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The Republic of Korea's First Biennial Transparency Report and Fifth National Communication

under the United Nations Framework Convention on Climate Change and the Paris Agreement

The Government of
the Republic of Korea

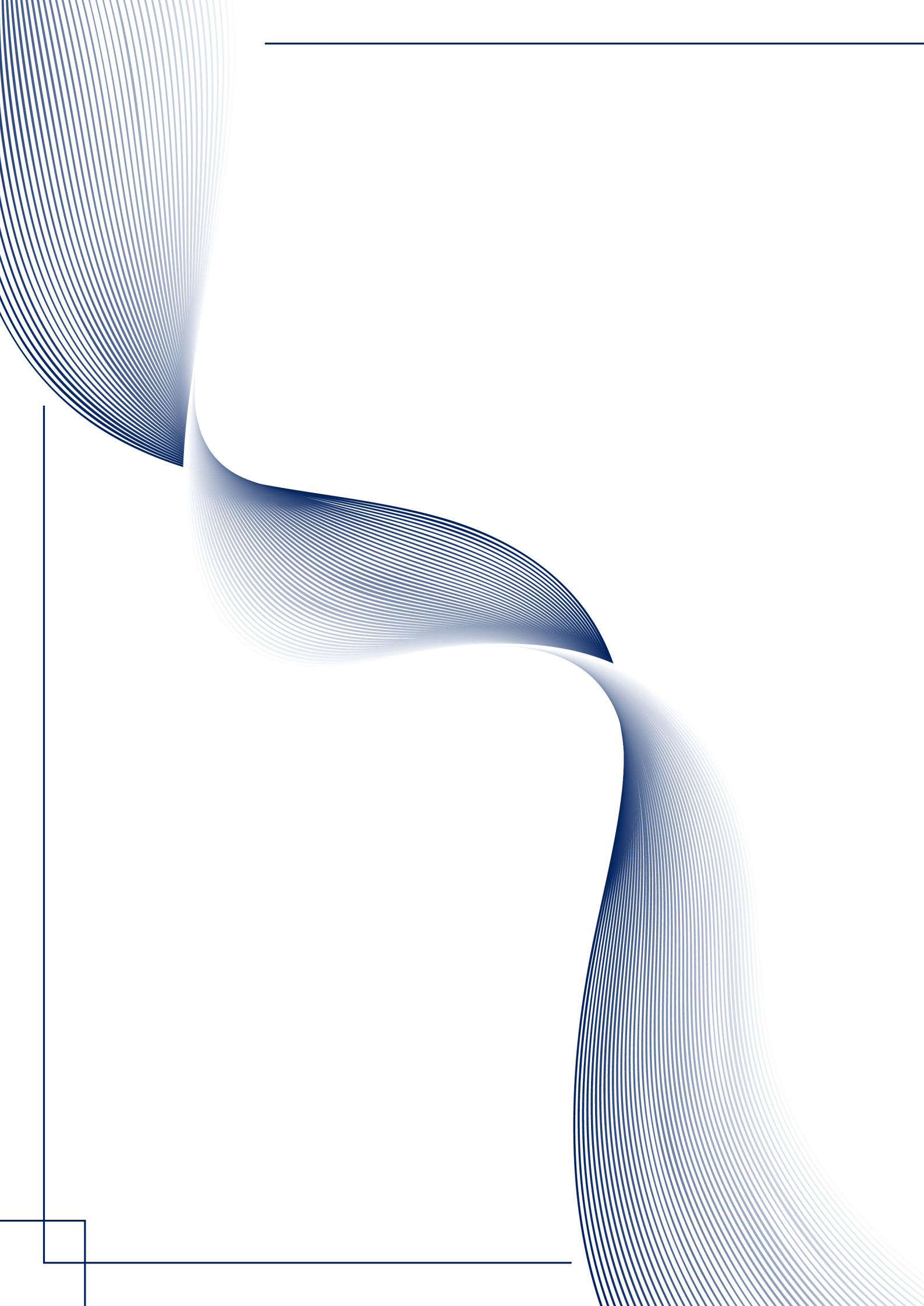


Table of Contents

List of Tables

List of Figures

- The Biennial Transparency Report (BTR) is prepared and submitted biennially to the United Nations Framework Convention on Climate Change (UNFCCC) after deliberation and resolution by the Presidential Commission on Carbon Neutrality and Green Growth, in accordance with Article 13 of the Paris Agreement, Decision 1/CP.24, Decision 18/CMA.1 and its annex, and Article 77 of the Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis.

- The National Communication (NC), submitted together with the BTR as an annex, is reported quadrennially in accordance with Article 12 of UNFCCC, Decision 17/CP.8, and Decision 1/CP.16.

- This report has been prepared under the supervision of the Ministry of Environment of the Republic of Korea (ROK), with the Greenhouse Gas (GHG) Inventory and Research Center (GIR) serving as the secretariat, in collaboration with relevant government ministries.

- The structure of the first BTR is as follows: ⅰ) GHG Inventory, ⅱ) Tracking progress in implementing and achieving the Nationally Determined Contribution (NDC), ⅲ) Climate change impacts and adaptation, ⅳ) Support provided to the global community, and v) Annexes, which include the Fifth National Communication (NC), the National Inventory Report (NIR), and the Common Tabular Formats (CTF) to track progress in implementing and achieving the NDC.

- While this report contains the latest information up to 2024, the national GHG inventory, reduced and projected GHG emissions estimates through mitigation policies and measures (PaMs), and support provided to global community are reported up to 2022, based on finalized official statistics.

- Chapter 1 presents the national GHG inventory that includes the latest emissions data from 1990 to 2022 following deliberation and confirmation by the National GHG Inventory Management Committee in December 2024.

- While the emissions and removals estimates in Chapter 1 of this report were calculated using methodologies recommended in the 2006 IPCC Guidelines and GWPs from the IPCC Fifth Assessment Report (AR5), information necessary to track progress of the NDC in Chapter 2 used the 1996 IPCC Guidelines and GWPs from the IPCC Second Assessment Report (SAR), resulting in difference in methodological approaches.

- Chapter 2 is prepared with the objective of tracking the implementation progress of the enhanced update of the 2030 NDC target (total emissions) submitted to UNFCCC in December 2021.

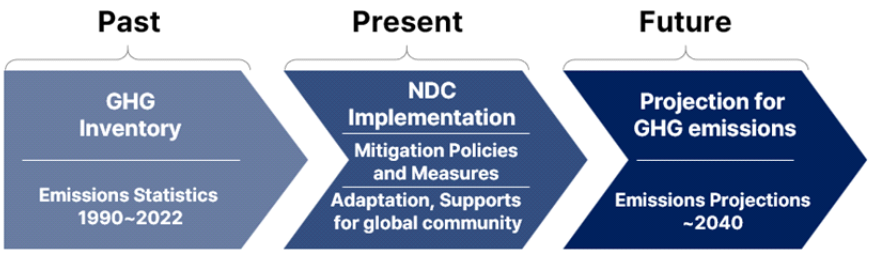
- Chapter 3 outlines updates on the ROK's Adaptation Communication (AdCom) published in April 2023, and Chapter 4 includes information on support provided to the global community under Article 13, Paragraphs 8 and 9 of the Paris Agreement.

- To avoid reiteration with the BTR, the 5th NC, submitted as an annex to the BTR, only includes separate sections on Research and Systematic Observation (RSO) and Education, Training, and Public Awareness.

Executive Summary

Overview

The first Biennial Transparency Report (BTR) of the Republic of Korea (ROK) is prepared in accordance with rules and guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, highlighting greenhouse gas (GHG) emissions and mitigation efforts of the Republic of Korea from past, present and the future. This report provides detailed information on GHG emissions and trends from 1990 to 2022 as well as current mitigation policies and measures to achieve the Nationally Determined Contributions (NDC) target. It also reports on GHG emission projections up to 2040, climate change adaptation actions, and the provision of financial and technological assistance including capacity building in developing country partners around the world, demonstrating the Republic of Korea's commitments under UNFCCC and the Paris Agreement.



National Greenhouse Gas Inventory

The ROK has opted to submit its latest National Inventory Report (NIR[1)]) as a stand-alone report in line with the *Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement* (Annex Part E, paragraph 12, Decision 18/CMA.1). Chapter I of this report provides a summary thereof.

GHG emissions and removals estimates presented in the NIR are organized and calculated using methodologies consistent with the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories.

Additionally, the 100-year global warming potential (GWP) values from the IPCC Fifth Assessment Report (AR5) were used to estimate emissions in accordance with the Paris Agreement (Annex 2.D Paragraph 37, Decision 18/CMA.1). The ROK has expanded the scope of GHG reported from six gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) to seven gases, which includes nitrogen trifluoride (NF_3).

1) In accordance with Paragraph 38 of the MPGs, the National Inventory Report (NIR) consists of the Common Reporting Tables (CRTs) and the National Inventory Document (NID).

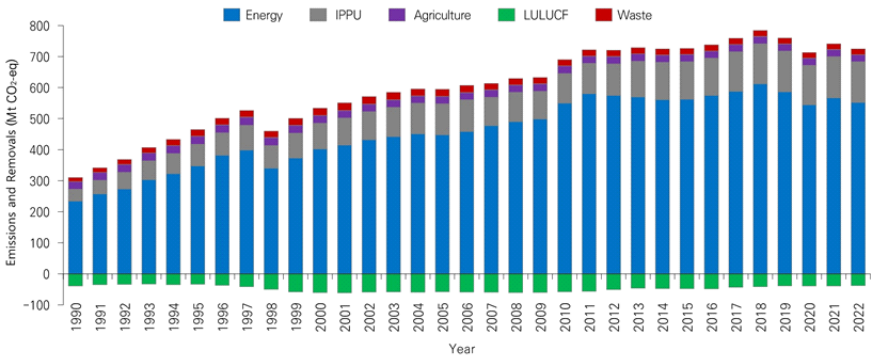
Executive Summary

The latest National GHG Inventory of the ROK covering the years 1990-2022[2)] found that total GHG emissions (excluding LULUCF) in 2022 were 724.3 $MtCO_2$-eq, representing an increase of 133.2% (413.7 $MtCO_2$-eq) compared to 1990 levels of 310.6 $MtCO_2$-eq. This marks a decrease of 2.3% (16.7 $MtCO_2$-eq) compared to 2021 levels of 741.0 $MtCO_2$-eq, and a decrease of 7.6% (59.6 $MtCO_2$-eq) from the peak emissions recorded in 2018. Net GHG emissions (including LULUCF) in 2022 were 686.5 $MtCO_2$-eq, reflecting an increase of 152.7% (414.8 $MtCO_2$-eq) compared to 1990 levels of 271.6 $MtCO_2$-eq, a decrease of 2.2% (15.5 $MtCO_2$-eq) compared to 2021 levels of 702.0 $MtCO_2$-eq, and a decrease of 7.5% (55.8 $MtCO_2$-eq) compared to 2018 levels of 742.3 $MtCO_2$-eq.

