Cement Production	CO ₂	20,077.37	6.6	59.2
7	4.D.1. Direct Soil Emissions	N ₂ O	12,914.56	4.2	63.4
8	4.D.3. Indirect Emissions	N ₂ O	9,902.41	3.2	66.6
9	1.B.2.a. Oil	CH ₄	7,070.67	2.3	68.9
10	6.B2. Domestic and Commercial Waste Water	CH ₄	6,826.79	2.2	71.2
11	1.A.4.b. Residential	CO ₂	6,773.17	2.2	73.4
12	4.B.14. Other AWMS	N ₂ O	6,191.24	2.0	75.4
13	5.B.1. Cropland remaining Cropland	CO ₂	5,772.54	1.9	77.3
14	4.A1. Cattle	CH ₄	5,399.23	1.8	79.1
15	6.A. Solid Waste Disposal on Land	CH ₄	5,004.79	1.6	80.7
16	5.F.2. Land converted to Other Land	CO ₂	4,619.08	1.5	82.2
17	1.B.2.c.i. Venting	CH ₄	3,733.74	1.2	83.4
18	1.A.2.e. Food Processing, Beverages and Tobacco	CO ₂	3,661.12	1.2	84.6
19	4.A.2. Buffalo	CH ₄	3,322.94	1.1	85.7

No	Category	Gas	Emission/ removal (ktCO ₂ e)	Percentage (%)	Cumulative percentage (%)
20	4.C.2. Rain fed	CH ₄	3,303.95	1.1	86.8
21	1.A.4.a. Commercial/Institutional	CO ₂	3,293.71	1.1	87.9
22	1.A.3.d. Navigation	CO ₂	2,500.07	0.8	88.7
23	1.B.2.b. Natural Gas	CH ₄	2,388.95	0.8	89.5
24	1.B.1.a. Coal Mining and Handling	CH ₄	2,243.07	0.7	90.2
25	6.B2. Domestic and Commercial Waste Water	N ₂ O	1,837.55	0.6	90.8
26	1.A.2.a. Iron and Steel	CO ₂	1,631.65	0.5	91.3
27	1.A.4.c. Agriculture/Forestry/Fisheries	CO ₂	1,617.32	0.5	91.9
28	6.B.1. Industrial Wastewater	CH ₄	1,617.10	0.5	92.4
29	5.E.2. Land converted to Settlements	CO ₂	1,535.29	0.5	92.9
30	5.C.1. Grassland remaining Grassland	CO ₂	1,497.16	0.5	93.4
31	1.A.2.c. Chemicals	CO ₂	1,450.50	0.5	93.9
32	4.F.1 . Cereals	CH ₄	1,431.42	0.5	94.3
33	1.A.1.b. Petroleum Refining	CO ₂	1,406.39	0.5	94.8

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

2.4.2. GHG inventory by sector

Energy

In Viet Nam, GHG emissions from the energy sector include emissions from fuel combustion and fugitive emissions in the course of fuel extraction and transportation activities.

Fuel combustion

GHG emissions from fuel combustion in 2010 were 124,275 thousand tonnes of CO₂ equivalent (Table 2.4), in which the main sources were energy industries (41,057.9 thousand tonnes), manufacturing industries and construction (38,077.6 thousand tonnes) and transport (31,817.9 thousand tonnes).

Table 2.4. GHG emissions from fuel combustion in 2010

Unit: thousand tonnes of CO₂e

Sub-sector	CO ₂	CH ₄	N ₂ O	Total
Energy Industries	40,940.1	15.0	102.8	41,057.9
Manufacturing Industries and Construction	37,852.3	71.8	153.4	38,077.6
Transport	31,624.7	105.3	87.9	31,817.9
Commercial / Institutional	3,293.7	9.1	11.4	3,314.2
Residential	6,773.2	297.1	27.4	7,097.6
Agriculture / Forestry / Fishing	1,617.3	9.2	4.3	1,630.8
Non-energy use	1,251.8	5.0	22.1	1,279.0
Total	123,353.2	512.4	409.3	124,275.0

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Fugitive emissions

Fugitive emissions are emissions that occur during extraction, processing, storage and delivery of fossil fuels to the end-use point.

Fugitive emissions in 2010 were 16,895.8 thousand tonnes of CO₂ equivalent, including emissions from coal mining (underground and surface) which were 2,243.1 thousand tonnes of CO₂ equivalent and from oil and natural gas mining, which were 14,652.7 thousand tonnes of CO₂ equivalent.

Table 2.5. GHG fugitive emissions in 2010

Unit: thousand tonnes of CO₂e

Category	CO ₂	CH ₄	N ₂ O	Total
Underground coal mining	0.0	1,752.3	0.0	1,752.3
Surface coal mining	0.0	490.8	0.0	490.8
Oil	775.4	10,813.4	3.4	11,592.2
Natural gas	670.7	2,389.6	0.2	3,060.5
Total	1,446.1	15,446.1	3.6	16,895.8

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Total GHG emissions in 2010 in the energy sector were 141,170.8 thousand tonnes of CO₂ equivalent, as shown in detail in Table 2.6 and Figure 2.2.

Table 2.6. 2010 GHG emissions in energy sector

Unit: thousand tonnes of CO₂e

GHG category	Total	Percentage (%)
Fuel combustion	124,275.0	88.03
Energy Industries	41,057.9	29.08
Manufacturing Industries and Construction	38,077.6	26.97
Transport	31,817.9	22.54
Commercial/Institutional	3,314.2	2.35
Residential	7,097.6	5.03
Agriculture/Forestry/Fishing	1,630.8	1.16
Non-Energy Use	1,279.0	0.91
Fugitive emissions	16,895.8	11.97
Solid fuel	2,243.1	1.59
Oil and natural gas	14,652.7	10.38
Total	141,170.8	100

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

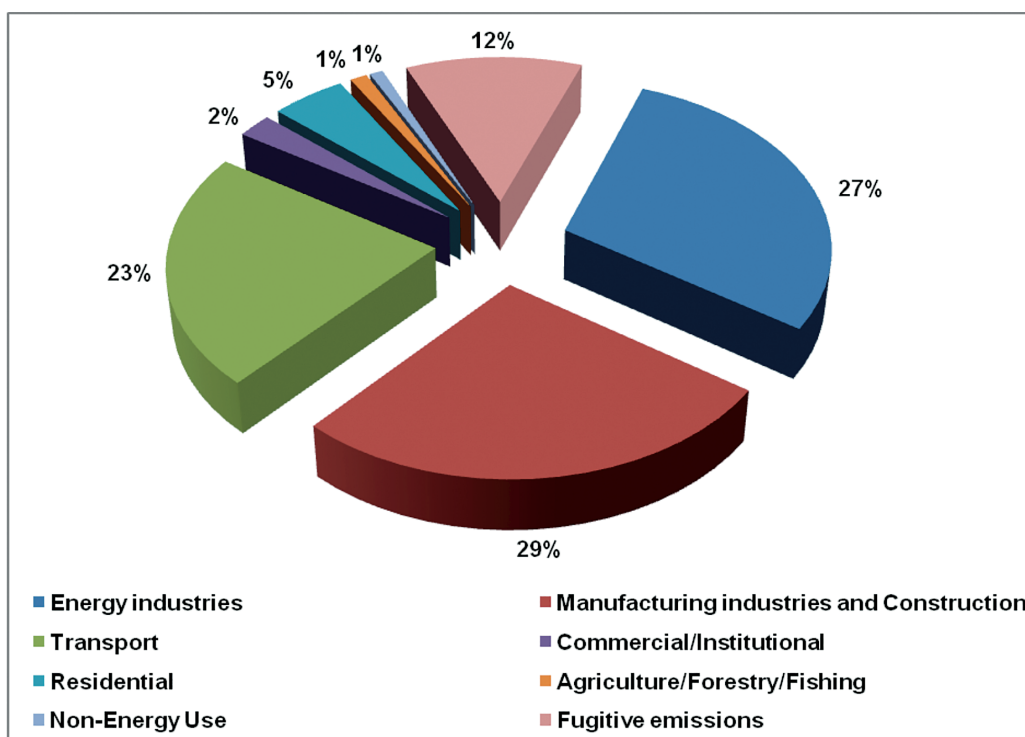


Figure 2.2. 2010 GHG emissions in energy sector

Industrial Processes

GHG emissions in industrial processes are estimated from industrial activities that are not related to the energy sector. The main emission sources in this sector are from chemical or physical conversion processes of raw materials. In 2010, the GHG emission inventory for this sector was only conducted for two manufacturing sub-sectors: cement and lime production. Other sub-sectors such as ammonia production, carbide production (in chemical industry) and steel production (in metallurgical industry) were not included due to data on fuels from these sub-sectors being already included in the energy sector.

Total CO₂ emissions from industrial processes in 2010 were 21,172 thousand tonnes of CO₂ equivalent, of which cement production contributed 20,077 thousand tonnes, accounting for 94.8% and lime production was 1,095 thousand tonnes, accounting for 5.2%.

Agriculture

The GHG inventory for the agriculture sector is implemented for six categories: enteric fermentation, manure management, rice cultivation, agricultural soils, prescribed burning of savannas and field burning of agricultural residues. Some data tables describing the above-mentioned activities are presented below.

Table 2.7. Irrigated rice area in 2010*Unit: thousand ha*

	Spring crop	Summer - Fall crop	Winter crop	Total	Data source
Irrigated area	2,955.4	2,226.3	1,851.2	7,032.9	Centre for Information and Statistics, MARD
The North	804.5	0	941.2	1,745.7	
The Central	616.5	340.1	426.2	1,382.8	
The South	1,534.4	1,886.2	483.8	3,904.4	

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Table 2.8. Number of cattle and poultry in 2010

Cattle and poultry	Heads	Data source
Dairy cow	128,400	Centre for Information and Statistics, MARD
Non-dairy cow	5,679,900	
Buffalo	2,877,000	Statistical Yearbook, General Statistics Office
Sheep	78,800	Goat and Rabbit Research Center. MARD
Goats	1,400,000	
Camels and Llamas	0	Not available
Horses	93,100	Statistical Yearbook, General Statistics Office
Mules and Asses	0	Not available
Swine	27,373,300	Statistical Yearbook, General Statistics Office
Poultry	300,500,000	

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Total GHG emissions in 2010 in the agriculture sector were 88,354.77 thousand tonnes of CO₂ equivalent, including emissions from rice cultivation accounted for 50.49%, from enteric fermentation: 10.72%, from manure management: 9.69%, from agricultural soil: 26.95% and from burning agricultural residues: 2.15%. Detailed results are shown in Table 2.9.

Table 2.9. 2010 GHG emissions in agriculture sector*Unit: thousand tonnes of CO₂e*

GHG category	CH ₄	N ₂ O	CO ₂ e	Percentage (%)
A. Enteric Fermentation	9,467.51	0.00	9,467.51	10.72
Cattle	5,399.23		5,399.23	
Buffalo	3,322.94		3,322.94	
Sheep	8.27		8.27	
Goats	127.04		127.04	
Horses	35.19		35.19	
Swine	574.84		574.84	

GHG category	CH ₄	N ₂ O	CO ₂ e	Percentage (%)
Poultry	0.00		0.00	
B. Manure management	2,319.51	6,240.49	8,560.00	9.69
Cattle	380.86		380.86	
Buffalo	406.84		406.84	
Sheep	1.54		1.54	
Goats	21.91		21.91	
Horses	14.65		14.65	
Swine	926.98		926.98	
Poultry	566.72		566.72	
Anaerobic lagoons		49.26	49.26	
Liquid systems		N/O ²	N/O	
Solid Storage and Dry Lot		N/O	N/O	
Other		6,191.24	6,191.24	
Daily spread		0.00	0.00	
Anaerobic treatment		6,109.64	6,109.64	
Anaerobic digester		81.59	81.59	
C. Rice cultivation	44,614.22	0.00	44,614.22	50.49
Irrigated	41,310.27		41,310.27	
Rain fed	3,303.95		3,303.95	
Deep water	0.00		0.00	
Other	N/O		N/O	
D. Agriculture soils	0.00	23,812.02	23,812.02	26.95
Direct Emissions		12,914.56	12,914.56	
Pasture range & Paddock		995.06	995.06	
Indirect Emissions		9,902.41	9,902.41	
E. Prescribed Burning of Savannas	1.44	0.26	1.70	
F. Field Burning of Agricultural Residues	1,506.29	393.04	1,899.33	2.15
Cereals	1,431.42	348.02	1,779.44	
Pulse	23.01	14.98	37.99	
Tuber and Root	36.33	26.47	62.80	
Sugar Cane	15.52	3.57	19.09	
Other	N/O	N/O	N/O	
G. Others	N/O	N/O	N/O	
Total	57,908.95	30,445.82	88,354.77	100

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

² N/O - Not occurring

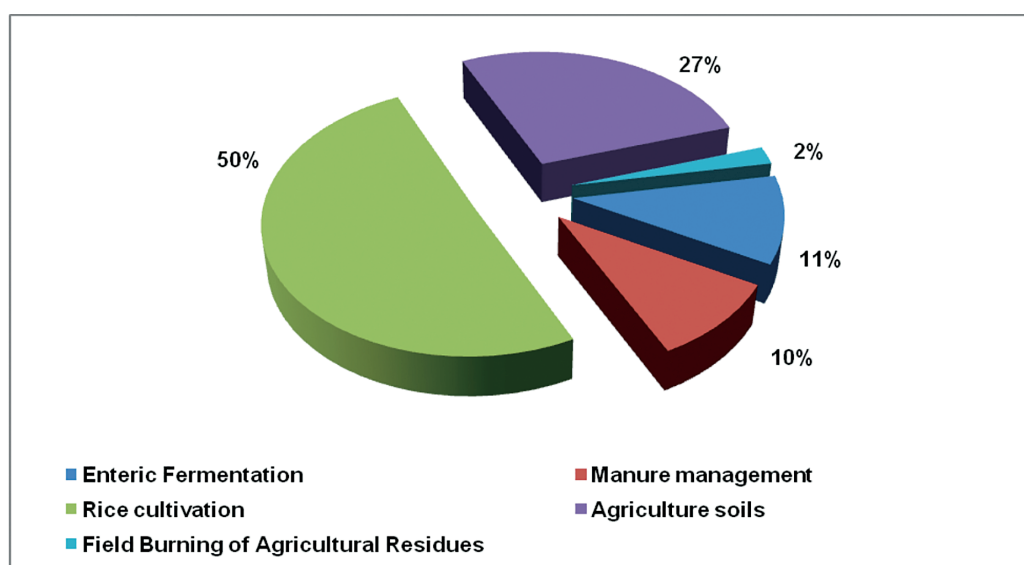


Figure 2.3. 2010 GHG emissions in agriculture sector

Land use, land use change and forestry (LULUCF)

GHG emissions/removals in the LULUCF sector mainly occur in the process of changing forest and biomass stocks and of land use and land use change.

According to the GPG-LULUCF 2003, in Viet Nam, land is classified into six categories: forest land, cropland, grassland, wetlands, settlements and other land. Each type of land is divided into two sub-categories, intact land and land which has been converted to other purposes. GHG emissions/removals in this sector are the changes in carbon stocks in: a) living biomass (aboveground biomass, underground biomass); b) dead organic matter (dead wood, litter) and; c) soils.

Table 2.10 shows the total land use and land converted to other uses in 2010 with the total of 33,095 thousand ha; of this 13,388 thousand ha of forest land, accounts for 40.45% of the total and 10,075 thousand ha of cropland, accounts for 30.44%.

Table 2.10. Land use and land use change in 2010

Unit: thousand ha

GHG source and sink category		Area
A. Forest land	Total	13,388.08
	Forest land Remaining Forest land	10,258.80
	Land Converted to Forest Land	3,129.28
B. Cropland	Total	10,075.40
	Cropland Remaining Cropland	6,587.74
	Land Converted to Cropland	3,487.66
C. Grassland	Total	2,000.74
	Grassland Remaining Grassland	1,607.60
	Land Converted to Grassland	393.14

GHG source and sink category		Area
D. Wetlands	Total	1,765.97
	Wetlands Remaining Wetlands	1,155.24
	Land Converted to Wetlands	610.73
E. Settlements	Total	2,591.70
	Settlements Remaining Settlements	1,551.30
	Land Converted to Settlements	1,040.40
F. Other Land	Total	3,273.47
	Other Land Remaining Other Land	1,935.18
	Land Converted to Other Land	1,338.29
Total		33,095.35

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Data on forest area and ecological regions in Viet Nam are collected from the Forest Protection Department, MARD and shown in Table 2.11.

