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Second Biennial Update Report of the Republic of Korea

Under the United Nations Framework Convention on Climate Change

The Government of
the Republic of Korea

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Foreword

On behalf of the Republic of Korea(ROK), I am pleased to present the Second Biennial Update Report to the United Nations Framework Convention on Climate Change.

The international society set a common goal to respond to climate change by adopting the Paris Agreement in December 2015. Keeping pace with this significant historic movement, the ROK has established its national GHG reduction target for 2030 and is committed to reach this goal.

The Second ROK Biennial Update Report contains information on the efforts and achievements we have made in response to climate change as a responsible member of the international society. The ROK developed the Roadmap to Achieve the National GHG Reduction Target for 2030 in December 2016. Prior to that, in 2015, we became the first country in Asia to launch a nation-wide emissions trading system. We also pledged USD 100 million to the Green Climate Fund and have been consistent in providing resources to support developing countries.

As President Moon Jae-in stated at the UN Leaders' Dialogue on Climate Change in September 2017, the ROK will prioritize policies that lead to climate change solutions. Our new administration is pursuing an energy system that is clean and safe. To this end, we will gradually reduce our dependence on coal and nuclear power and plan to increase the share of renewable energy in our electricity generation mix to 20 percent by 2030. The ROK will also expand incentives for green technology investments and promote technological innovation so that the national GHG reduction target can be met seamlessly.

In addition, the ROK will continuously strengthen our support and cooperation through finance, technology development and support, and capacity-building for developing countries to be able to address climate change. Looking forward, we hope other countries will join collaboratively in these efforts. Particularly, developed countries that are responsible for greater amounts of historical emissions must take the lead in the mission to proactively advance climate change response measures.

We believe the reward for our efforts to limit global warming will be reaped by our progeny whose future livelihoods depend on the inheritance of a sustainable planet.

Thank you.

Hong Nam-Ki

Minister of the Office for Government Policy Coordination
Prime Minister's Secretariat, Republic of Korea
November 2017

Executive Summary

1. National Circumstances

Records show the world average temperature is continually increasing with the phenomenon of global warming. The Republic of Korea (ROK) is no exception to the rise of global warming and its impacts. The annual mean temperature in 2016 was 13.6°C, which marked the highest record since 1990. In 2016, the national average number of heat wave days was 22.4, the 2nd highest since 1990; and the number of tropical nights was 10.8, which was the 4th highest since 1990.

The total population of the ROK is estimated at approximately 51.246 million and the elderly segment of the population, particularly vulnerable to climate change, is expected to grow rapidly. Exports and the manufacturing sector play a significant role in the national economy, and as of 2015, dependence on exports stood at 38.2%, while the share of the manufacturing sector accounted for 29.3% of the national GDP in 2016.

Against this backdrop, the ROK has been taking active measures to counter the global warming issue. Some examples include ratifying the Paris Agreement in November 2016 and restructuring its domestic climate change response system.

2. National Greenhouse Gas Inventory

The ROK prepared the national GHG inventory from 1990 to 2014 in accordance with the IPCC Guidelines for Energy; Industrial Processes; Agriculture; Land Use, Land-Use Change and Forestry (LULUCF); and Waste sectors. The national GHG inventory covers carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The emissions of CH_4, N_2O, HFCs, PFCs, and SF_6 are estimated in units of metric tons of carbon dioxide equivalent (CO_2eq.) using the 100-year time horizon Global Warming Potentials (GWPs) from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR).

Total GHG emissions in the ROK were 690.6 million tons of CO_2eq. and net emissions including sinks were 648.1 million tons of CO_2eq. in 2014. Total emissions in 2014 declined by 0.8% from 2013 attributed to the combined effects of less dependence on fossil fuel power plants for electricity generation, fewer livestock, decreased volume of waste incineration, and various GHG reduction policies implemented by the government.

The ROK's per capita GHG emissions in 2014 were 13.7 tons of CO_2eq., reflecting a relatively stable level since 2011. GHG emissions per GDP in the same year were 484.0 tons per KRW 1 billion, which indicates a continuous decline since 2011.

3. Mitigation Actions

In 2015, the ROK set a new national GHG reduction target of 37% below business-as-usual (BAU) level by 2030. The ROK prepared the Roadmap to Achieve the National GHG Reduction Target for 2030 in December 2016, in order to set the basic policy direction for reaching the national GHG reduction target.

This roadmap specifies the emissions projection, reduction target, and major reduction plans by sector and sub-sector for 2030. According to the roadmap, the ROK will reduce GHG emissions by applying technologies and policies taking into consideration sector-specific circumstances for energy transformation, industry, new energy industry, transport, building, public/other, agriculture and fisheries, forestry, and waste sectors.

This roadmap will be further elaborated through continuous revisions until the NDC submission in 2020. Through this process, the ROK will develop additional GHG reduction polices and measures, adjust reduction pathways, and review the plan for utilization of the international carbon market considering changes in domestic and international conditions.

The ROK introduced its Emissions Trading System (K-ETS) in 2015 to manage GHG emissions using the market mechanism and around 69% of GHG emissions are covered by the K-ETS. The K-ETS operates under three-year plans for Phase 1 (2015-2017) and Phase 2 (2018-2020), and five-year plans will begin from Phase 3. A total of 23 sub-sectors are regulated under Phase 1. For Phase 1, issuances have been as follows: 1,600 million Korean Allowance Units (KAU) of preliminary allocations, 6.4 million KAU of additional allocations, and 22.4 million KAU of cancelled allocations. In addition, 15.6 million Korean Offset Credits (KOC) issued from 75 offset projects were supplied to the market.

The ROK operates the GHG and Energy Target Management System (TMS) to manage emitters consuming significant amounts of energy, but not covered by the K-ETS. Controlled entities subject to the TMS fall into two categories: (1) companies with three-year annual average GHG emissions equal to more than 50,000 tons of CO_2eq. or energy consumption greater than 200 TJ, and (2) facilities with three-year annual average GHG emissions equal to more than 15,000 tons of CO_2eq. or energy consumption greater than 80 TJ. As a result of TMS operations in 2015, a total of 65 companies reduced 740,000 tons of CO_2eq., which is equivalent to 3.7 times higher than their reduction targets of 200,000 tons of CO_2eq.

4. International Support and Cooperation

While overcoming challenges from the global financial crisis and rising financial deficit, the ROK announced the donation of USD 100 million to the Green Climate Fund (GCF) at the UN Climate Summit in September 2014. Moreover, at the COP 22 in November 2016, the ROK with the European Union (EU) and 7 developed countries pledged a joint statement for a financial contribution of USD 23 million for the Climate Technology Center and Network (CTCN), which was unprecedented for non-Annex I countries.

Government organizations, including the Greenhouse Gas Inventory and Research Center of Korea (GIR), Korea Forest Service, and the Ministry of Environment, operate their own capacity building programs in order to foster experts in greenhouse gas inventory; land-use change, deforestation prevention, and forest restoration; and adaptation in developing countries.

Recognizing the significance of international cooperation for climate change response, the ROK reinforces its intent to support and cooperate with developing countries in terms of finance, technology development and transfer, and capacity building.

CHAPTER 1

NATIONAL CIRCUMSTANCES

JANGDOK
Earthenware pots for traditional condiments and sauce

1. Geography

The Republic of Korea (ROK) is located in the Korean Peninsula with some 3,400 adjacent islands. Forests cover about 63% of the total area[1] and the eastern region is higher than the western region.

The mean slope of the peninsula is quite steep at 5.7°[2], and there is a significant seasonal variability of precipitation. These characteristics results in hydrological features such as a high coefficient of river regime (indicating relatively harsh water management conditions) and heavy rains and droughts have severe impacts on the country. During the dry season, river channel sections with no water flow are witnessed even in big rivers, while there are overflows in tributaries and the major rivers that directly flow into the sea during the flooding season.

2. Climate

The Korean Peninsula is located in the mid-latitude temperate zone and exhibits clear seasonal differences. Due to the hot and humid North Pacific Anticyclone, the weather is sweltering in summer and the Continental Anticyclone makes it cold and dry in winter. The migratory anticyclones in spring and fall result in clear and dry days.

The annual mean temperature of the ROK[3] excluding its islands is 12.7°C. The hottest month is August with a mean temperature of 25.2°C, and January is the coldest month with a mean temperature of –0.8°C[4] (Table 1.1).

Seasonally, 50-60% of the ROK's annual precipitation falls in the summer; and in particular, 30% of the annual precipitation is concentrated during the monsoon season that lasts for about a month starting mid-June.

[Table 1.1] Monthly Mean Temperature and Precipitation (1990-2016) (Unit: temperature (°C), precipitation (mm))

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mean temperature	-0.8	1.6	6.2	12.2	17.4	21.5	24.7	25.2	20.7	14.6	8.0	1.6
Highest temperature	4.5	7.2	12.2	18.6	23.5	26.7	29.0	29.9	26.1	21.0	13.8	6.9
Lowest temperature	-5.4	-3.4	0.8	6.2	11.7	17.1	21.4	21.7	16.4	9.3	3.0	-3.1
Precipitation	25.9	37.2	56.8	89.3	102.9	153.7	288.9	274.9	155.8	55.2	49.8	28.6

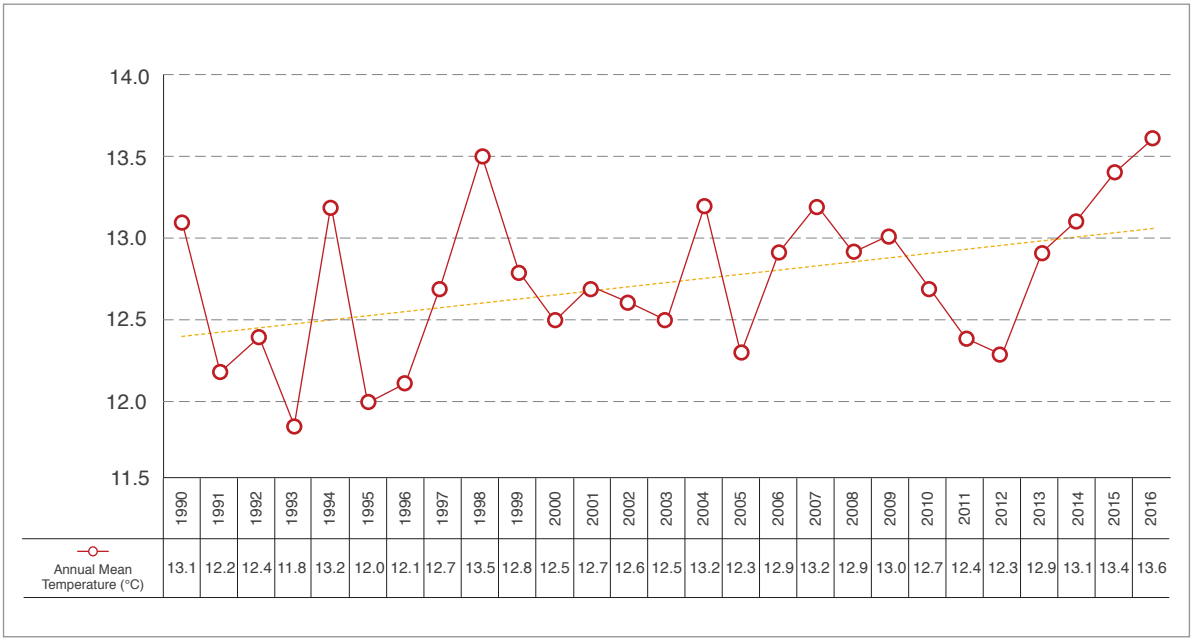
1 Statistical Yearbook of Forestry, Korea Forest Service, 2016.
2 The National Atlas of Korea, National Geographic Information Institute, 2016.
3 Average temperature between 1990 and 2016 of 45 major locations across the Republic of Korea excluding islands.
4 Temperature and precipitation, National Climate Data Center, 2017.

The ROK is no exception to the rise of global warming with its mean temperature in 2015 reaching the third highest record since 1990. The annual mean temperature in 2016 was 13.6°C, or 0.9°C higher than the mean temperature (12.7°C) for the period of 1990-2016, which marked the highest record since 1990 (Figure 1.1).

Both in 2015 and 2016, the mean temperature in May stood at 18.6°C, which was the highest during the period of 1990-2016. The temperature in May broke the record for three consecutive years beginning in 2014, and premature heat wave warnings[5] were issued for those years. Between late July and August 2016, there was a steep temperature rise that lingered for days and caused frequent heat waves and tropical nights in the region influenced by the North Pacific Anticyclone and other anticyclones that had formed in mainland China. In 2016, the national average number of heat wave days[6] was 22.4, the second highest since 1990 and the number of tropical nights[7] was 10.8, which was the fourth highest since 1990.

The ROK has distinctive wind systems due to its seasonal patterns of atmospheric pressures. The southwesterly wind is dominant in summer and the northwesterly wind prevails in winter, whereas the wind is relatively mild between September and October. Between May and October, an average of 20.7 typhoons occur on the western North Pacific, among which around three yield a direct or indirect impact on the ROK[8].

[Figure 1.1] Annual Mean Temperature (1990-2016)



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual Mean Temperature (°C)	13.1	12.2	12.4	11.8	13.2	12.0	12.1	12.7	13.5	12.8	12.5	12.7	12.6	12.5	13.2	12.3	12.9	13.2	12.9	13.0	12.7	12.4	12.3	12.9	13.1	13.4	13.6

5 In Korea, a heat wave warning is issued when a daily temperature high of 33°C or higher is forecasted to last for two days or longer.
6 Number of heat wave days: Number of days with daytime temperature high of 33°C or higher.
7 Number of tropical nights: Number of evenings with nighttime temperature low of 25°C or higher.
8 Number of typhoons, National Typhoon Center, 2016.

3. Population

In 2016, the total population of the ROK was estimated at approximately 51.246 million. Its population accounted for about 0.69% of the world's total population of 7.467 billion[9], ranking it as the 27th most populous country in the world. The nation's population is mostly concentrated in the Seoul Metropolitan Area (surrounding the capital Seoul) and regional metropolises, resulting in the ROK's high urban rate and population density.

The working age population (aged 15 to 64) in the total population is projected to decrease by 21.0 percentage points from 73.4% (37.627 million) in 2016 to 52.4% (25.905 million) in 2050. The ROK is expected to witness the rapid aging of its population. The nation's old-age dependency ratio, represented by the number of elderly persons (aged 65 or over) per one hundred working age persons, is expected to grow fourfold from 18.0 in 2016 to 72.6 in 2050 (Table 1.2).

[Table 1.2] Projection of Total Population, Working Age Population and Old-age Dependency Ratio (2016-2050)

Year / Type	2016	2020	2030	2050
Total population (million persons)	51,246	51,974	52,941	49,433
Working age population (Aged 15 to 64, %)	37,627 (73.4)	37,266 (71.7)	33,878 (64.0)	25,905 (52.4)
Old-age dependency ratio[a)]	18.0	21.8	38.2	72.6

a) Old-age dependency ratio: Number of elderly persons (aged 65 or over) per one hundred working age persons (aged 15-64)
※ Source: Population Projections for the Republic of Korea : 2015-2065, Statistics Korea, 2016.

4. Economy

As its economy has entered a mature phase, the ROK's real average annual growth rate has stabilized at around 3.0% on average since 2011—after having recorded 9.3% in 1990. In addition, the nominal Gross Domestic Product (GDP) grew eightfold from KRW 197.712 trillion in 1990 to KRW 1,637.421 trillion in 2016. During the same period, the nation saw its nominal GDP per capita rise sevenfold from KRW 4.61 million to KRW 31.95 million[10].

While the economy's dependence on exports and share of the manufacturing sector recently decreased after having continuously increased from 1990 to 2011, they still play a significant role in the national economy. As of 2015, the ROK's dependence on exports stood at 38.2%, while the share of the manufacturing sector accounted for 29.3% of the national GDP in 2016 (Table 1.3).

9 World Population Prospects: The 2017 Revision, United Nations, 2017.
10 The real GDP (in 2010 KRW) grew from KRW 419.518 trillion in 1990 to KRW 1,508.265 trillion in 2016 and during the same period, the real GDP per capita increased from KRW 9.79 million to KRW 29.43 million.

[Table 1.3] Dependence on Exports and Share of Manufacturing Sector in the National Economy (Unit: %)

Type \ Year	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Dependence on exports	23.3	22.5	30.7	31.7	42.6	46.2	44.8	42.9	40.6	38.2	-
Share of manufacturing sector	27.3	27.8	29.0	28.3	30.7	31.4	31.0	31.0	30.2	29.8	29.3

※ Source: Korean Statistical Information Service (KOSIS), Economic Statistics System (ECOS) of the Bank of Korea

5. Institutional and Legal Frameworks

The ROK has enacted the Framework Act on Low Carbon, Green Growth in 2010, and the Act on the Allocation and Trading of Greenhouse Gas Emission Permits in 2012 for greenhouse gas (GHG) reduction; the government introduced systems including the GHG & Energy Target Management System (TMS) in 2010, and Korea's Emissions Trading System (K-ETS) in 2015. Moreover, the Act on the Management and Improvement of Carbon Sinks has been implemented from 2013 to maintain and increase the forests' capacity to absorb carbon.

As of February 2016, the national climate change response system has been reorganized so that the Prime Minister's Office for Government Policy Coordination (OPC) oversees tasks related to climate change response and holds accountable each relevant ministry in charge of industries, environment, land, etc. is in charge of different sectors[11]. This reform was made in order to effectively achieve the nation's greenhouse gas reduction target by 2030 and to utilize climate change response as a driver for new economic growth. Accordingly, the OPC along with relevant ministries have worked together to set the reduction goals for each sector under the national GHG reduction target; and to formulate mitigation implementation plans by developing effective policies and measures, gathering the opinions of various stakeholders, etc.

Moreover, the National Communications (NCs), Biennial Update Reports (BURs) and Nationally Determined Contributions (NDCs) are also formulated jointly with relevant ministries under the reorganized system. Once these documents are prepared, they are reviewed by the Presidential Committee on Green Growth[12] under the Prime Minister and submitted to the international community. Meanwhile, the Ministry of Environment has launched fundamental research to submit the nation's 2050 Long-term Low Carbon Development Strategy to the international community by 2020.

In order to actively cooperate with the global community in the combat against climate change, the ROK proactively ratified the Paris Agreement in November 2016, before its entry into force. The ROK is committed to participating in the new universal global climate change regime for both developed and developing countries.

11 There were some benefits including implementation of the reduction policies which reflected the nature of each sector, according to evaluation after operation of the reformed system for over a year, but there were inefficiencies caused by implementation by multiple government organizations. The system is being additionally reformed to reinforce consistency and effectiveness of national GHG reduction policies, including systematic allocation of roles of the Office for Government Policy Coordination and the Ministry of Environment for setting and management of GHG reduction goals.

12 Organization charged with reviewing major policies related to low-carbon green growth and their progress based on the Framework Act on Low Carbon, Green Growth; it consists of less than 50 members, including ministerial-level officials of relevant ministries and low-carbon green growth experts.

CHAPTER 2

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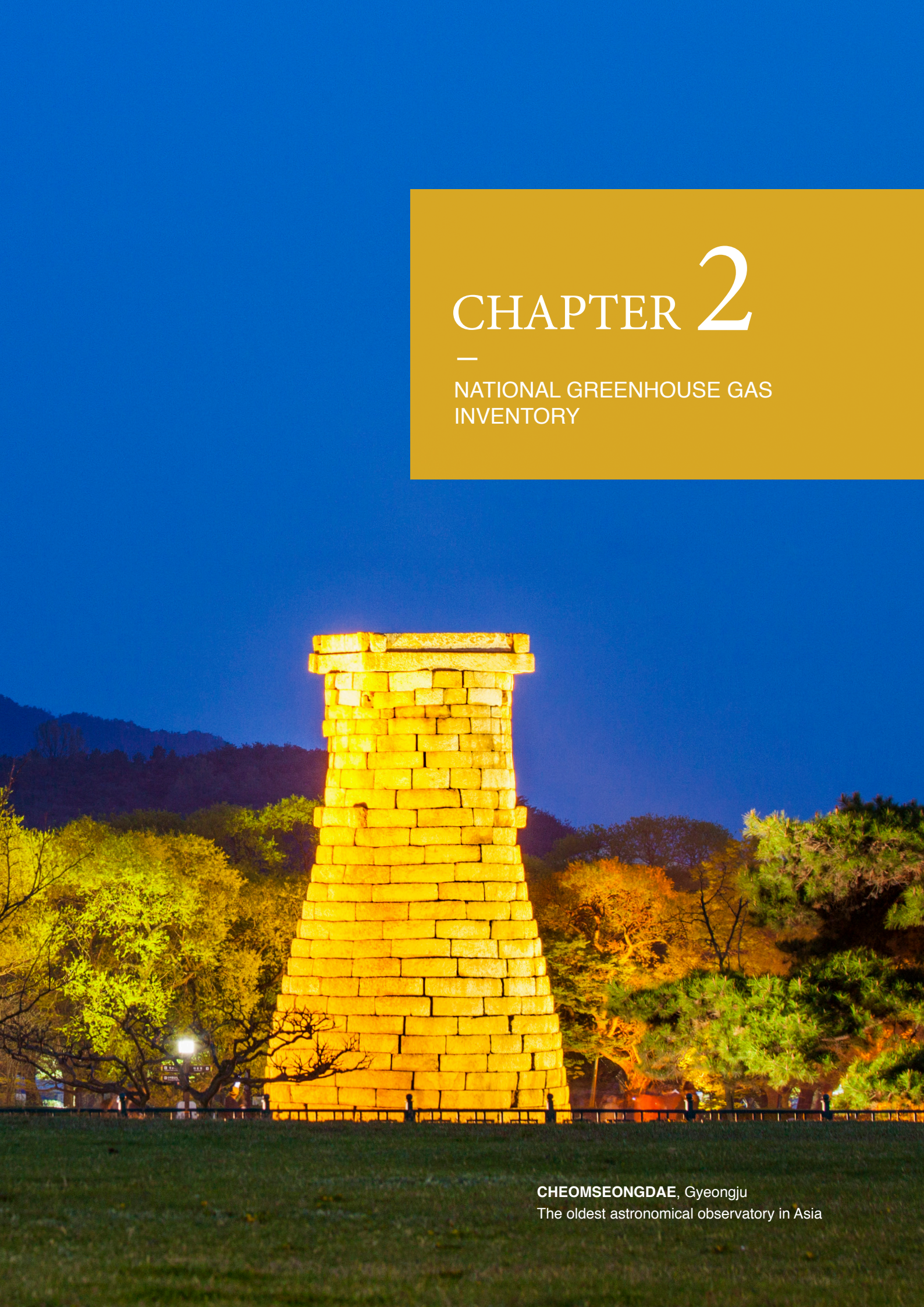
NATIONAL GREENHOUSE GAS INVENTORY



CHEOMSEONGDAE, Gyeongju
The oldest astronomical observatory in Asia

1. National Greenhouse Gas Inventory System

1.1 Institutional Arrangement

The Greenhouse Gas Inventory & Research Center (GIR), managed by the OPC, is in charge of tasks related to the national GHG inventory[13]. The main tasks of GIR for the national GHG inventory are: (1) to establish the Regulations on the Management of the National GHG Inventory; (2) to provide the Guidelines for Measurement, Reporting, and Verification (MRV Guidelines) for the estimation of the national GHG inventory; (3) to review the national GHG inventory data as well as emission/removal factors; (4) to organize and manage the National GHG Inventory Management Committee (Management Committee), the National GHG Working Group (Working Group), and National GHG Technical Group (Technical Group); (5) to collect and prepare the national GHG inventory; and (6) to develop and operate the IT system for data management (Figure 2.1).

The sectoral responsible ministries[14] of the five sectors subject to GHG inventory measurement oversee the management of the GHG inventory. Moreover, an agency with expertise in the statistics of a specific category is designated by the responsible ministry to estimate the GHG inventory of that category and to perform tasks including the development of country-specific emission/removal factors. The draft inventory compiled by the agency is reviewed by the responsible ministry and submitted to GIR. After the publication of the 1st BUR (2014), there has been a change in the institutional arrangement regarding the water-borne navigation transport category in the Energy sector; the responsible ministry for that category has been changed since 2016 from the Ministry of Land, Infrastructure and Transport (Korea Transportation Safety Authority) to the Ministry of Oceans and Fisheries (Korea Marine Environment Management Corporation).

The Technical Group—composed of external experts from academia and research institutes—provides technical advisory related to the MRV of the national GHG inventory and country-specific emission/removal factors. The Working Group was established to facilitate discussions among relevant organizations on: (1) the MRV of the national GHG inventory; (2) the development and verification of emission/removal factors; and (3) the adoption and revision of relevant guidelines. The Working Group, chaired by the president of GIR, consists of director-level government officials from sectoral responsible ministries and relevant organizations such as Statistics Korea (KOSTAT), the Korea Forest Service (KFS), etc.