While the ROK's emissions showed an increasing trend in the 1990s due to economic growth, the rate of increase gradually dropped since the 2000s, and emissions began to decline after reaching its peak in 2018. The financial crisis in 1998 led to a decrease of 12.5% in emissions compared to the previous year, followed by an increasing trend with an average annual rate of 2.6% from 1999 to 2008. In 2009, the year-on-year increase was limited to 0.6% due to the 2008 economic recession. Emissions in 2020 decreased by 6.1% compared to the previous year as a result of the outbreak of the COVID-19 pandemic.

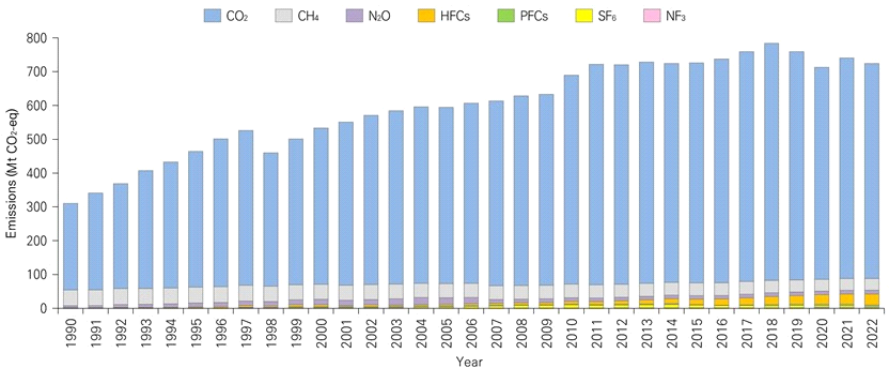
2) The latest revisions to the Yearbook of Energy Statistics (December 2024) have been incorporated to improve the accuracy and timeliness of the national GHG inventory. As a result, the submission schedule for the first BTR has been postponed from the originally planned December 2024 to February 2025.

By sector, energy accounts for the largest share at 76.2% of total emissions in 2022, followed by industrial processes and product use (IPPU) at 18.1%, agriculture at 3.2%, and waste at 2.5%. Notably, due to the manufacturing-centered industrial structure, the energy sector has consistently maintained a share of 74–80% since 1990.



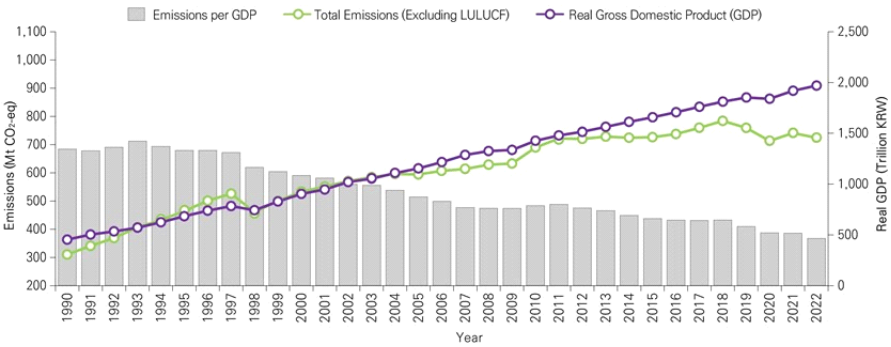
GHG Emissions and Removals by Sector (1990-2022)

By gas, CO_2 accounted for the largest share of 87.8%, followed by fluorinated gases of 5.9% (HFCs 4.5%, PFCs 0.56%, SF_6 0.55%, NF_3 0.2%), CH_4 of 4.9%, and N_2O of 1.5%. While most gases, including CO_2, have continued to increase, CH_4 has continuously decreased since 1990 due to reduced coal production and a decrease in rice cultivation areas. In particular, fluorinated gases have significantly increased compared to 1990 levels due to increased use of refrigerants (HFCs), and semiconductor and display manufacturing processes (PFCs, SF_6, NF_3).



GHG Emissions by Gas (1990-2022)

Total GHG emissions per unit of GDP in 2022 were 367.9 tCO_2-eq/KRW billion, showing a decrease of 46.2% compared to 1990 levels (683.9 tCO_2-eq/KRW billion) and a decrease of 4.7% compared to 2021 levels (386.2 tCO_2-eq/KRW billion). Since emissions peaked in 2018, a decoupling trend has been observed, with GDP continuing to grow while emissions decrease.



Total GHG Emissions per Real Gross Domestic Product (1990-2022)

Tracking Progress in Implementing and Achieving NDC

The ROK has established an institutional foundation for achieving carbon neutrality by legislating its 2050 carbon neutrality vision and specifying the 2030 NDC target therein. In 2021, the ROK submitted an enhanced NDC to UNFCCC, demonstrating its firm commitment to a 40% reduction in total emissions compared to 2018 levels by 2030.

Progress towards the 2030 NDC target shows that the reduction rate is approximately 8.4% compared to 2018 levels, based on total emissions in 2022. As shown in the table below, a continuous declining trend is observed with a decrease of 2.81% in emissions in 2022 compared to 2021, marking the second consecutive year of decline.

Information on Tracking Progress in Implementing and Achieving NDC (CTF Ⅱ.4)

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress Status
			2021	2022			
Annual Total GHG Emissions	MtCO2-eq	732.9	690.8	671.2	40%	2030	As of 2022, approx. 8.4% reduction compared to 2018
ITMOs Utilization	As international mitigation projects are at the initial stage, the ROK plans to report on NDC utilization of ITMOs and double counting prevention in its subsequent BTRs.						

1) Updated figures due to recalculation (727.6 → 732.9)
2) The ROK plans to use voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure to its domestic mitigation efforts including LULUCF to achieve its target

Executive Summary

While the emissions and removals estimates in Chapter I of this report were calculated using methodologies recommended in the 2006 IPCC Guidelines and GWPs from the IPCC Fifth Assessment Report (AR5), information necessary to track progress of the NDC submitted used the 1996 IPCC Guidelines and GWPs from the IPCC Second Assessment Report (SAR), resulting in difference in methodological approaches.

The ROK plans to apply the 2006 IPCC Guidelines for its 2035 NDC and subsequent BTRs, ensuring consistency between national GHG inventory and the 2035 NDC implementation.

The ROK's GHG mitigation policies and measures (PaMs) have served as an institutional foundation that led to the implementation of the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis 2022* (Carbon Neutrality Act). The Act introduced key mechanisms such as the Climate Response Fund and the Greenhouse Gas Reduction Cognitive Budget which were incorporated into the *First National Framework Plan for Carbon Neutrality and Green Growth 2023*, establishing the framework for implementing the ROK's 2030 NDC. In particular, the Korea Emissions Trading System (K-ETS), which has been in operation since 2015 as one of the most impactful climate mitigation measures that encourages voluntary reduction activities and investments by businesses, covers approximately 73.5% of national GHG emissions.

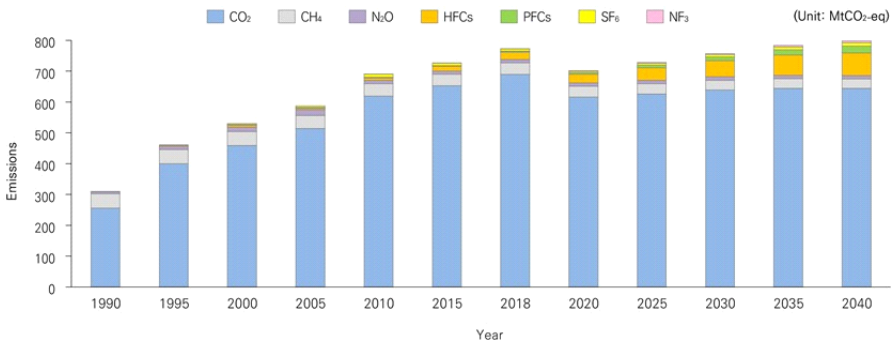
Major mitigation PaMs described in the report encompass: power generation, industry, building, transportation, agriculture, livestock farming and fisheries, waste, and carbon sinks. Examples of national-level policy actions include the phase-out of old coal power plants, the introduction of renewable energy facilities, and expansion of landfill methane capture. For some measures, reduced and projected emissions estimates for 2021–2022 and 2030 are also presented.

Not only at the national level, but also at the local level, 17 metropolitan and provincial governments have started submitting their first *Master Plan for Carbon Neutrality and Green Growth* starting from 2024, integrating climate actions into local operations and decision making.

This report outlines a long-term GHG emissions projection up to 2040 in accordance with Paragraph 92 of the MPGs. The projection is based on the "with measures scenario" (WM scenario) that includes policies announced and implemented up to 2021.

The emissions projection is based on GHG emissions data up to 2021 that are calculated in accordance with the 2006 IPCC Guidelines, as outlined in the *2023 National Greenhouse Gas Inventory (1990–2021)*, categorized by seven GHGs. Emissions by gas are specified in CO_2 equivalent values using GWPs from the IPCC AR5. The projection does not include indirect GHGs or international bunker fuel emissions from international aviation and maritime transport.

Under the WM scenario, total emissions in 2040 are projected to reach 798.0 $MtCO_2$-eq, reflecting an increase of 3.2% compared to 2018 levels, with an average annual rate of 0.3% from 2018 to 2040.



GHG Emissions by Gas: Trend and Projection

The emissions projection above does not include PaMs introduced after 2021. Future updates to the emission projection based on the latest available year are expected to show a decrease compared to the current projection with new PaMs in the following years.

Climate Change Impacts and Adaptation

The ROK has mandated its national-level climate change response through the Carbon Neutrality Act 2021, and has been developing the National Climate Change Adaptation Plan every five years since 2010. The *Third Enhanced National Climate Change Adaptation Plan* (June 2023) which complements the previous *Third Adaptation Plan* features a comprehensive monitoring and evaluation system, consisting of annual progress assessments as well as mid-term and final evaluations conducted in the third and fifth years.

Adaptation plans are established and implemented every five years not only at the national level, but also by 17 metropolitan and provincial governments, 226 municipal governments, and 62 public institutions responsible for critical infrastructure such as transportation and electricity. The government works together with various adaptation stakeholders, including the private sector and the public, providing support for climate change adaptation measures targeting vulnerable populations such as the elderly and low-income households.

The ROK completes scientific assessments to evaluate the current and future impacts of climate change and further develop effective adaptation strategies. Climate change impact and vulnerability assessments are carried out through the Model Of InTegrated Impact and Vulnerability Evaluation of climate change (MOTIVE) across sectors, including health, water, agriculture, forestry, ecosystem, ocean, and fisheries. The Vulnerability assESsment tool To build climate change Adaptation Plan (VESTAP) provides expertise as a basis for scientific decision-making by identifying priority areas vulnerable to climate change.

Supporting the Global Community

The ROK has been committed to enhancing global climate change efforts to address the climate crisis and support developing country partners by sharing its knowledge and experience.