Table 2.11. Forest area of eco-regions

Unit: ha

	Northeast	Northwest	Red River Delta	North Central	South Central	Central Highlands	Southeast	South West
Evergreen Broadleaf forest - Extremely rich forests	647	242	0	26,895	9,978	1,321	28	0
Evergreen Broadleaf forest - Rich forests	49,155	9,819	1,415	173,565	148,299	50,626	5,661	319
Evergreen Broadleaf forest - Average forests	201,022	129,951	13,273	451,643	461,542	367,196	24,089	3,917
Evergreen Broadleaf forest - Poor forests	848,961	442,854	6,798	980,557	877,242	1,022,757	105,163	28,180
Evergreen Broadleaf forest - Forests with no reserve	546,423	519,211	3,385	50,862	35,647	36,728	19,323	3,691
Deciduous forest - Extremely rich forests								
Deciduous forest - Rich forests								

	Northeast	Northwest	Red River Delta	North Central	South Central	Central Highlands	Southeast	South West
Deciduous forest - Average forests						10,940		
Deciduous forest - Poor forests					4,932	388,608		
Deciduous forest - Forests with no reserve						43,519		
Needle leaf forest						82,020		
Mixed Broadleaf and Needle leaf forest						38,348		
Bamboo forest	111,541	81,636	6	161,865	40,075	159,670	17,092	
Mixed Wood and Bamboo forest	199,803	76,861	956	87,745	99,486	190,444	58,530	
Mangrove forest	20,346	0	0	892	452	0	15,346	22,987
Rocky mountainous forest (limestone forest)	324,852	138,663	30,302	193,308	12,294	0	876	2,036
Plantation forest	1,101,020	152,328	68,302	679,873	518,744	193,395	161,840	207,757

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Results of GHG emission/removal estimation in the LULUCF sector are presented in Table 2.12 and Figure 2.4.

Table 2.12. 2010 GHG emissions/removals in LULUCF sector

Unit: thousand tonnes

GHG source and sink category	Total CO ₂ e	Net CO ₂	CH ₄	N ₂ O
A. Forest land	-22,543.84	-22,593.17	1.55	0.05
Forest Land Remaining Forest Land	-22,543.84	-22,593.17	1.55	0.05
Land Converted to Forest Land	IE ³	IE	IE	IE
B. Cropland	-4,634.57	-5,126.18	21.25	0.15
Cropland Remaining Cropland	-5,772.54	-5,772.54		
Land Converted to Cropland	1,137.97	646.36	21.25	0.15

³ IE - Included elsewhere

GHG source and sink category	Total CO ₂ e	Net CO ₂	CH ₄	N ₂ O
C. Grassland	322.67	320.82	0.08	0.001
Grassland Remaining Grassland	1,497.16	1,497.16		
Land Converted to Grassland	-1,174.49	-1,176.34	0.08	0.001
D. Wetlands	903.71	889.23	0.56	0.01
Wetlands Remaining Wetlands	562.46	561.03		0.005
Land Converted to Wetlands	351.27	335.56	0.68	0.005
E. Settlements	1,537.03	1,535.29	0.08	0.001
Settlements Remaining Settlements	NE ⁴	NE		
Land Converted to Settlements	1,537.03	1,535.29	0.08	0.001
F. Other Land	5,186.38	4,619.08	24.53	0.17
Other Land Remaining Other Land				
Land Converted to Other Land	5,186.38	4,619.08	24.53	0.17
Total	-19,218.59	-20,347.59	48.17	0.38

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

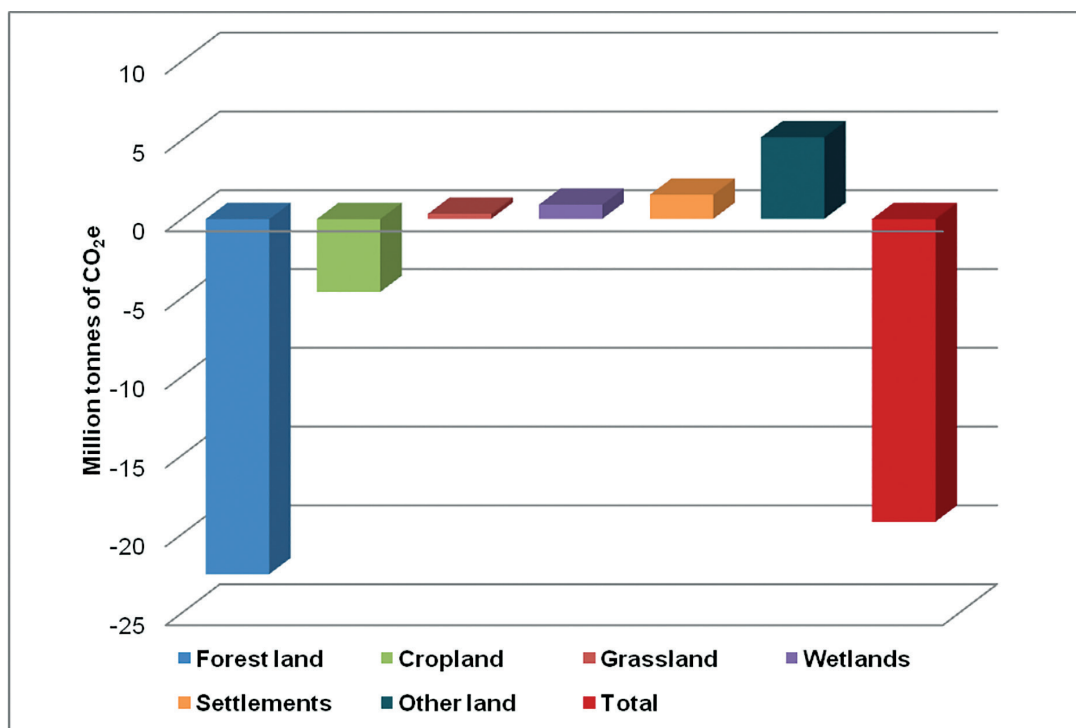


Figure 2.4. 2010 GHG emissions/removals in LULUCF sector

⁴ NE - Not estimated

Waste

GHG emissions from waste come from five main sources: waste landfill, industrial wastewater treatment, domestic wastewater treatment, human sewage and waste incineration.

Landfills are used for waste disposal in urban areas. Data analysis from the Environmental Status Reports of the Departments of Natural Resources and Environment of provinces/cities throughout the country shows that from 2006 to 2010, the average increase of total volume of municipal waste processed in the landfills was about 10% per year (Table 2.13). Waste composition analysis shows that food and organic substances account for 59.2%, plastic and other items account for 30.9% (Table 2.14).

Table 2.13. Total volume of municipal solid waste processed in landfills

Year	2006	2007	2008	2009	2010
Total (tonne/day)	18,732.8	20,664.4	22,787.4	25,134.2	27,648.7
Total (tonne/year)	6,837,473	7,542,509	8,317,393	9,173,979	10,091,780

Source: Environmental Status Reports of the Departments of Natural Resources and Environment of provinces and cities throughout the country, 2007 - 2011

Table 2.14. Average waste composition

No	Composition	Rate (%)
1	Food, organic	59.24
2	Branches and grass	2.76
3	Paper	2.70
4	Wood	1.05
5	Textile	3.30
6	Nappies	0.01
7	Plastic, other inert	30.94

Source: Environmental Status Reports of the Departments of Natural Resources and Environment of provinces and cities throughout the country 2007 - 2011

The amount of GHG emissions in industrial wastewater treatment depends on the volume of discharged wastewater and COD concentration in the wastewater. Table 2.15 shows the production of several important industries in 2010 and the volume of wastewater per ton of product and COD in a cubic metre of wastewater.

Table 2.15. Production, discharged wastewater volume and COD in wastewater of several important industries in 2010

No	Industry	Production (tonnes/year)	Wastewater generation (m ³ /tonnes)	COD (kg COD/m ³)
1	Iron and Steel	7,935,000	0.10	0.50
2	Non-ferrous metals	3,042,000	0.10	0.50
3	Fertilizer	2,573,900	0.20	0.23
4	Food & Beverage - Beer ⁵	2,377,200	11.50	3.50

⁵ The volume of beer, other alcohol and soft drinks is measured in thousand litres per year

No	Industry	Production (tonnes/year)	Wastewater generation (m ³ /tonnes)	COD (kg COD/m ³)
5	Food & Beverage - Other alcohol	349,400	12.00	1.20
6	Food & Beverage - Dairy products	579,500	7.50	0.80
7	Food & Beverage - Sugar	1,141,500	7.00	0.20
8	Food & Beverage - Fish processing	1,439,000	21.50	1.47
9	Food & Beverage - Coffee	1,168,600	0.63	0.02
10	Food & Beverage - Soft drinks	1,105,700	11.38	1.70
11	Paper	1,887,100	225.00	2.94
12	Pulp	437,600	225.00	2.94
13	Rubber	752,000	0.50	0.23

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

In Viet Nam, the incinerated solid waste is primarily hazardous medical solid waste. Data of hazardous medical waste incinerated during the period of 2006-2010 were collected from the annual Environmental Status Reports of provinces and cities (Table 2.16). 2010 GHG inventory results in the waste sector are shown in Table 2.17.

Table 2.16. Amount of hazardous medical waste burned in incinerators

Unit: tonnes/year

Year	Amount of hazardous medical waste burned in incinerators annually
2006	10,101.7
2007	11,243.9
2008	11,616.3
2009	12,156.2
2010	14,024.3

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Table 2.17. 2010 GHG emissions in waste sector

Unit: thousand tonnes

GHG category	Emission			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
CH ₄ emissions from solid waste landfills	NE	238,324		5,005
CH ₄ emissions from industrial wastewater		77,005		1,617
CH ₄ emissions from domestic wastewater		325,085		6,827
N ₂ O emissions from human sewage			5,928	1,838
CO ₂ emissions from waste incineration	65,429		NE	65
Total	65,429	640,413	5,928	15,352

Source: National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

Total GHG emissions from the waste sector in 2010 were 15,352 thousand tonnes of CO₂ equivalent, mainly from domestic wastewater which contributed 6,827 thousand tonnes of CO₂ equivalent, accounting for 44.5% and from landfills which equalled 5 million tonnes of CO₂ equivalent, accounting for 32.6% (Figure 2.5).

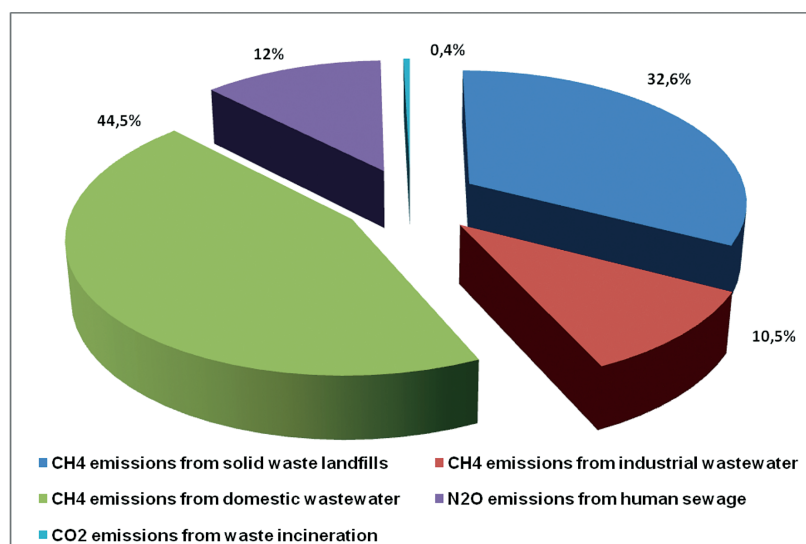


Figure 2.5. 2010 GHG emissions in waste sector

2.4.3. Total emission sources and sinks in 2010

In 2010, the total GHG emissions in Viet Nam were 246.8 million tonnes of CO₂ equivalent with LULUCF. Without LULUCF, the total GHG emissions were 266 million tonnes of CO₂ equivalent, including emissions from the energy sector accounting for the largest proportion of 53.05%, followed by agriculture of 33.20%. Emissions from industrial processes and waste were 7.97% and 5.78%, respectively. Details are in Table 2.18 and Figure 2.6.

Table 2.18. Summary of GHG emissions and removals in 2010

Unit: thousand tonnes of CO₂e

GHG source and sink category	CO ₂	CH ₄	N ₂ O	HFCs		PFCs		SF ₆		Total
				P	A	P	A	P	A	
Total Emissions (without LULUCF)	146,036.78	87,316.15	32,696.31							266,049.24
Total Emissions (with LULUCF)	125,689.19	88,327.66	32,813.79							246,830.64
Total Energy	124,799.34	15,958.52	412.93							141,170.79
A. Fuel Combustion Activities (Sectoral approach)	123,353.21	512.43	409.34							124,274.99

GHG source and sink category	CO ₂	CH ₄	N ₂ O	HFCs		PFCs		SF ₆		Total
				P	A	P	A	P	A	
1. Energy Industries	40,940.15	14.98	102.81							41,057.94
2. Manufacturing Industry and Construction	37,852.33	71.84	153.44							38,077.62
3. Transport	31,624.70	105.32	87.87							31,817.89
4. Other Sectors	11,684.21	315.29	43.08							12,042.58
5. Other	1,251.81	5.00	22.14							1,278.95
B. Fugitive Emissions from Fuels	1,446.13	15,446.09	3.59							16,895.80
1. Solid Fuels	0.00	2,243.07	0.00							2,243.07
2. Oil and Natural Gas	1,446.13	13,203.02	3.59							14,652.74
Total Industrial Processes	21,172.01	0.00	0.00	NE	NE	NE	NE	NE	NE	21,172.01
A. Mineral Products	21,172.01	0.00	0.00							21,172.01
B. Chemical Industry	0.00	0.00	0.00	NE	NE	NE	NE	NE	NE	IE
C. Metal Production	0.00	0.00	NE, N/O	NE	NE	NE	NE	NE	NE	IE
D. Other Production	NE									NE
E. Production of Halocarbons and SF ₆					NE		NE		NE	NE
F. Consumption of Halocarbons and SF ₆				NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total Agriculture	0.00	57,908.95	30,445.82							88,354.77
A. Enteric Fermentation		9,467.51								9,467.51
B. Manure Management		2,319.51	6,240.49							8,560.00
C. Rice Cultivation		44,614.22								44,614.22
D. Agricultural Soils		0.00	23,812.02							23,812.02
E. Prescribed Burning of Savannas		1.44	0.26							1.70
F. Field Burning of Agricultural Residues		1,506.29	393.04							1,899.33

GHG source and sink category	CO ₂	CH ₄	N ₂ O	HFCs		PFCs		SF ₆		Total
				P	A	P	A	P	A	
G. Other		N/O	N/O							0.00
Total Land-use Categories	-20,347.59	1,011.51	117.48							-19,218.59
A. Forest Land	-22,593.17	32.63	16.70							-22,543.84
B. Cropland	-5,126.18	446.32	45.30							-4,634.57
C. Grassland	320.82	1.68	0.17							322.67
D. Wetlands	896.58	14.27	2.89							913.74
E. Settlements	1,535.29	1.58	0.16							1,537.03
F. Other Land	4,619.08	515.03	52.27							5,186.38
G. Other										0.00
Total Waste	65.43	13,448.68	1,837.55							15,351.67
A. Solid Waste Disposal on Land	NE	5,004.79								5,004.79
B. Waste Water Handling		8,443.89	1,837.55							10,281.44
C. Waste Incineration	65.43	NE	NE							65.43
D. Other	NE	NE	NE							0.00

Source: National GHG Inventory Report 2010 of Viet Nam, The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

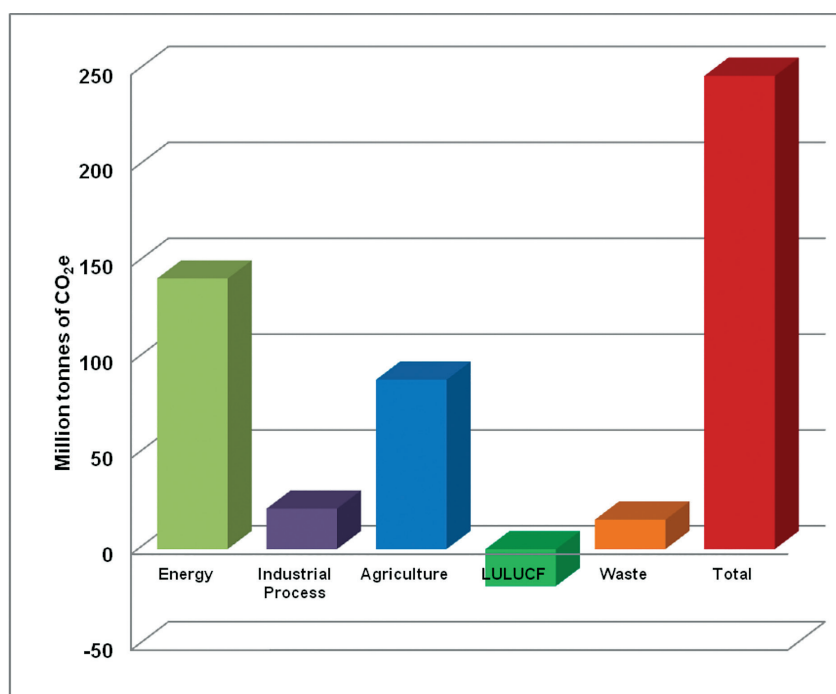


Figure 2.6. 2010 GHG emissions and removals by sector

2.4.4. Comparison of GHG emissions in 1994, 2000 and 2010

In the period of 1994-2010, total GHG emissions in Viet Nam (with LULUCF) increased sharply from 103.8 to 246.8 million tonnes of CO₂ equivalent, within which the energy sector had the highest increase from 25.6 to 141.1 million tonnes of CO₂ equivalent, becoming the largest emission sector in 2010 while the waste sector showed a sharp increase from 2.6 to 15.4 million tonnes of CO₂ equivalent. Emissions in the agriculture sector increased slowly. LULUCF sector changed from emission sources to sinks (Table 2.19 and Figure 2.7).