The Management Committee is the decision-making body that approves the final draft of the national GHG inventory, country-specific emission/removal factors, etc. submitted through the consultation of the Working Group. The Management Committee, chaired by the Second Vice Minister of the OPC, is an association of

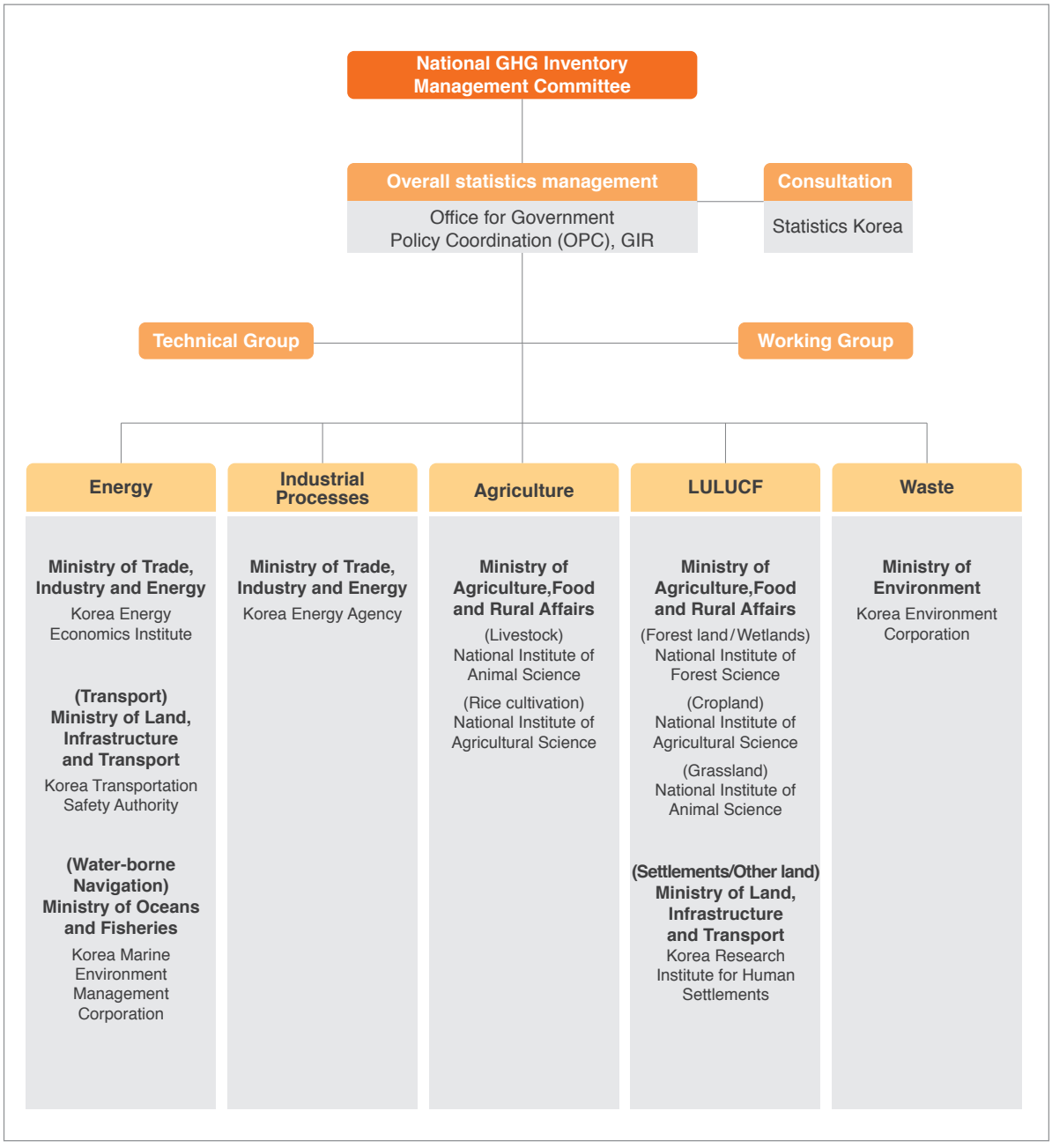
13 In accordance with the Framework Act on Low Carbon, Green Growth (Article 45) and Enforcement Decree of the Framework Act on Low Carbon, Green Growth (Article 36)

14 The sectoral responsible ministries are: (1) Energy: Ministry of Trade, Industry and Energy (excluding buildings and transport), Ministry of Land, Infrastructure and Transport (buildings and transport), and Ministry of Oceans and Fisheries (fisheries, water-borne navigation transport, and ports); (2) Industrial processes: Ministry of Trade, Industry and Energy; (3) Agriculture: Ministry of Agriculture, Food and Rural Affairs; (4) LULUCF: Ministry of Agriculture, Food and Rural Affairs (excluding settlements and oceans); and (5) Waste: Ministry of Environment

no more than 15 commissioners constituted of director general-level officials from sectoral responsible ministries and KOSTAT, and experts from academia and the public sector that have been recommended by responsible ministries.

The Management Committee is the decision-making body to approve the final draft of national GHG inventory, country-specific emission/removal factors, etc. submitted through the consultation of the Working Group. The Management Committee, chaired by the 2nd Vice Minister of the OPC, is composed of no more than 15 commissioners who are director-general level officials from sectoral responsible ministries and KOSTAT, and experts from academia and public sector recommended by responsible ministries.

[Figure 2.1] Institutional Arrangement for Preparation of the National GHG Inventory



1.2 Preparation Process

To enhance the transparency and the accuracy, the national GHG inventory of ROK is prepared through a multi-stage process of systematic MRV. GIR carries out the verification to be independent from the measurement conducted by sectoral relevant ministries. And the final inventory is confirmed after the review of the Working Group and deliberation of the Management Committee.

1.2.1. Measurement and Reporting

The first step in preparing the national GHG inventory is to determine the methodology. To enhance the inventory quality, GIR prepares revised MRV Guidelines at the beginning of each year reflecting the areas for improvement identified during the verification process in the previous year. Once the revised MRV Guidelines is confirmed through the review of the Working Group and deliberation of the Management Committee, GIR distributes it in March to the sectoral responsible ministries and agencies. Based on the distributed MRV Guidelines, sectoral responsible ministries review their respective category inventories estimated by the agencies and submit them to GIR by June 30.

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1.2.2. Verification

GIR collects the inventory draft reports submitted by sectoral responsible ministries and verifies the appropriateness of methodology, activity data, and emission/removal factors, while detecting any errors in the emission calculations of subcategories. GIR requests these ministries to revise and complement their drafts by correcting errors and improving areas identified during the verification process. After confirmation of the inventory drafts that have been revised by the ministries, GIR prepares a final draft.

1.2.3. Final Confirmation and Publication

GIR hosts the Working Group meetings for the review of the final draft of the inventory revised for each sector; and through the final deliberation of the Management Committee, the national GHG inventory is confirmed by December. Afterwards, GIR publishes the approved national GHG inventory through several platforms including its website.

2. Measurement Scope and Methodology

2.1 Scope of Greenhouse Gases

The ROK's national GHG inventory includes the anthropogenic emissions and removals of GHGs designated by the Kyoto Protocol; carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The emissions of CH_4, N_2O, HFCs, PFCs, and SF_6 are estimated in units of metric tons of carbon dioxide equivalent (tons of CO_2eq.) using the 100-year time horizon Global Warming Potentials (GWPs)[15] from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR) (Table 2.1).

[Table 2.1] Global Warming Potentials (GWPs) of Greenhouse Gases

Greenhouse Gas	Global Warming Potential
CO_2	1
CH_4	21
N_2O	310
HFCs	140-11,700
PFCs	6,500-9,200
SF_6	23,900

※ Source: IPCC Second Assessment Report (SAR), 1995.

2.2 Scope of Sectors and Time Period

The ROK prepared the national GHG inventory for Energy, Industrial Processes, Agriculture, Land Use, Land-Use Change and Forestry (LULUCF), and Waste sectors in accordance with the 1996 IPCC Guidelines. The national GHG inventory covers a total of 25 years from 1990 to 2014.

2.3 Methodology

The national GHG inventory was prepared mostly based on the 1996 IPCC Guidelines, but for some categories, applied the 2000 IPCC Good Practice Guidance (GPG 2000), 2003 IPCC Good Practice Guidance for LULUCF (GPG LULUCF), and 2006 IPCC Guidelines. The GPG 2000 was applied to the following: (1) Energy: Civil Aviation; and (2) Waste: Landfills, Wastewater Treatment, and Waste Incineration and the GPG LULUCF was applied to the LULUCF sector. The 2006 IPCC Guidelines were used for the following: (1) Industrial Processes: Semiconductor Manufacture and Electrical Equipment; (2) Agriculture: Rice Cultivation and Agricultural Soil Management; and (3) Waste: Other.

15 Global warming potentials (GWPs) are the level of each GHG's contribution to global warming on the basis of the CO_2's impact on global warming, which are expressed in numbers.

To ensure accuracy of the inventory, the ROK is consistently developing country-specific emission/removal factors. The use of country-specific emission factors is determined through MRV processes similar to the MRV processes for the national GHG inventory. Once country-specific emission/removal factors are developed by research institutes, they are submitted to GIR via sectoral responsible ministries. And then, GIR organizes a verification team consisting of experts in the Technical Group and internal experts who review the appropriateness of the development method, representativeness of factors, accuracy of measurement and analysis, etc. After verification, the emission factors are confirmed by the review of the Working Group and deliberation of the Management Committee. A total of 57 country-specific emission factors were applied in estimation of emissions for the relevant sectors in the national GHG inventory in 2014, which accounted for 85% of the total emissions. The following categories were estimated with country-specific emission factors: (1) Energy: Fuel Combustion; (2) Agriculture: Rice Cultivation and Agricultural Soil Management; (3) LULUCF: Forest Land ; and (4) Waste: Landfills, Wastewater Treatment, and Waste Incineration. The list of the ROK's country-specific emission factors is provided in Appendix 2.

The emissions for the categories not estimated with country-specific emission factors were mostly estimated with the default emission factors in the 1996 IPCC Guidelines; however, there were some categories for which the default emission factors in the 2006 IPCC Guidelines were applied. The default factors of the 2006 IPCC Guidelines were applied to the following: (1) Energy: Fuel Combustion of Refinery Gas and LPG Fuel and Fugitive Emissions from Oil and Natural Gas; (2) Industrial Processes: Semiconductor Manufacture and Electrical Equipment; (3) Agriculture: Agricultural Soil Management and Field Burning of Agricultural Residues; and (4) Waste: Wastewater Treatment and Biological Treatment of Solid Waste, etc.

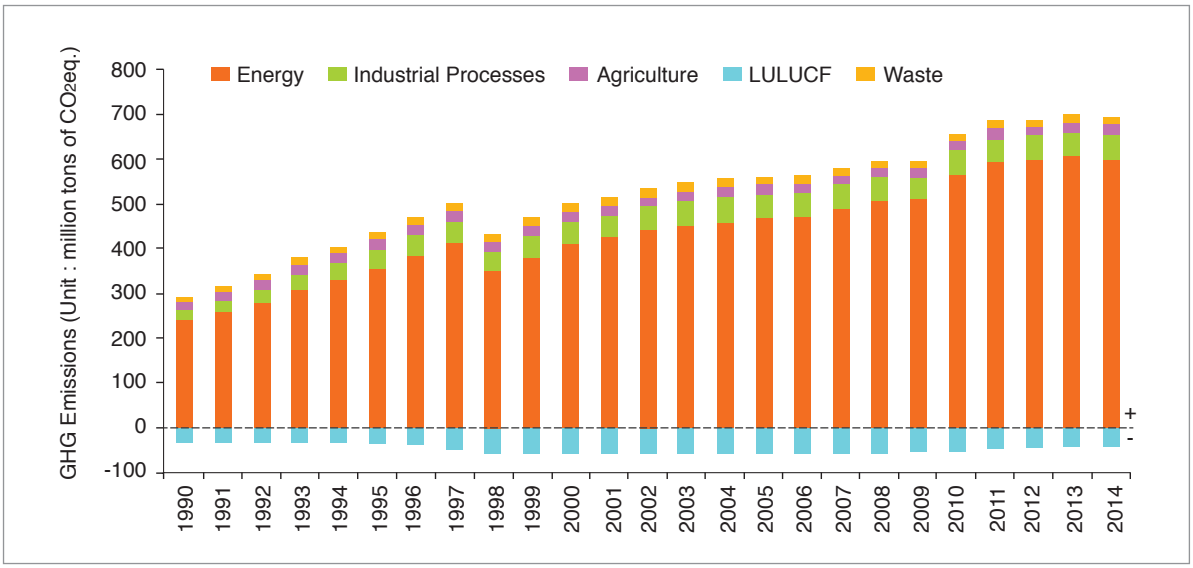
3. Greenhouse Gas Emissions and Trends

Total GHG emissions in the ROK in 2014 were 690.6 million tons of CO_2eq. and net emissions including sinks were 648.1 million tons of CO_2eq. Total emissions in 2014 had increased by 135.6% since 1990, and had declined by 0.8% since 2013 (Figure 2.2). Primary causes of the lower level of emissions compared to the previous year are the emissions decreases from the following: public electricity and heat production, CH_4 in the Agriculture sector, waste incineration, etc. More specific explanations are provided in Section 3.1. Also, the detailed time-series information for emissions by sector and gas is listed in Appendix 1.

To enhance the accuracy of the national GHG inventory, the ROK improves its activity data, emissions factors, and estimation methodology every year. Furthermore, to ensure time-series consistency, the ROK recalculates emissions in previous years for those categories in which methodological changes or refinements are applied. Recalculated categories, after the submission of the 1st BUR in 2014, are explained as follows: (1) the application of 2006 IPCC default emission factors

to the Fugitive Emissions from Natural Gas category in the Energy sector; (2) application of direct country-specific emission factors for direct N_2O emissions by crop in the Agricultural Soil Management category in the Agriculture sector; and (3) improvement of activity data for the amount of synthetic Nitrogen fertilizer and animal manure Nitrogen applied to soils in the Agricultural Soil Management category in the Agriculture sector.

[Figure 2.2] Trends in National Greenhouse Gas Emissions and Removals (1990-2014)



3.1 Greenhouse Gas Emissions by Sector

GHG emissions from the Energy sector in 2014 were 599.3 million tons of CO_2eq., accounting for 87% of total emissions. GHG emissions in this sector had increased by 148.3% since 1990, and decreased by 1.2% from the previous year. The emission reductions from the Energy sector in 2014 were largely attributable to a decline in electricity generation from fossil fuel power plants (-6.2%)[16], which resulted in 14.4 million tons of CO_2eq. reduction from the previous year in the Public Electricity and Heat Production category.

Emissions from the Industrial Processes sector were 54.6 million tons of CO_2eq., accounting for 7.9% of total emissions in 2014. This represented a 177.3% increase from the 1990 level and a 5.0% increase from the 2013 level. The key emission sources of this sector were the Mineral Products category and the Consumption of Halocarbons and SF_6 category, which accounted for 33.2 million tons of CO_2eq. and 20.1 million tons of CO_2eq., respectively.

Emissions from the Agriculture sector were 21.3 million tons of CO_2eq., accounting for 3.1% of total emissions in 2014. This represented a 1.5% decrease from the 1990 level and a 2.7% decrease from the 2013 level. Emissions have decreased since 1990 mainly due to the reduction of land used for rice cultivation.[17] Since 2000, emissions from the Enteric Fermentation and the Manure Management categories have increased due to the greater number of livestock being raised to match the

16 Yearbook of Energy Statistics, Ministry of Trade, Industry and Energy, 2016.
17 Agriculture, Food and Rural Affairs Statistics Yearbook, Ministry of Agriculture, Food and Rural Affairs, 2015.

growth in meat consumption. However, the number of livestock decreased in 2014[18], leading to declines in emissions from the Enteric Fermentation category and the Manure Management category by 3.9% and 4.3%, respectively, compared to the previous year.

The net removals from the LULUCF sector in 2014 was –42.5 million tons of CO_2eq., representing a 24.5% increase from the 1990 level and a 0.7% decrease from the 2013 level. The removals from the Forest Land category peaked in 1999 at –62.2 million tons of CO_2eq., mainly due to the large share of young trees under 30 years of age reaching the next forest age-class. This was the result of trees that were planted as part of the government's reforestation projects in the 1970s and 1980s. Post 1999, carbon removals showed a downward trend due to the maturation of forest age-class and the reduction of forest land area[19].

Emissions from the Waste sector were 15.4 million tons of CO_2eq. in 2014, representing a 47.8% increase from the 1990 level. The major contributor of this emissions growth was the Waste Incineration category that showed a 343.5% growth from the increased volume of incinerated waste. However, emissions in 2014 for the Waste sector decreased by 3.3% compared to the previous year reflective of a 9.2% emissions decrease from the Waste Incineration category. In addition to the decreased volume in waste incineration, an increased volume of waste being directed to energy recovery also contributed to the decrease in the Waste sector (Table 2.2).

[Table 2.2] Greenhouse Gas Emissions and Removals by Sector

Sector	1990	2000	2010	2012	2013	2014	Change between 1990 and 2014	Change between 2013 and 2014
	(million tons of CO_2eq.)						(%)	
Energy	241.4	410.4	565.2	597.7	606.7	599.3	148.3%	-1.2%
Industrial Processes	19.7	49.6	54.0	51.7	52.0	54.6	177.3%	5.0%
Agriculture	21.6	21.8	22.4	21.9	21.9	21.3	-1.5%	-2.7%
LULUCF	-34.1	-58.8	-54.3	-44.7	-42.8	-42.5	24.5%	-0.7%
Waste	10.4	18.9	15.1	15.8	16.0	15.4	47.8%	-3.3%
Total GHG Emissions [a] (excluding LULUCF)	293.1	500.6	656.6	687.1	696.5	690.6	135.6%	-0.8%
Net GHG Emissions [b] (including LULUCF)	259.0	441.8	602.3	642.4	653.8	648.1	150.2%	-0.9%

a) Total GHG Emissions: The sum of emissions from Energy, Industrial Processes, Agriculture and Waste Sectors excluding LULUCF

b) Net GHG Emissions: The sum of all sectors including the emissions and removals in LULUCF

18 Livestock Survey Report, Statistics Korea, 2014.

19 Statistical Yearbook of Forestry, Korea Forest Service, 2016.

3.2 Greenhouse Gas Emissions by Gas

The ROK's CO_2 emissions in 2014 were 628.8 million tons of CO_2eq., which accounted for 91.1% of total emissions. Among the non-CO_2 GHGs, the percentages of CH_4, N_2O, HFCs, SF_6 and PFCs stood at 3.9%, 2.2%, 1.2%, 1.4%, and 0.4%, respectively.

Compared to the GHG emissions by gas in 2013, the emissions of CO_2, CH_4, and N_2O decreased by 1.1%, 1.8%, and 0.8%, respectively while the emissions of HFCs, PFCs, and SF_6 increased by 5.5%, 4.6%, and 10.3%, respectively. Compared to the 1990 level, the emissions of PFCs and SF_6 grew by 879,213% and 5,288%, respectively in 2014 due to the increased production of semiconductors and panel displays. The emissions of HFCs grew by 768.7% which is attributable to the increased use of refrigerants. In 2014, CO_2 emissions rose by 149.2% compared to the 1990 level because of fuel consumption increase. N_2O emissions in 2014—similarly, attributed to the increase of fuel combustion emissions in the Energy sector caused by growth in fuel consumption—increased by 66.7% compared to the 1990 level. Meanwhile, CH_4 emissions had decreased by 13.4% since 1990 because of the decrease of land used for rice cultivation (Table 2.3).

[Table 2.3] Greenhouse Gas Emissions by Gas

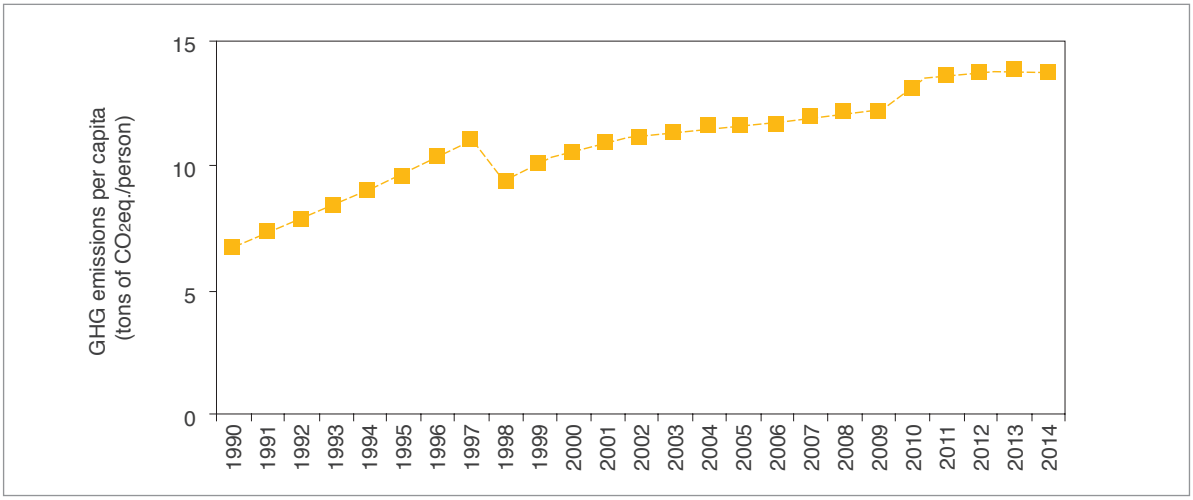
GHG \ Year		1990	2000	2010	2012	2013	2014	Change between 1990 and 2014	Change between 2013 and 2014
		(million tons of CO_2eq.)						(%)	
CO_2	Emissions	252.3	441.6	593.8	626.5	635.5	628.8	149.2	-1.1
	Percentage	86.1	88.2	90.4	91.2	91.2	91.1		
CH_4	Emissions	30.7	27.9	27.3	27.1	27.1	26.6	-13.4	-1.8
	Percentage	10.5	5.6	4.2	4	3.9	3.9		
N_2O	Emissions	8.9	17.6	13.3	14.8	15	14.9	66.7	-0.8
	Percentage	3.0	3.5	2.0	2.2	2.2	2.2		
HFCs	Emissions	1.0	8.4	8.1	8.7	8.1	8.5	768.7	5.5
	Percentage	0.3	1.7	1.2	1.3	1.2	1.2		
PFCs [a)]	Emissions	-	2.2	2.3	2.3	2.3	2.4	879,213	4.6
	Percentage	-	0.4	0.3	0.3	0.3	0.4		
SF_6	Emissions	0.2	2.9	11.8	7.8	8.5	9.4	5,288	10.3
	Percentage	0.1	0.6	1.8	1.1	1.2	1.4		
Total emissions (excluding LULUCF)		293.1	500.6	656.6	687.1	696.5	690.6	135.6	-0.8

a) The rate of change of PFCs was calculated based on the emissions in 1992 when the data was collected for the first time.

3.3 Greenhouse Gas Emissions per Capita

The ROK's per capita GHG emissions[20] in 2014 were 13.7 tons of CO_2eq., which represents a 100.3% increase from the 1990 level. For the past 5 years, per capita GHG emissions had risen as the national economy recovered from the 2009 global financial crisis, showing a 9.5% increase from 12.1 tons of CO_2eq. in 2009 to 13.3 tons of CO_2eq. in 2010. Since 2011, per capita emissions had remained at around 13.7 tons of CO_2eq. (Figure 2.3).

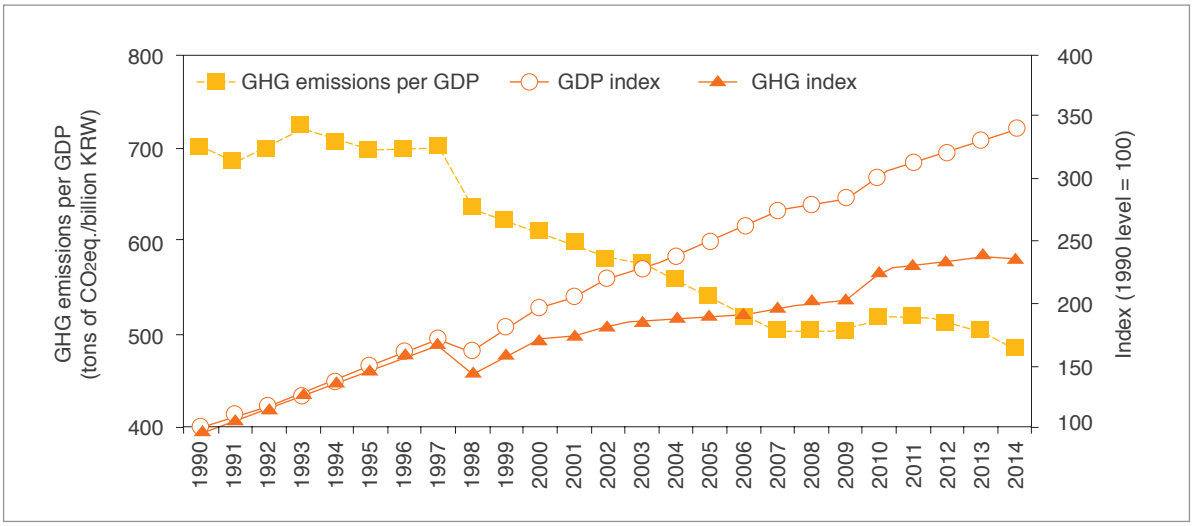
[Figure 2.3] Greenhouse Gas Emissions per Capita (1990-2014)



3.4 Greenhouse Gas Emissions per GDP

The ROK's GHG emissions per GDP[21] in 2014 were 484.0 tons of CO_2eq./billion KRW, which represented a 30.7% decrease from the 1990 level. The national emissions per GDP generally reflected a downward trend because the GDP growth rate surpassed the GHG emissions growth rate in most years since 1998 (Figure 2.4). Year-to-year changes of GHG emissions per GDP for the last three years in sequence were –1.6% in 2012, –1.5% in 2013, and –5.1% in 2014.