Bilateral financial support through Official Development Assistance (ODA) amounted to approximately USD 1,439 million in 2021 and USD 2,156 million in 2022, with climate change adaptation accounting for 79.5% and 61.8% of the total, respectively. To effectively reflect developing countries' climate change needs and priorities, the ROK has established Country Partnership Strategies (CPS) to provide tailored support for each country.

Multilateral funds for climate change response, including the Green Climate Fund (GCF) and the Global Environment Facility (GEF), have also been increased. By 2023, the ROK contributed USD 100 million to the GCF initial resource mobilization and USD 200 million to its first replenishment. Starting in 2024, the ROK has pledged an additional USD 300 million for the second replenishment. Support for the GEF amounted to KRW 2,230 million in 2022, which increased to KRW 2,420 million in 2023. Additionally, the ROK plans to contribute KRW 3,600 million to the Adaptation Fund for the period 2023-2025 and USD 7 million to the Loss and Damage Fund.

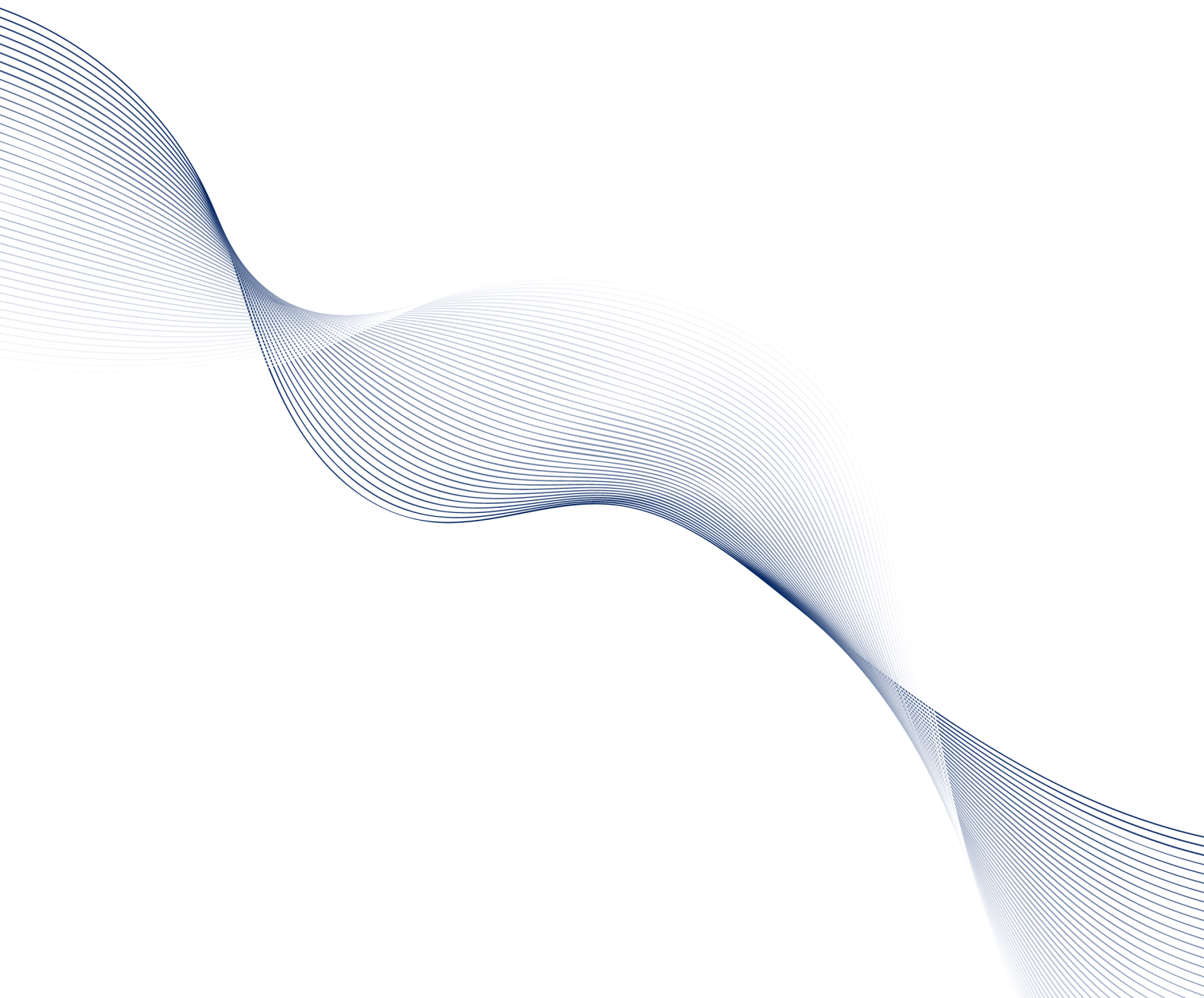
The ROK is also committed to enhancing international cooperation by working with international partners of which examples include funding for need-based climate finance projects under UNFCCC, support for the preparation of the IPCC Sixth Assessment Report (AR6), operation of the Climate Technology Centre and Network Partnership & Liaison Office (CTCN PALO), and management of the World Meteorological Organization (WMO) Regional Training Centre Trust Fund.

Activities for systematic technology development and transfer are carried out under the *Act on Promotion of Technology Development for Coping with Climate Change 2021* with the Ministry of Science and ICT as the National Designated Entity (NDE). Through CTCN Technical Assistance (TA) projects, a total of 18 pro-bono TA projects were implemented during 2021–2022, primarily supporting climate technology cooperation tailored to the needs of developing countries in the areas of energy, water and sanitation.

The ROK has been strengthening support to assist in achieving climate goals in developing countries that includes providing technical expertise, enhancing capacity for forest and GHG management, and supporting the establishment of environmental improvement master plans. Since 2017, in cooperation with UNFCCC, the ROK has been organizing the UNFCCC-GIR-CASTT (Climate Action and Support Transparency Training) Programme on GHGs to support developing countries in implementing the Enhanced Transparency Framework (ETF) and strengthening their GHG reporting capacity.

I

National Greenhouse Gas Inventory



1. Current Status and Institutional Arrangements

1.1 Background Information on Climate Change and Greenhouse Gas Inventory

1.1.1 Background Information on Climate Change

The average annual temperature in the Republic of Korea (ROK) has increased by approximately 1.6°C over the last 30 years (1991-2020) compared to the historical 30-year period from 1912 to 1940. Six of the ten warmest years on record between 1912 and 2020 have taken place in the last decade (2011-2020). In addition, extreme weather events have been escalating, as evidenced by the intensified precipitation in the past decade.[3] By the end of the 21st century (2081-2100), the ROK's average annual temperature is projected to increase by 2.3°C to 6.3°C compared to the period from 2000 to 2019.[4] Climate change continues to influence extreme weather events worldwide, and simultaneous and recurring climate hazards are expected to increase risks and impacts on health, ecosystems, infrastructure, and food security.[5]

Since the ROK's ratification of the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, the government has been actively participating in joint efforts to address climate change. Following the adoption of the Paris Agreement, a new global agreement for combating climate change in the post-Kyoto Protocol era, the ROK submitted its intended nationally determined contributions (INDCs) to the UNFCCC in June 2015. In 2020, the ROK declared its national vision to achieve carbon neutrality by 2050, and in the following year, submitted an enhanced update of its first nationally determined contribution (NDC) for 2030 with more ambitious greenhouse gas (GHG) reduction target. Both the 2050 carbon neutrality vision and the 2030 NDCs were codified in the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (Carbon Neutrality Act) and its Enforcement Decree, which were enacted in September 2021 and March 2022, respectively.

3) Korea Meteorological Administration & National Institute of Meteorological Sciences. (2021). Analysis report on climate change in Korea over 109 years (1912–2020) [in Korean].
4) National Institute of Meteorological Sciences (2022) developed detailed climate change scenarios for the ROK (with a 1 km resolution) based on the latest GHG pathways from the IPCC Sixth Assessment Report under the Shared Socioeconomic Pathways (SSP) and presented the projected annual average temperature increases for the years 2081–2100 for each scenario.
   * These scenarios include SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5.
5) IPCC (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

To achieve carbon neutrality and the 2030 NDC target, the ROK has established the *First National Framework Plan for Carbon Neutrality and Green Growth* (April 2023)[6] - a legally mandated plan spanning 20 years with quinquennial updates. The plan outlines both mid- and long-term national and sectoral reduction targets on an annual basis. Sectoral policies and measures to reduce GHG emissions - both implemented and planned - include enhancing the Korea Emissions Trading System (ETS), expanding zero-carbon electricity generation, strengthening building energy efficiency standards, and increasing new carbon sinks, such as urban forests. Additionally, each metropolitan city and provincial government has developed a *Master Plan for Carbon Neutrality and Green Growth* to implement climate change response policies tailored to their regions.

1.1.2 Background Information on GHG Inventory

As the existing Measurement, Reporting and Verification (MRV)[7] system for national GHG inventories transitions to the Enhanced Transparency Framework (ETF) under the Paris Agreement, all Parties shall submit a National Inventory Document (NID) and the Common Reporting Tables (CRTs), to the UNFCCC either as a stand-alone report or as part of a Biennial Transparency Report (BTR), due by the end of 2024.[8]

Chapter 1, 'National Greenhouse Gas Inventory,' contains information on the emissions and removals of the seven GHGs - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) - taking place within national territory and offshore areas over which the ROK has jurisdiction, in accordance with paragraphs 40 and 50 of the modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement (MPGs).

Anthropogenic emissions and removals, in accordance with paragraphs 17 and 20 of the MPGs, are estimated using the methodologies in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2006 IPCC Guidelines)[9] and, where appropriate, the *2019*

6) The ROK Government (2023). First National Framework Plan for Carbon Neutrality and Green Growth [in Korean].
7) The ROK, as a Non-Annex I country under the UNFCCC, has communicated its National Communications (NC) and Biennial Update Reports (BUR) to the UNFCCC in accordance with the principle of Common But Differentiated Responsibilities (CBDR).
※ NC1 (February 1998), NC2 (December 2003), NC3 (March 2012), NC4 (November 2019)
BUR1 (December 2014), BUR2 (November 2017), BUR3 (November 2019), BUR4 (December 2021)
8) UNFCCC (2018). Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement (Decision 18/CMA.1)

Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement)[10] is applied to certain emission sources (see Chapter Ⅰ, Section 1.3). For metrics, this inventory uses the 100-year time horizon global warming potential (GWP)[11] values from the IPCC Fifth Assessment Report,[12] as specified in paragraph 37 of the MPGs (see Chapter Ⅰ, Section 1.5).

The national GHG inventory consists of the Energy, Industrial Processes and Product Use (IPPU), Agriculture, Land Use, Land-Use Change and Forestry (LULUCF), and Waste sectors. In accordance with paragraph 50 of the MPGs, the 2006 IPCC Guidelines integrate Agriculture and LULUCF into the one category, Agriculture, Forestry and Other Land Use (AFOLU). The reporting period covers 33 years, from 1990 to 2022.