Table 2.19. Total GHG emissions in 1994, 2000 and 2010 by sector

Unit: thousand tonnes of CO₂e

Sector	1994	2000	2010
Energy	25,637.09	52,773.46	141,170.79
Industrial Process	3,807.19	10,005.72	21,172.01
Agriculture	52,450.00	65,090.65	88,354.77
LULUCF	19,380.00	15,104.72	-19,218.59
Waste	2,565.02	7,925.18	15,351.67
Total	103,839.30	150,899.73	246,830.65

Source: - The Initial National Communication, 2003

- The Second National Communication, 2010

- National GHG Inventory Report 2010 of Viet Nam,

The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

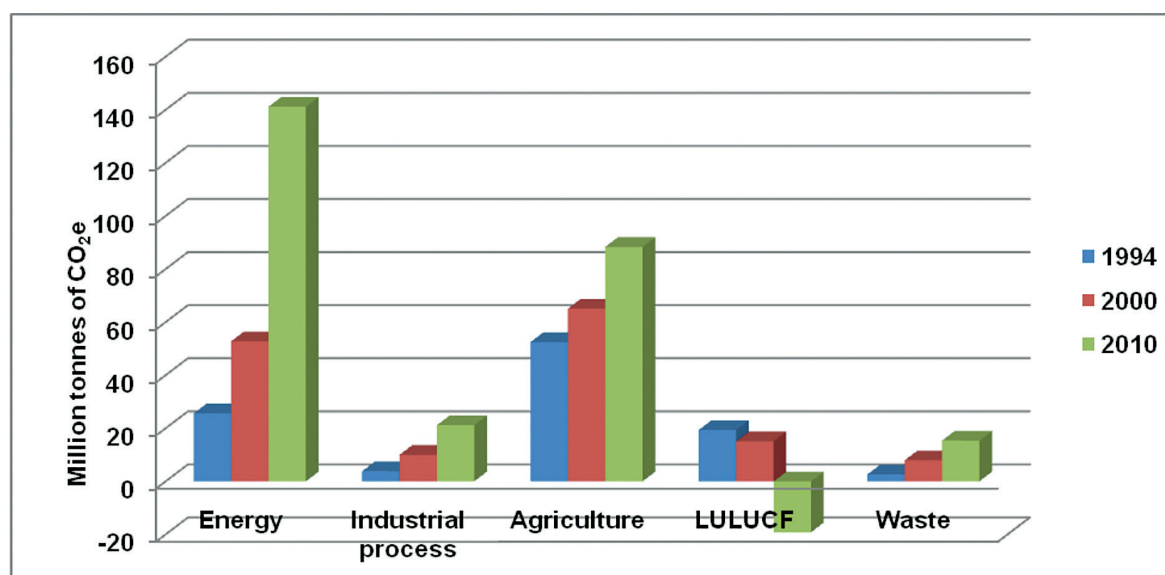


Figure 2.7. Total GHG emissions in 1994, 2000 and 2010 by sector

Comparison between 2000 and 2010 showed that CO₂ increased the most among gases. If including LULUCF, total CO₂ emissions increased from 67.8 to 125.7 million tonnes and from 55.9 to 146 million tonnes if excluding LULUCF (Table 2.20 and Figure 2.8).

Table 2.20. Total GHG emissions in 1994, 2000 and 2010 by gas

Unit: thousand tonnes of CO₂e

Sector	CO ₂			CH ₄			N ₂ O		
	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

Source: - The Initial National Communication, 2003

- The Second National Communication, 2010

- National GHG Inventory Report 2010 of Viet Nam,

The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

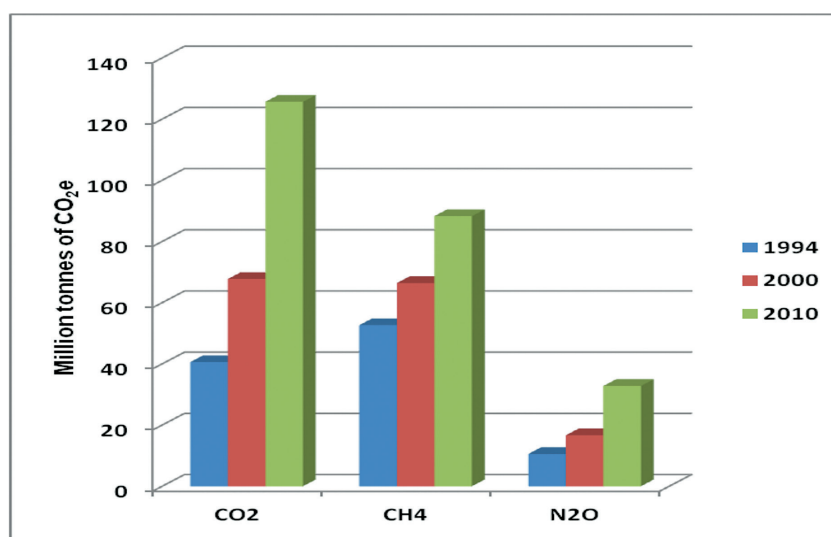


Figure 2.8. Total GHG emissions including LULUCF in 1994, 2000 and 2010 by gas

2.5. GHG emission projections for 2020 and 2030

Based on GHG inventories of Viet Nam in recent years, key GHG emission sources and sinks in Viet Nam identified are energy, agriculture, and LULUCF. GHG emissions from the waste sector are projected to increase rapidly during the period 2020-2030. Therefore, projections of GHG emissions and removals during this period are made for these four sectors.

2.5.1. General information

Based on medium scenario of economic development, forecasts of energy demand, GDP growth rate by sector, GDP structure by sector, population growth rate, forest area, number of cattle and cultivated area for the period of 2020-2030 are presented in the tables from 2.21 to 2.30.

Table 2.21. End-use energy demand forecast to 2030 by types of fuel-energy

Unit: KTOE

Type of fuel - energy	2015	2020	2025	2030	Average increasing rate 2015-2030 (%)
Coal	12,986.2	16,829.3	20,334.4	24,478.9	4.3
Electricity	12,472.1	19,828.3	28,932.3	42,024.5	8.4
Gas	775.5	1,208.8	1,683.3	2,344.0	7.7
LPG	1,919.6	2,669.5	3,580.2	4,769.6	6.3
Petroleum	6,224.6	8,541.4	11,163.5	14,591.1	5.8
Aviation petroleum	1,152.5	1,641.4	2,225.6	3,017.6	6.6
DO oil	9,099.0	11,874.8	14,646.5	18,055.5	4.7
FO oil	1,410.0	1,751.9	2,114.3	2,551.8	4.0
Kerosene	82.8	74.0	78.4	83.9	0.1
Firewood	4,037.5	3,172.4	2,186.3	1,124.5	-8.2
Crop residues	2,898.1	1,986.6	1,050.1	97.7	-20.2
Biogas	22.5	29.0	35.5	41.7	4.2
Ethanol	86.3	300.0	450.0	600.0	13.8
Solar	5.6	18.3	40.8	78.7	19.3
Total	53,172.2	69,925.6	88,521.2	113,859.6	5.2

Source: Report on mitigation options for energy sector in Viet Nam for the period 2020-2030, 2014

Table 2.22. End-use energy demand forecast to 2030 by sector

Unit: KTOE

Sector	2015	2020	2025	2030	Average rate 2015-2030 (%)
Industry	23,608.2	32,141.7	41,097.7	53,357.9	5.6
Transportation	14,421.4	19,481.7	24,887.3	31,762.1	5.4
Agriculture	709.3	835.8	942.7	1,032.7	2.5
Commercial services	2,464.0	3,698.9	5,448.5	8,114.7	8.3
Household appliances	11,969.0	13,768.0	16,145.0	19,592.2	3.3
Total	53,172.2	69,925.6	88,521.2	113,859.6	5.2

Source: Report on mitigation options for energy sector in Viet Nam for the period 2020-2030, 2014

Table 2.23. GDP growth forecast

Unit: %

Sector	2016-2020	2021-2030
GDP growth	7.00	7.22
Industry and Construction	7.50	7.35
Agriculture / Forestry / Fishing	2.00	2.00
Services	8.00	7.95

Source: National Power Development Plan 7, 2011

Table 2.24. GDP structure forecast at current prices

Unit: %

Sector	2015	2020	2030
Industry and Construction	41.00	42.00	41.41
Agriculture / Forestry / Fishing	17.10	15.00	10.10
Services	41.90	43.00	48.49

Source: National Power Development Plan 7, 2011

Table 2.25. Population growth forecast

Unit: %

Period	Growth
2011-2015	1.05
2016-2020	0.98
2021-2025	0.81
2026-2030	0.59

Source: Viet Nam Population Forecast 2009-2049, General Statistics Office, 2011

Table 2.26. Area and production of major crops in 2010, 2020 and 2030

No	Crop	Area (million ha)			Production (million tonnes)		
		2010	2020	2030	2010	2020	2030
1	Paddy	7.489*	7.012*	7.012*	40.0	42.0	44.0
2	Maize	1.126	1.440	1.440	4.63	7.20	8.64
3	Yams	0.151	0.175	0.175	1.318	1.75	1.75
4	Cassava	0.498	0.450	0.45	8.596	11.0	11.0
5	Peanut	0.231	0.300	0.35	0.487	0.800	0.930
6	Sugarcane	0.269	0.300	0.350	16.162	24.000	28.0
7	Cotton	0.009	0.040	0.040	0.013	0.050	0.050
8	Soybean	0.198	0.350	0.450	0.298	0.700	0.900
9	Tobacco	0.020	0.02	0.02	0.035	0.036	0.036
10	Beans		0.210	0.250		0.195	0.232
11	Agriculture land	10.170	9.590	9.800			

Source: - Statistical Yearbook 2011, General Statistics Office, 2012
 - Decision No. 124/QĐ-TTg dated February 2nd, 2012 of the Prime Minister approving the Master Plan on development of agricultural production in 2020 and vision towards 2030, 2012
 * Total paddy cultivated area of all crops in the year

Table 2.27. Area of irrigated paddy cultivation by region in 2010, 2020 and 2030

Unit: million ha

	2010	2020	2030
Paddy cultivated area*	7.489	7.012	7.012
Irrigated area	7.033	6.700	6.800
Of which			
North	1.746	1.668	1.693
Central	1.382	1.313	1.333
South	3.905	3.719	3.774

Source: - Statistical Yearbook 2011, General Statistics Office, 2012
 - Decision No. 124/QĐ-TTg dated February 2nd, 2012 of the Prime Minister approving the Master Plan on development of agricultural production in 2020 and vision towards 2030, 2012
 * Total paddy cultivated area of all crops in the year

Table 2.28. Number of cattle and poultry in 2010, 2020 and 2030

Unit: thousand heads

Cattle/Poultry	2010	2020	2030
Non-dairy cow	5,679.0	11,500.0	14,000.0
Dairy cow	128.4	500.0	800.0
Buffalo	2,877.0	3,000.0	3,000.0
Swine	27,373.3	34,000.0	39,000.0

Cattle/Poultry	2010	2020	2030
Goat/sheep	1,478.8	3,900.0	4,500.0
Poultry	300,500.0	380,000.0	440,000.0
Horse	93.1	No data	No data

Source: - Statistical Yearbook 2011, General Statistics Office, 2012
- Decision No. 124/QĐ-TTg dated February 2nd, 2012 of the Prime Minister approving the Master Plan on development of agricultural production in 2020 and vision towards 2030, 2012

Table 2.29. Planning for forest and forest land for 2020 and projections for 2030

Unit: million ha

Type of forest and forest land	Planning*	Projection**
	2020	2030
The total area of forest land	16.24	17.86
- Forested land	15.57	17.13
- Unused land	-	-
- Land for reforestation after harvesting	-	-
- Bare land in forest	0.05	0.06
- Land for forest rehabilitation and agro-forestry	0.62	0.68
1. Protection Forest	5.68	6.25
- Forested land	5.67	6.24
- Unused land and bare land in forest	0.01	0.01
2. Special Use Forest	2.16	2.38
- Forested land	2.12	2.33
- Unused land and bare land in forest	0.04	0.04
3. Production Forest	8.40	9.24
- Forested land	7.78	8.56
+ Natural forest	3.63	3.99
+ Plantation forest	4.15	4.57
- Unused land	-	-
- Land for reforestation after harvesting	-	0.33
- Land for forest rehabilitation and agro-forestry	0.62	0.68
Ratio of forested land (%)	47	50

Source: * Decision No. 18/2007/QĐ-TTg dated February 5th, 2007 of the Prime Minister approving the Strategy on forestry development of Viet Nam during the period of 2006-2020

** Report on Projection of GHG emissions from LULUCF sector in Viet Nam for 2020 and 2030, 2014

Table 2.30. Volume of solid waste processed in landfills in 2010 and projections for 2020 and 2030

Unit: thousand tonnes /year

Year	Volume		
	Urban	Rural	Industrial areas
2010	10,092	3,109	3,292
2020	26,175	3,530	8,537
2030	67,892	3,343	22,144

Source: Environmental Status Report in 5 years (2006-2010) of provinces and cities

2.5.2. GHG emission projections

Energy

Total emissions in the energy sector in 2020 are projected at about 381.1 million tonnes of CO₂ equivalent. Energy industries would be the largest source of emissions at 163.2 million tonnes of CO₂ equivalent, accounting for 42.8%.

Total emissions in the energy sector in 2030 are projected at about 648.5 million tonnes of CO₂ equivalent. The largest source of emissions would be also energy industries with 377.5 million tonnes of CO₂ equivalent, accounting for 58.2% (Table 2.31).

Table 2.31. GHG emission projections for 2020 and 2030 in energy sector

Unit: thousand tonnes of CO₂e

Category	2010*		2020**		2030**	
	Emission	(%)	Emission	(%)	Emission	(%)
1.A. Fuel Combustion	124,275.0	88.03	347,612.30	91.21	593,413.50	91.51
1.A.1. Energy Industries	41,057.9	29.08	163,159.4	42.81	377,461.9	58.21
1.A.2. Manufacturing Industries and Construction	38,077.6	26.97	69,308.8	18.18	92,523.8	14.27
1.A.3. Transport	31,817.9	22.54	87,871.1	23.06	87,871.1	13.55
1.A.4.a. Commercial/ Institutional	3,314.2	2.35	8,413	2.21	12,072.7	1.85
1.A.4.b. Residential	7,097.6	5.03	16,530	4.34	20,537.2	3.17
1.A.4.c. Agriculture/ Forestry/Fishing	2,909.8	2.06	2,330	0.61	2,946.8	0.45
1.B. Fugitive Emissions	16,895.8	11.97	33,515.60	8.79	55,065.60	8.49
1.B.1. Solid Fuel	2,243.1	1.59	16,004.73	4.20	18,466.88	2.85
1.B.2. Oil and natural gas	14,652.7	10.38	17,510.87	4.59	36,598.72	5.64
Total	141,170.8	100.00	381,127.90	100	648,479.10	100

*Source: *National GHG Inventory Report 2010 of Viet Nam,*

The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

*** Report on Projection of GHG emissions from energy sector in Viet Nam for 2020 and 2030, 2014*

Agriculture

In the agriculture sector, projecting from the year 2010, the two sub-sectors with increasing emissions in both volume and contribution to the total emissions would be livestock and agricultural soils while the sub-sector rice cultivation is anticipated to decrease in its contribution to the total emissions, from 50.5% in 2010 to 36.5% in 2030. The sub-sector field burning of agricultural residues will likely have increasing emissions but its contribution to the total emissions might not be large and almost unchanged, about 2.4% (Table 2.32).