[Figure 2.4] Greenhouse Gas Emissions Intensity (Emissions per Real GDP from 1990 to 2014)



20 Population Projection, Statistics Korea, 2016.
21 Gross Domestic Product (Real GDP as of 2010) Statistics, Bank of Korea, 2016.


ALL
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CHAPTER 3

MITIGATION ACTIONS

DONGDAEMUN DESIGN PLAZA (DDP), Seoul
Multi-cultural complex, Green building

1. National GHG Reduction Target and Roadmap

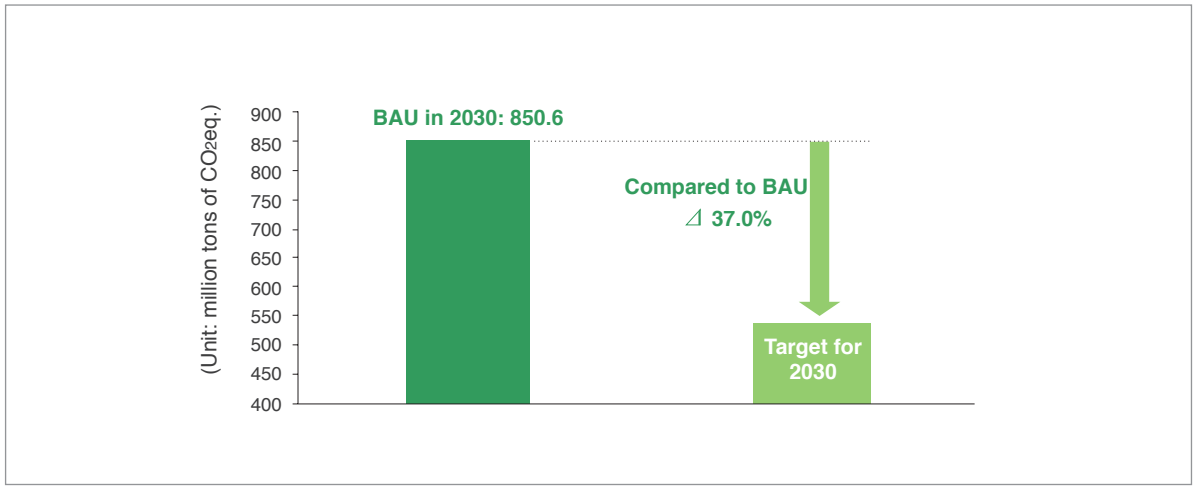
After declaring Low Carbon Green Growth as the national vision in 2008, the ROK officially announced a mid-term national GHG reduction target based on scientific and objective analysis in November 2009 the ROK which would aim to reduce emissions 30% below the business-as-usual (BAU) level by 2020. Since then, a joint task force composed of GIR and relevant ministries was established. The task force determined the 2020 reduction goals for 25 industries in 7 sectors in July 2011. Then, in January 2014, they established the Roadmap to Achieve the National GHG Reduction Target for 2020—encompassing action plans by sector.

During the course of such progress, the agreement for the new post-Kyoto climate regime joined by developed and developing nations had gained momentum, and intensified the need to set a reduction target beyond 2020. The ROK established the Post-2020 Joint Working Group with 15 specialized agencies including GIR. In June 2015, the determination was made to cut GHG emissions by 37% from BAU— including domestic and overseas reductions using the International Market Mechanism (IMM)–as its national GHG reduction target for 2030 (Figure 3.1).

The reduction target for 2030 calls for deeper emission cuts compared to the 2020 target, therefore it requires bold innovation across the nation. In particular, the ROK must exert great efforts to curb emissions faced with challenges of a high share of manufacturing in its industries and an energy efficiency level that has already reached a relatively high standard of advancement. Globally, the Paris Agreement, as the basis for the post-2020 new climate regime, was adopted in December 2015 and went into effect in November 2016 establishing a universal climate change response system participated by almost all nations in the global community.

Taking these domestic and international conditions into account, the ROK established the Roadmap to Achieve the National GHG Reduction Target for 2030 (2030 Roadmap) in December 2016 in order to provide specific policy direction to implement its mitigation actions and meet its reduction target effectively. The 2030

[Figure 3.1] National GHG Reduction Target for 2030

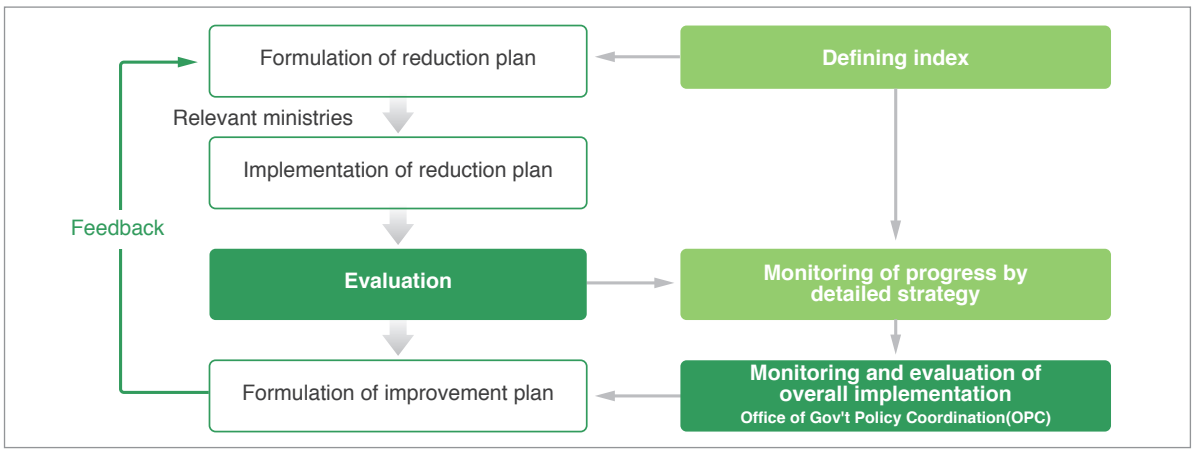


Roadmap specifies the emissions projection, reduction target and major reduction plans for 30 sub-sectors within 8 sectors. According to the roadmap, the greatest quantity of the reductions will be derived from energy transformation, followed by industry and buildings; while the sectors showing the highest rate of reductions is transport, followed by waste and energy transformation. The LULUCF sector was not included in the current national reduction target, but the ROK will consider incorporating it in its NDC in the future.

The 2030 Roadmap also introduces evaluation methods to practically implement reduction plans by sector. The evaluation system consists of two methods of evaluation: (1) evaluation of the implementation of specific strategies (e.g. policies, measures, etc.), and (2) evaluation of the implementation for the national reduction target. In addition, based on evaluations led by ministries responsible for each sector, the OPC will carry out comprehensive monitoring and evaluation of the overall implementation progress (Figure 3.2). Under the current schedule, a pilot evaluation of the 2030 Roadmap will be conducted based on the implementation plans submitted by each ministry from 2017 to 2019 for the purpose of improving and supplementing the evaluation system. The full-scale evaluation and feedback will be commenced in 2020.

In order to improve the feasibility of the 2030 Roadmap under the new climate regime, the roadmap will consistently be complemented and revised until 2020 when the NDC is to be submitted. During this process, the ROK plans to review reduction measures and adjust reduction pathways considering the changes in circumstances (e.g. emission results, economic conditions, international negotiation outcomes, and revision of related plans). The ROK will also continue to prepare a plan to procure emission allowances by utilizing international carbon markets. Moreover, it plans to present a GHG reduction implementation evaluation system that includes the establishment of a feedback system and the improvement of the national GHG inventory system for GHG reduction performance management. The feedback system includes development of evaluation techniques and an index for major reduction measures; it incorporates GHG reduction performance results into annual work performance evaluations, and budget planning for relevant ministries and agencies.

[Figure 3.2] 2030 Roadmap Evaluation System



2. Major Mitigation Policies

2.1 Emissions Trading System

The ROK's Emissions Trading System (K-ETS) was launched in January 2015. Currently, the emissions allowance trading market is being operated with the establishment of the Emission Permits Exchange in the Korea Exchange (KRX) through which the ROK manages 69% of the national GHG emissions. The K-ETS operates under three-year plans for Phase 1 (2015-2017) and Phase 2 (2018-2020), and five-year plans will begin from Phase 3.

A total of 23 industries are subject to Phase 1. Among them 20 were grandfathered (GF) based on past emissions, while the benchmarking (BM) method based on past activity data was applied to 3 industries; cement, oil refining, and aviation. Based on their business conditions and performance, some were given additional allowances or had a portion of allowances cancelled. As of September 2016, a total of 602 companies were designated for allocation of emission allowances.

For Phase 1, all emission allowances were allocated for free to entities in order to minimize the economic burden and to ensure the successful implementation of the K-ETS.[22] For the operation of Phase 1, preliminary allocations of 1,600 million KAU[23] were issued as of November 2014, additional allocations amounted to 6.4 million KAU, and cancelled allocations were at 22.4 million KAU as of September 2016. In addition, the K-ETS allows offset credits obtained through external reduction projects and as of December 2016, a total of 75 offset projects[24] were carried out, resulting in the supply of 15.6 million KOC[25] to the market.

In Phase 2, the BM allocation method that grants favor to companies with high facility efficiency will be expanded to induce further technological innovation of companies, and companies that have reduced their GHG emissions by investing in eco-friendly facilities will be granted incentives[26]. Then from Phase 2, allocations will be partially auctioned.[27] By supplying allowances to the market through regular auctions, the ROK plans to enhance the liquidity and vitality of the K-ETS market. Moreover, the transformation to a low-carbon high-efficiency industrial structure will be stimulated by a financial support system established for the purpose of reinvesting revenues from allowance auctions into the industrial innovation of companies participating in the K-ETS. An integrated platform will be built to provide information about trading volume and price in order to improve information asymmetry among K-ETS market participants and to vitalize the trading market (Table 3.1).

22 In accordance with article 13 of the Enforcement Decree of the Act on the Allocation and Trading of Greenhouse Gas Emission Permits
23 Korean Allowance Units, 1 KAU ≡ 1 ton of CO_2eq.
24 Seventy-four CDM projects (as of December 2016)
25 Korean Offset Credits, 1 KOC ≡ 1 ton of CO_2eq.
26 Reflected in the unused allocations for newly built or expanded facilities and reductions achieved for grandfathered facilities.
27 For each company subject to K-ETS, 97% of allowances will be free allocations and the remaining 3% will be from auctions.

[Table 3.1] Operational Plans for Phase 2 of the K-ETS (2018-2010)

Type	Description
Allocation of allowances	• Inducing improvements of facility efficiency by expanding BM allocations • Beginning the auctioning of allowances (for 3% of emission allowances obtained by companies subject to K-ETS)
Offset projects	• Promoting domestic offset projects • Promoting overseas offset activities by allowing the trading of domestic companies' overseas offset credits
K-ETS market	• Arranging regular auctioning of charged allowances • Developing an integrated platform for providing K-ETS related information
Industrial support	• Re-investing revenues from auctioned allowances as resources for eco-friendly investments

※ Source: The 2nd Master Plan for the Emissions Trading System, Ministry of Strategy and Finance, 2017.

2.2 GHG & Energy Target Management System

The GHG & Energy Target Management System (TMS) is designed for the systematic management of GHG emissions. Specifically, it imposes GHG reduction and energy saving targets on large businesses consuming significant amounts of energy, but not covered by the K-ETS. The ROK designates business that emit more than 50 thousand tons of CO_2eq. and consume over 200 TJ of energy annually—or own facilities that emit more than 15 thousand tons of CO_2eq., and consume over 80 TJ of energy annually—as controlled entities. Five ministries (i.e. Ministry of Land, Infrastructure and Transport; the Ministry of Agriculture, Food and Rural Affairs; the Ministry of Trade, Industry and Energy; the Ministry of Oceans and Fisheries; and the Ministry of Environment) oversee controlled entities by sector regulated under the TMS; and the Ministry of Environment, serving as the lead ministry, provides overall guidelines and standards, supervises the tasks of other ministries, and designates and manages verification agencies.

The ROK established Guidelines for the Operation of the GHG & Energy Target Management System in March 2011 and operates the TMS successfully according to international standards. Nineteen specialized agencies that employ auditors who have passed a strict qualifications exam were designated as verification agencies to ensure third-party verification of the GHG emission and energy consumption report submitted by the controlled entities.

Based on performance results of the TMS operated in 2015, 65 controlled entities reduced 740 thousand tons of CO_2eq., which is about 3.7 times greater than their originally established targets (200 thousand tons of CO_2eq.). The additional reductions (560 thousand tons CO_2eq.) achieved of the 54 controlled entities can be used as early reduction credits under the K-ETS.

3. Mitigation Actions by Sector

This section includes the status of implementation of reduction actions specialized by sector and future plans in addition to the emission trading system and the target management system described above.

3.1 Energy Transformation

3.1.1 Power Generation

The ROK is managing the mix of power generation facilities to reduce GHG emissions by gradually raising the shares of alternative and integrated energy while maintaining a stable power demand and supply (Table 3.2).

In July 2015, the ROK announced its 7th Master Plan for Electricity Supply and Demand, which outlines the nation's power demand projections and power generation facilities plan for the 15 years from 2015 to 2029. The plan specifies measures to ensure stable power supply, to increase low-carbon sources in the power mix for GHG reductions under the new climate regime, to manage electricity demand through new energy industries, and to expand distributed electricity systems.The ROK comprehensively takes into account various factors (i.e. economic feasibility, climate change, impact on the environment, and public safety) when formulating the subsequent master plan and operating the power market and power systems. In addition, the ROK will incorporate changing conditions such as demand management integrating information and communications technology (ICT) and business models, reduction of nuclear power plants and new and renewable energy development; and a power mix that reflects more distributed power generation resources, climate change mitigation, etc. into the 8th Master Plan for Electricity Supply and Demand.

The ROK introduced the Renewable Portfolio Standard (RPS) to expand renewable energy and has increased the annual mandatory supply rate to promote the use of renewable energy sources by power generators (Table 3.3). By 2020, the mandatory supply rate under the RPS system will be raised to 7.0% in order to encourage power generators to actively invest in renewable energy facilities.

[Table 3.2] Power Generation Segments by Year (MW, %)

Type / Year	Total	Hydro	Nuclear	Integrated energy	Alternative energy	Thermal			
						Coal	Natural gas	Combined cycle	Others
2013	86,969	6,454	20,716	3,106	3,519	24,534	888	23,473	4,280
	100	7.4	23.8	3.6	4.0	28.2	1.0	27.0	4.9
2014	93,216	6,467	20,716	4,323	4,474	26,274	388	27,296	3,280
	100	6.9	22.2	4.6	4.8	28.2	0.4	29.3	3.6
2015	97,649	6,471	21,716	5,360	5,649	26,274	388	28,512	3,280
	100	6.6	22.2	5.5	5.8	26.9	0.4	29.2	3.3

※ Source: Yearbook of Energy Statistics, Ministry of Trade, Industry and Energy, 2016.

The ROK plans to further reduce GHG emissions in the power generation sector by reducing coal-fired power generation, introducing high-efficiency power generation facilities for coal and LNG power plants, and introducing high-efficiency facilities that lower power loss during power transmission and distribution.

[Table 3.3] Implementation Results of the Renewable Portfolio Standard (RPS) Mandate

Type \ Year	2013	2014	2015
Mandatory supply rate	2.5%	3.0%	3.0%
Target (REC)	10,896,557	12,905,431	13,838,637
Implementation (REC)	7,324,861	10,078,351	12,486,461
Implementation / Target	67.2%	78.1%	90.2%

※ REC: Power generated from renewable sources (1MW) × Weight for each energy source
※ Source: Korea Energy Agency, 2016

3.1.2 Integrated Energy

The ROK is promoting integrated energy[28] projects to save energy and curb GHG emissions. As a result, the number of integrated energy businesses and their sales of heat and electricity from integrated energy have all been increasing (Table 3.4). In the future, the ROK plans to induce further GHG reductions and fuel savings of integrated energy business by expanding the real-time connection of heat supply among integrated energy providers considering changes in the heat demand, and promoting the recovery of unused energy within industrial complexes.

[Table 3.4] Integrated Energy Projects

Type \ Year	2013	2014	2015
No. of businesses	111	114	116
Sales of heat (thousand Gcal)	41,120	41,776	49,369
Sales of electricity (thousand MWh)	27,746	29,061	29,444

※ Source: Korea Energy Agency, 2016

3.2 Industry

The ROK has enacted the Energy Use Rationalization Act in order to ensure the rational and efficient use of energy and to tackle global warming, based on which various programs are being implemented—including the energy audit system, energy use plan consultations, and investment support and tax benefits for energy efficient facilities. In addition, the Energy Efficiency Standard and Labeling Program

28 Power generation business which produces heat or electricity at more than one integrated energy production facility such as combined heat and power, heat-only boiler, and resource recovery facility; and provides them en bloc for heating, cooling and hot water supply, to multiple users in houses, commercial buildings, and industrial complexes located within a certain area in order to increase energy use efficiency.

is in place to promote the production and R&D for high-efficiency products and to encourage consumers to purchase energy saving products. The E-standby Program was introduced to reduce the standby power of electronic devices and promote the distribution of products with low standby power. The High-efficiency Energy Equipment Certification System is in place to certify energy-saving appliances and electronic devices as highly efficient products and to promote their distribution.

The ROK also plans to further improve energy efficiency by introducing new technology and facilities to optimize energy consumption, improving the efficiency of commonly used equipment, and popularizing energy management systems.

The ROK is in the process of replacing high-GHG emitting fossil fuels (e.g. bituminous coal and B-C oil) that are used in combustion equipment (e.g. boilers) with low carbon fuel such as natural gas and biomass for reducing GHG emissions in heat generation. Steel, petrochemical, oil refining and cement industries are gradually replacing their conventional fuels of heavy oil and bituminous coal with LNG, and plan to use more biomass and waste plastics. In addition, the huge amount of heat produced in petrochemical industry facilities will be used for steam production and other processes to reduce fuel consumption, and the glass-making industry plans to cut GHG emissions by using more cullets that can be reused as a raw material for glass production.

In order to reduce GHG emissions in industrial processes, the semiconductor industry has installed and is operating PFC decomposition facilities in all new production lines built after 2011. The display industry is cutting the emissions of fluorinated gases by using reduction facilities such as scrubbers while some companies are using alternative gases with lower GWP in place of SF_6. In the electric/electronic and automobile industries, refrigerants used in some export products are being replaced with HFO-series gases (e.g. R1234yf) that have lower GWPs. The ROK plans to support the R&D of eco-friendly refrigerants and to promote the use of alternative refrigerants.

3.3 New Energy Industry

The New Energy Industry refers to a new type of industry that utilizes available new technologies and ICT to effectively solve major energy related-issues such as climate change mitigation, energy security, and demand management.

The ROK established the 2030 New Energy Industry Promotion Strategy in 2015 as the nation's mid- to long-term plan for encouraging active investments in the industry and participation of businesses. The 2030 Roadmap incorporated the GHG reduction strategies encompassing carbon capture utilization and storage (CCUS), hydrogen reduction technology, micro-grids, utilization of waste heat, smart factories, eco-friendly refrigerants, eco-friendly energy towns, green cars, and energy storage systems (ESS).

The ROK plans to lay the foundation for expanding the new energy industry through the implementation of policies that support deregulation, intensive investment, etc. Accordingly, it will further reduce GHG emissions by developing alternative industries that complement main industries.

3.4 Transport

In the transport sector, emissions from road transportation and aviation are increasing, while emissions from railways and marine transportation shows a decreasing trend. An increase of GHG emissions from road transportation was caused by the increased number of registered vehicles and high dependence on a road-oriented transport system. GHG emissions from aviation had increased due to the growing preference for high-end means of transport owing to income growth and the inflow of foreign tourists triggered by the Korean Wave[29].

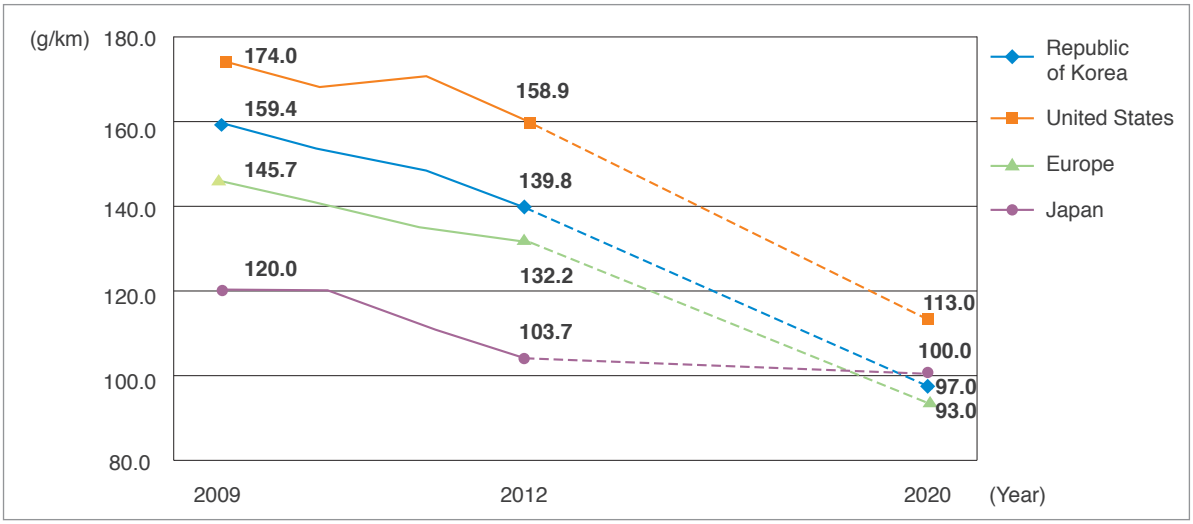
Major GHG reduction measures in the transport sector are improvement of the efficiency of transport modes and systems and expansion of the public transportation. In particular, fuel efficiency improvement of passenger cars took a large share of GHG reduction. In addition, the ROK plans to continuously tighten the average GHG emissions and fuel efficiency standards of cars and broaden the range of vehicle types subject to GHG emissions and fuel efficiency monitoring (Table 3.5) (Figure 3.3).

[Table 3.5] Standards on Vehicle Average GHG Emission and Fuel Efficiency (2015-2020)

Type \ Year	2015	2016	2017	2018	2019	2020
Average fuel efficiency standards of new vehicles (km/L)	17	18.4	19.9	21.3	22.8	24.3
Average GHG emission standards of new vehicles (g/km)	140	127	123	120	110	97

※ Source: Vehicle Average Greenhouse Gas Emission and Fuel Efficiency Standards (Draft), Ministry of Environment, 2014.

[Figure 3.3] National Vehicle GHG Emission Standards (Estimates after conversion of hybrid modes)



※ Source: Vehicle Average Greenhouse Gas Emission and Fuel Efficiency Standards (Draft), Ministry of Environment, 2014.

29 A terminology used to describe the increase in global popularity of South Korean culture

The ROK has been implementing the 3rd Master Plan for the Development and Distribution of Eco-friendly Vehicles since 2015. In accordance to the plan, the ROK supports the development of hybrid electric vehicles, electric vehicles, and fuel cell electric vehicles with high fuel efficiency and promotes the distribution of eco-friendly vehicles until 2030 through demonstration projects and subsidy provision (Table 3.6).

[Table 3.6] Eco-friendly Vehicle Distribution Plan (2016-2020) (Unit:10,000 vehicles)

Type \ Year	2016	2017	2018	2019	2020	Total
Hybrid electric vehicles	4.9	7.3	10.8	16.6	25.3	82
Electric vehicles	1	3	4	5	6.4	6.4
Fuel cell electric vehicles	0.01	0.03	0.25	0.26	0.39	0.9

※ Source: 3rd Master Plan for the Development and Distribution of Eco-Friendly Vehicles, jointly prepared by relevant ministries, 2015.