9) Eggleston, H. S., Buendia, L., Miwa, K., Ngara, T., & Tanabe, K. (2006). 2006 IPCC guidelines for national GHG inventories.
10) IPCC (2019). 2019 Refinement to the 2006 IPCC guidelines for national GHG inventories.
11) Equation for calculating CO_2-equivalent emissions using the GWP, an index measuring the radiative forcing resulting from the emission of a unit mass of a GHG relative to CO2:
12) IPCC (2014), IPCC Fifth Assessment Report

1.2 Institutional Framework

1.2.1 Institutional Arrangements

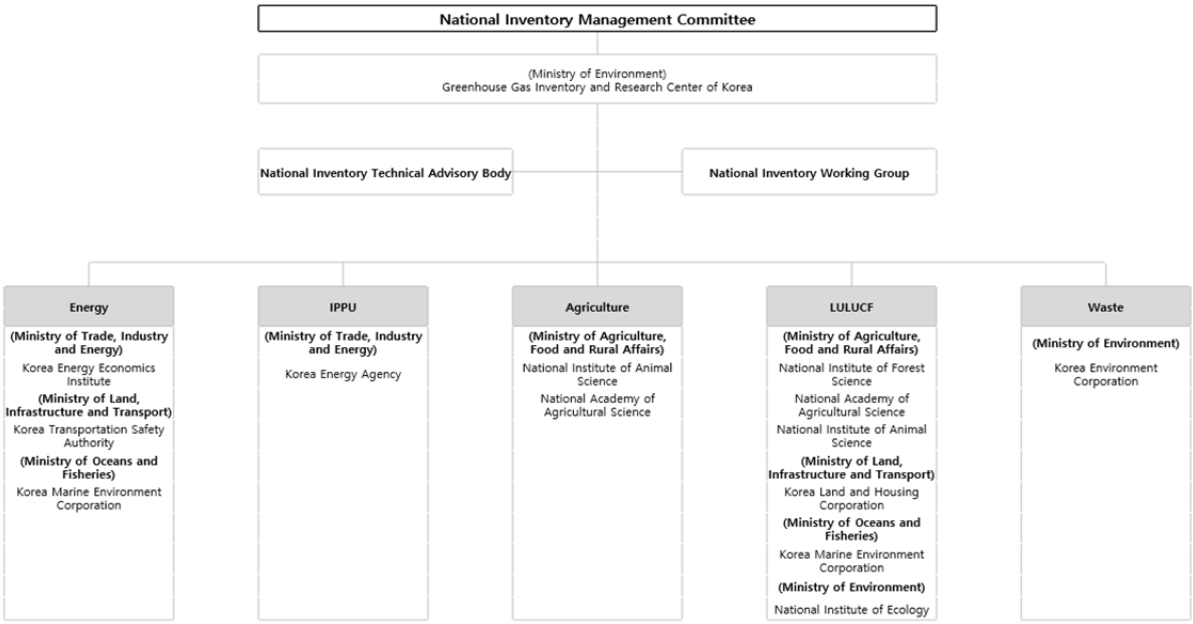
The Greenhouse Gas Inventory and Research Center of Korea (GIR) was established in 2010 under the Ministry of Environment to verify national GHG inventories and to develop and operate an integrated GHG data management system. The responsibilities of the GIR include developing a master plan for national inventories and MRV guidelines, verifying national inventories and country-specific emission/removal factors (CS EF/RFs), preparing NID and CRTs, operating and managing the national inventory reporting system, and promoting international cooperation. The GIR is also responsible for establishing and coordinating the National Inventory Management Committee (Management Committee), the National Inventory Working Group (Working Group), and the National Inventory Technical Advisory Body (Technical Advisory Body).

The Technical Advisory Body, composed of national GHG inventory experts recommended by government ministries, provides technical advice on inventories and CS EF/RFs.

The Working Group is an inter-ministerial coordination body responsible for the establishment and revision of MRV guidelines, as well as the development and verification of CS EF/RFs. It is chaired by the GIR president, and its members include division-director-level officials from the Office for Government Policy Coordination, Ministry of Agriculture, Food and Rural Affairs, Ministry of Trade, Industry and Energy, Ministry of Environment, Ministry of Land, Infrastructure and Transport, Ministry of Oceans and Fisheries, Rural Development Administration, Korea Forest Service, and Statistics Korea.

The Management Committee is the final deliberation and decision-making body for establishing and revising MRV guidelines as well as developing and verifying CS EF/RFs. It is chaired by the Vice Minister of Environment and its members include director-general-level officials from the Office for Government Policy Coordination, Ministry of Agriculture, Food and Rural Affairs, Ministry of Trade, Industry and Energy, Ministry of Environment, Ministry of Land, Infrastructure and Transport, Ministry of Oceans and Fisheries, and Statistics Korea, in addition to experts with extensive knowledge and experience in sector-specific GHG inventories, emission/removal factors, and statistics. The GIR serves as the secretariat for the Management Committee.

The management of sector-specific GHG inventories is handled by the respective competent authorities. The competent authorities appoint designated agencies to develop CS EF/RFs, and to estimate sector-specific GHG emissions and removals. The competent authorities review the national GHG inventory prepared by the designated agencies and forward it to the GIR for verification.



[Figure Ⅰ-1] National GHG Inventory Preparation Framework

Note: Statistical information is coordinated with Statistics Korea to ensure fairness and reliability of the national inventories.

<Table Ⅰ-1> Overview of National Inventory Arrangements by Sector and Category

Sector and category		Competent Authority	Designated Agency
Energy	Fuel Combustion (Energy industries and manufacturing industries and construction) and Fugitive Emissions	Ministry of Trade, Industry and Energy (MOTIE)	Korea Energy Economics Institute (KEEI)
	Transportation (Aviation, Road, Rail) and Buildings	Ministry of Land, Infrastructure and Transport (MOLIT)	Korea Transportation Safety Authority (KOTSA)
	Transportation (Maritime) and Fisheries	Ministry of Oceans and Fisheries (MOF)	Korea Marine Environment Corporation (KOEM)
IPPU		Ministry of Trade, Industry and Energy (MOTIE)	Korea Energy Agency (KEA)
Agriculture	Livestock	Ministry of Agriculture, Food, and Rural Affairs (MAFRA)	National Institute of Animal Science (NIAS)
	Cultivation		National Academy of Agricultural Science (NAAS)
LULUCF	Forest Land, Harvested Wood Products		National Institute of Forest Science (NIFOS)
	Cropland		National Academy of Agricultural Science (NAAS)
	Grassland		National Institute of Animal Science (NIAS)
	Wetlands-Inland	Ministry of Environment (ME)	National Institute of Ecology (NIE)
	Wetlands-Coastal	Ministry of Oceans and Fisheries (MOF)	Korea Marine Environment Corporation (KOEM)
	Settlements, Other Land	Ministry of Land, Infrastructure and Transport (MOLIT)	Korea Land and Housing Corporation (KLHC)
Waste		Ministry of Environment (ME)	Korea Environment Corporation (KECO)

1.2.2 Inventory Preparation Process

1) Preparation

The GIR and relevant ministries jointly develop a five-year rolling plan - the *Master Plan for National Greenhouse Gas Inventory* (Master Plan)[13] - to ensure the consistency and improvement of national inventories according to the international guidelines. The Master Plan provides guidance for continuous improvements aimed at enhancing the quality of the national inventories. These improvements include the advancement of estimation methodologies, the development, verification, and management of CS EF/RFs, securing and management of activity data, and the establishment and operation of IT systems.

The GIR prepares annual amendments to the MRV guidelines, incorporating requirements from the *Master Plan* and improvements identified during the previous year's inventory verification process. These amendments are finalized following review by the Working Group and deliberation by the Management Committee. The GIR forwards the revised guidelines to the competent authorities by December of the preceding year, ahead of the inventory submission.

The competent authorities develop an annual work plan for estimating GHG emissions and removals within their respective sectors, based on the methodologies outlined in the MRV guidelines distributed by the GIR. Other responsibilities include reviewing the activity data and tracking any changes in data provision. The competent authorities designate sector-specific agencies with relevant expertise to delegate the roles of developing CS EF/RFs and of estimating emissions/removals.

The verification and deliberative processes are essential for the competent authorities and designated agencies to the developed CS EF/RFs in the national inventories. The GIR forms a GHG verification expert team, consisting of internal and external experts who are independent from the development process of the factors, along with specialists from industries, academia, research institutions, and relevant national organizations. The verification results are then finalized and approved after review by the Working Group and deliberation by the Management Committee. The GIR incorporates the approved CS EF/RFs into the revised MRV guidelines for use in the national inventories, and the refinement is finalized after relevant ministries consultation and Management Committee deliberation.

13) *The First Master Plan(2015-2019) for National Greenhouse Gas Inventory* (2015) and *the Second Master Plan(2020-2024) for National Greenhouse Gas Inventory* (2024) have been published.

2) Measurement, Reporting, and Verification

The designated agencies collect the necessary data for estimating sectoral emissions by sources and removals by sinks in cooperation with data-providing institutions, and estimate national emissions in accordance with the MRV guidelines. The competent authorities perform quality assurance (QA) and quality control (QC) procedures on the overall inventory process, including activity data, emission/removal factors, and methodologies. Finally, the competent authorities prepare and submit to the GIR the emissions/removals estimates and inventory reports for the respective sectors, along with supporting documentation, by March of the year preceding the official national inventory submission.

The GIR compiles sectoral GHG inventory submitted by the competent authorities, verifies activity data, emission/removal factors and methodologies, and checks for any calculation errors. If errors or areas for improvement are identified during the verification process, the GIR requests corrections and supplementation from the respective competent authorities. After the final confirmation of the revised inventory resubmitted by the competent authorities, the GIR produces the final draft of the data tables and report for the national GHG inventory, covering all sectors.

3) Finalization, Publication and Improvement

The final draft of national GHG inventory prepared by the GIR is officially announced after consultations in the Working Group and deliberation by the Management Committee. The finalized national inventory is publicly disclosed online through the websites of the GIR and Statistics Korea. The published national inventory is then used in the NC, BTR, and NID submitted to the UNFCCC.

Areas for improvement identified during the inventory preparation process are incorporated into either the MRV guidelines for the following year or the subsequent Master Plan, depending on whether the improvements can be made in the short or long term. This process ensures the continuous improvement in the quality of national inventories.