Table 2.32. GHG emission projections for 2020 and 2030 in agriculture sector

Unit: thousand tonnes of CO₂e

Category	2010*		2020**		2030**	
	Emission	(%)	Emission	(%)	Emission	(%)
Livestock	18,030	20.4	24,948	24.8	29,322	26.8
Rice cultivation	44,614	50.5	39,360	39.1	39,949	36.5
Agriculture soils	23,812	27.0	33,947	33.6	37,397	34.3
Savanna burning	x ⁶		x		x	
Field burning of agricultural residues	1,899	2.1	2,504	2.5	2,673	2.4
Total	88,355	100	100,758	100	109,342	100

Source: * National GHG Inventory Report 2010 of Viet Nam,

The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

** Report on Projection of GHG emissions from agriculture sector in Viet Nam for 2020 and 2030, 2014

LULUCF

This sector would absorb about 42.5 and 45.3 million tonnes of CO₂ equivalent in 2020 and 2030, respectively. The emission sources and sinks are forest land and cropland (Table 2.33).

Table 2.33. GHG emission/removal projections for 2020 and 2030 in LULUCF sector

Unit: thousand tonnes of CO₂e

Category	GHG emission/removal		
	2010*	2020**	2030**
A. Forest land	-22,543.84	-50,378.79	-53,146.90
B. Cropland	-4,634.57	-1,613.55	-1,613.55
C. Grassland	322.67	0.00	0.00
D. Wetlands	903.71	584.46	584.46
E. Settlements	1,537.03	6,671.21	6,671.21
F. Other Land	5,186.38	2,194.67	2,202.86
Total	-19,218.59	-42,541.99	-45,301.92

Source: * National GHG Inventory Report 2010 of Viet Nam,

The project "Capacity Building for National GHG Inventory in Viet Nam", 2014

** Report on Projection of GHG emissions from LULUCF sector in Viet Nam for 2020 and 2030, 2014

⁶ The amount of emissions is very low or assuming that emissions do not occur

Waste

In the waste sector, compared to the year 2010, CH₄ emissions from waste landfills are expected to increase in both volume and contribution to the total emissions. In contrast, the percentage contribution of CH₄ emissions from domestic wastewater would decline from 44.5% in 2010 to 19.4% in 2030. N₂O emissions from human sewage would increase slightly in volume but decrease in contribution to the total emissions (Table 2.34).

Table 2.34. GHG emission projections for 2020 and 2030 in waste sector

Unit: thousand tonnes of CO₂e

Category	2010*		2020**		2030**	
	Emission	%	Emission	%	Emission	%
CH ₄ emissions from solid waste landfills	5,005	32.6	12,121	45.6	29,242	60.9
CH ₄ emissions from industrial wastewater	1,617	10.5	3,704	13.9	5,898	12.3
CH ₄ emissions from domestic wastewater	6,827	44.5	8,080	30.4	9,294	19.4
N ₂ O emissions from human sewage	1,838	12.0	2,479	9.3	3,241	6.7
CO ₂ emissions from waste incineration	65	0.4	198	0.8	334	0.7
Total	15,352	100	26,581	100	48,008	100

Source: * National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014
** Report on Projection of GHG emissions from waste sector in Viet Nam for 2020 and 2030, 2014

Table 2.35 shows that the total GHG emissions in the four sectors of energy, agriculture, LULUCF and waste were 225.6 million tonnes of CO₂ equivalent in 2010 and are projected to increase to 466 million tonnes in 2020 and 760.5 million tonnes in 2030. The energy sector would remain the largest source of GHG emissions with 381.1 million tonnes of CO₂ equivalent in 2020, and 648.5 million tonnes of CO₂ equivalent in 2030.

Table 2.35. Total GHG emissions in 2010 and projections for 2020 and 2030

Unit: million tonnes of CO₂e

Sector	2010*	2020**	2030**
Energy	141.1	381.1	648.5
Agriculture	88.3	100.8	109.3
LULUCF	-19.2	-42.5	-45.3
Waste	15.4	26.6	48.0
Total	225.6	466.0	760.5

Source: * National GHG Inventory Report 2010 of Viet Nam,
The project "Capacity Building for National GHG Inventory in Viet Nam", 2014
** Reports on Projection of GHG emissions from energy, agriculture, LULUCF, waste sectors
in Viet Nam for 2020 and 2030, 2014

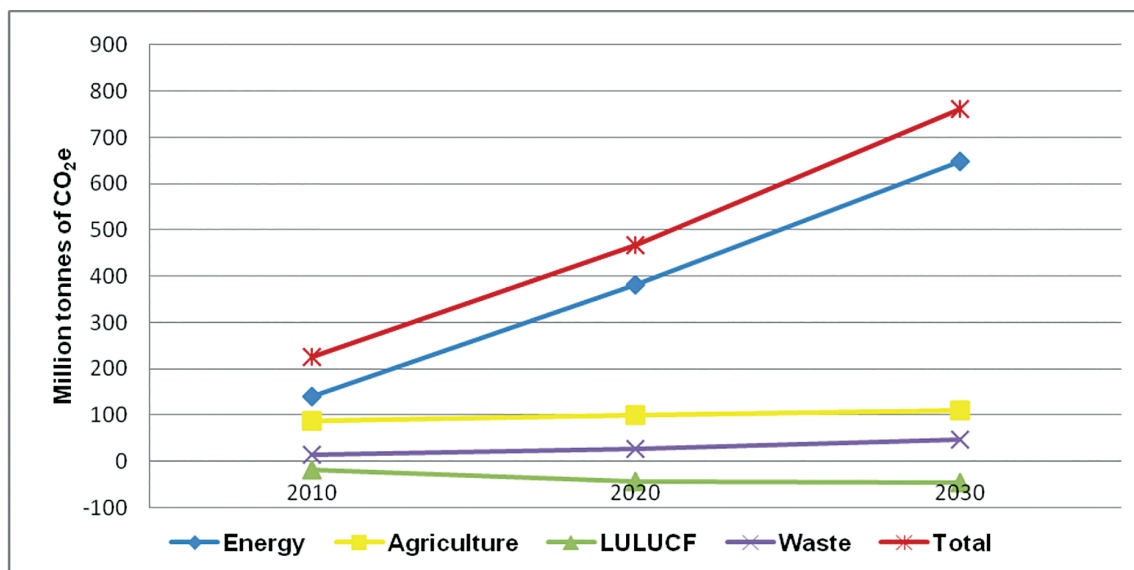


Figure 2.9. Total GHG emissions in 2010 and projections for 2020 and 2030



Figure 2.10. Workshop on the 2010 National GHG Inventory

CHAPTER 3

GREENHOUSE GAS EMISSION MITIGATION ACTIVITIES

3.1. NAMA preparation

3.1.1. General information

The Nationally Appropriate Mitigation Action (NAMA) is a new incentive to reduce GHG emissions for developing countries, formulated at COP13 in Bali, Indonesia and included in the Bali Action Plan. At COP17 in Durban, South Africa, procedures for NAMA registration were developed. COP17 also requires developing countries to submit BURs with information on NAMAs to the UNFCCC Secretariat.

Some developing countries have submitted plans to mitigate GHG emissions with support from developed countries in the forms of cooperation on technology and provision of finance and capacity-building. These GHG mitigation plans also can be considered as NAMAs. Currently, a number of NAMA proposals have been officially announced.

The Cancun Agreement proposed setting up an official international registration system for NAMAs and solutions for successful implementation of NAMAs. NAMAs that require international support will be included in the registration system to seek assistance from developed countries. Those which do not require international assistance will be registered separately. This registration system has been managed and operated by the UNFCCC Secretariat since 2013.

Developing countries provide information on NAMAs while developed countries provide information on support for NAMAs. Supporting activities should be Measurable, Reportable and Verifiable at international level. NAMAs that do not require international support would be MRV at national level.

On November 21st, 2012, the Prime Minister of Viet Nam issued Decision No. 1775/QĐ-TTg on approval of the Plan of management of GHG emissions and management of carbon trading activities to the world market. The overall objective of the Plan is to manage GHG emissions to implement the UNFCCC and international treaties to which Viet Nam is a Party, and at the same time take advantage of opportunities for economic development towards a low-carbon economy and green growth, contribute to international community efforts to mitigate GHG emissions and achieve sustainable development goals of the country.

Six specific objectives of the Plan are to:

- Strengthen capacity on national GHG inventory of line ministries, economic sectors and localities involved in the national GHG inventory system; establish and operate the national GHG inventory system and conduct GHG inventories every two years;
- Disseminate and apply technologies to reduce GHG emissions and increase carbon sinks in Viet Nam.
- Develop NAMA framework in Viet Nam, register and deploy NAMAs widely;
- Establish and put the national MRV system into operation;
- Increase awareness and responsibility of all levels, sectors, localities, enterprises and communities;

- Strengthen international cooperation in order to mobilize financial support and technology transfer from the international community to implement the National Climate Change Strategy.

To implement the above-mentioned Plan, MONRE issued Decision No. 187/QĐ-BTNMT dated February 21st, 2013 to establish NAMA Working Team to advise and propose to the Minister of Natural Resources and Environment, line ministries and relevant agencies on measures to establish the institutional framework including policies, legal documents to facilitate integration of NAMA into sustainable development programs, planning and plans of the line ministries, economic sectors, agencies and localities.

On March 4th, 2013, the Government issued Decree No. 21/2013/ND-CP, in which MONRE is responsible for:

- Developing and operating the national MRV systems; implementing national GHG inventory; proposing and recommending policies and measures to mitigate GHG emissions in Viet Nam appropriate to socio-economic development in each stage;

- Providing guidelines, monitoring and implementing measures to manage the carbon trading activities under the provisions of existing law and international treaties to which Viet Nam is a Party, issuing letters of approval for Clean Development Mechanism projects and other international mechanisms on GHG emission reduction for relevant organizations.

Currently, DMHCC under MONRE is the National Focal Point for NAMA registration to the UNFCCC.

3.1.2. Development of NAMA proposals

At present, the institutional arrangements for NAMAs in Viet Nam are under development. Some activities such as capacity-building and technical assistance to develop baseline scenarios, mitigation scenarios, the MRV system, etc. are also being carried out. The capacity of the ministries and agencies involved in development of NAMAs and for monitoring and evaluation of GHG mitigation is still limited.

Some NAMA proposals in the energy, industry, construction, agriculture, forestry and waste sectors in Viet Nam have been developed but are still unable to access international support.

The project “Facilitating Implementation and Readiness for Mitigation” funded by the Danish International Development Agency through the UNEP-DTU Partnership has been recently implemented by MONRE in collaboration with relevant agencies. The goal of the project is to support efforts to reduce GHG emissions and to contribute to economic development towards a low-carbon economy and green growth in Viet Nam. The project aims to remove non-financial barriers to develop and implement priority NAMAs. Under this project, two NAMAs are being developed for registration, namely (i) Supporting program for wind power development in Viet Nam and (ii) NAMA on biogas for on-site power generation for medium/large pig farms.

The General Department of Energy under MOIT has proposed the NAMA entitled “Fund for renewable energy development – Viet Nam GET FiT mechanism” submitted to NAMA Facility for its support recently. This project will help promote public and private investment in the renewable energy sector in order to obtain the goal, declared in the National Power Development Plan 7, of developing renewable energy and to contribute to achieving the goals of GHG emission mitigation identified in the National Green Growth Strategy.

Information about the three above-mentioned NAMAs is presented in the Appendix I.



Figure 3.1. The Fourth Capacity-building Workshop on LCD and NAMAs in Ha Noi

In addition, several preparatory activities for NAMAs have been conducted:

1. The Project “Climate Smart Agriculture” implemented in 2012 by MARD with financial support from FAO focuses on NAMA development for agriculture in northern mountain areas and considers the co-benefits of GHG mitigation activities. Development of NAMAs will be based on mitigation options identified in the National Communications of Viet Nam to UNFCCC and implemented by national and international research institutes. Through this project, biogas can be substituted for natural gases and fertilizers in low-lying areas with great potential of GHG emission reduction.

2. The project “Technical guidelines for NAMAs and MRV in Viet Nam” funded by UNDP and implemented by IMHEN, MONRE in 2013 has provided information and technical guidelines on developing and implementing NAMAs, including methodologies and tools for development and implementation and a list of potential emission mitigation activities that can be developed as NAMAs in a MRV manner as well as experiences of a number of countries in the world.

3. The project “Support to plan and implement NAMAs” (SPI-NAMA) funded by the JICA and expected to be implemented by MONRE in 2015 aims to (i) strengthen capacity of MONRE in promoting, coordinating and managing the planning and implementation of NAMAs and (ii) strengthen capacity of line ministries and stakeholders involved in the planning and implementation of NAMAs.

Besides, a number of NAMA proposals are also being developed by relevant agencies such as the Project on NAMA development for the building sector funded by UNEP; the Project on converting waste into resources for cities in Viet Nam funded by UN-ESCAP; the Project on capacity-building and development of action plans to mitigate GHG emissions in cement production in Viet Nam supported by the Nordic Development Fund; the Project on support for NAMAs in Viet Nam funded by the Federal Republic of Germany; the Project on strengthening cooperation and research on NAMA in a MRV manner in the solid waste sector supported by OECC.

3.1.3. MRV preparation

General information

The Bali Action Plan introduced the concept of NAMAs. NAMAs are developed not only to achieve GHG emission reductions but also to promote sustainable development, develop a low-carbon economy and green growth. To meet the requirements of NAMAs, a national MRV system should be developed.

In Viet Nam, one of the specific tasks for the period of 2012-2015 of the Plan of management of GHG emissions and management of carbon trading activities to the world market is to establish MRV systems at both national and sectoral levels in order to meet the requirements of national GHG inventory and GHG emission management, including the development of country-specific emission factors. In the next phase, the systems will be expanded to monitor GHG sources and meet the requirements on providing data for GHG inventories and preparing periodic reports.

Proposed structure for MRV system

Objectives of the MRV system

- Facilitate application of advanced technologies, products, services and infrastructures for low-carbon development as well as implement mitigation actions and contribute to sustainable development of the country;
- Assess the contribution of GHG emission reduction and enhancement of carbon sinks of an economic sector or the whole country; and
- Implement the UNFCCC's objectives through GHG emission reductions and enhancements of carbon sinks.

Required information and data for MRV system

The MRV system, for state management agencies at all levels, is essentially a system to control and monitor information and data provided or observed during a specific operational timeframe of a specific target. Information and data management of an MRV system needs to associate with functions and mandates of a state management agency.

Functions and duties of state management agencies on MRV system

For the national MRV system, the National Climate Change Committee is mandated to develop and modify guidelines and regulations necessary to implement mitigation actions, including development of methodologies, implementation of measurement, monitoring and evaluation of programs and projects on mitigation of GHG emissions, and verification of quantified GHG emission reduction or enhancement of carbon sinks, etc.

Based on legal documents and guidelines developed and promulgated by the National Climate Change Committee, line ministries, economic sectors and localities develop MRV methodologies for GHG emission reduction or enhancement of carbon sinks within the sectors and localities.

The proposed institutional arrangement for national and sectoral MRV systems is shown in Figure 3.1.