The ROK introduced the Renewable Fuel Standard (RFS) in July 2015 which obligates a certain blending ratio of bio-diesel to diesel used for motor vehicle fuels and plans to raise the ratio up to 3% by 2020. In addition, a standard on GHG emissions and average fuel efficiency will be applied to mid- to large-sized vehicles (The standard will be introduced in 2018 and a pilot project will be carried out from 2019), and city buses that are currently fueled by diesel or Compressed Natural Gas (CNG) will gradually be replaced with electric buses.

The ROK will promote the expansion of public transportation and various policies to manage transportation demand efficiently, such as expanding railway networks, introducing Bus Rapid Transit (BRT), building transit facilities, and etc. Also, it is putting efforts on transport modal shifts for freight from road to the eco-friendly coast shipping.

Various mitigation efforts are also being made in other categories besides road transportation. The aviation category is cutting GHG emissions by participating in the K-ETS, signing of voluntary GHG reduction agreements between the government and private airlines, enhancing fuel efficiency of aircraft, and improving aviation control and airport operation. In the railways category, the Third National Railway Network Plan was established and several policies has been implemented to improve the efficiency of existing railway networks and establish the Great Train Express (GTX) in the Seoul Metropolitan Area. Lastly, the ROK plans to achieve the GHG reduction goal for marine category earlier than the target year by introducing pilot GHG reduction projects and developing policies to ensure successful implementation of the TMS for the marine transportation and it will put efforts to gradually increase the reduction rate.

3.5 Buildings

The ROK established the 1st Master Plan on Green Building (2014-2018) in 2014 and is carrying out major strategies including strengthening the energy standards for new buildings, encouraging energy efficiency improvements of existing buildings, and promoting change in energy consumers' behavior.

First, under the objective of having all new buildings meet zero energy requirements by 2025, the ROK is gradually intensifying energy standards that new buildings must follow to obtain building permits and approvals. Moreover, various policies for improvement of building energy efficiency are implemented; e.g. high-performance and high-efficiency building certification, strengthening of insulation standards by region and by building use, and incentivizing application of the Energy Performance Based Building Code[30].

Creation of private demand and a market are the most important factors for promoting zero energy buildings. To that end, the Green Building Establishment Support Act was revised in January 2016 for the implementation of the Zero Energy Building Certification System which began in January 2017. Also, various incentives such as relaxing restrictions on floor area ratio, subsidy support for installation of new and renewable energy systems, and technical consultations have been offered in order to induce voluntary applications for certification.

Moreover, the Zero Energy Building Alliance was launched in September 2016 for successful implementation of policies through systematic cooperation among the private sector, public sector and academia. The economic feasibility and effectiveness of zero energy buildings are also improved by the Alliance's convergence of spheres including members from construction, energy, IT, and finance.

In the case of existing buildings, the Green Remodeling Interest Subsidy Program covers interest payments for energy performance improvement remodeling in private sector buildings; technology and construction assistance is provided for retrofitting delapidated public buildings (Table 3.7).

[Table 3.7] Major Results of Green Remodeling Projects (Unit: number of cases)

Type \ Year		2014	2015	2016	Total
Interest subsidy program for private sector		352	2,753	7,742	10,847
Public sector	Construction assistance	4	5	3	12
	Technology assistance	7	26	10	43

30 Policy of evaluating a building's overall energy performance, which is different from the current standard that evaluates the energy performance of each part a building.

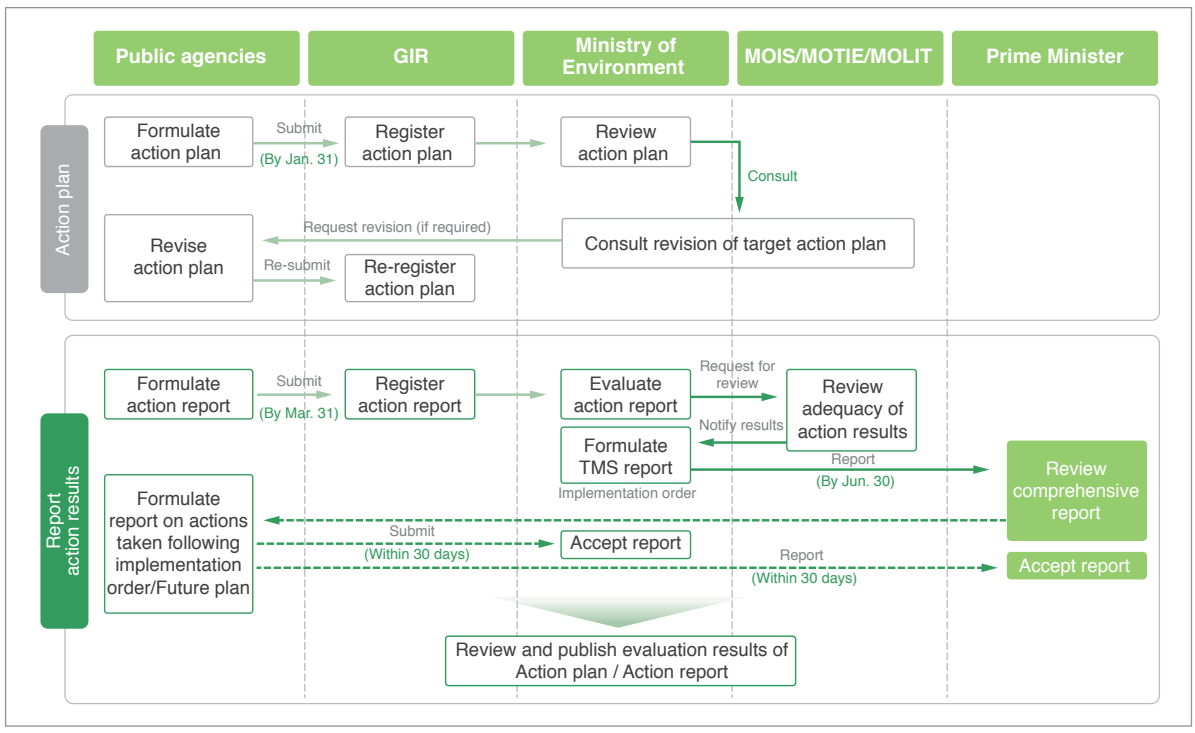
Moreover, since 2015, the ROK has disclosed energy consumption of public buildings (i.e. 4 times/year; 3,128 buildings of 616 public institutions) and recommends high energy-consuming buildings to improve their energy performance. A database containing the energy consumption information of all buildings (almost 7 million buildings in total) has been established and it provides energy performance information including energy ratings and GHG reduction levels by building in each region. Furthermore, the ROK plans to consistently strengthen energy efficiency rating standards and to expand the regulation scope for cooling and heating equipment and home/office appliances in the building sector.

Moreover, in 2016, around 480,000 high-efficient LED lamps were distributed to 343 business sites through a pilot project on the energy efficiency market and new and renewable energy systems were installed in 28,000 houses through a housing support project.

3.6 Public and Other Sectors

In order to take the lead for GHG reduction, the public sector is taking proactive steps to reduce emissions. One of the major reduction measures is the TMS, specifically, as applied to the public sector (Figure 3.4). The system is applied to 810 public agencies including central administrative ministries/agencies and local governments that are required to reduce emissions by more than 30% compared to baseline emissions (4.76 million tons of CO_2eq., the average emissions for the period of 2007-2009) by 2020 under annual reduction plans. However, certain public facilities are exempt from the reduction obligation for the purposes of national defense, public order, and education.

[Figure 3.4] System for GHG and the Energy Target Management System in the Public Sector



※ Source: Ministry of Environment, the Guidelines on Operation, Etc. of the Greenhouse Gases and Energy Target Management System for the Public Sector, 2015

An evaluation of GHG reduction implementation results in 2015 found that 0.83 million tons of CO_2eq. (including offset credits of 4,466 tons of CO_2eq.) were reduced, which represents 17.5% of baseline emissions.

In addition, the ROK is promoting the use of LED lamps and street lights, heat insulation improvement of new public buildings, and green remodeling of existing public buildings. The New & Renewable Energy (NRE) Mandatory Use for Public Buildings requires newly constructed, extended or reconstructed public buildings with more than 1,000 square meters of floor area to generate more than the required rate (18% for 2016) of total expected energy demand from new and renewable energy. The installation of renewable energy systems is also promoted by granting subsidies to local governments.

3.7 Agriculture and Fisheries

The ROK's agricultural sector is expected to be seriously affected by shifts in the geographical range of crop cultivation, inflow of foreign pests, and meteorological disasters caused by global warming. Climate change is also aggravating the environment of the fishery sector as the sea surface temperature of sea areas around the ROK had risen by around 1.23°C during the last forty-nine years from 1968 and 2016, which is about 2.5 times higher than that of the global average sea surface temperature rise. Thus, the ROK is pursuing policies to minimize the climate change impacts to agriculture and fisheries and to reduce GHG emissions while maintaining productivity.

In agriculture, efforts are made to promote intermittent irrigation[31] of rice paddies, reduce the use of chemical fertilizers, and consistently add facilities that convert methane gas into energy for power generation and/or livestock manure into fertilizer. In addition, the ROK is expanding cultivation areas for forage and mitigating emissions from enteric fermentation by enhancing livestock feed. Moreover, GHG emissions are reduced by the installation of eco-friendly heating and cooling systems that use new and renewable energy sources (e.g. geo-thermal heat pumps and wood pellet boilers) and the expansion of energy-saving facilities including multi-layered warm curtains and switchgears for greenhouse thermal tunnels.

In fisheries, nine types of fisheries[32], including inshore fishery among littoral fisheries, were selected and sampled for GHG emission surveys which have been conducted since 2014 to accurately investigate the GHG emissions. Results of the survey are incorporated into Life Cycle Assessments (LCAs) conducted[33] for ten types of fisheries[34], including large purse seine fishery, during the entire process from ship departure, fishery activities, entry, to unloading. As a pragmatic measure to reduce GHG emissions, the ROK has been providing energy–saving LED lights and replaced low-efficiency outdated engines and equipment through programs aimed at promoting high-efficiency, fuel saving equipment since 2008.

31 Method of reducing GHG emissions from continuous irrigation by draining then watering rice paddies 30 to 40 days prior to heading.

32 Offshore gill nets, offshore traps, offshore longline, coastal gill nets, coastal trap, anchovy drag net fisheries, eastern sea otter trawl, southwest sea Danish seines and southwest sea bottom pair trawl fisheries.

33 Conducted for six types of offshore fisheries (in 2015) and four types of coastal fisheries (in 2016).

34 Large bottom pair trawls, large Danish seines, large otter trawls, large purse seine, offshore stow net on anchors, offshore traps, coastal gill nets, coastal traps, coastal complex and coastal improved stow net on anchor fisheries.

In the future, the ROK plans: 1) to consistently implement these policies in order to establish a database by 2018 based on the results of tracking and surveying carbon emissions of littoral fisheries and on the results of LCAs of major littoral fisheries, and 2) to establish a climate change response system targeting the fishery sector. Further efforts will be made to reduce GHG emissions by managing the number of fishing vessels to promote sustainable fishing industries and adjusting their operation days by introducing fishing prohibition periods. Moreover, energy saving fishery systems and GHG reduction equipment will continuously be developed to counter climate change.

Best Practices: Farm-Business Mutual Cooperation for GHG Mitigation

The ROK has devised and implemented measures for farms by developing methodologies, supporting the verification of GHG reduction performance, and facilitating public-private partnerships to reduce emissions while increasing business profitability. As a part of the effort, the Ministry of Agriculture, Food and Rural Affairs, Chungcheongnam-do Province, and the Korean Western Power Inc. have signed a "Memorandum of Understanding on the Mutual Cooperation for Greenhouse Gas Reduction and Development of Agriculture" on November 25, 2015.

This is the nation's first partnership between farms and business for GHG reductions through which companies emitting large amounts of carbon partially cover installation costs of energy-saving facilities in farms, and farms in turn provide the emission allowances acquired from the GHG reductions to companies. Based on the agreement, Korea Western Power Inc. established a fund of KRW 10 billion to help farms in Chungcheongnam-do install new and renewable energy and energy-saving facilities for five years beginning in 2016.

In the first phase, one tomato farm and one strawberry farm selected in July 2016 were funded by Korea Western Power Inc. to install new and renewable energy facilities including geo-thermal heat pumps and wood pellet boilers, and in turn, Korea Western Power Inc. secured about 3,000 tons of CO_2eq. of GHG emission allowances obtained from the two farms as a result of the GHG reductions.

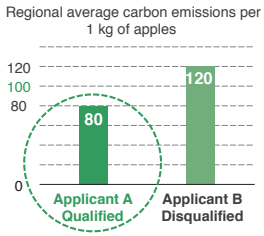
Such models of farm-business partnerships are expected to be more widely spread as it can help companies obtain emission allowances and improve their corporate image while farms can lessen the initial financial burden of energy saving equipment installation and save on production costs.

Best Practices: Low-carbon Agricultural and Livestock Product Certification System

The ROK has introduced the Low-carbon Agricultural and Livestock Product Certification System[35] (Figure 3.5) to gain various benefits such as generating new income for farmers and enhancing their competitiveness by introducing low-carbon farming techniques. Under the system, the government certifies agricultural and livestock products produced through comprehensive low-carbon farming techniques. Until 2016, 367 certified products reduced a total of 18,060 tons of CO_2eq. Moreover, the growth of ethical consumers has raised the demand for low-carbon certified agricultural products and expanded the number of farms willing to participate in the system, from 60 farms in 2012 to 1,164 farms in 2016.

35 Nineteen technologies related to fertilizer reduction, energy-saving of farming equipment, heating energy reduction, etc.

[Figure 3.5] Low-carbon Agricultural and Livestock Product Certification System and Label

Certification system		Low-carbon label
Low-carbon label issued to a product which emits less emissions compared to the national average emissions of the same product types.		

3.8 Forestry

The ROK's forests were degraded during World War II and the Korean War. However, the establishment of the KFS in 1967 and the success of the National Forest Development Plan conducted from 1973 to 1987 have enabled the restoration of the forests. Sustainable forest management activities including wildfire and landslide prevention; insect, pest, and disease control; reforestation after logging; and tending for forest protection have increased accumulation of forest stock removing GHGs from the atmosphere.

In order to effectively respond to climate change by maintaining and enhancing the forests' function of GHG removal, the Act on the Management and Improvement of Carbon Sinks[36] was enacted in 2012. Thereafter, the Carbon Sinks Improvement Master Plan (2015-2019) was established and implementation progress has been monitored on an annual basis.

The ROK is implementing four policies and measures to enhance the capacity of forests as carbon sinks. First, the ROK is planting high-quality seedlings from seed orchards, carrying out forest tending projects, and controlling deforestation. In addition, to mitigate and prevent increasing impacts of climate change on forests, the ROK is making efforts toward conducting climate change impact assessments, forecasting of forest pests, prevention and suppression of wildfires, and prevention of and recovery from landslides. Second, policies are being implemented to replant trees in urban and school areas and to restore damaged forests as new carbon sinks. Third, the ROK government is making efforts to expand the stable supply of domestic wood in order to promote the use of wood products that store carbon and to manufacture durable wood products into timber. Lastly, it plans to contribute to GHG reduction by promoting the use of forest biomass energy.

Furthermore, the Forest Carbon Offset Program[37] was launched from the second half of 2013, and by the end of 2016, a total of 110 projects had been registered. The program is expected to facilitate carbon removal by promoting forest management

36 Carbon sink refers to standing trees, bamboo, dead organic matter, soil, harvested wood products (HWP), or forest biomass energy.

37 In order to encourage voluntary GHG reduction efforts, the Forest Carbon Offset program issues credit for additional forest carbon sinks procured by companies, mountain owners and local governments in the course of carrying out activities with the purpose of adding carbon sinks.

practices for the public, facilitating the use of harvested wood products for construction and furniture materials, and encouraging the use of forest biomass energy.

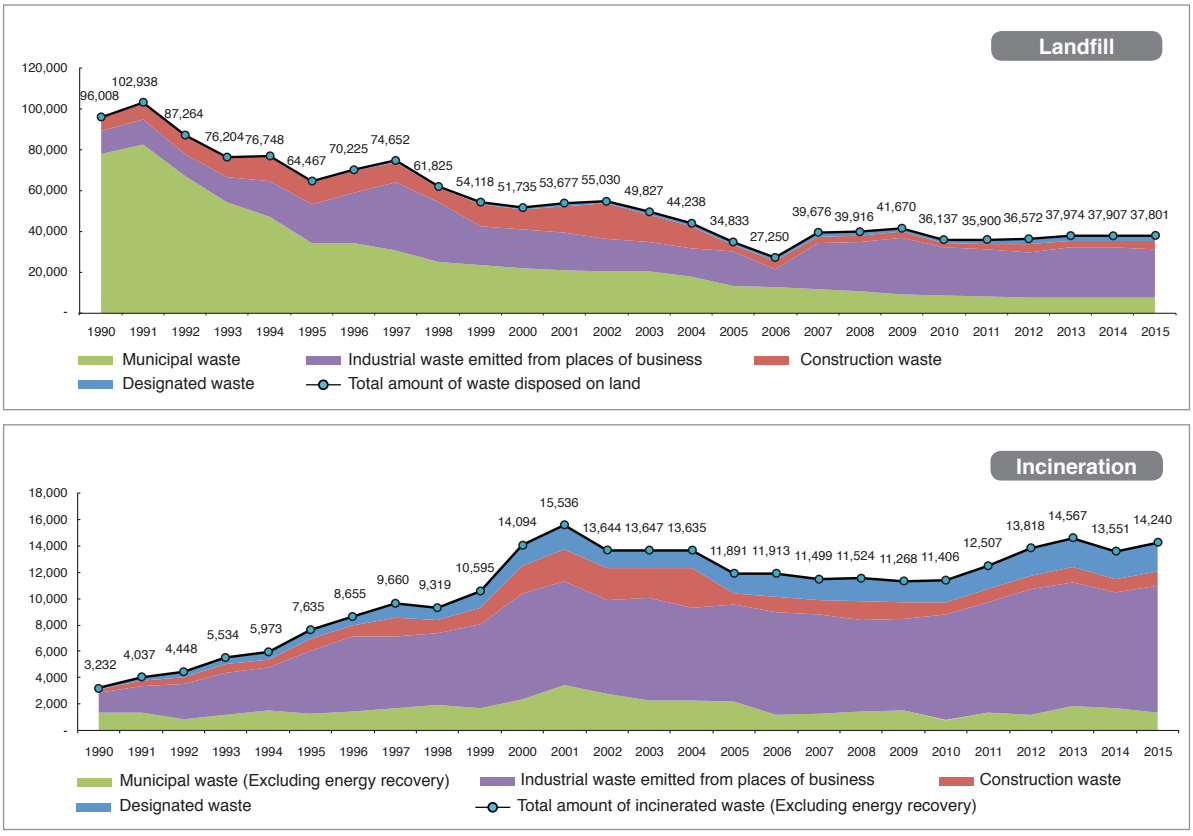
In the future, the ROK aims to refine the reporting of the GHG inventory for the forest sector by collecting data on land use change and strengthening the verification process through utilization of satellite image data.

3.9 Waste

Waste sector GHG emissions can be reduced by creating a resource circulating society in which the input of natural resources and energy is minimized by limiting the generation of waste and encouraging waste recycling. Reducing waste generation and enhancing the rate of recycling can decrease landfill-use and incineration activities cutting GHG emissions.

In 2015, waste disposal on land amounted to 37,801 tons/day and the volume of incinerated waste stood at 14,240 tons/day in the ROK. This represents a 60.6% decrease for waste disposal on land and a 340.7% increase for incinerated waste compared to their 1990 levels (estimated value). Relative to 2014, there was a 0.3% decrease for waste disposal on land and 5.1% increase for incinerated waste. There had been a consistent decline in the amount of landfill waste due to recycling policies that reduced the generation of municipal and industrial waste, but there has been a stagnation since 2007 (Figure 3.6).

[Figure 3.6] Waste Disposal on Land and Incineration Trends (1990-2015)



※ Source: Status of Generation and Treatment of Wastes of Korea, Ministry of Environment, 2016

The recycling rate of municipal waste had remained at similar levels, whereas the recycling rate of industrial waste (excluding waste from construction sites) increased from 73.0% in 2011 to 78.2% in 2015. As methane generation is decreasing due to the decline of landfill waste resulting from the growth of recycling and the changes in the properties of waste caused by minimized direct land disposal, the amount of methane collected from landfills is also being reduced (Figure 3.8).

In addition, waste-to-energy projects are consistently expanding by using more organic waste and flammable waste for energy conversion. As a result, 14 flammable waste pre-treatment facilities, 2 boilers that exclusively use solid fuel products, and 11 facilities that turn organic waste into biogas have been added. Moreover, at the end of 2016, the ROK annually produced 290,000 tons of solid fuel products and 67 million cubic meters of biogas, and achieved a 14.2% rate of waste-to-energy (1.656 million tons out of 11.69 million tons of available waste resources).

The ROK continues to improve policies aimed at facilitating waste recycling. In particular, the Framework Act on Resource Circulation was enacted in May 2016 and will go into effect in 2018 with the objective of transforming the nation into a resource circulating society by fundamentally improving the current socioeconomic structure of mass production, consumption, and disposal.