<Table Ⅰ-2> Annual Schedule for National GHG Inventory Preparation

Procedure	Entity	Main Activities	Year t~2	Year t-1				Year t
				~Jan	~Mar	~Oct	~Dec	
Preparation								
Development of MRV Guidelines	GIR	• Drafting and distributing MRV guidelines	■					
Establishment of an annual work plan	CA	• Reviewing the data necessary for GHG estimation	■					
Estimation and Reporting								
GHG estimation and reporting by sector	CA DA	• Estimating emissions and removals by sector • Conducting internal QA/QC processes and reporting to the GIR		■	■			
Verification								
Aggregation and verification	GIR	• Compiling sectoral inventories and preparing aggregated inventory tables • Reviewing the aggregated inventory tables and inventory reports • Requesting corrections and improvements to sector-specific inventories				■		
	CA	• Correcting and resubmitting sector-specific inventories				■		
Deliberation and Confirmation								
Review	WG	• Reviewing the draft of national emissions/removals • Developing the national inventory improvement plan					■	
Finalization	MC	• Reviewing and finalizing the national inventory					■	
Publication								
Domestic	GIR	• Public release of official statistics					■	■
International	ME MOFA	• Preparing for submission to the UNFCCC • Submission to the UNFCCC						■

Note: The reporting period extends from 1990 to two years prior to the submission year, in accordance with the MRV Guidelines for the National GHG Inventory

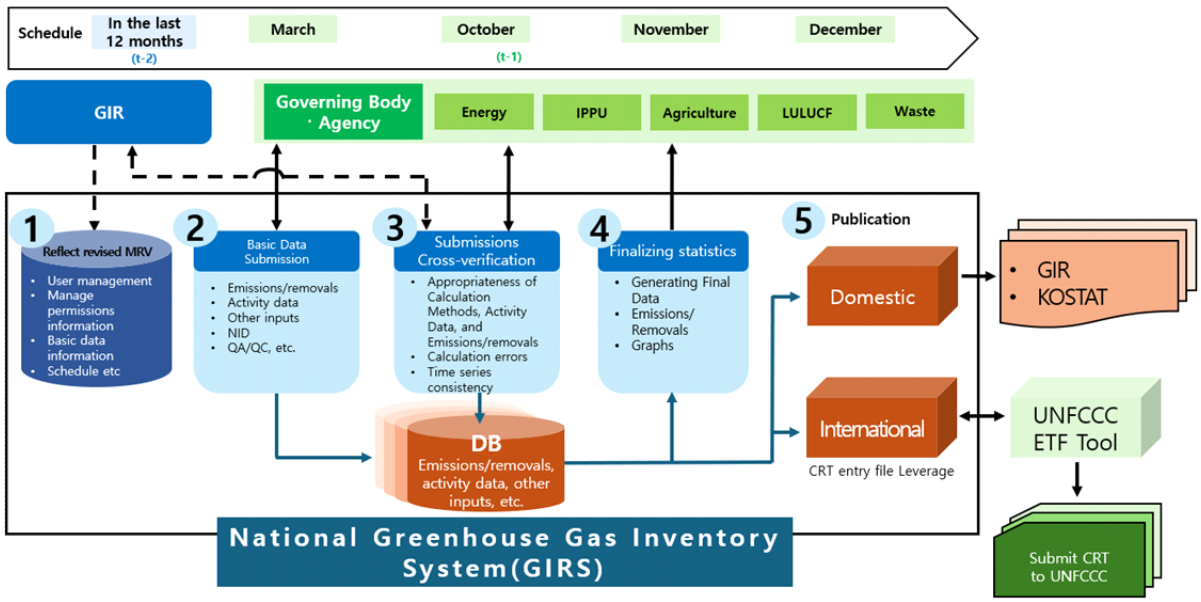
※ ME: Ministry of Environment, MOFA: Ministry of Foreign Affairs, GIR : Greenhouse Gas Inventory & Research Center of Korea, CA: Competent Authorities, DA: Designated Agencies, WG: Working Group, MC: Management Committee

1.2.3 Archiving of Information

The GHG Inventory Reporting System (GIRS) manages all data used for emissions estimation, ensuring the continuity of data collection and archiving for the national GHG inventory. It manages users, submission schedules, emissions/removals sources and basic data(activity data, emissions/removals, and methodologies) and records the history of data submissions and verification conducted by GIR.

The GIR updates the basic data (in Excel format) in accordance with the annually revied MRV guidelines and distributes them through GIRS. The designated agencies register basic data as well as NID and QA/QC reports through the GIRS. After verification by competent authorities, the data is submitted to GIR via the GIRS.

Once final approval is obtained through the Working Group and Management Committee, GIRS generates domestic publication(GIR, KOSTAT) and CRT entry files for the UNFCCC that can be input into the ETF Reporting Tool, the Paris Agreement's ETF reporting platform.[14)]



[Figure Ⅰ-2] Information Management System for National GHG Inventory

14) The function for ETF Reporting Tool input data generation is currently under trial operation.

1.3 Methodologies and Data Sources

1.3.1 Methodology

The national GHG inventory in the report applies the methodologies of the 2006 IPCC Guidelines in accordance with the paragraphs 17 and 20 of the MPGs. For certain sub-sector where detailed activity data are available and updated emission/removal factors from the 2019 Refinement are applicable, the methodologies from the 2019 Refinement were used. These include the emission factors for fugitive CH_4 from underground abandoned mines in the energy sector, and CO_2 estimation of the carbon stock in harvested wood products (HWP) in the LULUCF sector.

1.3.2 Data Sources

The sources of activity data used in national GHG inventory include national statistics, published by statistics agencies[15] designated under the *Statistics Act*, internal data from Statistics Korea, data provided by relevant associations, and performance reports from compliance entities under the GHG Target Management System (TMS) and ETS. When using national statistics as activity data, such as the designated agencies' own surveys, Clean Development Mechanism (CDM) reports, and electronic disclosure project reports, internal QA/QC procedures are strengthened to enhance and secure data accuracy of the national inventories by verifying the original sources of the data (see Chapter Ⅰ, Section 1.4 for QA/QC and Verification).

15) The ROK designates statistics agencies through a specific procedure based on Article 15 of the *Statistics Act*, to promote the production, dissemination, and use of statistics. These agencies are tasked with compiling numerical information used for government policy development and evaluation, as well as for research and analysis of economic and social phenomena.

<Table Ⅰ-3> Summary of Data Sources

Sector	Data and Statistics	Statistics Agency
Energy	Yearbook of Energy Statistics	Korea Energy Economics Institute
	Oil Supply Statistics	Korea National Petroleum Corporation
	Energy Census	Ministry of Trade and Industry
	Aviation fuel consumption	Korea Transportation Safety Authority
	Number of takeoffs and landings per aircraft type	Korea Transportation Safety Authority
	Urea water sales	Ministry of Environment Transportation Environment Department
	Lubricants Industry Resources	Korea Lubricant Industry Association
	Ship LNG supply	LNG suppliers
	Number of mines closed by year	Korea National Mining Corporation
IPPU	Glass production - shipments - inventory - imports - exports	Korea Energy Agency
	Import and export statistics	Customs and Excise Department
	Performance report from compliance entities from TMS and ETS	Ministry of Environment
	Survey on some activities in the mineral and chemical industry, etc.	Korea Energy Agency
	Clinker Production	Korea Cement Association
	Lime production	Korea Limestone Processing Cooperative
	Bottle Glass Production	Korea Glass Industry Cooperative
	Limestone, dolomite consumption	Korea Iron & Steel Association
	Aluminium production	Korea Association of Nonferrous Metals
	Lubricants and greases produced/imported/exported	Korea Lubricant Industry Association
	Gas consumption, etc.	Korea Semiconductor Industry Association
	Gas consumption, etc.	Korea Display Industry Association
	Pharmaceutical manufacturing import performance	Food and Drug Administration
	Petrochemicals	Korea Petrochemical Association
	Electronic Disclosure Business Report	Financial Conduct Authority
	CDM Reports	UNFCCC
	Yearbook of Energy Statistics	Energy Economics Institute

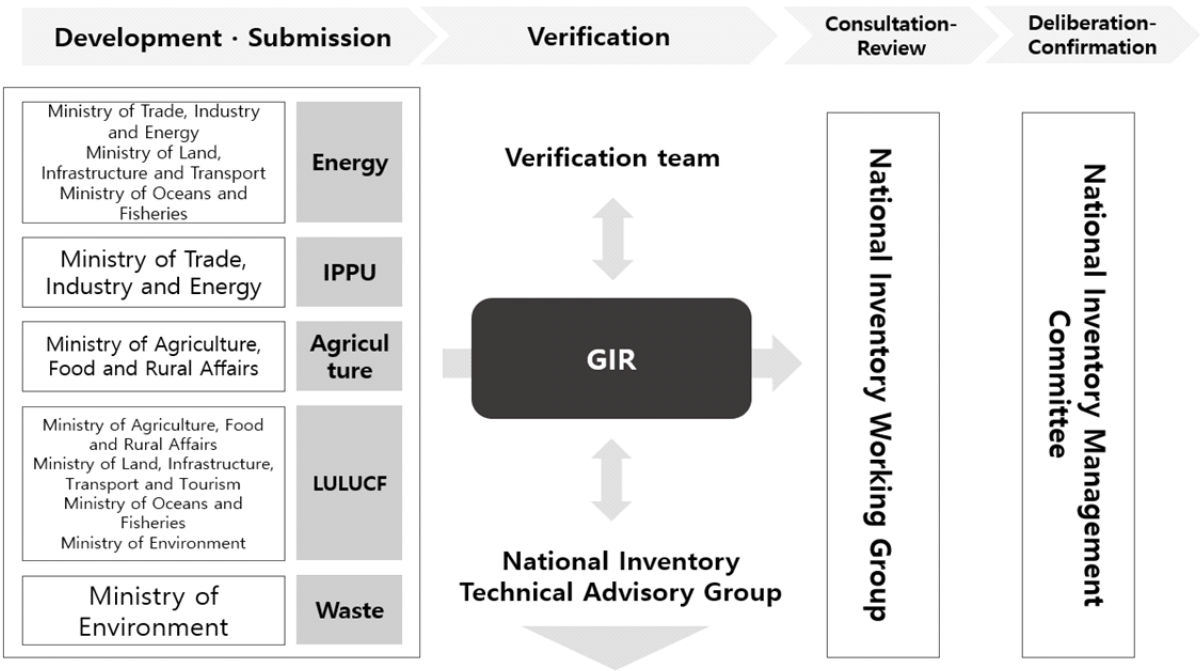
Sector	Data and Statistics	Statistics Agency
Agriculture	Livestock Trends Survey	Statistics Korea
	Annals of Agricultural and Livestock Statistics	Ministry of Agriculture, Food and Rural Affairs/Statistical Office
	Agriculture and Fisheries Survey	Statistics Korea
	Agricultural Area Survey	Statistics Korea
	Census of Agriculture and Fisheries	Statistics Korea
	Crop Production Survey	Statistics Korea
	Agricultural Production Cost Survey	Statistics Korea
	Fertiliser Business Statistics Cradle	Nonghyup Economic Holdings
	Federal Statistics Records	Korea Fertiliser Association
LULUCF	Statistical Yearbook of Forestry	Korea Forest Service
	Forest Basic Statistics	Korea Forest Service
	Market Survey of Timber Products	Korea Forest Service
	Agricultural Area Survey	Statistics Korea
	Current status and future development of orchard cultivation (1992)	Rural Development Administration
	Soil Classification and Explanation of Korea (2011)	Rural Development Administration
	Cadastral statistics	Ministry of Land, Infrastructure and Transport
	Number of freezing days	Korea Meteorological Administration
	National Blue Carbon Information System (K-BIS)	Ministry of Oceans and Fisheries
Waste	Status of Waste Generation and Treatment	Ministry of Environment
	Survey on Waste Materials	Ministry of Environment
	Statistics of Sewerage	Ministry of Environment
	Generation and treatment of industrial wastewater	Ministry of Environment
	Yearbook of Metropolitan Landfill	Sudokowon Landfill Site Management Corporation
	BOD-COD loadings by industry	National Institute of Environmental Research

1.3.3 Country-Specific Emission and Removal Factors (CS EF/RFs)

To improve accuracy and robustness of national GHG inventories, the government establishes the Master Plan, which includes a national plan for developing CS EF/RFs. The GIR also establishes the *Guidelines for Developing and Verifying National Greenhouse Gas Emission and Removal Factors* (CS EF/RFs Guidelines) to systematically develop, verify, and manage the ROK's CS EF/RFs.