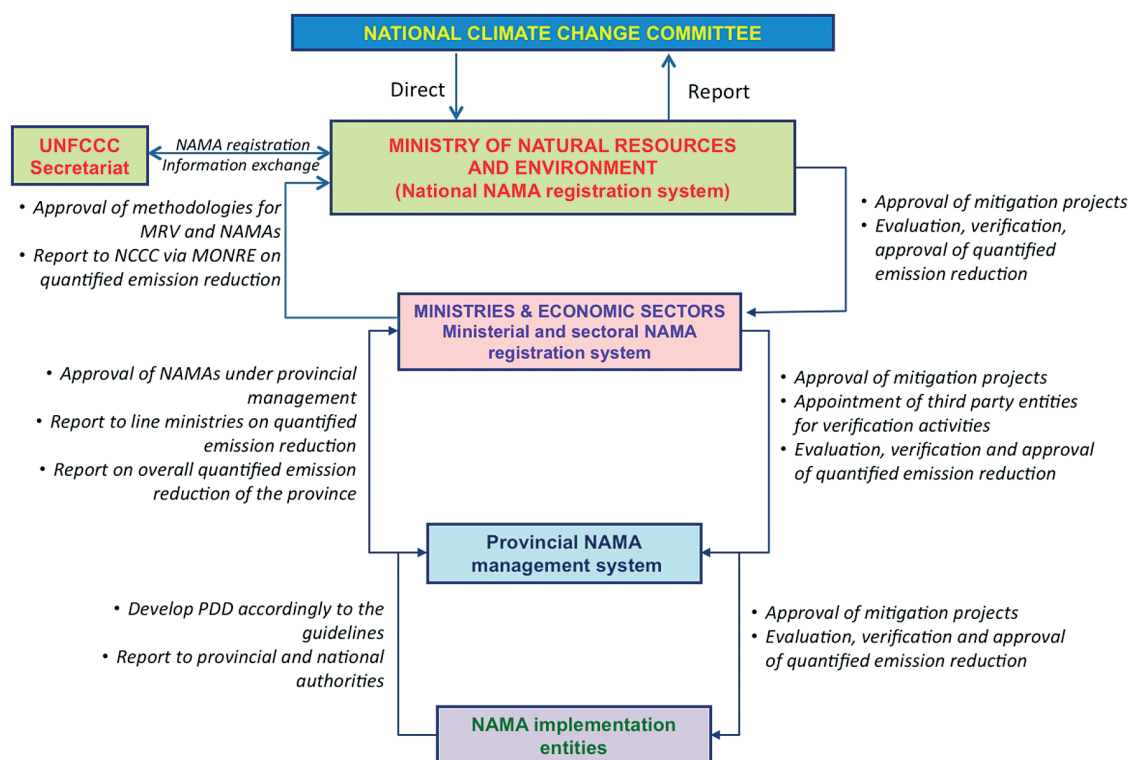


Figure 3.2. Proposed institutional arrangement for national and sectoral MRV systems

3.2. CDM Implementation

As of June 2014, Viet Nam had 253 CDM projects and 11 PoA registered and 10,068,987 CERs issued by EB through CDM activities. At the moment, Viet Nam is ranked 4th in the world for the number of registered CDM projects and 11th for the issued CERs. Total GHG emissions reduced by 253 CDM projects are about 137 million tonnes of CO₂ equivalent during the crediting periods. Among the above-mentioned CDM projects, the number of projects in the energy sector accounted for 88.19%; those in the waste sector for 9.96%; those in afforestation and reforestation for 0.37%; and other project types for 1.48%. Distribution of Viet Nam's registered CDM projects by sector is shown in Figure 3.2.

The Second National Communication of Viet Nam to the UNFCCC in December 2010 listed the CDM projects in Viet Nam registered by the EB at that time. Since then, 219 new CDM projects have been registered. General information about these new CDM projects is presented in Appendix II.

In order to create favourable conditions for domestic and international investors and attract investment for CDM activities to achieve sustainable development objectives of the country, Viet Nam has issued a number of legal documents as follows:

- Decision No.130/2007/QĐ-TTg dated August 2nd, 2007 by the Prime Minister on a number of mechanisms and policies to finance investment projects under the CDM;
- Joint Circular No.58/2008/TTLT-BTC-BTNMT dated July 4th, 2008 of the Ministry of Finance and MONRE guiding the implementation of some articles of Decision No. 130/2007/QĐ-TTg dated August 2nd, 2007 by the Prime Minister on a number of mechanisms and policies to finance investment projects under the CDM;

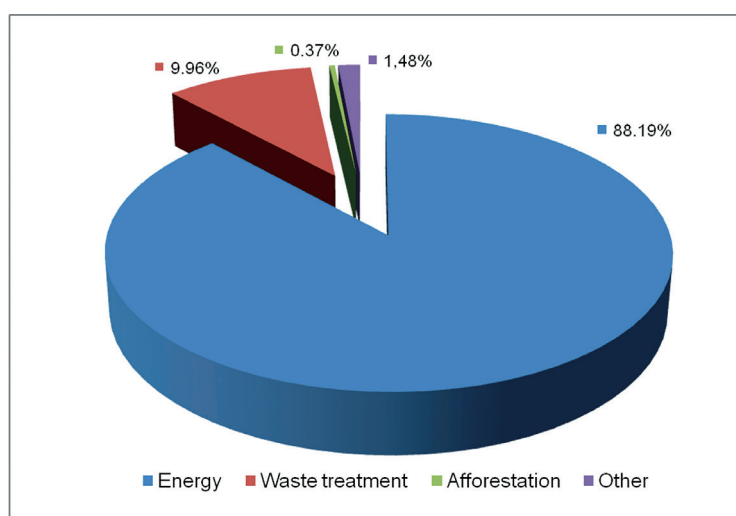


Figure 3.3. Distribution of Viet Nam's registered CDM projects by sector

- Circular No.12/2010/TT-BTNMT dated July 26th, 2010 of MONRE on CDM project development, letter of endorsement, letter of approval for the CDM projects in the framework of Kyoto Protocol.

- Joint Circular No.204/2010/TTLT-BTC-MONRE dated December 15th, 2010 of the Ministry of Finance and MONRE amending and supplementing some contents of Joint Circular No. 58/2008/TTLT-BTC-MONRE dated July 4th, 2008;

- Circular No.15/2011/TT-BTNMT dated April 28th, 2011 of MONRE on amending and supplementing a number of articles of Circular No.12/2010/TT-BTNMT dated July 26th, 2010;

- Circular No.15/2014/TT-BTNMT dated March 24th, 2014 of MONRE on CDM project development, letter of endorsement, letter of approval for the CDM projects in the framework of Kyoto Protocol, replacing Circular No.12/2010/TT-BTNMT dated July 26th, 2010 and Circular No.15/2011/TT-BTNMT dated April 28th, 2011.

In addition, DMHCC, in collaboration with relevant agencies, has developed and published emission factors for the national grid for 2008, 2010, 2011 and 2012 to serve CDM project development. The emission factors of the national grid are shown in Table 3.1.

Table 3.1. Emission factors of national grid for 2008, 2010, 2011 and 2012

	2008	2010	2011	2012
Emission factor (tCO₂/MWh)	0.5764	0.5408	0.6244	0.5603

Source: Research reports on development of emission factors of the national grid in Viet Nam from 2010-2013, Department of Meteorology, Hydrology and Climate Change

However, CDM activities in the past two years in Viet Nam have slowed due to the decline of international carbon markets, consequently CDM is no longer attractive to domestic and foreign investors. During the period of 2013-2014, there were only two PDDs submitted to the Viet Nam DNA for approval.



*Recovery of associated gas in Rang Dong oil field,
Ba Ria Vung Tau Province*



Landfill gas recovery in Ho Chi Minh City



*Wastewater treatment in Intimex tapioca starch
manufacturing plant, Nghe An Province*



*Small hydropower plant in Muc River,
Thanh Hoa Province*

Figure 3.4. Photos of several CDM projects in Viet Nam

3.3. Implementation of JCM and other mechanisms

To strengthen bilateral cooperation on climate change and contribute to the target to limit global average temperature increase to less than 2°C by the end of this century, Japan and Viet Nam signed a Memorandum of Cooperation on low-carbon growth in July 2013. On the Vietnamese side, MONRE, as appointed by the Government of Viet Nam, in collaboration with relevant ministries, works with the Japanese side to establish the Joint Committee for Joint Crediting Mechanism (JCM) and to issue guidelines to implement the JCM in the country.

According to the Memorandum, Japan and Viet Nam conduct joint consultations on policies at all levels to work towards low-carbon growth under the framework of the UNFCCC as well as through other multilateral and bilateral cooperation. The two sides also promote investment and development of technologies, products, services and infrastructure for low-carbon emissions in Viet Nam.

At the First Joint Committee meeting on September 18th, 2013, both sides adopted the Rules of Procedures for the Joint Committee, appointed the Secretariat to the Joint Committee and discussed technical guidelines. At the Second Joint Committee meeting on February 17th, 2014, technical guidelines were adopted for developing several pilot JCM projects in Viet Nam.

To implement the direction of the Prime Minister in Official Document No. 10728/VPCP-QHQT dated December 19th, 2013, MONRE, in cooperation with relevant ministries and agencies, conducts the pilot JCM projects. Currently, a circular guiding the implementation of the JCM projects is under development and is expected to be issued by the end of 2014.

The total GHG emission reduction potential of 28 JCM projects (proposed by the Ministry of Environment and the Ministry of Economy, Trade and Industry of Japan) in the feasibility study phase is estimated at about 10 million tonnes of CO₂ equivalent per year, including 18 energy projects, four transport projects, three waste projects and three forestry projects. At the Second Joint Committee meeting, the following four projects were selected for development and implementation during the pilot phase:

1. Improving the general efficiency of energy use in a brewery;
2. Using heat pump technology to improve energy efficiency in fisheries processing factories;
3. Application of the energy management system to reduce emissions in hotels;
4. Building a Green Hospital through efficient energy use.

In the near future, Viet Nam and Japan will continue to carry out more feasibility studies to expand the JCM projects in the country with experience from the pilot JCM projects.

Apart from the implementation of the JCM projects, some enterprises in Viet Nam have participated in carbon crediting projects under the Verified Carbon Standard (VCS) and Gold Standard (GS) to trade on voluntary carbon markets. As of June 15th, 2014, Viet Nam has four projects registered under the GS and 15 projects under the VCS with 419,452 credits issued for these VCS projects.

3.4. Development of GHG mitigation options

3.4.1. GHG mitigation options in energy sector

GHG mitigation options in the energy sector are based on Business-As-Usual scenario (BAU), assuming that more policies will be issued to support development of GHG mitigation technologies, including technologies for energy conservation, saving and renewable energy. GHG mitigation options are reviewed and assessed on effectiveness, incremental costs, potentials and benefits from emission reduction compared to BAU.

The Long-range Energy Alternatives Planning System (LEAP) model was used for development of GHG mitigation options in the energy sector. This model allows analysis of energy - environment supply and demand of energy system, including sources of primary energy, transformation, distribution and use of energy on the basis of assumptions on population, economic development, technologies and energy prices.

Forecast of primary energy demand by fuel type for the period of 2015 - 2030 is presented in Table 3.2 below:

Table 3.2. Primary energy demand for the period of 2015 - 2030

Unit: KTOE

	2015	2020	2025	2030	Growth rate 2015-2030 (%)
Coal	27,156.1	43,205.8	59,664.9	90,281.9	8.3
Crude oil	6,848.6	21,072.7	31,609.0	42,145.4	12.9
Oil products⁷	12,492.2	4,925.0	1,783.9	856.6	-16.4
Natural gas	8,345.6	11,967.2	16,167.0	17,558.5	5.1
Nuclear	0.0	0.0	1,138.1	7,091.8	N/A ⁸
Hydropower	3,663.6	4,732.4	5,046.2	5,497.8	2.7
Renewable	1,148.6	1,749.8	2,272.1	2,595.6	5.6
Biomass	7,009.0	5,243.7	3,349.4	1,363.5	-10.3
Imported electricity	622.0	845.6	1,069.2	1,325.4	5.2
Total	67,285.7	93,742.2	122,099.8	168,716.5	6.6

Source: Report on development of mitigation options for energy in Viet Nam for the period of 2020-2030, 2014

Six GHG mitigation options for the energy sector are:

E1. Using high efficiency air conditioners

The assumption is that by 2030 the use of high efficiency air conditioners would increase from 30% as estimated in the BAU to 85% of total households in urban areas and from 15% to 70% in rural areas.

Air conditioning equipment currently used has a capacity of 12,000 BTU, corresponding to 1,200 W of power capacity. High efficiency air conditioners with the same cooling capacity cost US\$100 more but can reduce power consumption by 40-50%. Both types have a lifespan of 15 years.

The total investment cost to implement the E1 option is US\$1,861 million, which would reduce 63,872.5 million kWh; emission reduction potential is 39.1 million tonnes of CO₂ equivalent. Mitigation cost is -7.8 US\$/tCO₂ equivalent.

E2. Converting to LPG in transport sector

The assumption is that by 2030 there would be 200 thousand taxis using LPG instead of petrol. On average, petrol-fueled taxis run 50,000 km per year, petrol consumption is about 10 liters per 100 km while LPG-fueled taxis consume 12.5 liters per 100km. The price of LPG-fueled vehicles is about US\$ 2,500 higher than petrol-fueled vehicle but the price of LPG is only 90% of petrol. The lifespan of both vehicles is 15 years.

The incremental cost for LPG use is US\$ 625 million, while increased demand for LPG is 8,269.8 KTOE, but 8,313.9 KTOE of petrol and 4.7 million tonnes of CO₂ equivalent would be reduced. Mitigation cost is US\$ -10.9/tCO₂ equivalent.

E3. Switching from petroleum to ethanol use in transport sector

The assumption is that ethanol production used by 2020 would be 870 thousand tonnes, equivalent to 550 KTOE (compared to 300 KTOE of the BAU) and by 2030 would be 1.5 million tonnes, equivalent 960 KTOE (compared to 600 KTOE of the BAU).

⁷ Imported oil products excluding exported oil products

⁸ N/A - Not applicable

Cassava will be used as an input for ethanol production. In 2010, the price of dried cassava in Viet Nam was around VND 4,100-4,200/kg (equivalent to US\$ 210/tonne) and prices are expected to rise to US\$ 300/tonne in 2030 due to the increasing demand of raw materials for production. The lifespan of plants is expected to be 30 years.

The investment cost for ethanol plants is US\$ 1,200/TOE, operation and maintenance (O&M) cost is estimated at 30% of investment costs, equivalent to US\$ 36/TOE per year, operating cost is about US\$ 20/TOE. Total investment cost for ethanol production is US\$ 4,985.5 million while 4,230 KTOE of petrol and 12.3 million tonnes of CO₂ equivalent would be reduced. Mitigation cost is US\$ 19.2/tCO₂ equivalent.

E4. Biomass thermo-power development

The assumption is that biomass thermo-power capacity would reach 500 MW by 2020 and 2,000 MW by 2030 to replace coal-fired thermo-power.

Biomass thermo-power efficiency is 32% with the load factor of 60%. The investment cost for biomass thermo-power is US\$ 1,800/kW, O&M cost is US\$ 70/MW, and operating cost is US\$ 10/MWh. The fuel cost for biomass thermo-power is US\$ 20/TOE. The lifespan of plants is expected to be 30 years.

Coal-fired thermo-power efficiency is 35% with the load factor of 80%. The investment cost for coal-fired thermo-power is US\$ 1,300/kW, O&M cost is US\$ 42/MW, and operating cost is US\$ 0.15/MWh. The fuel cost for coal-fired thermo-power is US\$ 35/TOE. The lifespan of plants is expected to be 30 years.

The increase in total cost of investment and operation of biomass thermo-power compared to coal-fired thermo-power is US\$ 2,458.7 million while the fuel cost decreases by US\$ 2,196.4 million and 57.3 million tonnes of CO₂ equivalent would be reduced. Mitigation cost is US\$ 4.8/tCO₂ equivalent.

E5. Small hydropower development

The assumption is that the capacity of small hydropower (SHP) by 2015 would reach 2,950 MW (350 MW increase compared to BAU) and by 2025 would be 5,600 MW (1,600 MW increase compared to BAU) to replace coal-fired thermo-power.

SHP plants have the load factor of 50%. The investment cost for SHP is US\$ 1,700/kW, O&M cost is estimated at 2.5% of investment cost and operating cost is US\$1.0/MWh. The lifespan of SHP is 25 years.

Coal-fired thermo-power efficiency is 35% with the load factor of 80%. The investment cost for coal-fired thermo-power is US\$ 1,300/kW, O&M cost is US\$ 42/MW, and operating cost is US\$ 0.15/MWh. The fuel cost for coal-fired thermo-power is US\$ 35/TOE. The lifespan of plants is 30 years.