[Table 3.8] Municipal and Industrial Waste Recycling Rates (%) and Methane Gas Recovery in Landfills (thousand tons)

(Unit: %, thousand tons)

Type \ Year	2011	2012	2013	2014	2015
Municipal waste recycling rate	59.1	59.1	59.1	59.0	59.2
Industrial waste recycling rate	73.0	76.5	75.4	77.3	78.2
Methane recovered from landfills	139	153	153	142	-

※ [Recycling rate] Source: Status of Generation and Treatment of Wastes of Korea, Ministry of Environment, 2016
※ [Methane gas] Source: 2016 National Greenhouse Gas Inventory Report, Greenhouse Gas Inventory and Research Center, 2016

[Table 3.9] Mitigation Actions and Performance Indicators

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
All Sectors	Emission Trading System	CO_2 CH_4 N_2O HFCs PFCs SF_6	Effective achievement of national GHG reduction targets using market functions	• The GHG emission trading system was launched in January 2015 to manage approximately 69% of national GHG emissions - The 1st phase (2015 through 2017) and the 2nd phase (2018 through 2020) programs are operated as three-year programs, and the 3rd phase program and programs thereafter are operated as five-year programs • The 1st phase program will be operated for 23 types of businesses (602 businesses have been designated for allocation as of September 2016) - Pre-allocated volume: 16 million KAU (November 2014) - Additionally allocated volume: 6.4 million KAU - Volume of cancelled allocation: 22.4 million KAU (September 2016) - Volume of emissions offset: 15.6 million KOC	Regulation	• Ministry of Strategy and Finance • Ministry of Land, Infrastructure and Transport • Ministry of Agriculture, Food and Rural Affairs • Ministry of Trade, Industry & Energy • Ministry of Oceans and Fisheries • Ministry of Environment	Implemented	2015	Amount of GHG emission reduction (ton CO_2eq.)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
All Sectors	Greenhouse gas & Energy Target Management System (GHG & Energy TMS)	CO_2 CH_4 N_2O	GHG reduction and energy saving	• To regulate GHG emissions and the energy consumption of business entities emitting large amounts of GHGs in order to achieve national mid-and long-term GHG reduction targets and to reduce energy consumption - In 2015, businesses subject to the system reduced 740,000 tons of CO_2eq.	Regulation	• Ministry of Environment/ Korea Environment Corporation • Ministry of Trade, Industry & Energy/ Korea Energy Agency • Ministry of Land, Infrastructure and Transport/ Korea Energy Agency, Korea Appraisal Board, Korea Transportation Safety Authority • Ministry of Agriculture, Food and Rural Affairs/ Foundation of Agricultural Technology Commercialization and Transfer, Korea Forestry Promotion Institute • Ministry of Oceans and Fisheries/ Korea Ship Safety Technology Authority	Implemented	2010	Amount of GHG emission reduction (ton CO_2eq.)
	GHG & Energy TMS in the Public Sector	CO_2 CH_4 N_2O	GHG reduction and energy saving	• To set and implement annual GHG reduction and energy saving target in order to the fulfillment of national GHG reduction - In 2015, 831 thousand tons of CO_2eq. was reduced, representing 17.5% of baseline emissions (4,761 thousand tons of CO_2eq.)	Voluntary agreement	• Ministry of Environment/ Korea Environment Corporation	Implemented	2011	Amount of GHG emission reduction (ton CO_2eq.) in the public sector

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Energy transforma-tion	Low-carbon power mix	CO_2 CH_4 N_2O	GHG reduction and maintenance of stable power supply and demand	• To add low-carbon power facilities in the power generation sector based on the 7th Master Plan for Electricity Supply and Demand for GHG reduction by Post-2020 and for stable power supply and demand	Policy	• Ministry of Trade, Industry & Energy/ Power generation companies	Implemented	2015	Share of low-carbon power generation (%)
	Renewable Portfolio Standard (RPS)	CO_2	Contribut to creation of new & renewable energy markets by encouraging GHG emission reductions and by creating a stable investment environment where companies can invest in new & renewable energy industries	• To require power generation companies possessing more than certain amount of power generation facilities (500, MW) to supply new & renewable energy of more than a certain percentage of the total power generation	Policy	• Ministry of Trade, Industry & Energy/ Power generation companies (18), Korea Energy Agency	Implemented	2012	Renewable Energy Certificates (REC) issued
	Integrated energy system	CO_2 CH_4 N_2O	National GHG reduction and energy saving	• A project to provide a large number of users with energy (heat and/or electricity) produced in the energy production facilities composed of one or more of combined heat and power plant, heat-only boilers, and resource recovery facilities through district heating and cooling businesses and integrated energy systems of industry complexes	Policy	• Ministry of Trade, Industry & Energy/ District heating and cooling businesses (86), Korea Energy Agency	Implemented	1985	Sales volumes of heat and electricity

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Industry	Energy audit system	CO_2 CH_4 N_2O	Promoting efficient use of energy of energy-intensive businesses	• To require businesses consuming more than 2,000 toe annually to receive energy audit on a periodic basis	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	2007	Energy savings (toe)
	Consultation on energy use plan	CO_2 CH_4 N_2O	Encouraging rational energy use and energy savings	• To analyze how the implementation of agreed target projects affects energy supply and demand and GHG emissions as a result of energy consumption • To create plans for required energy supplies and the rational use of energy and its evaluation	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1991	-
	Investment support and tax benefit for energy efficient facilities	CO_2 CH_4 N_2O	Promoting an energy-saving facilities supply, and the enhancement of energy reduction and energy use efficiency	• To give long-term loans with low interest rates for investment in energy-saving facilities for energy use rationalization and GHG reduction	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1980	Energy savings (toe)
	Expansion of energy service company project	CO_2 CH_4 N_2O	Promotion of energy-saving facilities supply, and enhancement of energy reduction and energy use efficiency	• A project to allow energy users in need of technical skills and funding ability to make replacement for energy-saving facilities through contracts with energy service company (ESCO)	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1992	-

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Industry	Energy efficiency standard & labelling program	CO_2 CH_4 N_2O	Promotion of high-efficiency products production, technology development and energy-saving products purchase of consumer	• A system to enforce efficiency grade labelling (from 1st to 5th grade) according to energy consumption efficiency (usage) of target products - To prohibit production and sales of products not meeting the lowest consumption efficiency standards	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1992	Energy savings (toe)
	Standby power warning indication system	CO_2 CH_4 N_2O	Promotion of the implementation of standby power reduction function of electronic products and the supply of the products excellent in standby power reduction	• To induce the adoption of power saving mode during standby time and the minimization of standby power • To permit energy saving marks for the products meeting standby power reduction standards and to force the display of warning labels on the products failing to meet the standards	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1999	-
	High-efficiency energy equipments certification system	CO_2 CH_4 N_2O	Promotion of the distribution of equipments with large energy-saving effects	• A system for the government to certify the products that meet certain criteria for energy consumption efficiency to promote the development of the technologies for high efficiency products and to expand their supply - The certificate is issued for certified product and the product is displayed with high efficiency energy equipment marks	Policy	• Ministry of Trade, Industry & Energy/ Korea Energy Agency	Implemented	1996	-

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Transport	Strengthening of vehicle average fuel efficiency and distribution of eco-friendly vehicles	CO_2 CH_4 N_2O	GHG reduction by strengthening vehicle fuel efficiency management system and expanding the distribution of eco-friendly vehicles	• To strengthen vehicle average fuel efficiency standards - Strengthen vehicle average fuel efficiency standards (24.3km/ℓ by 2020) • To distribute eco-friendly vehicles - Develop and distribute high-efficiency low-cost hybrid electric vehicles, enhance performance of electric vehicles and expand charging stations, improve durability and safety of fuel cell electric vehicles, implement demonstration project and grant subsidies to facilitate distribution - Distribution of HEVs (4 million by 2030) - Distribution of EVs (1 million by 2030) - Distribution of FCEVs (0.64 million by 2030) • To enforce regulation on average fuel efficiency of mid- to large-sized vehicles - Enhance by 20% by 2020, by 40% by 2035	Regulation, research (R&D)	• Ministry of Land, Infrastructure and Transport • Ministry of Trade, Industry & Energy	Implemented	2017	Vehicle fuel efficiency standards
	Biodiesel blending in road transport	CO_2 CH_4 N_2O	Implementation of policy to obligate the blending of biodiesel with diesel used as vehicle fuel and mandatory supply	• To enforc policy to require diesel used as vehicle fuel to contain 3% of biodiesel by 2020	Regulation	• Ministry of Land, Infrastructure and Transport • Ministry of Trade, Industry & Energy	Implemented	2017	Biodiesel blending rate

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Transport	Adoption and operation of system for plug-in and wireless charge electric buses	CO_2 CH_4 N_2O	Commercialize plug-in and wireless charge electric buses that will replace diesel and CNG city buses	• To distribute 12,300 electric buses (battery exchangeable and wireless charging)	Other	• Ministry of Land, Infrastructure and Transport • Ministry of Trade, Industry & Energy	Planned	2017	Number of distributed plug-in and wireless charge electric buses
	Discouraging the use of passenger cars and expanding the operation of public transportation	CO_2 CH_4 N_2O	Discourage the use of passenger cars through traffic demand management and expand the operation of public transportation by building traffic system focused on public transportation	• To discourage the use of passenger cars - To reducethe annual average mileage of passenger cars - To encourage drivers to practice economical driving • To expand the operation of public transportation - To expand BRT system and establish transfer facilities - To reduce the use of passenger cars by improving railroad network - To reduce the operation of passenger cars by 5%	Regulation, research (R&D)	• Ministry of Land, Infrastructure and Transport	Implemented	2017	Changes in mileage of passenger cars
	Enhancing the efficiency of green logistics	CO_2 CH_4 N_2O	Promote the modal shift of freight transportation from road to rail and coast shipping	• To revitalize 3PL • To ensure efficient freight transportation by promoting modal shift	Information provision	• Ministry of Land, Infrastructure and Transport • Ministry of Oceans and Fisheries	Implemented	2017	-
	Enhancing the efficiency of air transport	CO_2 CH_4 N_2O	Reduce GHG by promoting K-ETS	• To sign agreement on voluntary GHG mitigation with domestic airliners	Voluntary agreement	• Ministry of Land, Infrastructure and Transport	Implemented	2017	Number of companies that have signed voluntary agreement

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Building	Strength-ening of standards on energy performance including insulation	CO_2 CH_4 N_2O	Enhance energy use efficiency in the building sector by strengthening energy saving design standards applied to buildings such as prevention of heat loss through efficient energy management from the designing stage	• To strengthen standards on energy saving design of buildings such as insulation standards for efficient building energy management ※ Window (W/㎡K): 3.0 (Jul. 2008) → 2.1 (2010) → 1.5 (2013) → 1.2 (2015) ※ Outer wall (W/㎡K): 0.47 (Jul. 2008) → 0.36 (2010) → 0.27 (2013) → 0.21 (2015)	Regulation	• Ministry of Land, Infrastructure and Transport/ Korea Energy Agency	Implemented	2001	Number of reviewed energy saving plans
	Building energy efficiency grade certification system	CO_2 CH_4 N_2O	Promotion of the buildings excellent in energy performance and enhancement of energy use efficiency in the building sector	• To assess the amount of energy required for building operations–including heating, cooling, hot water–with design documents and to give a grade to each building from 1+++ to 7 (10 grades) according to its energy performance for certification - A certificate (preliminary certification and certification) is issued after the certification evaluation by a certification authority and the certification results are managed in the operating agency	Information provision	• Ministry of Land, Infrastructure and Transport/ Korea Energy Agency	Implemented	2001	Number of certificates issued

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Building	Zero-energy building certification system	CO_2 CH_4 N_2O	Expand the distribution of buildings with maximized energy performance and improve energy efficiency of the building sector	• To apply energy performance standards more stringent than the existing energy efficiency grade, and grant incentives accordingly - To evaluate energy requirement (Grade1++ or above), energy self-sufficiency rate (20% or above), and installation of Building Energy Management System and certify in five grades (from Grade 5 to 1)	Information provision	Ministry of Land, Infrastructure and Transport/ Korea Energy Agency	Adopted	2017	Gross area of certified buildings
	Green remodeling	CO_2 CH_4 N_2O	Improve the energy performance of existing old buildings	• To grant government financial assistance to improve energy performance of old buildings by 20% or more - Since launch in 2014, 10,847 projects have been approved for the three years	Economic/ financial policy	Ministry of Land, Infrastructure and Transport/ Korea Land & Housing Corporation	Implemented	2014	Number of approved projects
Agriculture, livestock and fishery	Enlarging areas of intermittent irrigation in rice cropland	CH_4	GHG reductions through the management of water supplies in rice cropland	• GHG reductions in rice cropland through development and distribution of related technologies to manage water more efficiently in rice cropland - Agricultural Technology Centers through the New Year Farming Planning program induce the practice of intermittent irrigation by providing safe harvesting training for high-quality rice production and management - To ensure conditions for proper water management by building and renovating irrigation facilities such as waterway ※ 551km added in 2015 (Accumulated length of 8,111km) → 411km added in 2016 (Accumulated length of 8,522km)	Training, financial policy	Ministry of Agriculture, Food and Rural Affairs/ Rural Development Administration	Implemented	2010	Percentage of areas applied with intermittent irrigation (%)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Agriculture, livestock and fishery	Reduction in chemical fertilizer usage	N_2O	GHG reductions by reducing the use of chemical fertilizers	• To reduce chemical fertilizer usage by supporting the use of organic fertilizers and soil conditioners - Encourage the use of proper amount of fertilizers by issuing "fertilizer use prescription" based on soil evaluation results on Soil and Environmental Information System ※ Number of fertilizer use prescriptions issued: 52,500 in 2015 → 453,000 in 2016 - Provide training on the proper way of using farming equipment in order to reduce the use of chemical fertilizers	Research (R&D), training	Ministry of Agriculture, Food and Rural Affairs	Implemented	2000	Amount of chemical fertilizers used (kg/ha)
	Expansion of livestock manure treatment facility	CH_4	GHG reductions by using livestock manure as resource	• GHG reductions by expanding facilities that convert manure into energy and fertilizers - GHG reductions by expanding facilities with livestock manure treatment to generate more efficient levels of energy and resources ※ Facilities that convert manure into energy: 9 in 2015 → 12 in 2016 ※ Facilities that treat manure to use it as resources: 112 in 2015 → 117 in 2016	Financial policy	Ministry of Agriculture, Food and Rural Affairs	Implemented	2007	Number of livestock manure treatment facilities

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Agriculture, livestock and fishery	Expansion of high-quality forage cultivation	CH_4	GHG reductions by increasing provision of high-quality forage to livestock	• GHG reductions through improved enteric fermentation of animals by cultivating high-quality forage and increasing provision to livestock - Launch of "forage quality grading system" to promote the production and use of high-quality forage (2016) - To expand the base for stable forage production by maintaining and expanding large-scale production complexes that collectively specialize in forage production ※ Number of specialized complexes: 40 (19,489.1ha) in 2015 → 45 (29,630.1 ha) in 2016, an increase of 1,141 ha	Regulation, financial policy	• Ministry of Agriculture, Food and Rural Affairs	Implemented	1998	Supply of high-quality forage (Thousand ton)
	Expansion of new & renewable energy facility	CO_2 CH_4 N_2O	Reduction of GHG from controlled agriculture through expansion of new & renewable energy facilities	• To reduce fossil fuel consumption through expanded supplies of new & renewable energy facilities - To reduce GHG by supporting the installation of heater and coolers that use new and renewable energy such as geo-thermal cooling and heating system within greenhouse and wood pellet boilers ※ Geo-thermal cooling and heating system: 378ha in 2015 → 383ha in 2016 ※ Wood pellet boilers: 710ha in 2015 → 731ha in 2016	Financial policy	• Ministry of Agriculture, Food and Rural Affairs	Implemented	2010	Area of renewable energy facilities supported (ha)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Agriculture, livestock and fishery	Expansion of energy reduction facilities supply	CO_2 CH_4 N_2O	GHG reduction through expanded supply of energy reduction facilities for greenhouse farming	• To reduce fossil fuel consumption through expanded supplies of energy reduction facilities for controlled agriculture - To reduce fossil fuel consumption and GHG emissions by distributing energy-saving insulation materials such as multi-layered warm covers and recirculated water curtain systems ※ Multi-layered warm covers: 1,904ha in 2015 → 2,204ha in 2016 ※ Recirculated water curtain systems: 292ha in 2015 → 299ha in 2016	Financial policy	• Ministry of Agriculture, Food and Rural Affairs	Implemented	2009	Area of energy reduction facilities supported (ha)
	Supporting high-efficiency fuel-saving equipment of fishing ships	CO_2	Distribution of high-efficiency LED lights (fishing lure lights and operation lights) and replacement of decrepit engines of littoral fishing ships for GHG reduction	• To reduce GHG by supporting high-efficiency fuel-saving equipment of fishing ships - To support the distribution of energy-savig LED lights and fishing lure lights from 2009 -To support the installation of fuel-saving equipment in fishing ships -To replace low-efficiency and decrepit engines • To carry out the distribution of high-efficiency LED lights and replacement of decrepit engines of littoral fishing ships ※ Reduced a total of 38,358 ton CO_2eq. of GHG from 2009 to 2015 ※ Reduced a total of 15,500 ton CO_2eq. of GHG in 2016 ※ Target in 2017: To install LED lights in 64 ships, and to support the replacement of engines, equipment and facilities of 1,069 ships	Financial policy	• Financial policy	Implemented	2009	Amount of GHG emission reduction (ton CO_2eq.)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Forestry	Sustainable forest management	CO_2	Maintaining and improving forests' function as carbon sink	• To pursue intensive forest management by combining forest road construction, tree planting and forest tending • To increase GHG removal by planting high-quality seedlings grown in seed orchard mountains	Economic/ Financial policy	• Korea Forest Service	Implemented	2015	Use of seed orchard forests for planting (%), collection of forest biomass by forest tending (%)
	Establishment of new sinks including urban forests	CO_2	Expansion of GHG absorption by establishing forest sinks such as urban forests and school forests.	• To establish urban forests, plant trees in unused land, build coastal forest belts and restore damaged forests for adding new carbon sinks	Other	• Korea Forest Service	Implemented	2003	Area of newly established carbon sinks including urban forest (ha)
	Utilization of domestic wood	CO_2	Promoting the use of wood in that captures CO_2	• To expand production of domestic wood products and develop technology for processing lumber with long carbon storing period	Information provision	• Korea Forest Service	Implemented	2015	Amount of domestic wood produced (m^3), Percentage of lumber produced from domestic wood(%)
	Utilization of forest biomass energy	CO_2	Use the eco-friendly fuel of forest biomass energy to enhance fossil fuel replacement rate	• To enhance production of domestic wood pellets and use of domestic fuel	Information provision	• Korea Forest Service	Implemented	2015	Amount of domestic pellets produced (thousand tons)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Forestry	Forest carbon offset scheme	CO_2	Promotion of voluntary CO_2 reduction activities in the private sector	• A scheme of providing economic incentive to promote active management of privately-owned forests that account for 67% of the nation's forests	Economic/ Financial policy	• Korea Forest Service	Implemented	2013	Number of forest carbon offset projects and amount of GHG emission reduction (ton CO_2eq.)
	National forest fire prevention	CO_2	Establish forest fire prevention and rapid suppression measures to minimize damages and maintain forests' function as carbon sink	• To establish various forest fire prevention and suppression plans to minimize damages inflicted by forest fire to forests that function as GHG sink	Information provision	• Korea Forest Service	Implemented	2017	Area damaged by forest fire compared to dry days
Waste	Enhance recycling rate of municipal waste and reduce percentage of municipal waste disposal on land	CO_2 CH_4	Enhance recycling rate of municipal waste and reduce disposal of municipal waste on land in order to cut GHG emissions	• To enhance recycling rate of municipal waste and reduce disposal of municipal waste on land in order to curb emissions of GHGs generated during land disposal and incineration	Regulation	• Ministry of Environment/ Korea Environment Corporation	Implemented	2008	Recycling rate of municipal wastes (%)

Sectors[a]	Mitigation action	GHG(s) affected	Objectives	Description of mitigation actions and progress (major achievements)[b]	Type of instrument[c]	Implementing ministry/ agency	Status of Implementation[d]	Start year of implementation	Performance indicator
Waste	Enhance recycling rate of industrial waste and reduce percentage of industrial waste disposal on land	CO_2 CH_4	Enhance recycling rate of industrial waste and reduce disposal of industrial waste on land in order to cut GHG emissions	• To enhance Enhance recycling rate of industrial waste and reduce disposal of industrial waste on land in order to cut GHG emissions in order to curb emissions of GHGs generated during land disposal and incineration	Regulation	• Ministry of Environment/ Korea Environment Corporation	Implemented	2008	The recycling rate of industrial wastes (%)
	Increase recovery of methane gas in landfills	CH_4	Recover more methane gas by capturing and utilizing methane gas in order to cut GHG emissions	• To recover methane gas in landfills in order to reduce a certain amount of GHG emissions in landfills - In 2015, 118,000 tons of methane gas was recovered in landfills nationwide	Regulation	• Ministry of Environment/ Korea Environment Corporation	Implemented	2010	Amount of recovered methane gas (thousand ton/yr)

a) Sectors: All sectors; Energy transformation; Industry; Transport; Building; Agriculture, livestock and fishery; Forestry; and Waste.

b) Description of mitigation actions and progress (major achievements): The name of related policy or legislation is provided, along with recent progress (with emphasis on major achievements and official quantitative information (when available)).

c) Type of instrument: Regulation; Economic/financial policy; Voluntary agreement; Information provision; Training (capacity building); Research (R&D); and other

d) Implementation status: Implemented; Adopted (implementation scheduled); Planned

※ Compared to the implemented year, the implementation status is categorized as (1) “Implemented” if the implementation year is earlier than present (2017); (2) “Adopted” if implementation year is later than present (2017); and (3) “Planned” if expected policy implementation year (Draft) has been determined but no policy has been drafted.

CHAPTER 4

INTERNATIONAL SUPPORT AND COOPERATION

SEONGSAN ILCHULBONG PEAK, Jeju
UNESCO World Heritage Site

1. Introduction

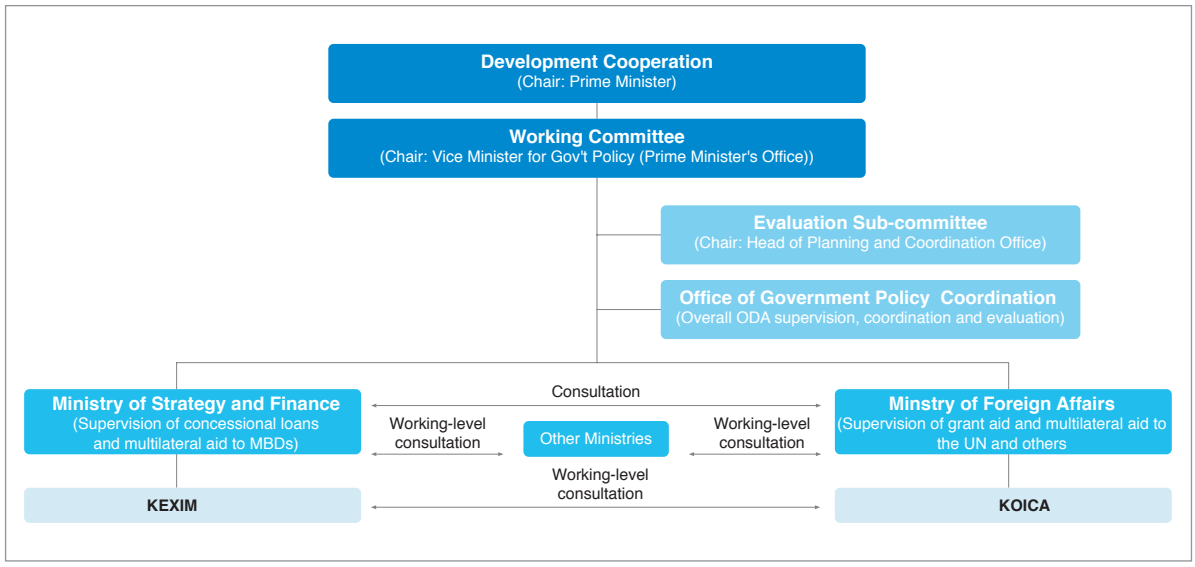
The ROK acknowledges the importance of cooperation among nations for climate change response and has been amplifying its assistance to developing countries to curtail emissions and build resilience to climate change impacts. Related information is shared in this chapter as the ROK continues to participate in the cooperative efforts of the international community.

The ROK is providing concessional loans and grant aid, through Official Development Assistance (ODA) and other means for developing countries, Korea voluntarily carries out assistance projects such as technology development and transfer, and capacity building. At the same time, the ROK receives support learning from the experience of the European Union for continued enhancement of its climate change mitigation capacity via the EU-Korea Emissions Trading Scheme Project (2016-2018).

2. Financial Support and Cooperation

The ODA of the ROK is supervised and coordinated by the Committee for International Development Cooperation chaired by the Prime Minister in accordance with the Framework Act on International Development Cooperation, and the OPC (Director General for Development and Cooperation Policy) serves as the secretariat. Concessional loans are overseen by the Ministry of Strategy and Finance, and implemented by the Export-Import Bank of Korea (KEXIM). Grant aid under the charge of the Ministry of Foreign Affairs, and the implementing agency is the Korea International Cooperation Agency (KOICA). In addition, individual ministries and local governments are also engaged in grant aid projects based on their areas of expertise (Figure4.1).

[Figure 4.1] ROK's ODA Implementing Arrangements



While overcoming struggles of the global financial crisis and rising financial deficit, the ROK puts its efforts toward making contributions as a member of the international community. Under the 1st International Development and Cooperation Master Plan (2011-2015), the amount of ODA grew by an annual average of around 12% from USD 1.17 billion to USD 1.85 billion, which is quite high compared to other donor countries.[38] In addition, the 2nd International Development and Cooperation Master Plan (2016-2020) was established in 2015 and is currently being executed.

Meanwhile, an implementation plan incorporating both concessional loans and grant aid is established every year, based on which the ROK is assisting developing countries. The general direction for international development cooperation reflected in the ROK's 2018 Implementation Plan for International Development Cooperation established in June 2017 is as follows: the ROK plans to distribute ODA resources and implement projects focused on strengthening assistance for recipient countries achieving the Sustainable Development Goals[39]. In particular, with respect to climate change mitigation response, the ROK plans to assist a total of 45 projects in 2018. For climate change adaptation, the ROK plans to enhance the capabilities of developing countries by carrying out projects for improving water resource safety and sanitation—e.g. water and sewage treatment and drinking water facilities—, comprehensive development and transfer of farming techniques for self-sufficient rural communities, etc.

At the UN Climate Summit in September 2014, the ROK announced the donation of USD 100 million to the Green Climate Fund (GCF) and is taking the initiative in mobilizing the initial funds for GCF after concluding the contribution agreement in June 2015. Moreover, KOICA provides financial assistance through bilateral, regional and other channels including climate-related ODA as grant aid totaling USD 62,802,493 to 34 countries in 2014, followed by USD 67,674,607 to 34 countries in 2015, and USD 39,548,477 to 32 countries in 2016.

For concessional loans, KEXIM develops climate change-related projects as a top priority financing solar thermal power stations, small hydropower stations, eco-friendly transportation, waste treatment, etc.; and pays special attention to related projects by offering preferential treatment.

38 During the same period, average ODA growth rate of OECD DAC stood at 1.16%.

39 Sustainable Development Goals(SDGs): Global joint targets to be fulfilled by 2030 based on the joint effort of developed and developing nations. Adopted in the 2015 UN Generally Assembly, SDGs consist of 17 social, environmental and economic goals and 169 targets.