In accordance with the CS EF/RFs Guidelines, the competent authorities develop factors that reflect the characteristics of emission by sources and removal by sinks considering domestic circumstances. The calculation methods used for CS EF/RFs development include methodologies presented by the IPCC, methodologies in line with the MRV guidelines for ETS and TMS, and academically recognized methodologies (such as those published in SCI(E)-indexed journals).

The CS EF/RFs developed by the designated agencies are verified by the GIR, and finalized and published after consultation and review by the Working Group and deliberation by the Management Committee. The finalized national emission and removal factors are ultimately incorporated into revisions of the MRV guidelines and used as the basic data for national inventories.



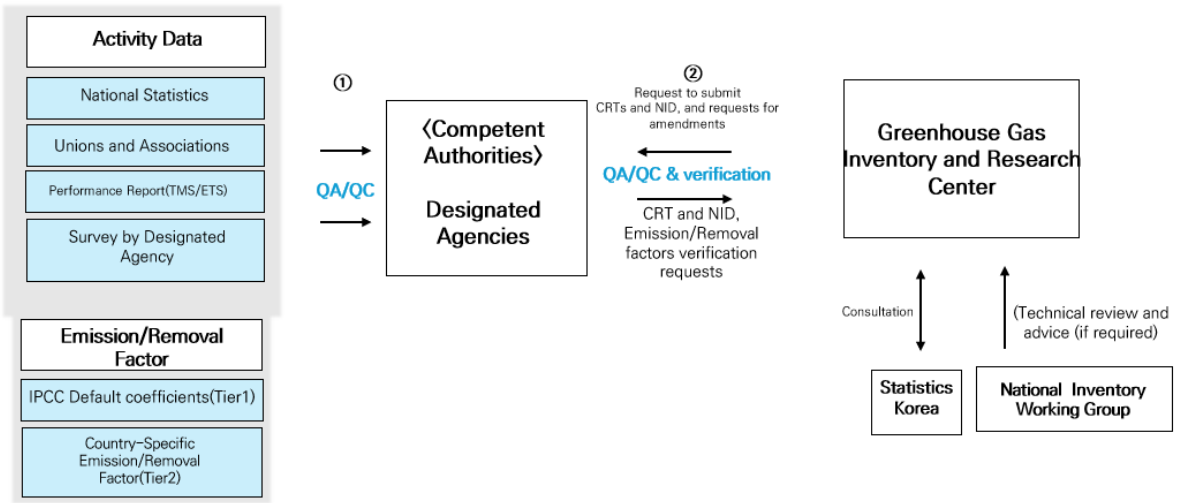
[Figure Ⅰ-3] Process for the Development of National GHG Emission and Removal Factors (CS EF/RFs)

1.4 Quality Assurance, Quality Control (QA/QC) and Verification

1.4.1 Procedure of QA/QC and Verification

To ensure and enhance the transparency, accuracy, consistency, completeness, and comparability of the national GHG inventory, the ROK implements QA/QC procedures in accordance with the 2006 IPCC Guidelines.

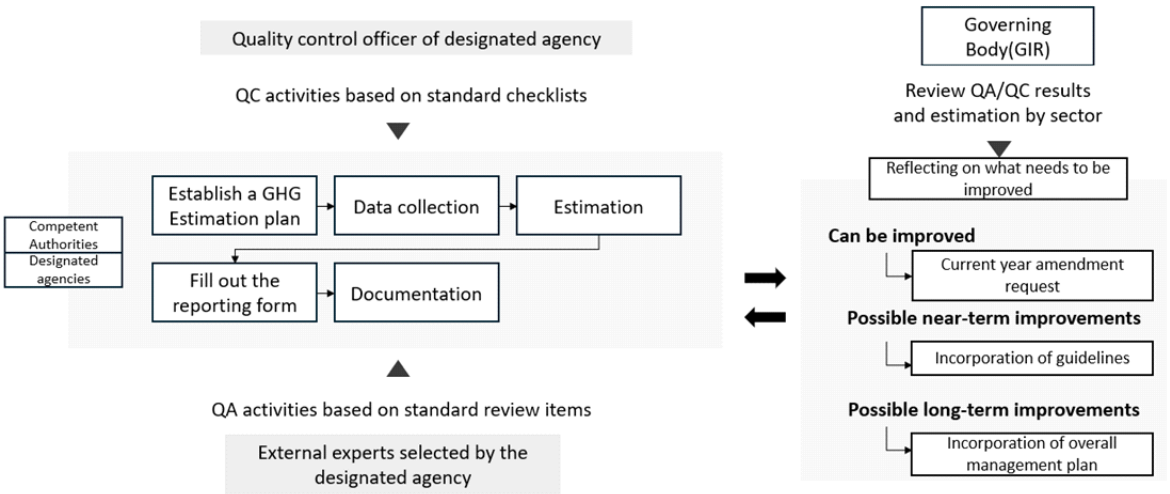
The competent authorities and designated agencies carry out their own QC activities at all stages of estimating and reporting GHG emissions and removals for their respective sectors. They undergo verification by external experts who are not involved in inventory preparation to review the appropriateness of activity data, the compliance of guided emission/removal factors and estimation formulas, and the time series consistency of activity data and emission/removal estimates.



[Figure Ⅰ-4] Framework for QA/QC and Verification in National GHG Inventory

The competent authorities, designated agencies, and external experts conduct QA/QC activities according to standardized criteria. It is divided into common criteria applicable to all sectors and sector-specific criteria. The common QC criteria include elements that need to be routinely reviewed during the planning, estimation, and reporting processes of sectoral inventory estimation, while the common QA criteria consist of technical elements that must be checked to ensure the accuracy of emission estimates, such as activity data, emission/removal factors, and methodologies. Sector-specific QA and QC criteria include specific checklists needed for estimating the inventory of each sub-sector.

The competent authorities and designated agencies report the results of their independently performed QA/QC activities to the GIR. The GIR reviews the QA/QC reports and the sectoral emissions and removals submitted, verifying the accuracy of the emissions estimates to improve the quality of the national inventory. Furthermore, among the areas of improvement identified during QA/QC procedures and verification, those that can be addressed immediately are implemented in the current year, those that can be improved in the short term are reflected in the following year's MRV guidelines, and those requiring long-term improvement are incorporated into the five-year rolling *Master Plan*. This process ensures continuous improvement in the quality of the national GHG inventory.



[Figure Ⅰ-5] QA/QC and Verification Procedure

To ensure the accuracy of the national inventory, all activity data, emission/removal factors, and emission/removal estimates must undergo the QA/QC and verification procedures mentioned above. In particular, for national statistics under the *Statistics Act* and CS EF/RFs, more detailed QA/QC and verification procedures are implemented to further enhance the accuracy of the inventory. More detailed information is as follows.

1.4.2 QA/QC of National Statistics

A significant portion of the activity data used for estimating the national GHG inventory is from national statistics. National statistics refer to data that has been approved by, or has undergone consultation with, the Commissioner of Statistics Korea Pursuant to Articles 18 or 20 of the *Statistics Act*. Statistics agencies are required to consult with the Commissioner and obtain approval when creating new statistics or when making modifications to or discontinuing existing statistics.

Statistics Korea systematically manages the quality of national statistics through three types of evaluations and consultations. Regular assessments are conducted on key statistics identified in the *five-year National Statistical Quality Management Plan*. A team of experts is selected to perform basic assessments based on statistical information reports submitted by statistics agencies, along with in-depth and specialized evaluations (e.g., data collection systems, questionnaire design, sampling design) to assess the quality of the statistics. *Ad hoc* assessment are conducted following the regular evaluation process for statistics where quality issues have been identified, with additional detailed assessments addressing specific statistical concerns. Self-assessment promote internal quality improvement by encouraging statistics agencies to evaluate their own statistics through responses to questionnaires and checks of quality-related matters. Consultation and technical assistance for quality improvement are provided upon request from statistics agencies, especially when agencies face challenges in improving quality independently due to limited statistical expertise or budget constraints.

<Table Ⅰ-4> Quality Management System for Official Statistics

	Regular assessment	Ad hoc assessment	Self-assessment	Consulting
Mandate	Article 9, Statistics Act	Article 10, Statistics Act	Article 11, Statistics Act	Article 13, Statistics Act
Scope	Major Statistics[1)]	Statistics subject to improvement[2)]	National Statistics[3)]	Statistics upon request
Interval	5 years	As needed	1 year	As needed
Entity	Statistics Korea	Statistics Korea	Statistics agencies	Statistics Korea

Note: 1) Statistics extensively utilized for the formulation and evaluation of government policies or for the production of other statistical data
2) Statistics for which quality issues have been identified through continuous monitoring (e.g., external critiques by the media) or planned monitoring (e.g., self-diagnosed statistics with low evaluation scores)
3) Excluding subject to regular or ad hoc assessment, statistics of local governments and statistics, and unpublished statistics in the relevant year

1.4.3 QA/QC and Verification for Country-specific Emission/Removal Factors (CS-EF/RFs)

The competent authorities develop CS-EF/RFs for their respective sectors and submit them to the GIR after conducting a self-assessment using a standard verification procedure based on a checklist of indicators. The GIR forms a verification team, comprising both internal and external experts, along with a technical advisory body primarily composed of external experts, to assess the appropriateness, representativeness, and accuracy of the measurement and analysis methods used in the emission/removal factor development submitted by the competent authorities. The verified emission and removal factors are finalized and announced after consultation and review by the Working Group and subsequent deliberation by the Management Committee.