The increase in total cost of investment and operation of SHP plants compared to coal-fired thermo-power is US\$ 2,240 million while the fuel cost decreases by US\$ 2,507.7 million and 55.7 million tonnes of CO₂ equivalent would be reduced. Mitigation cost is US\$ -4.7/tCO₂ equivalent.

E6. Wind power development

The assumption is that wind power capacity would reach 1,000 MW by 2020 and 6,200 MW by

2030 if there are new policies to support wind power.

The wind power farms have 100% efficiency with the load factor of about 25%. The investment cost for wind power farms is US\$ 2,000/kW, O&M cost is US\$ 15/MW, and operating cost is US\$ 0.5/MWh. The lifespan of wind power plants is 25 years.

Coal-fired thermo-power efficiency is 35% with the load factor of 80%. The investment cost for coal-fired thermo-power is US\$ 1,300/kW, O&M cost is US\$ 42/MW and operating cost is US\$ 0.15/MWh. Fuel cost for coal-fired thermo-power is US\$ 35/TOE. The lifespan of plants is expected to be 30 years.

The increase in total cost of investment and operation of wind power is US\$ 6,334.7 million compared to coal-fired thermo-power while the fuel cost for power generation decreases by US\$ 3,655.8 million and US\$ 68.1 million tonnes of CO₂ equivalent would be reduced. Mitigation cost is US\$ 41.1/tCO₂ equivalent.

Total GHG emission reduction potential and cost of the six above options compared to the BAU are shown in Table 3.3.

Table 3.3. Potential and cost of GHG mitigation options in energy sector

Option	Code	GHG reduction potential (million tCO ₂ e)	Incremental cost ⁹ (US\$ million)	Cost (US\$/tCO ₂ e)
Using high efficiency air conditioners	E1	39.083	-68.868	-7.8
Converting to LPG in transport sector	E2	4.726	-15.614	-10.9
Switching from petroleum to ethanol use in transport sector	E3	12.265	70.497	19.2
Biomass thermo-power development	E4	57.343	69.390	4.8
Small hydropower development	E5	55.741	-75.117	-4.7
Wind power development	E6	68.145	668.888	41.1
Total		237.303		

3.4.2. GHG mitigation options in agriculture sector

In the process of developing GHG mitigation options in this sector, DeNitrification – DeComposition (DNDC) model is used to estimate GHG emissions from paddy fields. Marginal abatement cost curves (MACC) are developed based on determining the GHG emission reduction potential and cost-effectiveness of GHG mitigation options.

⁹ At current prices with discount rate of 10%

The BAU scenario is developed according to the Agriculture Development Plan to 2020 and Vision to 2030 at Decision No.124/QD-TTg dated December 2nd, 2012 of the Prime Minister. Some agricultural production targets for 2010, 2020 and vision to 2030 are summarized in Table 3.4.

Table 3.4. Agricultural production targets for 2010, 2020 and vision to 2030

Category	2010	2020	2030
Agricultural land area (million ha)	10.17	9.59	9.80
Paddy area (million ha)	7.49	7.01	7.01
Maize area (million ha)	1.13	1.44	1.44
Dairy cow (thousand head)	128.40	500.00	700.00
Non-dairy cow (thousand head)	5,679.90	12,500.00	14,500.00
Buffalo (thousand head)	2,877.00	3,900.00	4,500.00

Source: - Statistical Yearbook 2011, General Statistic Office, 2012;
- Decision No. 124/QD-TTg dated February 02nd, 2012 of the Prime Minister approving the Master Plan on development of agricultural production in 2020 and vision towards 2030, 2012

Two options for GHG mitigation in the agriculture sector are:

A1. Alternate wetting and drying irrigation or system of rice intensification (AWD-SRI)

According to this option, by 2030 on-demand irrigation would be implemented for 2.3 million ha of rice fields in the irrigated delta areas. The area of rice fields using this irrigation technology was 90,000 ha in 2010; under this option, this would increase to 1.5 million ha in 2020 and 2.3 million ha in 2030. GHG reduction potential of option A1 is 1.47 million tonnes of CO₂ equivalent; mitigation cost is US\$ 76.3/tCO₂ equivalent.

A2. Re-using rice crop residues as composts

According to this option, by 2030 re-using rice crop residues as composts would be implemented on 51% of the rice-cultivated area, equivalent to about 3.6 million ha. The area under this option was 0.1 million ha in 2010; increasing to 2.5 million ha in 2020 and 3.6 million ha in 2030. GHG reduction potential of option A2 is 9.34 million tonnes of CO₂ equivalent, mitigation cost is US\$ -59.1/tCO₂ equivalent.

Potential and cost of GHG mitigation options in the agriculture sector are presented in Table 3.5.

Table 3.5. Potential and cost of GHG mitigation options in agriculture sector

Option	Code	GHG reduction potential (million tCO ₂ e)	Cost (US\$/tCO ₂ e)
Alternate wetting and drying irrigation or system of rice intensification	A1	1.47	76.3
Re-using rice crop residues as composts	A2	9.34	-59.1
Total		10.81	

3.4.3. GHG mitigation options in LULUCF sector

The Comprehensive Mitigation Assessment Process (COMAP) model is used to develop and assess a number of GHG emission mitigation options for this sector.

The BAU scenario in the LULUCF sector is developed on the basis of National Forest Development Strategy in the period of 2006 – 2020. The main content of this scenario is to sustainably develop

and manage 1.75 million ha of production and protection forests, of which 1 million ha would be mixed planting of indigenous tree species, 0.5 million ha would be forest natural regeneration with enrichment planting of indigenous tree species under forest canopy and management and protection of the remaining 0.25 million ha of natural forest, would be combined with development of non-timber forest products (NTFPs) for the period of 2010 – 2030. Areas selected for the implementation of mitigation options are the South Central and Central Highlands regions.

Three GHG mitigation options for this sector are:

F1. Mixture plantation of indigenous tree species

According to this option, one million ha of *Michelia mediocris* Dandy, *Pterocarpus macrocarpus* and *Hopea odorata* would be planted within 10 years, at an annual planting rate of 100,000 ha on bare land or fallow cultivation land with soil layer thickness $\geq 40\text{cm}$, and a density of 1,660 seedlings per ha in a 30-year business rotation. The potential of enhancing GHG sinks of option F1 is 504.17 million tonnes of CO_2 ; mitigation cost is US\$ 1.3/t CO_2 .

F2. Natural forest regeneration with enrichment planting of indigenous trees under forest canopy

According to this option, 0.5 million ha of *Hopea odorata* and *Erythrophloeum fordii* would be planted in the first five years, the annual planting rate of 100,000 ha on poor forest land with a density of 500 seedlings per ha in a form of rows or clusters with a 30-year business rotation. The potential of enhancing GHG sinks of option F2 is 151.29 million tonnes of CO_2 ; mitigation cost is US\$ 1.6/t CO_2 .

F3. Community based-forest management under the forestry socialization policy with planting of NTFPs

According to this option, 0.25 million ha of existing natural forest would be protected with planting of NTFPs under forest canopy over a period of 30 years. The planted species are *Calamus tetradactylus* and *Amomum longiligulare* within the first five years. The density of *Calamus tetradactylus* is 2,000 seedlings per ha and *Amomum longiligulare* is 3,000 seedlings per ha. The potential of enhancing GHG sinks of option F3 is 137.30 million tonnes of CO_2 ; mitigation cost is US\$ 0.9/t CO_2 .

Potential of GHG mitigation and cost-effectiveness of the three options above are presented in Table 3.6.

Table 3.6. Potential and cost of GHG mitigation options in LULUCF sector

Option	Code	GHG mitigation potential (million t CO_2)	Cost (US\$/t CO_2)
Mixture plantation of indigenous tree species	F1	504.17	1.3
Natural forest regeneration with enrichment planting of indigenous trees under forest canopy	F2	151.29	1.6
Community based-forest management under the forestry socialization policy with planting of NTFPs	F3	137.30	0.9
Total		792.76	

CHAPTER 4

FINANCIAL, TECHNOLOGY AND CAPACITY NEEDS AND SUPPORT RECEIVED FOR CLIMATE CHANGE ACTIVITIES

Viet Nam has been actively developing and implementing activities to respond to climate change. In recent years, the Government of Viet Nam has issued the National Climate Change Strategy, the National Target Program to Respond to Climate Change (NTP-RCC) and the Action Plan to Respond to Climate Change.

For the 2012-2015 period, NTP-RCC identifies 13 tasks and projects to develop and deploy action plans to respond to climate change with participation of relevant ministries, economic sectors and localities. In addition, the Program also sets out six tasks to improve State management on climate change, and develop and implement educational programs for the community and strengthen communication activities, raise public awareness and develop training programs on climate change.

On science and technology, NTP-RCC sets the task of developing and implementing the science and technology program on climate change with an estimated cost of about VND 320 billion for the period of 2009-2015.

The Support Program to Respond to Climate Change (SP-RCC) was formed in 2009 and has received substantial support from a number of international donors. During the period of 2010-2014, Viet Nam mobilized funding for SP-RCC with more than US\$ 800 million from major donors such as JICA, AFD, CIDA, WB, AusAID, and Korea Eximbank.

However, current financial, technical and capacity support has not met demand in the country. Besides, some gaps and constraints also need to be overcome in the near future.

4.1. Gaps and constraints

Gaps and constraints in Viet Nam in terms of finance, technology, and capacity building for GHG inventory, development and implementation of NAMAs and application of technologies to respond to climate change are as follows:

4.1.1. National GHG Inventory

- The system for national GHG inventory has not been officially established. The legal foundation for responsibilities of ministries, sectors and stakeholders in the GHG inventory is insufficient.
- Implementation of the GHG inventory is not comprehensive.
- Most of the emission factors used for GHG inventory are IPCC's default values;
- QA/QC is insufficient; inadequate and lacking specific guidelines in the country;
- Activity data for the GHG inventory is inadequate. There is a lack of a specific database to implement the GHG inventory periodically.
- Domestic financial resources and availability of local experts for the national GHG inventory are limited.
- Most of national GHG inventories are conducted primarily under programs and projects funded by international donors; involvement of line ministries, sectors and stakeholders are limited.

4.1.2. NAMA

- Understanding of NAMA is limited;
- National and sectoral policies to develop and implement NAMA/MRV are inadequate;
- The MRV systems at the national and sectoral levels are in the research and development phase;
- Ministries, economic sectors, localities and the private sector face various difficulties with limited organizational capacity in applying environmentally sound technologies and implementing NAMA in an MRV manner;
- Lack of an effective coordination mechanism among line ministries, economic sectors, localities, public and private sectors to develop and implement inter-sectoral NAMAs;
- NAMA developers face difficulties in accessing financial sources from both domestic and international sides.

4.1.3. Application of climate change response technologies

Energy sector

- Lack of mechanisms and policies to encourage investment, price subsidization and localization of technologies;
- High investment costs;
- Price of electricity produced from renewable energy sources such as wind, solar, geothermal, biomass is still higher than from fossil fuels;
- Difficulties in accessing finance from commercial banks for renewable energy projects due to low rate of return;
- Limited domestic technological capacity, and low quality and lifespan of products;
- Limited ability to receive and apply technologies;
- Lack of infrastructure and technical support services to repair, maintain and replace equipment.

Agriculture sector

- Low public awareness of benefits of environmentally sound technologies; limited capacity to apply new technology;
- Long-standing tradition of using conventional technologies or practices;
- Insufficient existing infrastructure and outdated domestic technology resulting in low quality products, to meet immediate needs to adapt to climate change;
- High cost of soil improvement and investment in new seeds to adapt to climate change;
- Lack of available technologies in aquaculture for different wetland conditions.

LULUCF sector

- Inconsistent policies in terms of interdisciplinary research and technology application;
- Limited financial resources for transferring and applying technologies remain;
- Lack of capacity in research, development and dissemination of technology;
- Insufficient land planning to ensure sustainable development of forests;
- Lack of updated information on bio-technology and of means for research and development.

4.2. Financial, technology and capacity needs

4.2.1. Financial needs

According to the Climate Public Expenditure and Institutional Review of Viet Nam carried out by UNDP recently, the Government of Viet Nam has spent considerable funds, about 0.1% of GDP, for activities to respond to climate change. Results compiled from the five ministries of Agriculture and Rural Development, Natural Resources and Environment, Industry and Trade, Construction and Transportation showed that the budget for climate change response was about VND 4,300 billion in 2010, but had dropped to about VND 3,800 billion in 2013 (at constant 2010 prices) due to the economic recession affecting the country.

According to that Review, most of the funding for responding to climate change came from domestic investment. Development partners' support from Official Development Assistance (ODA) to respond to climate change was about 31%, most of which was loans (about 97% in the period of 2004-2013).

In the investment structure, funds for climate change adaptation take up a large proportion while investment for GHG mitigation is insignificant. This limits the ability to apply GHG mitigation technologies in Viet Nam. The total investment for climate change response in Viet Nam is shown in Table 4.1.

**Table 4.1. Total investment to respond to climate change in Viet Nam
(constant 2010 prices)**

Unit: VND billion

Activity	2010	2011	2012	2013
Mitigation	111	20	41	149
Adaptation combined with mitigation	435	385	366	267
Adaptation	3,770	3,025	2,922	3,413

*Source: Climate Public Expenditure and Institutional Review of Viet Nam,
United Nations Development Programme, 2014*

To actively respond to climate change, Viet Nam has developed a number of programs, such as NTP-RCC, SP-RCC, Plan of management of GHG emission, management of carbon trading activities to the world market. Those programs and plan require huge capital investments that are still difficult to obtain.

The NTP-RCC for the period of 2012 - 2015 includes three component projects:

- Project 1: Assessment of climate change and sea level rise;
- Project 2: Development and implementation of action plans to respond to climate change;
- Project 3: Capacity-building, communication, monitoring and evaluating the program implementation.

The total budget for the NTP-RCC is VND 1,771 billion, with an estimated VND 770 billion from the national budget, VND 153 billion from provincial budgets and other sources, and VND 848 billion from international support.

The Plan of management of GHG emission and management of carbon trading activities to the world market approved by the Prime Minister requires a total budget of about VND 220 billion, including VND 120 billion from the national budget and VND 100 billion from ODA sources.

To implement priority projects for climate change response, selected from 400 climate change projects proposed by localities, the Prime Minister approved 61 priority projects with a total budget of VND 17,893 billion, including VND 14,326 billion from SP-RCC; remaining funding will be arranged by localities (Document No.1443/TTg-QHQT dated September 19th, 2012). In addition, upon the request of the Ho Chi Minh City People's Committee, Muong Chuoi culvert project has been added to the list of priority projects with a total funding requirement of VND 2,634 billion. The total funding needed for these 62 priority projects is VND 20,527 billion, including VND 16,960 billion from SP-RCC.

As of July 2014, 16 projects have been funded with a total budget of VND 916 billion (2013: VND 496 billion, 2014: VND 420 billion), meeting only 21% of the total required budget for these 16 projects and only about 4.4% of the total funds approved for the 62 projects. The projects under the SP-RCC are primarily related to climate change adaptation, including projects to upgrade, renovate and build new dikes and embankments against floods and erosions.

4.2.2. Technology needs

Technology needs for GHG mitigation

Viet Nam has carried out the technology needs assessment to cope with climate change within the framework of the Global Technology Needs Assessment Project - First stage (TNA - completed in 2012) with financial and technical support from UNEP through UNEP-DTU Partnership (formerly UNEP Risoe Centre). The process of selecting criteria for technology needs assessment for GHG mitigation for the priority areas is carried out on the basis of the document "*Handbook for conducting technology needs assessment for climate change*" issued by the UNFCCC and the UNDP, published in October 2010. Four criteria for assessment and selection of priority mitigation technologies are (i) economic benefits; (ii) social benefits; (iii) environmental benefits and (iv) potential for reducing GHG emissions.

Table 4.2 presents a number of GHG mitigation technologies that are selected according to the needs of the three sectors of energy, agriculture and LULUCF. These technologies have the ability to perform in the short, medium and long terms.