[Table 4.1] Financial Support Provided via Multilateral Institutions (2014-2016) (Currency exchange rate[a]: KRW 1,053.064/USD)

2014							
Multilateral Institutions[b]	Total		Status[d]	Funding sources[e]	Financial instruments[f]	Support type[g]	Sector[h]
	Climate-related[c]						
	million KRW	thousand USD					
CGIAR (Consultative Group on International Agricultural Research)	334	317	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
FAO (Food and Agriculture Organization of the United Nations)	300	285	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
GCF (Green Climate Fund)	11,584	11,000	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
GGGI (Global Green Growth Institute)	10,531	10,000	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
IBRD (International Bank for Reconstruction and Development)	11,096	10,537	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
IFAD (International Fund for Agricultural Development)	2,106	2,000	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
IPCC (Intergovernmental Panel on Climate Change)	147	140	Completed	ODA	Contribution	Mitigation and AdaptaZion	All sectors
ITTO (International Tropical Timber Organization)	395	375	Completed	ODA	Contribution	Mitigation	Forestry
UNCCD (United Nations Convention to Combat Desertification)	2,000	1,899	Completed	ODA	Contribution	Mitigation	Forestry
Montreal Protocol Secretariat	104	99	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
WMO (World Meteorological Organization)	60	57	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
Total	38,657	36,709					

(Currency exchange rate[a]: KRW 1,131.309/USD)

2015							
Multilateral Institutions[b]	Total Climate-related[c]		Status[d]	Funding sources[e]	Financial instruments[f]	Support type[g]	Sector[h]
	million KRW	thousand USD					
ESCAP (United Nations Economic and Social Commission for Asia and the Pacific)	111	98	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
FAO (Food and Agriculture Organization of the United Nations)	10,342	9,142	Completed	ODA	Contribution	Mitigation and daptation	Agriculture
GCF (Green Climate Fund)	11,770	10,404	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
GGGI (Global Green Growth Institute)	11,313	10,000	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
IBRD (International Bank for Reconstruction and Development)	26,722	23,621	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
IFAD (International Fund for Agricultural Development)	3,281	2,900	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
IPCC (Intergovernmental Panel on Climate Change)	147	130	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
ITTO (International Tropical Timber Organization)	346	306	Completed	ODA	Contribution	Mitigation	Forestry
UNCCD (United Nations Convention to Combat Desertification)	2,076	1,835	Completed	ODA	Contribution	Mitigation	Forestry
UNEP (United Nations Environment Programme)	1,744	1,542	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
UNFCCC (United Nations Framework Convention on Climate Change)	879	777	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
WFP (World Food Programme)	113	100	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
WMO (World Meteorological Organization)	65	58	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
Total	68,909	60,913					

(Currency exchange rate[a]: KRW 1,160.589/USD)

2016							
Multilateral Institutions[b]	Total		Status[d]	Funding sources[e]	Financial instruments[f]	Support type[g]	Sector[h]
	Climate-related[c]						
	million KRW	thousand USD					
CGIAR (Consultative Group on International Agricultural Research)	297	256	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
ESCAP (United Nations Economic and Social Commission for Asia and the Pacific)	116	100	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
FAO (Food and Agriculture Organization of the United Nations)	11,355	9,784	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
GGGI (Global Green Growth Institute)	11,606	10,000	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
IBRD (International Bank fo Reconstruction and Development)	57,913	49,900	Ongoing	ODA	Contribution	Mitigation and Adaptation	All sectors
IFAD (International Fund for Agricultural Development)	2,635	2,270	Completed	ODA	Contribution	Mitigation and Adaptation	Agriculture
IOC (Intergovernmental Oceanographic Commission)	1	1	Completed	ODA	Contribution	Adaptation	All sectors
ITTO (International Tropical Timber Organization)	308	265	Completed	ODA	Contribution	Mitigation	Forestry
UN(United Nations)	1,585	1,366	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
UNCCD (United Nations Convention to Combat Desertification)	193	166	Completed	ODA	Contribution	Mitigation	Forestry
UNEP (United Nations Environment Programme)	1,891	1,629	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
UNFCCC (United Nations Framework Convention on Climate Change)	886	763	Ongoing	ODA	Contribution	Mitigation and Adaptation	All sectors
WFP (World Food Programme)	116	100	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
WMO (World Meteorological Organization)	64	55	Completed	ODA	Contribution	Mitigation and Adaptation	All sectors
Total	88,966	76,655					

a) Exchange rate: OECD/DAC exchange rate for 20XX
b) Multilateral institutions: (a) The Global Environment Facility, the Least Developed Countries Fund, the Special Climate Change Fund, the Adaptation Fund, the Green Climate Fund and the Trust Fund for Supplementary Activities; (b) Other Multilateral Climate Change Funds; (c) Multilateral Financial Institutions, including regional development banks; (d) Specialized United Nations bodies
c) Climate-related: Financial contribution related to climate change including mitigation, adaptation and LULUCF (In case only a part of the contribution is climate-related, the author has determined the applicable amount)
d) Status: Completed, ongoing, planned (Amount approved but not executed)
e) Funding sources: Official Development Assistance (ODA), Other Official Flows (OOF), other
f) Financial instruments: Concessional loan; stock or equity; grant aid; contribution; and subscribed capital
g) Support type: Mitigation; adaptation; mitigation and adaptation; cross-cutting (Cross-cutting refers to support provided in all areas of mitigation, adaptation, and mitigation and adaptation)
h) Sectors: Categorized by applying the OECD classifications including all sectors; energy; environment; drinking water and sanitation; and agriculture and livestock.
※ General contribution Includes financial contribution in areas not related to climate (For instance, in case contributions to UNEP were not exclusively used for climate purposes.)

[Table 4.2] Financial Support Provided through Bilateral, Regional, and Other Channels (2014-2016)

(Currency exchange rate[a]: KRW 1,053.064/USD

2014							
Nation/Region	Total amount		Status[c]	Funding sources[d]	Financial instruments[e]	Support type[f]	Sector[g]
	Climate-related[b]						
	Million won	thousand USD					
Bangladesh	1,176	1,117	Completed	ODA	Grant aid	Adaptation	Forestry
Bolivia	309	294	Ongoing	ODA	Grant aid	Cross-cutting	Drinking water and sanitation
Cambodia	1,470	1,396	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Cameroon	2,106	2,000	Ongoing	ODA	Grant aid	Mitigation	Energy
China	250	237	Ongoing	ODA	Grant aid	Cross-cutting	Forestry
Colombia	5,432	5,158	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Dominican Republic	172	164	Completed	ODA	Grant aid	Cross-cutting	All sectors
Ecuador	201	191	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Ethiopia	4,342	4,123	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Ghana	356	338	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Grenada	122	116	Completed	ODA	Grant aid	Mitigation and Adaptation	Energy
Indonesia	6,439	6,114	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Jordan	317	301	Completed	ODA	Grant aid	Mitigation	All sectors
Kenya	5,289	5,022	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Laos	501	476	Ongoing	ODA	Grant aid	Cross-cutting	Energy
Madagascar	388	369	Completed	ODA	Grant aid	Mitigation	Other social infrastructure
Mongolia	5,452	5,177	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Other regions or multiple nations	6,097	5,790	Completed	ODA	Grant aid	Mitigation and Adaptation	Unclassified
Nigeria	418	397	Completed	ODA	Grant aid	Cross-cutting	All sectors
Oceania	527	500	Completed	ODA	Grant aid	Adaptation	General environ-mental protection
Other regions	659	626	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Peru	223	212	Completed	ODA	Grant aid	Cross-cutting	All sectors
Philippines	3,914	3,717	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Solomon Islands	5,265	5,000	Ongoing	ODA	Grant aid	Cross-cutting	Education
Sri Lanka	361	343	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Sudan	228	217	Completed	ODA	Grant aid	Adaptation	Reconstruction
Tanzania	1,472	1,398	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Tunisia	2,106	2,000	Ongoing	ODA	Grant aid	Mitigation	Forestry
Uganda	136	129	Completed	ODA	Grant aid	Cross-cutting	All sectors
Vietnam	17,250	16,381	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Total	72,978	69,303					

(Currency exchange rate[a]: KRW 1,131.309/USD)

2015							
Nation/Region	Total amount Climate-related[b]		Status[c]	Funding sources[d]	Financial instruments[e]	Support type[f]	Sector[g]
	Million won	thousand USD					
Afghanistan	13,123	11,600	Ongoing	ODA	Grant aid	Adaptation	All sectors
Algeria	284	251	Completed	ODA	Grant aid	Cross-cutting	All sectors
Bangladesh	1,517	1,341	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Bolivia	329	291	Ongoing	ODA	Grant aid	Adaptation	All sectors
Cambodia	1,344	1,188	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
China	250	221	Completed	ODA	Grant aid	Cross-cutting	Forestry
Colombia	645	570	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Democratic Republic of the Congo	117	104	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Cuba	527	466	Completed	ODA	Grant aid	Cross-cutting	General environmental protection
Dominican Republic	130	115	Completed	ODA	Grant aid	Cross-cutting	All sectors
Ecuador	284	251	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Ethiopia	825	730	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Fiji	181	160	Completed	ODA	Grant aid	Cross-cutting	All sectors
Ghana	3,280	2,900	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Guatemala	239	212	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Indonesia	13,401	11,846	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Iraq	119	105	Ongoing	ODA	Grant aid	Cross-cutting	General environmental protection
Jordan	246	217	Completed	ODA	Grant aid	Cross-cutting	All sectors
Laos	116	102	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Laos	60,025	53,058	Ongoing	ODA	Concessional loan	Adaptation	Drinking water and sanitation
Mali	526	465	Completed	ODA	Grant aid	Cross-cutting	Forestry
Mongolia	4,052	3,582	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Morocco	4,525	4,000	Ongoing	ODA	Grant aid	Cross-cutting	General environmental protection
Mozambique	5,677	5,018	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Other regions or multiple nations	9,426	8,332	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Myanmar	3,983	3,521	Ongoing	ODA	Grant aid	Cross-cutting	All sectors

2015							
Nation/Region	Total amount		Status[c]	Funding sources[d]	Financial instruments[e]	Support type[f]	Sector[g]
	Climate-related[b]						
	Million won	thousand USD					
Myanmar	69,349	61,300	Ongoing	ODA	Concessional loan	Adaptation	Drinking water and sanitation
Nepal	880	778	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Nigeria	149	132	Completed	ODA	Grant aid	Cross-cutting	All sectors
Other regions	1,351	1,194	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Paraguay	7,955	7,032	Ongoing	ODA	Grant aid	Cross-cutting	Forestry
Pakistan	265	234	Ongoing	ODA	Grant aid	Adaptation	All sectors
Peru	4,681	4,138	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Philippines	17,887	15,811	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Rwanda	3,126	2,763	Ongoing	ODA	Grant aid	Cross-cutting	Forestry
Saint Lucia	223	197	Completed	ODA	Grant aid	Adaptation	General environmental protection
Senegal	5,835	5,158	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Sierra Leone	1,131	1,000	Ongoing	ODA	Grant aid	Adaptation	Drinking water and sanitation
Solomon Islands	131	116	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
South Sudan	1,131	1,000	Planned	ODA	Grant aid	Adaptation	General environmental protection
Sri Lanka	542	479	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Tanzania	3,384	2,991	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Turkmenistan	121	107	Completed	ODA	Grant aid	Mitigation	Energy
Uganda	320	283	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Uzbekistan	926	818	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Vietnam	9,101	8,045	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Vietnam	87,036	76,934	Ongoing	ODA	Concessional loan	Adaptation	Drinking water and sanitation
Total	340,695	301,156					

(Currency exchange rate[a]: KRW 1,160.589/USD)

2016							
Nation/Region	Total amount		Status[c]	Funding sources[d]	Financial instruments[e]	Support type[f]	Sector[g]
	Climate-related[b]						
	Million won	thousand USD					
Afghanistan	447	385	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Algeria	303	261	Completed	ODA	Grant aid	Cross-cutting	All sectors
Asia (Not allocated)	4,300	3,705	Completed	ODA	Grant aid	Mitigation and Adaptation	General environmental protection
Bangladesh	9,255	7,975	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Bolivia	299	258	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Cambodia	902	778	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Cambodia	98,760	85,095	Planned	ODA	Concessional loan	Adaptation	General environmental protection
China	250	215	Completed	ODA	Grant aid	Mitigation and Adaptation	Forestry
Democratic Republic of the Congo	683	588	Ongoing	ODA	Grant aid	Adaptation	All sectors
Cuba	1,710	1,473	Completed	ODA	Grant aid	Adaptation	Food aid
Ecuador	1,220	1,051	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Ethiopia	769	663	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Egypt	367	316	Completed	ODA	Grant aid	Cross-cutting	All sectors
Fiji	451	389	Completed	ODA	Grant aid	Cross-cutting	All sectors
Ghana	429	370	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Guatemala	331	285	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Indonesia	1,676	1,444	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Iraq	248	214	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Jordan	133	115	Completed	ODA	Grant aid	Cross-cutting	All sectors
Kazakhstan	1,550	1,335	Completed	ODA	Grant aid	Cross-cutting	All sectors
Kenya	234	202	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Kyrgyzstan	1,410	1,215	Completed	ODA	Grant aid	Cross-cutting	All sectors
Laos	5,036	4,339	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Laos	66,856	57,605	Planned	ODA	Concessional loan	Adaptation	Drinking water and sanitation
Madagascar	228	197	Completed	ODA	Grant aid	Cross-cutting	All sectors
Mali	1,710	1,473	Completed	ODA	Grant aid	Adaptation	Food aid
Mongolia	2,152	1,854	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Other regions or multiple nations	5,578	4,806	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Myanmar	942	812	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Nepal	2,838	2,445	Ongoing	ODA	Grant aid	Cross-cutting	All sectors

2016							
Nation/Region	Total amount		Status[c]	Funding sources[d]	Financial instruments[e]	Support type[f]	Sector[g]
	Climate-related[b]						
	Million won	thousand USD					
Nicaragua	38,740	33,380	Planned	ODA	Concessional loan	Mitigation and Adaptation	All sectors
Nigeria	284	244	Completed	ODA	Grant aid	Cross-cutting	All sectors
Other regions	1,651		Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Paraguay	129	111	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Pakistan	182	157	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Peru	8,492	7,317	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Philippines	2,965	2,555	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Rwanda	3,649	3,144	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Senegal	184	158	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Solomon Islands	535	461	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Sri Lanka	1,819	1,567	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Tanzania	283	244	Completed	ODA	Grant aid	Cross-cutting	All sectors
Thailand	1,027	885	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Uganda	390	336	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Uzbekistan	349	301	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Vietnam	865	746	Ongoing	ODA	Grant aid	Cross-cutting	All sectors
Zimbabwe	278	239	Completed	ODA	Grant aid	Cross-cutting	All sectors
Total	272,889	235,130					

a) Exchange rate: OECD/DAC exchange rate for 20XX
b) Climate-related: Financial contribution related to climate change including mitigation, adaptation and LULUCF (In case only a part of the contribution is climate-related, the author has determined the applicable amount)
c) Status: Completed, ongoing, planned (Amount approved but not executed)
d) Funding sources: Official Development Assistance (ODA), Other Official Flows (OOF), other
e) Financial instruments: Concessional loan; stock or equity; grant aid; contribution; and subscribed capital
f) Support type: Mitigation; adaptation; mitigation and adaptation; cross-cutting (Cross-cutting refers to support provided in all areas of mitigation, adaptation, and mitigation and adaptation)
g) Sectors: Categorized by applying the OECD classifications including all sectors; energy; environment; drinking water and sanitation; and agriculture and livestock.

3.Support and Cooperation for Technology Development and Transfer

Immediately following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change in 2015, the ROK designated and registered the Ministry of Science and ICT as its National Designated Entity (NDE) for the Technology Mechanism. Accordingly, since 2016, the ROK's NDE has been raising the awareness of organizations in industry, academia and research institutes for climate technology cooperation to promote participation in the Climate Technology Center & Network (CTCN), an implementation arm of the Technology Mechanism. As a result, the number of CTCN members in the ROK has grown from 9 in 2015 to 43 as of July 2017, putting it in the top ranks of actively networked countries for technology cooperation.

In October 2016, the Ministry of Science and ICT invited the NDEs of 11 countries including Bhutan, Bangladesh, Vietnam, Iran, Indonesia, Thailand, Mongolia, Fiji, Philippines, Colombia, and Senegal and hosted a conference, titled the 'Green Climate Technology Conference and Briefing', in order to figure out their technological needs, and identify areas for capability building cooperation and support. From 2017, the ROK has been carrying out new projects worth around USD 2.5 billion to lay the foundation for climate technology cooperation.

Moreover, in Marrakesh in November 2016, the ROK with the NDEs of 8 developed countries pledged a joint statement for a financial contribution (worth around USD 23 million) towards CTCN, which was unprecedented for non-Annex I countries. Accordingly, the ROK plans to donate KRW 1 billion in phases over the course of four years beginning in 2017.

From late 2016, the Green Technology Center (GTC) and other Korean research institutes have been directly and indirectly engaged in CTCN Technical Assistance (TA) projects that are foundational to the UNFCCC; two of these projects were for Guinea and Kenya. Moreover, GTC and other Korean research institutes are taking part in overseas climate technology cooperation projects (with Honduras and Mongolia) by tapping into other public funds (Table 4.3.).

The ROK concerts the capacities of domestic institutions to ensure the success of the two CTCN TA projects that it has participated since in 2016 and plans to conduct a multi-faceted assessment for follow-up activities by considering the results of the projects.

In addition, based on the platform for climate technology cooperation launched in 2017, the ROK plans to assist projects to build an international cooperation network, identify the demand for cooperation, and manage and develop promising projects (master plan, feasibility studies, technology demonstration, capacity building, etc.) in order to develop climate technology cooperation projects with various countries and scale up assistance by 2020.

Meanwhile, the special education programs for global climate technology cooperation were established at Korea Institute of Human Resources Development in Science and Technology (KIRD) for working-level members of academia, industry and research who are in charge of global cooperation, in order to develop a broad range of expertise for climate technology cooperation. The programs aim to transfer knowledge necessary for technology cooperation of the climate area, including theories on responses to the global climate changes, the technology commercialization process, outlook for climate technologies and cases of commercialization. In addition, workshops, seminars and symposiums will be held for members of research organizations, businesses and local governments to continuously introduce climate technology cooperation trends and response strategies.

[Figure 4.2] Program for Global Climate Technology Cooperation Strategies

[Table 4.3] Technology Development and Transfer Support Provided (2015-2016)

Sector	Recipient country	Targeted area	Measures and activities related to technology transfer	Funding source	Implementing agency	Status	Additional Information
Agriculture, forestry, Meteorology, urban stream (Cross-Sectors)	Guinea	Adaptation	Establishment of finance engagement strategy for deploying adaptation technologies	Public funds (CTCN) + In-kind contributions (GTC)	Private and public institutions (Leader) GERES (Participating) GTC	Completed	(CTCN TA) Optimizing Access to Funding of Technology Projects for Adapting to Climate Change - From Nov. 2016 to Apr. 2017 (About 6 months) - About KRW 12 million - Capacity building of national finance experts for implementing climate change adaptation priority projects and structural designing of adequate funding
Water resources	Kenya	Mitigation and adaptation	Development of a Public-Private Partnership business model and capacity building	Public funds (CTCN) + In-kind contri-butions (GTC)	Public institutions (Leader) GTC (Participating) KEPCO, KICT	Completed	(CTCN TA) Catalyzing Low Cost Green Technologies for Sustainable Water Service Delivery - From Dec. 2016 to Jun. 2017 (About 6 months) - About KRW 56 million - Analyzed the feasibility of public-private partnership and developed a business model for deploying water services technologies
Power	Honduras	Mitigation	Development of a business model and investment plan, capacity building	Public funds (KEXIM-IDB)	Private and public institutions (Leader) GTC (Participating) LSIS	Completed	(KSP-IDB) Establishment of a Smart Grid Introduction Plan for the Diversification of Electricity Production in the Island of Bahia in Honduras - From Oct. 2016 to May 2017 (About 8 months) - About KRW 200 million - Proposal of business model and strategy for expanding supply of renewable energy in Bahia Islands, Honduras
Building	Mongolia	Mitigation and adaptation	Development of a Public-Private Partnership model, provision of technical guideline, and capacity building	Public funds (GGGI)	Private and public institutions (Leader) GTC (Participating) KRIEA, University of Seoul, Huree University (Mongolia)	Completed	(GGGI) Greening Public-Private Partnership Educational Buildings in Mongolia - From Nov. 2015 to Jun. 2016 (About 7 months) - About KRW 150 million - Provision of technical guideline for greening of Mongolia's schools and establishment of PPP plan.

※ GERES: Group for Environment, Renewable Energy and Solidarity (French NGO specializing in international development projects)
※ GTC: Green Technology Center
※ KEPCO: Korea Electric Power Corporation
※ KICT: Korea Institute of Civil Engineering and Building Technology
※ KRIEA: Korea Research Institute of Eco-Environmental Architecture
※ KEXIM: Export-Import Bank of Korea
※ IDB: Inter-American Development Bank

4. Capacity Building Support and Cooperation

From 2011, the Greenhouse Gas Inventory & Research Center of Korea (GIR) has held a 3 to 4 week professional training program to build the capacity for GHG management in developing countries. GIR invites government officials and researchers from non-Annex I countries to participate in intensive lectures and practical exercises on GHG inventory preparation and mitigation modeling analysis by sector.

Thirty-four trainees graduated from the fourth training program in 2014, followed by 37 trainees from 27 countries in 2015, and 31 trainees from 24 countries in 2016. From 2017, the program is being hosted in collaboration with the UNFCCC secretariat[40].

[Figure 4.3] GIR Training Program: Opening ceremony (Left), Training session (Right)

GIR has also convened the Cooperative Green Growth Modeling Forum (C2GMF) on an annual or semi-annual basis since 2011, in order to assist developing countries in establishing GHG reduction targets and building capacity to evaluate the progress of mitigation actions through modeling analysis. As of 2016, a total of 10 forums had been held and 3 joint research projects have been carried out (i.e. power, waste, buildings and residential sectors).

During the 2016 forum participated by nine Asian countries[41], GIR announced the new Capacity Building Initiative for Nationally Determined Contributions (CBI-NDC). The initiative will facilitate sharing national GHG reduction targets, domestic progress on mitigation actions, status on preparing National Communications, and areas that require mitigation potential modeling analysis among participating countries. To that end, GIR has been conducting joint research (2016-2017) with participating countries for the power, transport, residential and forestry sectors.

40 In March 2017, a memorandum of understanding was signed between GIR and the UNFCCC secretariat for the UNFCCC-GIR-CASTT (Climate Action and Support Transparency Training) Programme on Greeenhouse Gases. Visit GIR website (www.gir.go.kr/eng) for more information and application guide.

41 Azerbaijan, Cambodia, Jordan, Laos, Malaysia, Mongolia, Nepal, Pakistan, Thailand

[Figure 4.4] Cooperative Green Growth Modeling Forum

The KFS carries out climate change-related projects to prevent the land-use change of forest areas jointly with developing countries including Indonesia, Myanmar, and Cambodia. While sharing successful experiences of the ROK restoring its forests, KFS assists the Reducing Emissions from Deforestation and Forest Degradation (REDD+) in developing countries by establishing and implementing measures for preventing forest destruction and on-site projects as they help developing countries identify the reason for land-use change and deforestation. KFS also provides capacity building programs to government officials from developing countries for national forest monitoring systems and GHG reduction strategies. Between 2012 and 2016, 129 government officials from 11 countries have completed the REDD+ capacity building program.

[Figure 4.5] 9th REDD + Capacity Building Program (Asia)

[Figure 4.6] 10th REDD + Capacity Building Program (Africa)

[Figure 4.7] Forest carbon survey (Indonesia)

[Figure 4.8] Donation of forest firefighting equipment (Indonesia)

The Ministry of Environment invites government officials from developing countries and provides various climate-change related training programs in topics including the International Training Course on Environmental Policy and the International Specialized Course on Environmental Technology.

From 2010, the ROK has organized annual international adaptation workshops jointly with international organizations and networks including the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP) and the Asia Pacific Adaptation Network (APAN) to enhance the adaptation capacities of developing and least developed countries vulnerable to climate change. Furthermore, since 2015, around 30 foreign government officials have been recruited annually for the Global Environment Scholarship Program, receiving assistance to enroll in a 2-year master's course in Korean universities.

Moreover, in 2016, the Ministry of Environment and the UNFCCC secretariat have jointly hosted the Capacity Building Support and Cooperation Workshop on National GHG Inventory MRV for the Asia-Pacific and Eastern European regions. Forty-two working-level officials from 39 Non-Annex I countries participated in the workshop. Under the theme of building sustainable national GHG inventory management systems and the use of the 2006 IPCC Guidelines, best practices of the ROK and other participating countries were shared during the workshop lecture and practicum sessions.