The GIR considers six major verification criteria and fourteen verification elements during the development and verification process of emission/removal factors. The methodology and representativeness of the factors are verified by confirming whether appropriate methodologies, as outlined by the IPCC, were used in their development, and whether sample target groups were selected appropriately, considering factors such as emission/removal ratios and production ratios. The accuracy of measurement and analysis is confirmed by verifying whether the selected methodologies account for emission/removal characteristics, and whether extreme values or missing values in raw data were appropriately addressed. The validation of factors through QA/QC procedures, as well as uncertainty assessments, is also a critical element reviewed during the factor development and verification process. Following these verifications, the factors are discussed in the *Working Group* with input from relevant ministries, and are then deliberated and finalized by the Management Committee. The finalized CS EF/RFs are ultimately incorporated into the revision of MRV guidelines, serving as fundamental data for national GHG inventory.

<Table Ⅰ-5> Verification Criteria for National GHG Emission/Removal Factors

Criteria	Elements
Methodology	① Consistency with national and international (IPCC) emission/removal estimation guidelines
	② Appropriateness of methodology for developing emission/removal factors
	③ Consideration of emission/removal characteristics
Representativeness	④ Appropriateness of sample target group
	⑤ Adequacy of sample size
Accuracy	⑥ Appropriateness of measurement/analysis type and methodology
	⑦ Reliability of measurement/analysis entities
	⑧ Reliability of measurement/analysis tools
Data Management	⑨ Appropriateness of data management
	⑩ Consistency of time ranges between factor development data
QA / QC	⑪ Adequacy of QA/QC activities
	⑫ Factor equivalence evaluation
Uncertainty assessment	⑬ Appropriateness of uncertainty estimation methods
	⑭ Uncertainty assessment

Source: Guidelines for Development, Verification, and Management of Greenhouse Gas Emission and Removal Factors (GIR, 2020)

1.5 Metrics

The contribution of each GHG to global warming varies depending on factors such as how long it stays in the atmosphere and how much heat it absorbs. To compare and evaluate the emissions of different GHGs, the international community uses the carbon dioxide equivalent (CO_2-eq).[16] The CO_2-eq is calculated using the GWP of each greenhouse gas. The GWP values are applied based on the IPCC assessment reports. The first BTR uses the 100-year GWP values presented in the IPCC Fifth Assessment Report, in accordance with paragraph 37 of the MPGs.

<Table Ⅰ-6> Global Warming Potential

Gas	Chemical formula	GWP100
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Hydrofluorocarbons		
HFC-23	CHF_3	12,400
HFC-32	CH_2F_2	677
HFC-41	CH_3F	116
HFC-125	CHF_2CF_3	3,170
HFC-134	CHF_2CHF_2	1,120
HFC-134a	CH_2FCF_3	1,300
HFC-143	CH_2FCHF_2	328
HFC-143a	CH_3CF_3	4,800
HFC-152	CH_2FCH_2F	16
HFC-152a	CH_3CHF_2	138
HFC-161	CH_3CH_2F	4

16) In the IPCC Fifth Assessment Report, the GWP of CO_2 is 1, while that of CH_4 is 28. This means that for the same amount of CO_2 and CH_4, CH_4 contributes 28 times more to global warming than carbon dioxide. Therefore, 1 tonne of CH_4 can be converted to 28 tCO_2-eq.

Gas	Chemical formula	GWP100
HFC-227ea	CF_3CHFCF_3	3,350
HFC-236cb	$CH_2FCF_2CF_3$	1,210
HFC-236ea	CHF_2CHFCF_3	1,330
HFC-236fa	$CF_3CH_2CF_3$	8,060
HFC-245ca	$CH_2FCF_2CHF_2$	716
HFC-245fa	$CHF_2CH_2CF_3$	858
HFC-365mfc	$CH_3CF_2CH_2CF3$	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	1,650
Perfluorocarbons(PFCs)		
PFC-14	CF_4	6,630
PFC-116	C_2F_6	11,100
PFC-218	C_3F_8	8,900
PFC-318	$c\text{-}C_4F_8$	9,540
PFC-31-10	C_4F_{10}	9,200
PFC-41-12	C_5F_{12}	8,550
PFC-51-14	C_6F_{14}	7,910
PCF-91-18	$C_{10}F_{18}$	7,190
Trifluoromethyl sulfur pentafluoride	SF_5CF_3	17,400
Perfluorocyclopropane	$c\text{-}C_3F_6$	9,200
Sulfur hexafluoride	SF_6	23,500
Nitrogen trifluoride	NF_3	16,100

2. Trends in National GHG Inventory

2.1 Trends in National GHG Emissions and Removals

1) Introduction

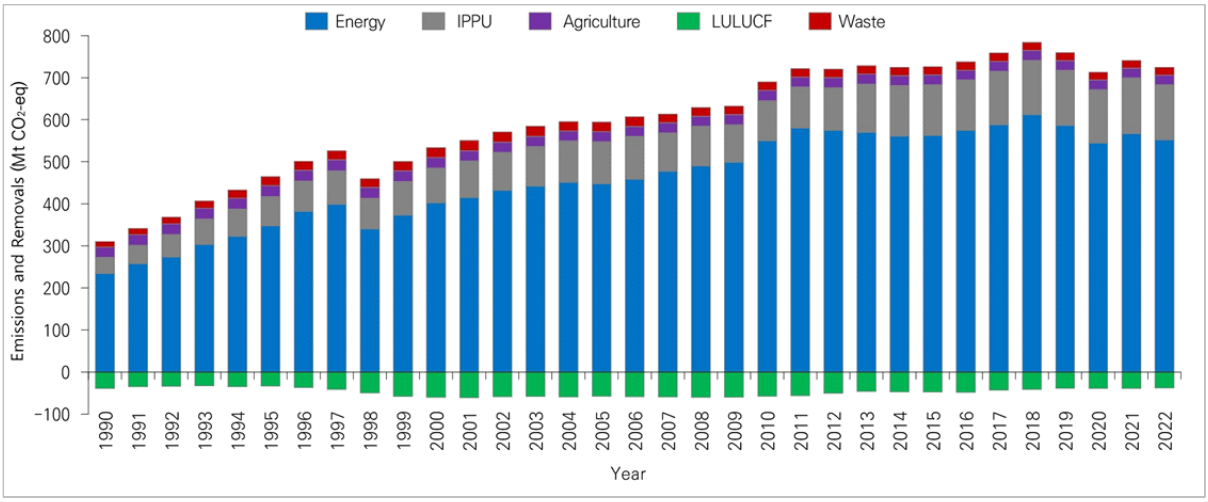
The ROK's total GHG emissions in 2022 (excluding LULUCF)[17] were 724.3 $MtCO_2$-eq, representing a 133.2% (413.7 $MtCO_2$-eq) increase from 310.6 $MtCO_2$-eq in 1990, a 2.3% (16.7 $MtCO_2$-eq) decrease from 741.0 $MtCO_2$-eq in 2021, and a 7.6% (59.6 $MtCO_2$-eq) decrease from the emission peak in 2018.

The net GHG emissions in 2022 (including LULUCF)[18] were 686.5 $MtCO_2$-eq, showing a 152.7% (414.8 $MtCO_2$-eq) increase from 271.6 $MtCO_2$-eq in 1990, a 2.2% (15.5 $MtCO_2$-eq) decrease from 702.0 $MtCO_2$-eq in 2021, and a 7.5% (55.8 $MtCO_2$-eq) decrease from 742.3 $MtCO_2$-eq in 2018.

National total emissions generally followed an increasing trend during the 1990s due to economic growth. However, the rate of increase gradually slowed after the 2000s, and emissions began to decline after reaching their peak in 2018. There were temporary sharp decreases in emissions due to the 1998 financial crisis, the 2008 economic recession, and COVID-19 pandemic in 2020. In 1998, GHG emissions decreased by 12.5% compared to the previous year due to the financial crisis, followed by an increasing trend with an average annual growth rate of 2.6% from 1999 to 2008. However, in 2009, the year-on-year increase was limited to 0.6% due to the economic recession. In 2020, emissions decreased by 6.1% compared to the previous year as a result of the COVID-19 pandemic.

By sector, energy accounted for the largest share of total emissions in 2022 at 76.2%, followed by IPPU at 18.1%, agriculture at 3.2%, and waste at 2.5%. Notably, due to the manufacturing-centered industrial structure, the energy sector has consistently maintained a share of 74–80% since 1990.

17) Total emissions are the sum of emissions from the energy, IPPU, agriculture, and waste sectors, excluding the LULUCF sector. For the analysis of the country's total emissions share, and growth rate in this report, total emissions excluding the LULUCF sector are used.
18) Net emissions are the sum of emissions from all sectors (energy, IPPU, agriculture, waste, and LULUCF), including both emission sources and carbon sinks in the LULUCF sector.



[Figure Ⅰ-6] GHG Emissions and Removals by Sector (1990-2022)

<Table Ⅰ-7> GHG Emissions and Change Rate by Sector

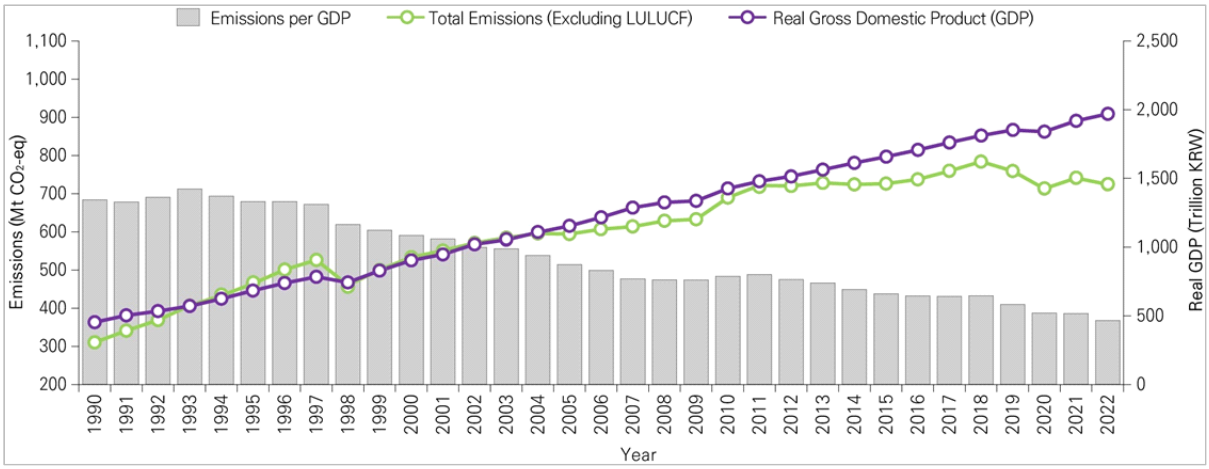
(Unit: $MtCO_2$-eq)

Sector		1990	2000	2010	2018	2020	2021	2022	Change Rate(%)	
									Compare with 1990	Compared to previous year
Energy	Emission	234.5	402.2	550.3	612.1	544.6	566.8	551.9	135.4	-2.6
	Share(%)	75.5	75.4	79.8	78.1	76.4	76.5	76.2		
IPPU	Emission	37.8	83.1	95.0	128.9	126.8	132.8	131.3	247.3	-1.1
	Share(%)	12.2	15.6	13.8	16.4	17.8	17.9	18.1		
Agriculture	Emission	24.9	24.7	24.7	23.5	23.1	23.1	23.0	-7.7	-0.5
	Share(%)	8.0	4.6	3.6	3.0	3.2	3.1	3.2		
LULUCF	Emission	-39.0	-60.4	-57.4	-41.6	-38.8	-39.0	-37.8	-2.9	-3.0
Waste	Emission	13.4	23.4	19.7	19.4	18.5	18.3	18.2	35.3	-0.8
	Share(%)	4.3	4.4	2.9	2.5	2.6	2.5	2.5		
Total Emissions (excluding LULUCF)	Emission	310.6	533.5	689.8	783.9	713.0	741.0	724.3	133.2	-2.3
	Share(%)	100	100	100	100	100	100	100		
Net Emissions (including LULUCF)	Emission	271.6	473.1	632.4	742.3	674.1	702.0	686.5	152.7	-2.2

2) Total GHG Emissions per Unit of Real Gross Domestic Product (GDP)

The GHG emissions intensity (emissions per unit GDP) in 2022 was 367.9 tCO_2-eq/billion won, showing a 46.2% decrease from 683.9 tCO_2-eq/billion won in 1990, and a 4.7% decrease from 386.2 tCO_2-eq/billion won in 2021.