Table 4.2. Priority technologies for GHG mitigation by sector

Sector/Technology		Availability/Scale
Energy sector		
1	Wind power	Short term/Medium
2	Energy-saving compact fluorescent lamps	Short term/Small and Medium
3	Cogeneration	Short and Medium term/Medium
4	Bus rapid transit	Medium and Long term/Large
Agriculture sector		
1	Biogas	Short term/Small and Medium
2	Nutrition improvement through controlled fodder supplement	Short and Medium term/Small
3	Wet and dry irrigation in certain rice growth stages	Short and Medium term/Medium
LULUCF sector		
1	Sustainable Forest Management	Short term/Large
2	Afforestation and reforestation	Short term/Large
3	Rehabilitation of mangroves	Short term/Large

Source: Report on technology needs assessment to respond to climate change, the Global technology needs assessment project - First stage, 2012

Technology needs for climate change adaptation

The process of selecting criteria for technology needs assessment for climate change adaptation for priority areas were conducted on the basis of the document “*Handbook for conducting technology needs assessment for climate change*” published by the UNFCCC and the UNDP in October 2010. Four criteria to evaluate and select priority adaptation technologies are (i) economic benefits; (ii) social benefits; (iii) environmental benefits, and (iv) reduction of vulnerability to climate change.

Table 4.3 presents some adaptation technologies selected according to the needs of four areas with high vulnerability. These technologies can be applied in the short, medium and long terms.

Table 4.3. Priority technologies for adaptation by sector

Sector / Technology		Availability/Scale
Agriculture sector		
1	Plant Genetic/Breeding	Long term/Large
2	Rice to upland grain	Long term/Medium
3	Triple cropping to double cropping + shrimp/fish/poultry crop	Long term/Small
LULUCF sector		
1	Plant Science/Genetics ¹⁰	Short term/Large
2	Agro-forestry	Short term/Small
Coastal zone management sector		
1	Sea-dike	Short and Medium term/Large
2	Coastal wetland Rehabilitation	Short and Medium term/Large
Water resources sector		
1	Rooftop rainfall harvesting for household usages	Short term/Small
2	Harvesting runoff water	Short term/Small and Medium
3	Integrated River Basin Management	Short and Medium term/Large

Source: Report on technology needs assessment to respond to climate change, the Global technology needs assessment project - First stage, 2012

4.2.3. Capacity needs

As a developing Party to the UNFCCC, in order to implement effectively climate change response activities and contribute to the ultimate objective of the Convention, Viet Nam focuses on implementing a number of activities for strengthening capacity as follows:

a. Supplementing and completing legal documents for implementation of the UNFCCC and response to climate change in the country to ensure comprehensive and consistent coordination from central to local authorities with participation of the whole society.

b. Developing, updating and downscaling climate change scenarios as a basis for assessment of climate change impacts for developing and implementing action plans to respond to climate change at local level.

c. Improving capacity and effectiveness of early warning and disaster prevention; research and application of modern technology for meteorological forecasts, warnings, and observations; assessment of water resources, climate resources, climate change and climate change impacts.

¹⁰ Plant genetics to select and create new drought-, flood-, and pest-resistant species for climate change adaptation

d. Building capacity for officials who are focal points for climate change and NAMA, MRV, CDM and JCM at line ministries;

e. Developing a database system that can be integrated into the General Statistics Office database to meet demands of GHG inventory, climate change response, and national periodic reports on climate change;

f. Studying and developing country-specific emission factors for GHG inventory; improving capacity for measurement and quantification of GHG mitigation programs and projects at local and regional levels;

g. Improving capacity to develop a low-carbon economy for local authorities at all levels as well as enterprises;

h. Researching and developing several climate services and insurance systems.

4.3. Support received for climate change activities

To mobilize funding to implement climate change response activities, MONRE, in collaboration with line ministries, has implemented SP-RCC. In 2009, the SP-RCC had only two sponsors, JICA and AFD, but more donors have participated in the program since that time, including the WB, CIDA, DFAT (formerly AusAID), Korea Eximbank, etc. Total funds mobilized for the program in 2010, 2011, 2012, 2013 and 2014 respectively were US\$ 138 million, US\$ 212 million, US\$ 136 million, US\$ 173 million and US\$ 204 million.

In addition, MONRE, MOIT, MOC, MOT, and MARD have been receiving financial and technical assistance, and capacity-building for some projects to mitigate GHG emissions from both domestic and international institutions with a total fund estimated at about US\$ 200 million.

The Project “Preparation of Viet Nam’s Initial Biennial Updated Report to UNFCCC” has been considered for GEF support. However, in pursuant of Decision 2/CP.17 dated March 15th, 2012 of COP17 on submission of BUR1 by December 2014 (Article a, Paragraph 41), the Government of Viet Nam issued Decision No. 44/QD-TTg dated January 8th, 2014 approving the Policy Matrix Framework in 2014, in which the BUR1 development should be completed in 2014 using the national budget resources.

AFTERWORD

The Viet Nam Initial Biennial Updated Report to the UNFCCC has been chaired and coordinated by MONRE with contributions from line ministries, economic sectors and relevant agencies according to the existing UNFCCC Guidelines. Information, data and research results used in this Report have been collected from governmental agencies and research institutes at both central and local levels. Methodologies applied for the GHG inventory are from IPCC Guidelines.

The editing team includes experts and scientists in the fields of energy, agriculture, forestry and environment.

One of the important aspects of the Report is the inclusion of the results of the 2010 National GHG Inventory, with enhanced coverage of specific sectors, compared to inventories in the previous National Communications. As well, initial information on development and implementation of NAMAs and on establishment of the national MRV system is included.

This is the Initial Biennial Updated Report of Viet Nam. Some gaps may possibly remain in some areas. These gaps will be addressed gradually in future reports.

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APPENDICES

Appendix I: Information on preparations for three NAMAs

1. Supporting Program for Wind Power Development in Viet Nam

1.1. Scope

The scope of the Program will be nationwide to support and enable the creation of a favourable, long-term and viable environment for both public and private investors to effectively exploit wind energy through developing institutional and policy frameworks, human resources, technical infrastructure and maintenance services. This Program refers to wind power projects of any size for grid connection, and applies to all organizations and individuals participating in the wind power market.

The timeframe of the Program is a minimum of 10 years to allow enough time for enabling the establishment of a service market in the initial phase and to create the continuity needed to stabilize the suppliers' position in the market.

1.2. Objectives

• **Overall objective:** build a favourable environment for wind power development in Viet Nam in order to promote renewable energy and contribute to the reduction of GHG emissions and to sustainable development in Viet Nam.

• **Specific objectives:**

- Remove barriers on policy, capacity, technology and finance to achieve around 1,000 MW of installation capacity or 0.7% of total power generation output by 2020, ensuring adequate levels of service and product quality.
- Contribute to Viet Nam's national target to mitigate GHG emissions from 10% to 20% by 2020 and from 20% to 30% by 2030 below BAU.
- Create jobs and income opportunities in the wind power industry by supporting and enabling a service market for wind power development in Viet Nam.

1.3. Proposed outcomes and activities

Outcome 1: A policy framework will be created, including an investment incentive for the development of supporting industries; financial subsidy for feasibility studies; new, convenient and suitable regulations for investment, construction and operation of wind farms; and a legal basis for MRV in the wind energy sector

Activities:

- Setting up price-based support mechanisms (FiT) as an investment incentive.
- Carrying out feasibility studies into financial subsidy.
- Developing convenient registration and investment procedures for wind farms.
- Setting up supporting policies for wind power - related industries (manufacturing tower, turbines, blades and other equipment).
- Establishing a legal framework for implementing MRV for wind power projects.

Outcome 2: Technical capacity will be improved, including wind rose maps, information, construction facilities and maintenance services to enable preparation of wind power projects in the country

Activities:

- Building wind rose maps to locate appropriate sites for wind power plants and a communication system to provide information to stakeholders.
- Developing technical regulations for designing, operating and maintaining wind farms.
- Promoting supplementary industry for wind power.
- Developing maintenance services.

Outcome 3: Awareness and business skills among appropriate groups will be enhanced to enable efficient preparation, implementation and maintenance of wind power projects for both public and private sectors

Activities:

- Setting up a training program on wind power in Hanoi University of Technology and in the Electric Power University.
- Facilitating training on wind power technology for relevant stakeholders.
- Creating a network of experts to share experience and knowledge on wind power.
- Promoting PPP model for wind power development to mobilize private capital and to enable efficient preparation and implementation of projects.

2. NAMA on Biogas for on-site power generation for medium/large pig farms

2.1. Scope

This NAMA proposal for biogas power generation will be developed for medium and large-scale farms with an average generating capacity of 100 kW, consistent with the capacity of the farms. A pilot project on biogas power generation in three areas with capacity of 100 kW is expected to win investment and to be implemented.

2.2. Objectives

- **Overall objective:** Develop a favourable environment for using biogas at pig farms, enhancing sustainable development in medium and large-scale farms in rural areas by mitigating GHG emissions.

- **Specific objectives**

- Set up a policy and institutional framework for investment on developing commercial biogas-electricity generation at large-scale pig farms in Viet Nam.
- Develop biogas-electricity generation at pig farms in order to mitigate GHG emissions as well as protect the local environment.

2.3. Proposed outcomes and activities

Outcome 1: A policy framework to encourage biogas use for electricity generation is developed

Activities:

- Researching, including on-site study on needs, identification and removal of barriers related to biogas electricity development in existing policies in Viet Nam.

- Proposing a policy/institutional framework for biogas electricity generation development at pig farms.

- Facilitating the establishment of supporting policy to encourage development of biogas electricity generation.

Outcome 2: Appropriate technology for biogas electricity generation will be chosen; quality control standards/criteria and maintenance system for biogas electricity generation will be established.

Activities:

- Researching, including onsite study on technologies, equipment and system of biogas electricity generation, proposing appropriate technologies.

- Developing regulations/standards for quality control and management of biogas electricity generation machinery.

- Developing maintenance systems for biogas electricity generation devices and machines.

Outcome 3: A management system of electricity generation from biogas will be integrated into the existing national electricity management system

Activities:

- Collecting activity data and information on electricity operation, distribution and management system of the Electricity of Viet Nam.

- Proposing integration of biogas electricity operation, distribution and management systems into existing electricity operation systems.

- Conducting workshops for exchanging information about biogas electricity operation, distribution and management system.

Outcome 4: Stakeholders' capacity for implementation of biogas NAMA will be enhanced

Activities:

- Surveying stakeholders' capacity relating to the NAMA.

- Developing and carrying out a communication plan on the NAMA, climate change and GHG mitigation to facilitate improvement and establishment relevant policies relating to the encouragement of biogas electricity generation.

Outcome 5: Capacity for management, operation and maintenance of biogas electricity generation systems will be enhanced

Activities:

- Developing three demonstration models of biogas electricity generation with grid connection at pig farms in three areas.

- Capacity-building for operation, management and maintenance of biogas electricity generation systems at the pig farms.

- Carrying out MRV for the three pilot projects.

Outcome 6: Biogas electricity generation technology will be replicated throughout the country. The rate of farms using biogas electricity generation will be at least 50% in 2020 and 70% in 2030 (connected to national grid or local stations). GHG reduction is estimated at 3 million tCO₂e/year in 2020 and 7 million tCO₂e/year in 2030.

Activities:

- Carrying out communication activities on biogas electricity generation.
- Implementing periodic MRV.
- Conducting workshops to summarize and assess biogas NAMA implementation with participation of relevant stakeholders.
- Proposing a program for trading credits obtained from the biogas NAMA.

3. Renewable Energy Development Facility (REDF) – GET FiT Viet Nam

3.1. Objectives

Overall objective: Promote implementation of the National Green Growth Strategy with regard to the targets for renewable energy, GHG mitigation and thus to contribute to sustainable economic growth in Viet Nam.

Specific objectives: Ensure that the “Renewable Energy Development Facility” (REDF) is operational within the existing policy and regulatory framework for renewable energy.

3.2. Proposed outcomes and activities

Outcome 1: REDF will be established and operational with regard to coordination, communication and decision-making within the Ministry of Industry and Trade and among relevant national administrations

Activities:

- Carrying out an in-depth organizational analysis to define structure, roles and functions and legal requirements for the establishment of REDF within the national administration.
- Facilitating the setting up of an inter-ministerial steering committee.
- Outlining the structure of REDF within the national administration and supporting the legal and administrative approval process.
- Developing a decision-making and communication-reporting system within the national administration and facilitating its implementation.
- Developing a business plan and facilitating the national approval process.

Outcome 2: Institutional and human resource capacities to support efficient and effective decision-making within the national administration with regard to implementation of the REDF will be enhanced.

Activities:

- Supporting the institutional set-up within the national administration by developing organizational and managerial guidelines.
- Defining the respective staff profiles and draft terms of reference for their duties.
- Recruiting respective staff and providing initial trainings.

- Initiating stakeholder consultation on the roles and functions of the REDF.
- Finalizing procedures and decision-making with respect to the national administration system.

Outcome 3: An MRV-based data management and overall information service system will be established

Activities:

- Conducting roadmaps to promote the new organization to build awareness among public and private stakeholders on the purpose and mechanism of the REDF.
- Supporting and developing baseline scenarios for selected renewable energy projects.
- Supporting development of a renewable energy specific MRV system within the national NAMA framework.
- Setting up a database and information service platform in the REDF to allow transparency and to disseminate information via different channels.
- Facilitating information services to support relevant stakeholders in developing project proposals for funding.
- Preparing lessons learnt from the REDF and communicating these on national and international levels.
- Supporting national and international dialogues on climate change with regard to achievements of the REDF.
- Preparing a roadmap to enable access to international climate finance in the renewable energy sector.
- Conducting regular monitoring and evaluation for selected renewable energy projects based on the requirements of the NAMA Facility.



Wind power project in Binh Thuan Province and Biogas project in Quang Nam Province

Appendix II: List of Viet Nam's CDM Projects registered by the EB from October 2010

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
1	Nam Chien 2 Hydropower Project	465,941	3442	11/10/2010
2	La Hieng 2 Hydropower Project	216,083	3667	27/10/2010
3	Thai An Hydropower Project	1,264,501	3711	29/10/2010
4	Song Quang Hydropower Project	196,945	3421	03/11/2010
5	Nam Tang and Na Hau Hydropower Bundled Projects	149,954	3682	06/11/2010
6	Su Pan 2 Hydro Power Project	576,541	3745	27/11/2010
7	Tra Linh 3 Hydropower Project	105,581	3810	02/12/2010
8	Nam Ngan Hydropower Project	205,254	3858	13/12/2010
9	Dak Nong 2 Hydropower Project	1,685,970	3944	18/12/2010
10	Ngoi Phat Hydropower Project	191,261	3872	18/12/2010
11	Dak N'Teng Hydropower Project	222,873	3942	18/12/2010
12	Group of Nam Tha Hydropower Projects	308,532	4259	22/12/2010
13	Chau Thon Hydropower Project	122,094	3396	25/12/2010
14	Da Den Hydropower Project	184,359	3980	08/01/2011
15	Lao Cai - Lai Chau - Kontum Bundled Hydropower Project	149,912	4279	14/01/2011
16	Song Chung Hydropower Project	99,491	3532	20/01/2011
17	Ban Coc Hydropower Project	134,869	4236	24/01/2011
18	Song Ong Hydropower Project	302,995	4117	04/02/2011
19	Dak Rung 1 Hydropower Project	311,262	3552	19/02/2011
20	Ngoi Hut 1 Hydropower Project	303,706	3557	19/02/2011
21	Ho Bon Hydropower Project	147,196	3954	21/02/2011
22	Dak Srong 2 Hydropower Project	247,490	3389	23/02/2011
23	Nam Mu & Khuoi Luong Hydropower Bundled Project	39,660	4156	05/3/2011
24	Ha Nang Hydropower Project	333,330	4417	08/3/2011
25	Dak Hnol Hydropower Project	48,334	4392	16/3/2011
26	La La Hydropower Project, Viet Nam	280,070	4626	29/3/2011
27	Dak Doa Hydropower Project	187,147	4384	11/4/2011
28	Dak Psi 5 Hydropower Project	166,033	4656	13/4/2011
29	Nam Phang Hydropower Project	579,119	4720	20/4/2011
30	Vedan Binh Phuoc Plant tapioca starch wastewater biogas extraction and utilization project, Binh Phuoc Province, Socialist Republic of Viet Nam	298,530	4702	25/4/2011
31	Doc Cay Hydropower Project	242,781	4714	03/5/2011
32	Thanh Thuy Hydropower Project	287,912	4338	03/5/2011