[Figure 4.9] International Training Course on Environmental Policy

[Figure 4.10] UNFCCC-Ministry of Environment Capacity Building Workshop

[Table 4.4] Capacity Building Support Provided (2014-2016)

2014				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
29 nations including Azerbaijan, Bhutan, Egypt, United Arab Emirates and Paraguay (including five Korean trainees)	Greenhouse Gas Inventory & Research Center (GIR)	2014 GIR Training Program for GHG Inventory & Mitigation Modeling	Mitigation	• GHG inventory: Basics of inventory measurement, uncertainty measurement, industrial method by sector (energy, industrial processes, agriculture, waste and LULUCF) • GHG mitigation modeling: Basic modeling data, basic statistics and econometrics, projection and mitigation by sector (construction, transport, power generation, industry and agriculture), LEAP model (usage, emissions projection and mitigation scenario analysis) - Small group sessions: Measurement by sector (agriculture, LULUCF, waste and industrial processes), projection and mitigation by sector (building, transport, power generation and industry)
12 nations including Argentina, Azerbaijan, Cambodia, Democratic Republic of the Congo and Thailand	Greenhouse Gas Inventory & Research Center (GIR)	Cooperative Green Growth Modeling Forum 7th Steering Committee Meeting & 2nd Technical Working Group	Mitigation	• Steering Committee: Present each nation's GHG policy, inventory status and related issues • Technical Working Group: Present progress report and discuss building and waste sectors
9 nations including Azerbaijan, Bangladesh, Egypt, Peru and Thailand	Greenhouse Gas Inventory & Research Center (GIR)	2014 Cooperative Green Growth Modeling Forum 8th Steering Committee Meeting	Mitigation	• Selected best reports (Nepal and Cambodia) and held discussion for improving the forum

2014				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
Ghana, Nigeria, East Timor, Laos, Mongolia, Myanmar, Bangladesh, Vietnam, Bolivia, Bulgaria, Yemen, Jordan, Uzbekistan, Egypt, Indonesia, Kyrgyzstan, Cambodia	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 10th International Training Course on Environmental Policy/Realizing a Resource Circulating Society through Advanced Waste Management	Mitigation	• Lectures on advanced waste management and field trip to help participating nations establish and announce action plan compatible with their circumstances in order to pursue system improvement and solutions
South Africa, Libya, Senegal, Sri Lanka, Algeria, Egypt, Indonesia, China, Colombia, Paraguay, Philippines	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 13th&14th International Specialized Course on Environmental Technology/Water and Sewage Treatment and Waste Management	Mitigation and Adaptation	• Capacity building in the areas of waste-to-energy for developing nations' sustainable development, supply of clean and safe drinking water, wastewater management for sustainable water use
Nepal, Maldives, Mongolia, Bangladesh, Vietnam, Sri Lanka, Indonesia, Cambodia, Thailand, Fiji, Philippines	Korea Adaptation Center for Climate Change (KACCC)/ United Nations Environment Programme (UNEP)	Training on Climate Change Adaptation and Evaluation	Adaptation	• Enhancing adaptation capacity with training on the socioeconomic damages suffered by Asia Pacific nations due to climate change, related assessment and decision-making
Indonesia, Cambodia, Myanmar, Laos	Korea Forest Service/ Forest Training Institute	4th and 5th REDD+ Capacity Building Program	Mitigation and Adaptation	• Provide training on REDD+ governance and safeguard to public officials of countries selected as targets of REDD+ pilot project for capacity building

2015				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
37 participants from 27 nations including Bangladesh, Ecuador, Ghana, Jordan and Iran (including three Korean trainees)	Greenhouse Gas Inventory & Research Center	2015 GIR Training Program for GHG Inventory & Mitigation Modeling	Mitigation	• GHG inventory: Basics of inventory measurement, uncertainty measurement, industrial method by sector (energy, industrial processes, agriculture, waste and LULUCF) • GHG mitigation modeling: Basic modeling data, basic statistics and econometrics, projection and mitigation by sector (construction, transport, power generation, industry and agriculture), LEAP model (usage, emissions projection and mitigation scenario analysis)
8 nations including Argentina, Jordan, Ghana, Kenya and Nepal	Greenhouse Gas Inventory & Research Center	2015 Cooperative Green Growth Modeling Forum 9th Steering Committee Meeting	Mitigation	• Discuss climate damages suffered by each nation, and introduce related project and ways to use the financial funds of the Green Climate Fund
Laos, Romania, Malaysia, Mongolia, Bangladesh, Vietnam, Bulgaria, Jordan, Ukraine, Egypt, Indonesia, Cambodia, Colombia, Kyrgyzstan, Pakistan, Peru	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 11th International Training Course on Environmental Policy/Climate Change and Adaptation Policy	Mitigation and Adaptation	• Contribute to the establishment of environmental policies for the sustainable development of participating nations through field trips and lectures on climate change adaptation policy, GHG mitigation status and related policies

2015				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
Mongolia, Indonesia, Kazakhstan, Colombia, Turkey	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 15th International Specialized Course on Environmental Technology/Korea's Policy and Technology of Natural Gas Vehicle	Mitigation	• Introduce the ROK's natural gas vehicle policy and transfer technology for capacity building aimed at establishing sustainable environmental policies.
Laos, Malaysia, Vietnam, Sri Lanka, Thailand, Philippines	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 16h International Specialized Course on Environmental Technology/Water and Sewage Treatment and Waste Management	Mitigation	• Introduce the ROK's waste, wastewater and waste-to-energy policies and transfer technology for capacity building aimed at establishing sustainable environmental policies
Mongolia, Bangladesh, Vietnam, Sri Lanka, Algeria, Indonesia, China, Kazakhstan, Cambodia, Costa Rica, Colombia, Thailand, Philippines	Ministry of Environment/ Korea Environmental Industry & Technology Institute (KEITI)	Global Environment Scholarship Program (GESP) - The Master's for capacity building in environmental policy	Various sectors	• Share ROK's experience of having developed environmental policies
Guinea, Nepal, Burkina Faso, Cambodia, Comoros, Tuvalu	Korea Adaptation Center for Climate Change (KACCC)/ United Nations Environment Programme (UNEP)	National Adaptation Planning Good Practice Workshop	Adaptation	• Introduce theory and tools for formulating climate change adaptation plan and share best practices for capacity building
Indonesia, Cambodia, Myanmar, Laos	Korea Forest Service/ Forest Training Institute	6th and 7th REDD+ Capacity Building Program	Mitigation and Adaptation	• Support training on REDD+ governance and safety system to public officials of countries selected as targets of REDD+ pilot project for capacity building

2016				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
31 participants from 24 nations including Algeria, Cambodia, Nicaragua and Uzbekistan (including one Korean trainee)	Greenhouse Gas Inventory & Research Center	2016 GIR Training Program for GHG Inventory	Mitigation	• GHG inventory : Basics of inventory measurement, uncertainty measurement, industrial method by sector (energy, industrial processes, agriculture, waste and LULUCF)
8 nations including Cambodia, Malaysia, Mongolia, Pakistan and Thailand	Greenhouse Gas Inventory & Research Center	The 10th Cooperative Green Growth Modeling Forum	Mitigation	• Launch of Capacity Building Initiative and joint research on four sectors (power generation, transport, household and forestry)
39 Non-Annex I nations in Asia-Pacific and Eastern European Regions	Ministry of Environment/ UNFCCC secretariat	The Workshop on the Building of Sustainable National Greenhouse Gas Inventory Management Systems, and the use of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for the Asia-Pacific and Eastern European Regions	Mitigation	• Theory and practical training and introduction of best practices for establishment of GHG inventory management system and use of the 2006 IPCC Guidelines
South Africa, Mexico, Myanmar, Bangladesh, Vietnam, Algeria, Ethiopia, Indonesia, China, Cambodia, Colombia, Thailand, Philippines	Ministry of Environment/ Korea Environmental Industry & Technology Institute (KEITI)	Global Environment Scholarship Program (GESP) - The Master's course for capacity building in environmental policy	Various areas	• Share ROK's environmental policy and management, sustainable development and planning, forest resources and ecological restoration

2016				
Recipient Country / Region	Implementing Agency	Name of Project / Program	Targeted area	Additional Information
South Africa, East Timor, Laos, Malaysia, Bangladesh, Bulgaria, Jordan, Ukraine, Iran, Indonesia, Chile, Cambodia, Kyrgyzstan, Turkey, Pakistan	Ministry of Environment/ National Institute of Environmental Human Resources Development	The 12th International Training Course on Environmental Policy/Resource Recirculation Policy for Sustainable Development	Mitigation	• Share the ROK's experience and knowhow on resource circulating policies to contribute the participating nations' establishment of environmental policies for sustainable development
Nauru, Nepal, Niue, Marshall Islands, Malaysia, Maldives, Mongolia, Vietnam, Samoa, Sri Lanka, Iran, China, Cook Islands, Tonga, Pakistan, Papua New Guinea, Palau, Fiji, Philippines	Korea Adaptation Center for Climate Change (KACCC)/ United Nations Environment Programme(UNEP)/ United Nations Development Programme (UNDP)	Asia-Pacific National Adaptation Plans Training Workshop	Adaptation	• Discuss the success and difficulties of each nation's NAP establishment process and share experience in order to enhance capacity for NAP establishment
Dominican Republic, Paraguay, Chile, Cambodia, Myanmar, Nepal, Bhutan, India, Trinidad and Tobago	Korea Forest Service/ Forest Training Institute	8th and 9th REDD+ Capacity Building Program	Mitigation and Adaptation	• Support capacity building program to public officials of countries selected as targets of REDD+ pilot project for cooperation and assistance in the area of forestry

[**Table 5.1**] Emission trends: Summary

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Change from base to latest reported year
	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	(%)
CO_2 emissions including net CO_2 from LULUCF	217,805.03	241,508.57	267,235.07	300,551.82	324,227.79	349,730.12	377,756.73	395,010.78	321,055.84	350,217.91	382,601.99	400,178.52	419,743.04	426,886.75	434,981.71	437,792.75	443,827.84	464,409.46	478,539.48	485,968.17	539,261.26	574,700.64	581,530.41	592,571.71	586,140.35	169.11
CO_2 emissions excluding net CO_2 from LULUCF	252,328.68	275,230.28	299,001.70	334,403.65	356,378.12	385,195.10	417,749.87	443,604.94	377,357.41	409,614.64	441,589.26	456,962.34	475,788.18	484,139.73	490,182.19	494,445.90	501,089.23	522,486.29	536,062.92	540,688.48	593,829.68	623,461.18	626,460.94	635,538.07	628,816.11	149.21
CH_4 emissions including CH_4 from LULUCF	30,856.51	30,743.84	30,123.23	29,547.47	29,551.45	29,173.95	29,459.59	29,668.25	28,414.19	28,081.18	28,052.73	28,359.65	28,522.95	28,500.72	27,584.40	27,493.30	27,442.81	27,104.02	27,066.97	27,042.01	27,496.65	27,255.02	27,311.24	27,276.65	26,792.84	-13.17
CH_4 emissions excluding CH_4 from LULUCF	30,722.25	30,618.94	29,992.09	29,420.99	29,422.02	29,044.38	29,328.64	29,524.74	28,265.02	27,935.99	27,898.93	28,201.15	28,357.35	28,334.69	27,421.54	27,339.40	27,278.23	26,935.89	26,890.48	26,871.44	27,331.08	27,079.32	27,145.06	27,106.65	26,614.80	-13.37
N_2O emissions including N_2O from LULUCF	9,187.20	9,613.56	12,147.09	12,564.72	13,275.74	14,271.30	15,203.09	16,119.88	16,495.03	16,973.08	17,635.45	17,758.39	17,539.90	20,820.81	23,439.83	21,937.63	21,164.30	12,435.94	12,660.55	12,664.51	13,389.76	13,402.21	14,822.95	15,024.77	14,898.66	62.17
N_2O emissions excluding N_2O from LULUCF	8,916.35	9,383.25	11,971.24	12,435.24	13,211.67	14,206.56	15,152.86	16,070.09	16,437.99	16,914.02	17,576.49	17,705.22	17,481.12	20,767.36	23,388.95	21,888.14	21,119.11	12,384.06	12,606.95	12,609.15	13,333.39	13,349.47	14,775.48	14,982.42	14,867.04	66.74
HFCs	982.80	798.88	1,877.22	2,117.21	3,837.90	5,084.87	5,779.02	7,160.07	4,911.10	8,061.49	8,443.31	5,851.64	8,652.61	6,442.92	6,590.97	6,651.18	6,097.96	7,362.99	6,881.07	5,846.15	8,087.59	7,907.00	8,694.42	8,094.74	8,537.55	768.70
PFCs	NO	NO	0.28	1.62	NO	63.21	587.40	1,682.59	1,649.15	1,878.66	2,238.78	1,984.30	1,967.37	2,266.90	2,774.07	2,796.76	2,925.12	2,978.31	2,792.80	2,047.14	2,264.59	2,071.79	2,267.88	2,320.56	2,426.90	866,650.00
SF_6	173.58	332.61	372.43	385.73	910.71	3,491.43	2,235.00	2,421.74	1,367.93	3,337.93	2,875.08	3,012.42	2,785.88	3,744.35	4,301.10	5,397.23	5,270.89	7,310.67	7,540.63	8,628.39	11,790.40	8,712.10	7,764.30	8,480.76	9,352.21	5,287.84
Total (including LULUCF)	259,005.12	282,997.46	311,755.31	345,168.57	371,803.59	401,814.89	431,020.83	452,063.31	373,893.24	408,550.25	441,847.34	457,144.92	479,211.76	488,662.45	499,672.08	502,068.85	506,728.91	521,601.38	535,481.50	542,196.38	602,290.26	634,048.76	642,391.20	653,769.19	648,148.51	150.25
Total (excluding LULUCF)	293,123.66	316,363.96	343,214.96	378,764.46	403,760.41	437,085.56	470,832.79	500,464.18	429,988.60	467,742.72	500,621.86	513,717.07	535,032.51	545,695.96	554,658.83	558,518.62	563,780.54	579,458.21	592,774.84	596,690.76	656,636.73	682,580.85	687,108.08	696,523.20	690,614.60	135.61

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Change from base to latest reported year
	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	kt CO_2eq.	(%)
1. Energy	241,397.26	259,335.53	279,160.83	309,247.90	328,297.20	354,078.00	385,839.70	410,151.97	350,358.18	381,146.01	410,376.06	424,407.97	443,151.32	450,766.37	458,413.36	466,371.14	472,647.79	491,567.13	505,773.75	512,222.57	565,170.99	593,918.70	597,747.62	606,726.11	599,317.80	148.27
2. Industrial Processes	19,679.00	23,441.69	28,975.79	33,227.28	37,815.87	43,764.78	44,452.05	49,074.27	39,936.69	47,279.80	49,571.13	48,282.19	52,054.80	55,293.16	57,618.87	54,320.81	52,887.66	50,801.60	50,046.38	47,042.09	53,956.15	51,674.02	51,680.06	51,953.18	54,575.84	177.33
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	21,609.25	21,894.60	22,303.07	22,763.82	23,190.14	23,447.16	23,954.35	23,940.73	23,631.04	22,441.04	21,824.62	21,286.17	21,124.33	20,837.37	20,910.21	21,080.91	21,180.60	21,400.50	21,452.21	21,961.70	22,391.43	21,458.28	21,906.37	21,881.39	21,288.77	-1.48
5. LULUCF	-34,118.54	-33,366.50	-31,459.65	-33,595.89	-31,956.82	-35,270.67	-39,811.96	-48,400.87	-56,095.36	-59,192.47	-58,774.52	-56,572.15	-55,820.75	-57,033.50	-54,986.74	-56,449.77	-57,051.64	-57,856.82	-57,293.34	-54,494.38	-54,346.48	-48,532.09	-44,716.88	-42,754.01	-42,466.09	24.47
6. Waste	10,438.15	11,692.15	12,775.27	13,525.45	14,457.21	15,795.62	16,586.70	17,297.21	16,062.68	16,875.88	18,850.05	19,740.74	18,702.06	18,799.05	17,716.39	16,745.75	17,064.50	15,688.98	15,502.50	15,464.40	15,118.16	15,529.86	15,774.03	15,962.51	15,432.18	47.84
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)	259,005.12	282,997.46	311,755.31	345,168.57	371,803.59	401,814.89	431,020.83	452,063.31	373,893.24	408,550.25	441,847.34	457,144.92	479,211.76	488,662.45	499,672.08	502,068.85	506,728.91	521,601.38	535,481.50	542,196.38	602,290.26	634,048.76	642,391.20	653,769.19	648,148.51	150.25

※ Reference: (1) Detail information is listed as “Emission trends (CO_2),” “Emission trends (CH_4),” “Emission trends (N_2O),” and “Emission trends (HFCs, PFCs and SF_6)” according to the common reporting format. (2) 2014 is the most recent year for which inventory data is avaliable ; (3) 1 kt CO_2eq. is equal to 1 Gg CO_2eq.

※ Abbreviations: LULUCF = Land Use, Land-Use Change and Forestry, NO = Not Occurring, NE = Not Estimated, NA = Not Applicable.

[Table 5.2] Emission trends (CO_2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	232,686.74	251,598.44	272,605.33	303,540.64	323,263.17	349,450.00	381,206.27	405,402.68	345,948.09	376,406.32	405,347.59	419,247.61	437,779.95	445,234.06	452,558.77	460,359.87	466,468.81	485,025.03	498,338.10	505,362.32	557,322.49	585,339.15	587,709.37	596,599.20	589,435.42
A. Fuel Combustion (Sectoral Approach)	232,686.74	251,598.44	272,605.33	303,540.64	323,263.17	349,450.00	381,206.27	405,402.68	345,948.09	376,406.32	405,347.59	419,247.61	437,779.95	445,234.06	452,558.77	460,359.87	466,468.81	485,025.03	498,338.10	505,362.32	557,322.49	585,339.15	587,709.37	596,599.20	589,435.42
1. Energy Industries	47,611.98	54,031.22	61,469.59	68,500.91	82,294.43	91,304.40	107,202.41	120,710.19	104,710.02	114,360.65	134,397.09	145,475.81	153,883.74	157,941.35	171,359.03	176,517.10	185,560.69	196,958.33	210,168.12	229,113.69	254,412.01	262,148.51	266,157.44	272,544.65	258,029.10
2. Manufacturing Industries and Construction	76,131.86	88,257.22	97,369.10	107,481.34	112,455.69	116,134.87	123,746.80	127,499.35	118,612.01	124,237.56	128,850.17	129,246.04	134,792.69	137,016.98	134,415.24	133,779.24	135,170.76	141,570.31	146,137.07	135,773.78	159,867.46	181,137.04	178,401.33	180,411.86	192,142.30
3. Transport	35,256.78	38,336.35	43,663.21	55,191.66	57,175.98	64,289.26	68,330.20	73,687.06	57,118.55	62,092.53	69,374.99	72,495.19	77,438.98	80,223.73	80,372.05	81,175.81	81,968.55	84,346.48	82,173.22	83,022.44	84,730.32	84,405.72	85,773.50	87,690.37	88,009.00
4. Other Sectors	73,505.62	66,344.37	67,178.61	69,236.15	68,514.90	74,925.21	78,875.38	80,601.46	62,869.12	73,006.63	70,337.35	68,939.17	68,850.69	66,758.37	63,289.36	65,686.15	60,942.36	59,267.71	57,280.45	54,599.96	55,389.85	54,791.54	54,472.93	52,994.52	48,416.10
5. Other	180.49	4,629.29	2,924.83	3,130.59	2,822.18	2,796.26	3,051.47	2,904.62	2,638.38	2,708.95	2,387.99	3,091.41	2,813.86	3,293.62	3,123.08	3,201.56	2,826.46	2,882.20	2,579.23	2,852.45	2,922.86	2,856.33	2,904.17	2,957.80	2,838.91
B. Fugitive Emissions from Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	18,248.57	21,759.7	24,073.85	28,033.42	30,124.03	31,666.21	31,929.22	33,088.08	26,626.76	27,629.45	28,796.55	29,848.05	31,280.93	32,126.97	30,857.35	28,274.32	28,166.93	31,724.59	32,052.13	29,781.29	31,089.76	32,150.31	32,200.5	32,254.88	33,337.36
A. Mineral Products	18,151.19	21,679.62	23,986.64	27,923.32	29,999.48	31,524.13	31,778.38	32,916.85	26,486.20	27,454.99	28,617.13	29,673.57	31,097.09	31,939.48	30,656.48	28,069.08	28,021.74	31,542.58	31,831.30	29,624.49	30,910.26	31,970.01	32,017.33	32,075.45	33,164.63
B. Chemical Industry	1.95	2.18	2.37	2.57	3.63	4.28	5.12	4.60	3.43	32.90	31.71	30.86	30.45	30.33	31.50	11.07	2.13	1.83	1.84	1.53	1.73	1.83	1.81	1.77	1.72
C. Metal Production	95.43	77.90	84.84	107.53	120.91	137.80	145.72	166.63	137.13	141.56	147.70	143.61	153.39	157.16	169.36	194.18	143.05	180.18	218.99	155.27	177.77	178.47	181.37	177.65	171.01
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6																									
F. Consumption of Halocarbons and SF_6																									
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture																									
A. Enteric Fermentation																									
B. Manure Management																									
C. Rice Cultivation																									
D. Agricultural Soils																									
E. Prescribed Burning of Savannas																									
F. Field Burning of Agricultural Residues																									
G. Other																									

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
5. Land Use, Land-Use Change and Forestry	-34,523.65	-33,721.71	-31,766.62	-33,851.83	-32,150.32	-35,464.98	-39,993.15	-48,594.16	-56,301.57	-59,396.73	-58,987.28	-56,783.82	-56,045.14	-57,252.99	-55,200.48	-56,653.16	-57,261.4	-58,076.83	-57,523.44	-54,720.3	-54,568.42	-48,760.53	-44,930.54	-42,966.36	-42,675.75
A. Forest Land	-34,603.37	-34,035.16	-32,439.29	-34,810.25	-33,484.00	-37,523.56	-42,536.86	-51,347.36	-59,161.29	-62,229.80	-61,800.16	-59,693.90	-59,110.52	-60,410.61	-58,402.29	-60,000.81	-61,021.89	-62,222.04	-61,988.73	-59,414.38	-59,352.59	-53,685.73	-49,259.78	-47,250.00	-47,008.44
B. Cropland	474.29	751.60	1,086.12	1,366.70	1,740.30	2,456.75	2,961.78	3,179.66	3,286.88	3,266.00	3,250.07	3,326.34	3,443.97	3,531.05	3,555.51	3,674.05	3,966.09	4,280.61	4,550.78	4,763.14	4,846.42	4,946.96	4,370.85	4,313.80	4,346.84
C. Grassland	-535.71	-567.90	-548.87	-543.35	-542.16	-555.91	-568.28	-580.01	-581.84	-581.23	-587.40	-568.68	-532.49	-519.41	-484.80	-415.29	-282.50	-217.12	-184.08	-169.20	-155.57	-117.70	-127.35	-116.37	-102.94
D. Wetlands	141.15	129.74	135.43	135.06	135.54	157.75	150.21	153.54	154.68	148.31	150.22	152.42	153.91	145.98	131.09	88.90	76.91	81.72	98.59	100.14	93.32	95.94	85.74	86.21	88.78
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	1,393.37	1,872.14	2,322.51	2,829.6	2,990.92	4,078.89	4,614.38	5,114.18	4,782.56	5,578.87	7,445.13	7,866.68	6,727.30	6,778.70	6,766.07	5,811.71	6,453.49	5,736.67	5,672.69	5,544.87	5,417.43	5,971.72	6,551.07	6,683.99	6,043.33
A. Solid Waste Disposal on Land	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Waste-water Handling																									
C. Waste Incineration	1,393.37	1,872.14	2,322.51	2,829.60	2,990.92	4,078.89	4,614.38	5,114.18	4,782.56	5,578.87	7,445.13	7,866.68	6,727.30	6,778.70	6,766.07	5,811.71	6,453.49	5,736.67	5,672.69	5,544.87	5,417.43	5,971.72	6,551.07	6,683.99	6,043.33
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 emissions including net CO_2 from LULUCF	217,805.03	241,508.57	267,235.07	300,551.82	324,227.79	349,730.12	377,756.73	395,010.78	321,055.84	350,217.91	382,601.99	400,178.52	419,743.04	426,886.75	434,981.71	437,792.75	443,827.84	464,409.46	478,539.48	485,968.17	539,261.26	574,700.64	581,530.41	592,571.71	586,140.35
Total CO_2 emissions excluding net CO_2 from LULUCF	252,328.68	275,230.28	299,001.70	334,403.65	356,378.12	385,195.10	417,749.87	443,604.94	377,357.41	409,614.64	441,589.26	456,962.34	475,788.18	484,139.73	490,182.19	494,445.90	501,089.23	522,486.29	536,062.92	540,688.48	593,829.68	623,461.18	626,460.94	635,538.07	628,816.11
Memo Items:																									
International Bunkers	13,865.47	16,682.81	20,707.28	21,942.79	25,292.83	29,141.23	34,729.26	38,114.63	37,705.72	40,790.79	38,667.09	37,788.30	37,868.49	40,496.30	42,273.77	42,723.56	40,806.40	41,383.94	38,984.30	35,772.95	38,238.39	37,962.87	37,164.47	37,228.61	37,771.22
Aviation	6,188.94	4,221.64	5,049.73	5,582.32	6,269.04	7,088.33	7,746.39	8,435.33	6,990.98	7,216.94	7,617.70	7,982.79	9,016.73	9,476.44	10,099.19	10,510.30	8,522.62	12,006.59	10,954.16	10,433.84	11,615.98	11,715.28	11,804.66	12,464.00	12,494.12
Marine	7,676.53	12,461.18	15,657.55	16,360.46	19,023.78	22,052.90	26,982.87	29,679.30	30,714.74	33,573.85	31,049.39	29,805.51	28,851.76	31,019.86	32,174.58	32,213.26	32,283.78	29,377.36	28,030.15	25,339.11	26,622.41	26,247.59	25,359.81	24,764.61	25,277.10
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	3,656.50	2,781.63	3,257.90	3,337.25	4,076.49	4,718.91	5,177.39	5,956.06	6,796.43	8,090.77	9,569.82	11,093.64	13,262.11	14,689.85	18,006.78	17,818.86	19,416.23	21,361.65	22,624.88	23,150.72	25,171.50	27,355.35	33,026.03	36,349.05	43,963.62

※ Abbreviations: LULUCF = Land Use, Land-Use Change and Forestry, NO = Not Occurring, NE = Not Estimated, NA = Not Applicable.

[Table 5.3] Emission trends (CH_4)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	377.84	330.07	270.63	226.42	192.69	170.36	167.43	169.93	158.89	171.07	180.91	184.85	190.83	196.75	209.88	216.89	223.87	236.98	240.91	230.34	261.17	277.46	292.94	299.55	282.90
A. Fuel Combustion (Sectoral Approach)	134.25	112.82	89.93	75.20	61.63	56.22	52.72	51.26	46.24	49.49	52.86	55.08	60.49	62.95	62.76	67.31	68.89	71.52	73.17	72.29	77.59	81.25	81.83	82.93	84.30
1. Energy Industries	0.63	0.71	0.97	1.26	1.65	1.85	2.10	2.43	2.18	2.43	2.54	2.76	3.11	3.17	3.96	4.10	4.58	5.10	5.48	5.17	6.33	6.70	6.73	6.55	6.59
2. Manufacturing Industries and Construction	5.90	6.91	8.44	9.59	10.06	10.64	11.63	12.47	12.55	13.27	14.47	15.24	16.00	16.64	17.61	17.55	18.09	19.46	20.35	19.42	22.66	25.18	26.33	27.46	30.67
3. Transport	6.82	7.50	8.63	10.22	11.39	12.74	13.90	14.78	13.03	14.75	17.03	18.32	19.47	19.99	20.32	20.92	21.62	22.83	23.05	23.96	24.51	24.06	23.88	23.95	23.32
4. Other Sectors	120.87	97.05	71.47	53.71	38.13	30.61	24.66	21.18	18.12	18.67	18.49	18.33	21.51	22.69	20.43	24.30	24.20	23.72	23.93	23.34	23.69	24.92	24.48	24.56	23.32
5. Other	0.02	0.64	0.40	0.43	0.39	0.39	0.42	0.40	0.36	0.38	0.33	0.43	0.39	0.46	0.44	0.45	0.39	0.40	0.36	0.39	0.40	0.40	0.40	0.41	0.39
B. Fugitive Emissions from Fuels	243.59	217.25	180.70	151.22	131.06	114.14	114.71	118.67	112.65	121.58	128.05	129.77	130.34	133.80	147.13	149.57	154.98	165.47	167.74	158.05	183.58	196.20	211.11	216.62	198.60
1. Solid Fuels	230.13	201.27	160.00	126.22	99.42	76.46	66.18	60.34	58.29	56.10	55.47	51.02	44.35	44.08	42.65	37.85	37.75	38.58	37.07	33.67	27.86	27.86	27.99	24.26	23.36
2. Oil and Natural Gas	13.46	15.98	20.70	25.00	31.64	37.68	48.53	58.33	54.36	65.48	72.58	78.75	85.99	89.72	104.47	111.72	117.23	126.89	130.67	124.38	155.72	168.35	183.12	192.36	175.23
2. Industrial Processes	5.31	7.40	10.51	11.72	12.53	12.87	14.59	17.82	18.60	19.77	20.66	19.80	21.54	21.42	21.98	22.42	23.34	24.48	23.73	23.95	24.54	24.62	25.83	25.57	26.83
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	5.31	7.40	10.51	11.72	12.53	12.87	14.59	17.82	18.60	19.77	20.66	19.80	21.54	21.42	21.98	22.42	23.34	24.48	23.73	23.95	24.54	24.62	25.83	25.57	26.83
C. Metal Production	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO	NA, IE, NO
D. Other Production																									
E. Production of Halocarbons and SF_6																									
F. Consumption of Halocarbons and SF_6																									
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use																									
4. Agriculture	696.65	698.06	696.09	700.43	697.25	691.53	695.17	689.95	683.15	655.52	641.16	630.48	626.76	618.18	611.85	606.47	606.60	609.12	610.78	616.76	623.55	603.17	607.46	600.44	587.08
A. Enteric Fermentation	140.96	148.80	160.08	178.02	188.95	196.01	210.74	212.38	204.39	176.85	160.80	149.43	147.73	147.13	152.87	157.38	165.00	172.92	181.82	190.24	202.97	201.03	209.05	207.77	199.66
B. Manure Management	38.28	40.26	42.24	44.71	46.33	48.04	49.58	50.44	52.42	52.17	54.22	55.61	56.99	57.01	55.78	56.45	57.17	58.08	56.76	58.71	60.86	53.27	59.49	61.25	60.81
C. Rice Cultivation	516.27	507.99	492.84	476.84	461.14	446.60	433.88	426.11	425.35	425.51	425.13	424.38	421.01	413.09	402.28	391.71	383.48	377.19	371.30	366.92	358.87	348.10	338.20	330.69	325.87
D. Agricultural Soils																									
E. Prescribed Burning of Savannas																									

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
F. Field Burning of Agricultural Residues	1.14	1.01	0.94	0.86	0.84	0.88	0.97	1.03	0.99	0.99	1.00	1.06	1.03	0.95	0.91	0.93	0.95	0.93	0.90	0.90	0.84	0.77	0.73	0.73	0.74
G. Other																									
5. Land Use, Land-Use Change and Forestry	6.39	5.95	6.24	6.02	6.16	6.17	6.24	6.83	7.10	6.91	7.32	7.55	7.89	7.91	7.76	7.33	7.84	8.01	8.40	8.12	7.88	8.37	7.91	8.10	8.48
A. Forest Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
B. Cropland	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
C. Grassland	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
D. Wetlands	6.39	5.95	6.24	6.02	6.16	6.17	6.24	6.83	7.10	6.91	7.32	7.55	7.89	7.91	7.76	7.33	7.84	8.01	8.40	8.12	7.88	8.37	7.91	8.10	8.48
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
6. Waste	383.16	422.51	450.96	462.43	498.58	508.30	519.41	528.24	485.31	483.93	485.80	507.78	511.22	512.92	462.08	456.10	445.15	412.08	405.08	408.54	392.21	384.24	366.39	365.24	370.57
A. Solid Waste Disposal on Land	356.75	390.64	416.45	436.18	454.88	466.47	480.92	496.94	454.65	453.34	454.43	475.49	475.34	479.59	429.21	422.67	410.20	379.63	374.14	377.79	369.27	362.37	345.25	342.11	349.30
B. Waste-water Handling	26.41	31.87	34.52	26.25	43.34	41.79	38.36	30.90	30.27	29.22	28.68	29.64	31.90	29.35	28.73	27.42	27.69	24.74	23.00	22.26	21.92	20.35	20.01	19.35	18.55
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NO	NO	NO	NO	0.36	0.04	0.13	0.40	0.38	1.37	2.69	2.65	3.98	3.99	4.14	6.01	7.25	7.71	7.94	8.48	1.03	1.52	1.13	3.77	2.72
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH_4 emissions including CH_4 from LULUCF	1,469.36	1,463.99	1,434.70	1,407.02	1,407.21	1,389.24	1,402.84	1,412.77	1,353.06	1,337.20	1,335.84	1,350.46	1,358.24	1,357.18	1,313.54	1,309.20	1,306.80	1,290.67	1,288.90	1,287.71	1,309.36	1,297.86	1,300.54	1,298.89	1,275.85
Total CH_4 emissions excluding CH_4 from LULUCF	1,462.96	1,458.04	1,428.46	1,401.00	1,401.05	1,383.07	1,396.60	1,405.94	1,345.95	1,330.29	1,328.52	1,342.91	1,350.35	1,349.27	1,305.79	1,301.88	1,298.96	1,282.66	1,280.50	1,279.59	1,301.48	1,289.49	1,292.62	1,290.79	1,267.37
Memo Items:																									
International Bunkers	0.55	0.85	1.06	1.11	1.29	1.50	1.83	2.01	2.07	2.26	2.09	2.01	1.96	2.10	2.18	2.19	2.18	2.04	1.94	1.76	1.85	1.83	1.78	1.74	1.78
Aviation	0.04	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.07	0.06	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.09
Marine	0.51	0.82	1.03	1.07	1.25	1.45	1.78	1.95	2.02	2.21	2.04	1.96	1.89	2.04	2.11	2.11	2.12	1.95	1.86	1.68	1.77	1.74	1.70	1.66	1.69
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass																									

※ Abbreviations: LULUCF = Land Use, Land-Use Change and Forestry, NO = Not Occurring, NE = Not Estimated, NA = Not Applicable.

[Table 5.4] Emission trends (N_2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	2.50	2.60	2.81	3.07	3.19	3.39	3.60	3.81	3.46	3.70	3.97	4.12	4.40	4.52	4.67	4.70	4.77	5.05	7.67	6.53	7.63	8.88	12.54	12.38	12.71
A. Fuel Combustion (Sectoral Approach)	2.50	2.60	2.81	3.07	3.19	3.39	3.60	3.81	3.46	3.70	3.97	4.12	4.40	4.52	4.67	4.70	4.77	5.05	7.67	6.53	7.63	8.88	12.54	12.38	12.71
1. Energy Industries	0.30	0.32	0.36	0.39	0.44	0.48	0.53	0.58	0.54	0.58	0.69	0.76	0.84	0.85	0.94	0.96	1.01	1.10	3.67	2.65	3.33	4.23	7.75	7.43	7.33
2. Manufacturing Industries and Construction	0.98	1.14	1.39	1.57	1.66	1.74	1.87	1.99	1.96	2.07	2.22	2.30	2.42	2.50	2.62	2.61	2.67	2.87	2.95	2.82	3.21	3.56	3.70	3.84	4.30
3. Transport	0.30	0.33	0.37	0.47	0.49	0.55	0.58	0.63	0.49	0.52	0.57	0.59	0.63	0.65	0.64	0.64	0.64	0.65	0.63	0.64	0.65	0.66	0.66	0.68	0.69
4. Other Sectors	0.92	0.77	0.66	0.61	0.58	0.60	0.59	0.58	0.45	0.51	0.46	0.45	0.49	0.49	0.44	0.46	0.41	0.41	0.39	0.39	0.40	0.41	0.40	0.40	0.38
5. Other	0.00	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
B. Fugitive Emissions from Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	0.52	1.27	7.84	7.88	8.65	10.29	11.66	14.02	16.10	19.22	21.88	23.13	22.31	33.10	40.75	34.61	32.05	2.94	0.91	0.76	0.67	1.02	0.68	0.86	1.16
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	0.52	1.27	7.84	7.88	8.65	10.29	11.66	14.02	16.10	19.22	21.88	23.13	22.31	33.10	40.75	34.61	32.05	2.94	0.91	0.76	0.67	1.02	0.68	0.86	1.16
C. Metal Production																									
D. Other Production																									
E. Production of Halocarbons and SF_6																									
F. Consumption of Halocarbons and SF_6																									
G. Other																									
3. Solvent and Other Product Use																									
4. Agriculture	22.51	23.34	24.79	25.98	27.57	28.79	30.18	30.49	29.95	27.98	26.97	25.96	25.69	25.34	26.00	26.92	27.23	27.77	27.83	29.06	29.99	28.36	29.52	29.91	28.90
A. Enteric Fermentation																									
B. Manure Management	6.70	7.27	8.00	8.84	9.43	9.98	10.72	10.91	10.60	9.57	9.01	8.61	8.64	8.64	8.94	9.40	9.83	10.23	10.46	10.98	11.65	11.26	11.25	11.31	10.67
C. Rice Cultivation																									
D. Agricultural Soils	15.79	16.04	16.77	17.12	18.13	18.79	19.44	19.55	19.33	18.39	17.93	17.32	17.02	16.68	17.04	17.49	17.38	17.51	17.34	18.07	18.31	17.08	18.25	18.58	18.22
E. Prescribed Burning of Savannas																									
F. Field Burning of Agricultural Residues	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
G. Other																									

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
5. Land Use, Land-Use Change and Forestry	0.87	0.74	0.57	0.42	0.21	0.21	0.16	0.16	0.18	0.19	0.19	0.17	0.19	0.17	0.16	0.16	0.15	0.17	0.17	0.18	0.18	0.17	0.15	0.14	0.10
A. Forest Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
B. Cropland	0.87	0.74	0.57	0.42	0.21	0.21	0.16	0.16	0.18	0.19	0.19	0.17	0.19	0.17	0.16	0.16	0.15	0.17	0.17	0.18	0.18	0.17	0.15	0.14	0.10
C. Grassland	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
6. Waste	3.22	3.06	3.17	3.18	3.21	3.36	3.43	3.52	3.51	3.66	3.88	3.91	4.00	4.03	4.02	4.37	4.07	4.19	4.27	4.32	4.72	4.80	4.93	5.19	5.18
A. Solid Waste Disposal on Land																									
B. Waste-water Handling	3.10	2.90	2.98	2.94	2.95	3.03	3.06	3.08	3.09	3.08	3.06	3.05	3.03	3.02	3.00	3.31	2.96	2.94	3.00	3.05	3.37	3.36	3.32	3.40	3.33
C. Waste Incineration	0.12	0.16	0.19	0.23	0.24	0.33	0.37	0.41	0.39	0.48	0.62	0.66	0.67	0.71	0.71	0.61	0.57	0.67	0.68	0.64	0.80	0.80	0.95	0.98	0.96
D. Other	NO	NO	NO	NO	0.03	0.00	0.01	0.03	0.03	0.10	0.20	0.20	0.30	0.30	0.31	0.45	0.54	0.58	0.60	0.64	0.55	0.64	0.66	0.82	0.89
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N_2O emissions including N_2O from LULUCF	29.64	31.01	39.18	40.53	42.82	46.04	49.04	52.00	53.21	54.75	56.89	57.29	56.58	67.16	75.61	70.77	68.27	40.12	40.84	40.85	43.19	43.23	47.82	48.47	48.06
Total N_2O emissions excluding N_2O from LULUCF	28.76	30.27	38.62	40.11	42.62	45.83	48.88	51.84	53.03	54.56	56.70	57.11	56.39	66.99	75.45	70.61	68.13	39.95	40.67	40.67	43.01	43.06	47.66	48.33	47.96
Memo Items:																									
International Bunkers	0.24	0.22	0.27	0.29	0.33	0.37	0.43	0.47	0.44	0.47	0.46	0.46	0.48	0.51	0.54	0.55	0.49	0.57	0.53	0.50	0.54	0.54	0.53	0.55	0.55
Aviation	0.17	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.20	0.20	0.22	0.23	0.25	0.27	0.29	0.30	0.24	0.34	0.31	0.29	0.33	0.33	0.33	0.35	0.35
Marine	0.06	0.10	0.12	0.13	0.15	0.17	0.21	0.23	0.24	0.26	0.24	0.23	0.23	0.24	0.25	0.25	0.25	0.23	0.22	0.20	0.21	0.21	0.20	0.20	0.20
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass																									

※ Abbreviations: LULUCF = Land Use, Land-Use Change and Forestry, NO = Not Occurring, NE = Not Estimated, NA = Not Applicable.

[Table 5.5] Emission trends (HFCs, PFCs and SF_6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Emissions of HFCsa - (kt CO_2equivalent)	982.80	798.88	1,877.22	2,117.21	3,837.90	5,084.87	5,779.02	7,160.07	4,911.10	8,061.49	8,443.31	5,851.64	8,652.61	6,442.92	6,590.97	6,651.18	6,097.96	7,362.99	6,881.07	5,846.15	8,087.59	7,907.00	8,694.42	8,094.74	8,537.55
HFC-23	0.08	0.07	0.16	0.18	0.19	0.22	0.24	0.29	0.17	0.32	0.29	0.05	0.18	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
HFC-32	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO, NE	NO, NE	NO, NE	NO, NE	1.21	1.90	2.25	2.92	2.21	3.32	3.90	4.00	5.01	4.83	4.94	4.97	4.51	5.45	5.11	4.33	6.03	5.88	6.44	5.96	6.19
HFC-152a	NO, NE	NO, NE	0.04	0.08	0.00	0.00	0.00	0.01	NO, NE	0.03	0.22	0.11	0.36	0.33	0.12	0.16	0.22	0.24	0.07	0.05	0.07	0.07	0.06	0.09	0.65
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of listed HFCs[a] - (Gg CO_2equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of PFCs[a] - (Gg CO_2equivalent)	NO	NO	0.28	1.62	NO	63.21	587.40	1,682.59	1,649.15	1,878.66	2,238.78	1,984.30	1,967.37	2,266.90	2,774.07	2,796.76	2,925.12	2,978.31	2,792.80	2,047.14	2,264.59	2,071.79	2,267.88	2,320.56	2,426.90
CF_4	NO	NO	NO	NO	NO	NO	NO	0.09	0.09	0.09	0.09	0.07	0.08	0.10	0.13	0.14	0.19	0.22	0.21	0.17	0.19	0.17	0.22	0.23	0.26
C_2F_6	NO	NO	0.00	0.00	NO	0.00	0.06	0.12	0.11	0.14	0.17	0.14	0.11	0.11	0.12	0.11	0.11	0.12	0.11	0.07	0.08	0.07	0.06	0.06	0.06
C_3F_8	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.01	0.03	0.06	0.09	0.12	0.11	0.08	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.01
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of listed PFCs[a] - (Gg CO_2equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of SF_6[a] - (Gg CO_2equivalent)	173.58	332.61	372.43	385.73	910.71	3,491.43	2,235.00	2,421.74	1,367.93	3,337.93	2,875.08	3,012.42	2,785.88	3,744.35	4,301.10	5,397.23	5,270.89	7,310.67	7,540.63	8,628.39	11,790.40	8,712.10	7,764.30	8,480.76	9,352.21
SF_6	0.01	0.01	0.02	0.02	0.04	0.15	0.09	0.10	0.06	0.14	0.12	0.13	0.12	0.16	0.18	0.23	0.22	0.31	0.32	0.36	0.49	0.36	0.32	0.35	0.39

※ Abbreviations: LULUCF = Land Use, Land-Use Change and Forestry, NO = Not Occurring, NE = Not Estimated, NA = Not Applicable.

[Table 6.1] List of Country-specific Emission Factors Applied to the Energy Sector

Sector	Fuel Type	Units	Carbon Emission Factors	
			2007-2011	2012-2014
Energy (Fuel Combustion)	Gasoline	ton C/TJ	19.7	20
	Jet oil	ton C/TJ	19.6	19.8
	Kerosene	ton C/TJ	19.5	19.6
	Diesel	ton C/TJ	20	20.2
	Bunker-A (B-A)	ton C/TJ	20.2	20.4
	Bunker-B (B-B)	ton C/TJ	20.6	20.5
	Bunker-C (B-C)	ton C/TJ	20.8	20.6
	By-product fuel oil No.1 (kerosene type)	ton C/TJ	-	19.7
	By-product fuel oil No.2 (heavy oil type)	ton C/TJ	-	21
	Propane	ton C/TJ	17.6	17.6
	Butane	ton C/TJ	18.1	18.1
	Naphtha	ton C/TJ	18.6	19.2
	Asphalt	ton C/TJ	21.5	21.6
	Lubricants	ton C/TJ	19.7	19.9
	Petroleum coke	ton C/TJ	27.2	27.2
	Domestic anthracite	ton C/TJ	29.7	30.5
	Imported anthracite (fuel)	ton C/TJ	-	28.6
	Imported anthracite (coking coal)	ton C/TJ	-	29.2
	Bituminous (coking coal)	ton C/TJ	-	26.2
	Bituminous (fuel)	ton C/TJ	25.9	26
	Sub-bituminous coal	ton C/TJ	29.3	26.2
	Liquified Natural Gas (LNG)	ton C/TJ	15.4	15.3
	City gas (LNG)	ton C/TJ	15.4	15.3
	City gas (LPG)	ton C/TJ	17.6	17.6

※ Due to the unavailability of a country-specific emission factor for petroleum coke calculated based on official calorific value for the year 2011 (Announced by the Ministry of Trade, Industry & Energy), the country-specific emission factor in accordance with the calorific value announced in 2006 was used to measure the emissions for the period of 2012-2014.

[Table 6.2] List of Country-specific Emission Factors Applied to the Sectors of Agriculture and LULUCF

Sector	Name of factor	Unit	Emission Factor
			1990-2014
Agriculture (Rice Cultivation)	Baseline emission factor for continuously flooded fields without organic amendments (EF_C)	kg CH_4 $ha^{-1}day^{-1}$	2.32
	Scaling factor for organic amendment applied (SF_O) for Rice straw when applying rice straw(dry matter) of 4-8 mg/ha	-	2.5
	Scaling factor for the differences in water regime (SF_W): Continuously flooded	-	1
	Scaling factor for the differences in water regime (SF_W): Intermittently flooded – 1 week	-	0.83
	Scaling factor for the differences in water regime (SF_W): Intermittently flooded – 2 weeks	-	0.66
	Scaling factor for the differences in water regime (SF_W): Intermittently flooded – 3 weeks	-	0.49
Agriculture (Agricultural Soils)	Direct N_2O emission factor from synthetic fertiliser for Potato (EF_{1i})	kg N_2O-N/kg N	0.0049
	Direct N_2O emission factor from synthetic fertiliser for Chili pepper (EF_{1i})	kg N_2O-N/kg N	0.0086
	Direct N_2O emission factor from synthetic fertiliser for Soybeans (EF_{1i})	kg N_2O-N/kg N	0.0119
	Direct N_2O emission factor from synthetic fertiliser for Spring cabbage (EF_{1i})	kg N_2O-N/kg N	0.0056
	Direct N_2O emission factor from synthetic fertiliser for Autumn cabbage (EF_{1i})	kg N_2O-N/kg N	0.0058
	Weighted average of direct N_2O emission factor from synthetic fertiliser for field crops (EF_{1i})	kg N_2O-N/kg N	0.00596
	Indirect N_2O emission factor from N leaching and runoff (EF_5)	kg N_2O-N/kg N	0.0135
LULUCF	Basic wood density (D) for coniferous forest	td.m./m^3	0.46
	Basic wood density (D) for broadleaf forest	td.m./m^3	0.68
	Biomass Expansion Factor (BEF) for coniferous forest	-	1.43
	Biomass Expansion Factor (BEF) for broadleaf forest	-	1.51
	Ratio of below-ground biomass to above-ground biomass (R) for coniferous forest	-	0.27
	Ratio of below-ground biomass to above-ground biomass (R) for broadleaf forest	-	0.36

[Table 6.3] List of Country-specific Emission Factors Applied to the Waste Sector

Sector	Name of factor	Unit	Value
			1990-2014
Waste (Solid Waste Disposal on Land)	Fraction of DOC(Degradable Organic Carbon) that can decompose (DOC_F): Paper waste	-	0.6256
	Fraction of DOC(Degradable Organic Carbon) that can decompose (DOC_F): Food waste	-	0.6343
	Fraction of DOC(Degradable Organic Carbon) that can decompose (DOC_F): Wood waste	-	0.4446
	Fraction by volume of CH_4 in landfill gas (F)	-	0.5629
	Methane generation rate constant (k)	-	0.05
Waste (Waste-water Handling)	CH_4 factor by biological wastewater treatment	Ton CH_4/Ton BOD	0.018
	CH_4 factor by advanced wastewater treatment	Ton CH_4/Ton BOD	0.0071
	CH_4 emission factor for Chemical industry	Ton CH_4/Ton COD	0.0012
	CH_4 emission factor for Electric and electronic industry	Ton CH_4/Ton COD	0.0016
	CH_4 emission factor for Food and beverage industry	Ton CH_4/Ton COD	0.01
	CH_4 emission factor for Tobacco, paper, and wood industry	Ton CH_4/Ton COD	0.0034
Waste (Waste Incineration)	N_2O emission factor for Municipal solid waste	g N_2O/Ton	52.1
	N_2O emission factor for Industrial solid waste	g N_2O/Ton	129.7
	N_2O emission factor for Sewage sludge	g N_2O/Ton	595

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Office for Government Policy Coordination
Prime Minister's Secretariat
Greenhouse Gas Inventory and Research Center

#501, Gwanghwamun Officea, Saemunan-ro 92, Jongno-go,
Seoul, Republic of Korea, 03186

Tel: 82-2-6943-1353 Fax: 82-2-6943-1354

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