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
33	Methane Recovery and Utilization Project of Dai Viet Co. Ltd, Viet Nam	1,193,093	4291	10/5/2011
34	Ia Puch 3 Hydropower Project	115,013	4755	13/5/2011
35	Ba Thuoc 2 Hydropower Project	965,020	4823	24/5/2011
36	Dak Pone Hydropower Project	241,790	4550	02/6/2011
37	DakRTih Hydropower Project, Viet Nam	2,544,065	4537	08/6/2011
38	Vinh Son 5 Hydropower Project	411,026	4703	10/6/2011
39	Ngoi Xan Hydropower Project	283,885	4577	16/6/2011
40	Quang Ngai APFCO Tapioca starch wastewater biogas extraction and utilization project, Quang Ngai Province, Socialist Republic of Viet Nam	348,353	4514	20/6/2011
41	H'Mun Hydropower Project	226,296	4765	20/6/2011
42	Nam Soi & Nam Cong Hydropower Project	282,072	4544	22/6/2011
43	Dak Srong 2A Hydropower Project	232,501	4210	02/7/2011
44	Muong Kim Hydropower Project	383,120	3843	26/7/2011
45	Boiler Fuel Conversion from Fuel Oil to Briquettes Biomass Fuel at Saigon Ve Wong Co., Ltd, Ho Chi Minh city, Viet Nam	248,658	4847	29/7/2011
46	Nam Trai 4 Hydropower Project	147,595	4829	16/8/2011
47	Srepok 4 Hydropower Project	1,265,082	5115	22/8/2011
48	Nam Hong Hydropower Project	251,726	5164	02/9/2011
49	Nam Khanh Hydropower Project	195,328	5030	05/9/2011
50	Dak Mi 4c Hydropower Project, Viet Nam	278,887	5056	13/9/2011
51	Nam Chanh Hydropower Project, Viet Nam	33,109	5273	30/9/2011
52	DAKFOCAM Wastewater project	175,573	5290	07/10/2011
53	Dasiat Hydropower Project	227,200	3908	11/10/2011
54	Ea Kar Hydropower Plant, Viet Nam	44,295	5337	14/10/2011
55	Dak Mi 4 Hydropower Project, Viet Nam	3,036,229	4970	18/10/2011
56	Lao Cai-Yen Bai Bundled Hydropower Project	306,093	5183	25/10/2011
57	Song Tranh 3 Hydropower Project	888,580	4974	28/10/2011
58	Muong Hum 32 MW Hydropower Project in Lao Cai Province, Viet Nam	481,689	4949	04/11/2011
59	Dak Psi 3 and 4 Hydropower Project	621,267	4891	06/11/2011
60	Ayun Thuong 1A Hydropower Project	183,456	5376	09/11/2011
61	Song Con 2 Hydro Power Project	801,348	4809	11/11/2011
62	Khe Giong Hydropower Plant, Viet Nam	70,336	5338	16/11/2011
63	Nam Xay Noi 2 Hydropower Project	179,627	5420	16/11/2011
64	Van Chan Hydropower Project.	1,013,831	5191	18/11/2011

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
65	Methane Recovery and Use of the Biogas in Son Hai - Son Ha and Dong Xuan Tapioca Starch Making Plants of APFCO, Viet Nam	366,330	5438	25/11/2011
66	Song Chay 5 Hydropower project	341,560	5189	28/11/2011
67	Song Nhiem 3 Hydropower Project	136,514	5248	09/12/2011
68	Za Hung Hydropower Project	485,163	4551	12/12/2011
69	Minh Luong Hydro Power Project	554,130	4991	19/12/2011
70	Nam Pong Hydropower Project	492,471	5573	20/12/2011
71	Ho Nui Coc Hydropower Project, Viet Nam	28,714	5591	23/12/2011
72	Chi Khe Hydropower Project	643,572	4520	03/01/2012
73	Waste to Energy Project of SURE VN in Binh Duong Province, Viet Nam	912,240	5105	04/01/2012
74	Nam Nua Hydropower Project	162,190	5524	10/01/2012
75	Dak Sin 1 Hydropower Project	600,190	5533	18/01/2012
76	TV Daklak Wastewater Treatment and Methane Recovery Project	482,390	5347	27/01/2012
77	Song Bung 6 Hydropower Project	478,975	5727	31/01/2012
78	Nhan Hac and Sao Va Hydropower Project	759,115	4962	13/02/2012
79	Ta Loi 3 Hydropower Project	119,742	5601	17/02/2012
80	Ia Grai 1 Hydropower Project	153,076	5793	21/02/2012
81	Da Dang 2 Hydropower Project	602,483	5600	13/3/2012
82	Wastewater Treatment and Methane Recovery at Green Field Joint Stock Company	1,380,089	5364	16/3/2012
83	Song Bung 5 Hydropower Project	915,432	5144	16/3/2012
84	Dinh Hai rice husk cogeneration Project	162,715	5907	20/3/2012
85	Dakrosa2 Hydropower Project	44,324	5949	27/3/2012
86	Dak Srong 3B Hydropower Project.	70,015	5631	29/3/2012
87	Nam Cat Hydropower Project	296,835	5970	29/3/2012
88	Rhodia Nuoc Trong Biogas Capture & Utilization Project, Viet Nam	99,008	5568	03/4/2012
89	Nam Mo 3 Hydro Power Project, Viet Nam	152,718	6012	13/4/2012
90	Lang Bang Hydropower Project	55,517	5967	14/4/2012
91	Nam Cat Hydropower Plant, Viet Nam	52,178	5579	16/4/2012
92	Dakrong 3 Hydropower Project	126,574	6050	17/4/2012
93	Nho Que 3 Hydropower Project	1,978,088	5343	30/4/2012
94	Nam Chim Hydro Power Project	249,648	5310	01/5/2012
95	Suoi Trang Hydropower Plant, Viet Nam	40,138	5615	01/5/2012
96	Dakdrinh Hydropower Project	2,108,666	6184	10/5/2012

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
97	Song Mien 5 Hydropower Project	1,350,923	6203	21/5/2012
98	Da M'Bri Hydropower Project	264,964	5870	21/5/2012
99	Nam An Hydropower Project	97,757	5432	22/5/2012
100	Tra Xom Hydropower Project	2,414,363	6103	31/5/2012
101	Dong Nai 5 Hydropower Project	288,127	5911	31/5/2012
102	Farm Household Biogas Project Contributing to Rural Development in Can Tho City	8,420	6132	05/6/2012
103	Avoided methane emission through aerobic composting at Vietstar municipal solid waste treatment facility	1,814,928	5556	06/6/2012
104	Alin B1 Hydropower Project	685,720	6334	08/6/2012
105	Nam La Hydro Electric Power Project, Viet Nam	411,334	5261	11/6/2012
106	Xoong Con Hydropower Project	300,450	6358	12/6/2012
107	Ha Tay Hydropower Project	368,634	6397	25/6/2012
108	Nam Luc Hydro Power project	134,890	6446	25/6/2012
109	Trung Ho & Van Ho Hydropower Project	209,628	6393	29/6/2012
110	Nam Mo Hydropower Project	250,572	5902	03/7/2012
111	01 million Compact Fluorescent Lamps (EVN-2010) Project in Viet Nam	94,306	6236	05/7/2012
112	Dak Lo Hydropower Project	364,091	6574	05/7/2012
113	Masan Biomass Boiler Project	219,760	5779	05/7/2012
114	Muong Sang, Thu Cuc, Tat Ngoang Hydropower Project	168,506	6587	09/7/2012
115	Song Giang 2 Hydro Power Project	516,296	6604	09/7/2012
116	Nam Non Hydropower Project	345,646	5973	16/7/2012
117	Cu Chi Municipal Solid Waste (MSW) Treatment Plant in Ho Chi Minh City, Viet Nam Project	1,111,091	6680	18/7/2012
118	Nam Cau 1,2 Hydropower Project	225,391	6716	20/7/2012
119	Dak Mi 2 Hydropower Project	1,600,760	6489	26/7/2012
120	To Buong Hydropower Plant, Viet Nam	132,362	6738	26/7/2012
121	Nam Tha 3 Hydropower Project	206,283	6800	27/7/2012
122	Bao Nhai Hydropower Project, Viet Nam	183,547	6790	30/7/2012
123	Pao Cu Sang Hydropower Plant, Viet Nam	151,319	6847	30/7/2012
124	Dak Glun 2 and 3 Hydropower Plants, Viet Nam	156,436	6789	30/7/2012
125	Nam Toong Hydro Power Project	576,156	6837	31/7/2012
126	Vinh Son 3 Hydro Power Project	457,289	6729	02/8/2012
127	La Ngau Hydropower Project	773,801	6921	08/8/2012
128	Hoi Xuan Hydropower Plant, Viet Nam	1,554,357	6735	20/8/2012
129	Nam Na 2 Hydropower Project	1,467,410	5885	20/8/2012

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
130	Khanh Khe Hydro Power Project	94,066	7063	22/8/2012
131	Song Bung 4 Hydropower Project	1,567,335	6919	22/8/2012
132	Ngoi Hut 2 Hydro Power Project	744,100	7081	29/8/2012
133	A Roang Hydropower Project	163,640	6937	30/8/2012
134	Bagasse Cogeneration Project at Lam Son Sugar JSC	317,060	7070	05/9/2012
135	Ta Thang Hydropower Project	919,254	5445	10/9/2012
136	Dak Mek 3 Hydropower Project	93,898	6583	11/9/2012
137	Bac Lieu Province Wind Power Plant	1,006,328	7250	13/9/2012
138	Song Bung 2 Hydropower project, Viet Nam	1,629,901	6061	14/9/2012
139	Chu Linh and Coc San Hydropower Project	591,549	7338	20/9/2012
140	Ba Thuoc 1 Hydropower Project	854,245	7400	25/9/2012
141	Dak Mi 3 Hydropower Project, Viet Nam	836,675	7395	25/9/2012
142	Huong Son Hydropower Project	747,940	7120	26/9/2012
143	Chiem Hoa Hydropower Project	785,285	6118	28/9/2012
144	Ia H'Rung and Chu Prong Hydropower Project	230,340	7069	02/10/2012
145	Nam Can 2 Hydropower Project	380,803	7389	02/10/2012
146	Nam Xa Hydropower Project	143,745	7509	03/10/2012
147	Thac Xang Hydropower Project	736,414	6439	04/10/2012
148	Hoa Tham Hydropower Project	244,482	7586	04/10/2012
149	Song Bung 4A Hydro Power Project	77,749	6679	04/10/2012
150	Nam Khoa 1&2 Hydropower Project	108,854	7616	10/10/2012
151	Trung Son Hydro Power Project, Viet Nam	3,809,006	6099	12/10/2012
152	Tin Thanh Biomass Boiler Project No. 1	365,810	7665	17/10/2012
153	Boiler Fuel Conversion from Fuel Oil to Biomass Briquette at Viet Nam Paiho. Ltd, Ho Chi Minh city, Viet Nam	168,280	6598	17/10/2012
154	Tin Thanh Biomass Boiler Project No. 2	303,360	7695	17/10/2012
155	Tin Thanh Biomass Boiler Project No. 3	260,130	7702	17/10/2012
156	Dak Glun Hydro Power Project	255,059	7554	18/10/2012
157	Ban Ra Hydropower Project	282,968	7691	18/10/2012
158	Thuong Kon Tum Hydropower Project	4,214,517	6688	18/10/2012
159	Dam B'ri 1 Hydropower Project	152,411	6556	19/10/2012
160	Methane Recovery and Utilization Project of PetroViet Nam Central Biofuels Joint Stock Company	1,018,950	7721	19/10/2012
161	Tin Thanh Biomass Boiler Project No. 4	446,560	7706	19/10/2012
162	Hon Chong Waste Heat Recovery Power Plant	242,970	7738	23/10/2012
163	Song Tranh 4 Hydropower Project, Viet Nam	787,185	7593	23/10/2012
164	Dong Nai 2 Hydropower Project	925,911	7809	24/10/2012

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
165	Dong Chum 2 Hydro Power Project	133,308	6682	26/10/2012
166	Thien Nam Hydropower Project	317,262	7848	29/10/2012
167	Tin Thanh Biomass Boiler Project No. 7	735,900	7833	31/10/2012
168	Dak Me 1 Hydropower Project in Viet Nam	72,751	4955	02/11/2012
169	Ta Co Hydroelectric Power Plant	471,436	5811	02/11/2012
170	Dak Srong 3A Hydropower Project	124,026	7956	06/11/2012
171	Ban Nhung Small Hydropower Project	185,040	8017	07/11/2012
172	Nam Dong 4 Hydro Power Project	107,051	6589	08/11/2012
173	Thuan Nhen Phong Wind Power Project	353,815	7280	08/11/2012
174	Phuong Mai 3 Wind Power Project	223,846	7279	08/11/2012
175	Srepok 4A Hydropower Project, Viet Nam	1,237,908	6065	09/11/2012
176	Son Tay Hydropower Project	279,174	7064	09/11/2012
177	Sap Viet Hydropower Plant, Viet Nam	322,924	6736	12/11/2012
178	Suoi Lum 1 Hydroelectric Power Plant	296,254	7028	12/11/2012
179	Tin Thanh Biomass Boiler Project No. 8	584,971	8031	13/11/2012
180	Dong Ngai Hydropower Project	113,050	8200	15/11/2012
181	DaKrong 2 Hydropower Project	411,540	8054	15/11/2012
182	Tin Thanh Biomass Boiler Project No. 5	848,130	8073	16/11/2012
183	Song Luy Hydropower Project	338,970	8154	16/11/2012
184	6 MW Eatul 4 Hydro Power Project	138,500	8278	19/11/2012
185	Nam Si Luong 3 Hydropower Project	364,450	8254	20/11/2012
186	A Luoi Hydro Power Project	2,728,341	8248	20/11/2012
187	Nam Cong 3 Hydropower Project	194,130	8309	23/11/2012
188	Dak Mi 1-1A Hydroelectric Power Project	846,755	7378	26/11/2012
189	Nam Si Luong 4 Hydropower Project	339,370	8296	26/11/2012
190	Ta Loi 2 Hydro Power Project	4,158,119	8396	27/11/2012
191	Dong Nai 4 Hydropower Project	177,198	8405	27/11/2012
192	Avoid methane emission through aerobic composting at Tan Thanh solid waste treatment plant	312,209	7330	29/11/2012
193	Quang Tin Hydropower Project, Viet Nam	71,491	7898	11/12/2012
194	Xim Vang 2 Hydroelectric Power Plant	278,025	8418	14/12/2012
195	Nam Hoa 2 Hydro Power Project	117,677	7193	17/12/2012
196	Nam He Hydropower Project	1,186,206	8720	18/12/2012
197	Se San 4A Hydropower Project	146,776	9017	18/12/2012
198	Nam Pung Hydropower Project	1,872,050	8753	18/12/2012
199	Nam Na 3 Hydropower Project	91,721	8804	18/12/2012
200	Song Cho 2 Hydro Power Project	242,795	8860	18/12/2012
201	Suoi Choang Hydro Power Project	53,935	8902	19/12/2012

No	Project title	GHG mitigation potential (tCO ₂ e)	Reference	Registered
202	Chieng Ngam Thuong Hydro-power	158,867	8813	20/12/2012
203	Methane Recovery and Utilization Project of PetroViet Nam Biofuels Joint Stock Company	862,900	8874	21/12/2012
204	Seo Chong Ho Hydropower Project	376,530	9066	21/12/2012
205	Khau Chu Hydropower Project	64,169	8169	22/12/2012
206	Bac Me Hydropower Project	1,047,660	9148	27/12/2012
207	Khe Bo Hydropower Project	2,424,160	9036	28/12/2012
208	Biogas recovery and utilization at Tung Lam Ethanol Factory	742,800	9369	31/12/2012
209	Phu Quy Wind Power Project	182,871	9050	31/12/2012
210	Biogas Recovery and Utilization project in Tay Ninh Province, Viet Nam	239,850	9425	25/01/2013
211	Song Bac Hydropower Project	909,810	7504	14/02/2013
212	Tram Tau Hydroelectric Power Plant	473,284	7450	12/3/2013
213	Nghi Son Waste Heat Recovery and Utilization Project	539,930	9641	30/5/2013
214	Methane Recovery and Use of the Biogas in the Dak To Tapioca Starch Making Plant of APFCO, Viet Nam	226,629	8752	21/6/2013
215	Dak Rong 4 Hydropower Project	381,060	7672	23/9/2013
216	Da Dang-Dachomo Hydropower Project	415,730	8803	03/12/2013
217	Biomass Power Project of Gia Lai Cane Sugar and Thermoelectricity Joint Stock Company	317,730	8444	30/12/2013
218	Gas Collection, Incineration and Electricity Generation System at Da Phuoc Integrated Waste Management Facility	2,532,833	9253	10/3/2014
219	Expansion of coffee manufacturing capacity from 4000MT/Annum to 12000MT/Annum	332,780	8579	2/4/2014

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