The ROK's GHG emissions intensity has shown a gradual declining trend, and after reaching peak emissions in 2018, a decoupling[19] phenomenon emerged where GDP increased while emissions decreased. In the 1990s, both GDP growth rate and total GHG emissions growth rate showed similar increases of 5-10%. Beginning in the 2000s, weak decoupling started to appear as the emissions growth rate (2000-2009 annual average growth rate of 1.9%) became lower than the GDP growth rate (2000-2009 annual average growth rate of 4.4%). After 2010, as the average annual economic growth rate settled into the 2-3% range (2010-2017), the average annual growth rate of total emissions slowed to 1.4%. Absolute decoupling was achieved after 2018, when the total emissions growth rate became negative (-3.1%). However, phenomena of simultaneous sharp increases in both GDP and emissions were observed temporarily during recovery periods following the 1998 financial crisis (1998-1999), the 2008 economic recession (2010-2011), and the COVID-19 pandemic (2020-2021).



[Figure Ⅰ-7] Total GHG Emissions per Real Gross Domestic Product (1990-2022)

<Table Ⅰ-8> Total GHG Emissions per Real Gross Domestic Product

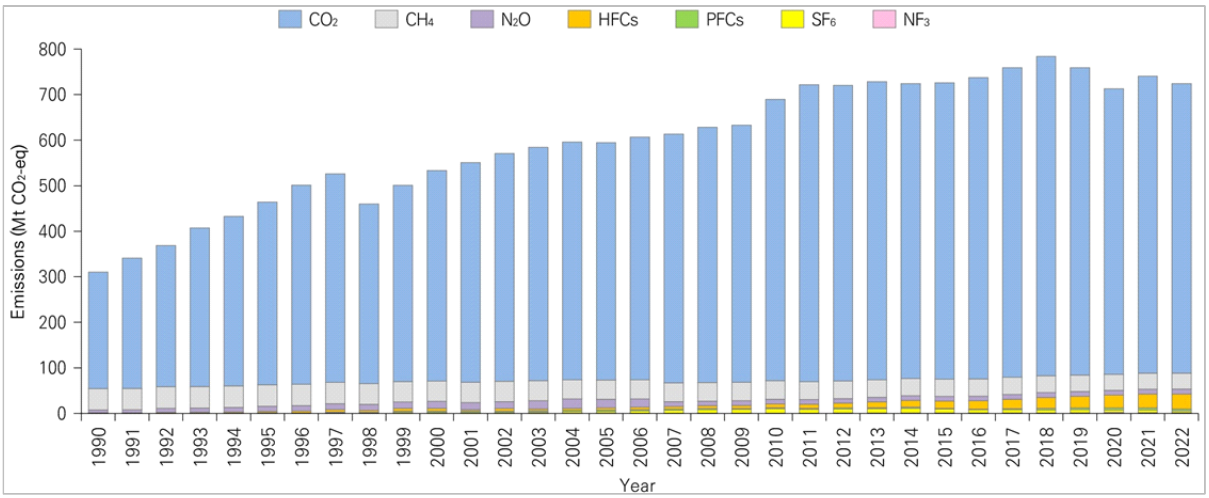
	1990	2000	2010	2018	2020	2021	2022
Total Emissions ($MtCO_2$-eq)	310.6	533.5	689.8	783.9	713.0	741.0	724.3
GDP(Trillion KRW)*	454	904	1,427	1,812	1,840	1,919	1,969
Total Emission per GDP (tCO_2-eq/1 Billion KRW)	683.9	590.4	483.5	432.6	387.6	386.2	367.9

Source: National Accounts, GDP and GNI by Economic Activity (Real, 2015 Basis) (Bank of Korea, 2023)

19) GHG decoupling refers to the phenomenon where the paths of GHG emissions and economic growth become separated.

2.2 Trends in GHG Emissions and Removals

Among GHGs, CO_2 accounts for the largest share at 87.8% of total emissions in 2022, followed by fluorinated gases at 5.9% (HFCs 4.5%, PFCs 0.56%, SF_6 0.55%, NF_3 0.2%), CH_4 at 4.9%, and N_2O at 1.5%.



[Figure Ⅰ-8] GHG Emissions by Gas (1990-2022)

<Table Ⅰ-9> GHG Emissions and Change Rate by Gas

(Unit: $MtCO_2$-eq)

GHG		1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
									Compared to 1990	Compared to previous year
CO_2	Emission	256.2	462.6	618.0	701.1	626.7	652.5	635.8	148.2	-2.6
	Share(%)	82.5	86.7	89.6	89.4	87.9	88.1	87.8		
CH_4	Emission	46.8	44.6	40.6	37.2	35.6	35.3	35.2	-24.9	-0.5
	Share(%)	15.1	8.4	5.9	4.7	5.0	4.8	4.9		
N_2O	Emission	6.3	14.9	10.6	10.9	10.7	10.8	10.7	68.9	-0.9
	Share(%)	2.0	2.8	1.5	1.4	1.5	1.5	1.5		
HFCs	Emission	1.0	6.0	7.6	23.6	27.9	30.3	32.9	3,062.5	8.8
	Share(%)	0.3	1.1	1.1	3.0	3.9	4.1	4.5		
PFCs	Emission	-	2.5	2.5	3.9	4.5	4.7	4.1	116.6[1)]	-14.4
	Share(%)	-	0.5	0.4	0.5	0.6	0.6	0.6		
SF_6	Emission	0.2	2.8	10.0	6.3	5.4	5.5	4.0	2,243.3	-28.4
	Share(%)	0.1	0.5	1.4	0.8	0.8	0.7	0.5		
NF_3	Emission	-	-	0.4	1.0	2.1	1.8	1.7	359.7[2)]	-7.7
	Share(%)	-	-	0.1	0.1	0.3	0.2	0.2		
Total Emission (excluding LULUCF)		310.6	534.0	689.8	783.9	713.0	741.0	724.3	133.2	-2.3
p%		100	100	100	100	100	100	100		

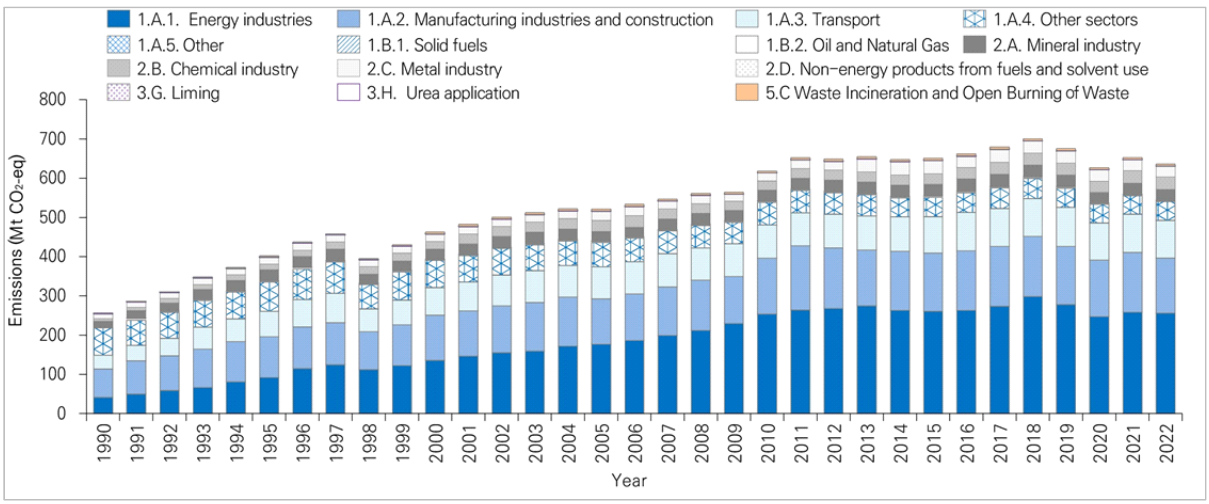
Note: 1) The growth rate for PFCs is calculated based on the year 1997, when the first inventory were estimated.
2) The growth rate for NF3 is calculated based on the year 2008, when the first inventory were estimated.

While GHG including CO_2 show an overall increasing trend, CH_4 emissions have consistently decreased since 1990 due to reduced coal production in the energy sector and decreased rice cultivation area in the agriculture sector. Fluorinated gases show particularly high growth rates in 2022 compared to 1990, primarily due to increased use of HFCs as refrigerants in refrigeration and air conditioning equipment, and increased use of PFCs, SF_6, and NF_3 in semiconductor and display manufacturing processes.

1) Carbon Dioxide (CO_2)

Total CO_2 emissions in 2022 (excluding LULUCF) were 635.8 $MtCO_2$-eq, accounting for 87.8% of total national GHG emissions. This represents a 148.2% increase compared to 256.2 $MtCO_2$-eq in 1990, and a 2.6% decrease compared to 652.5 $MtCO_2$-eq in 2021. The net CO_2 emissions in 2022, including the LULUCF sector, were 597.4 $MtCO_2$-eq showing an increase of 175.5% compared to 1990 and decrease of 2.6% compared to 613.1 $MtCO_2$-eq in 2021.

2022 CO_2 emission (excluding LULUCF) was highest in the energy sector at 85.5%, followed by IPPU sector at 13.9%, waste sector at 0.7%, and agriculture sector at 0.01%.



[Figure Ⅰ-9] CO_2 Emissions and Removal by Sector (1990-2022)

<Table Ⅰ-10> CO_2 Emissions and Removals by Sector

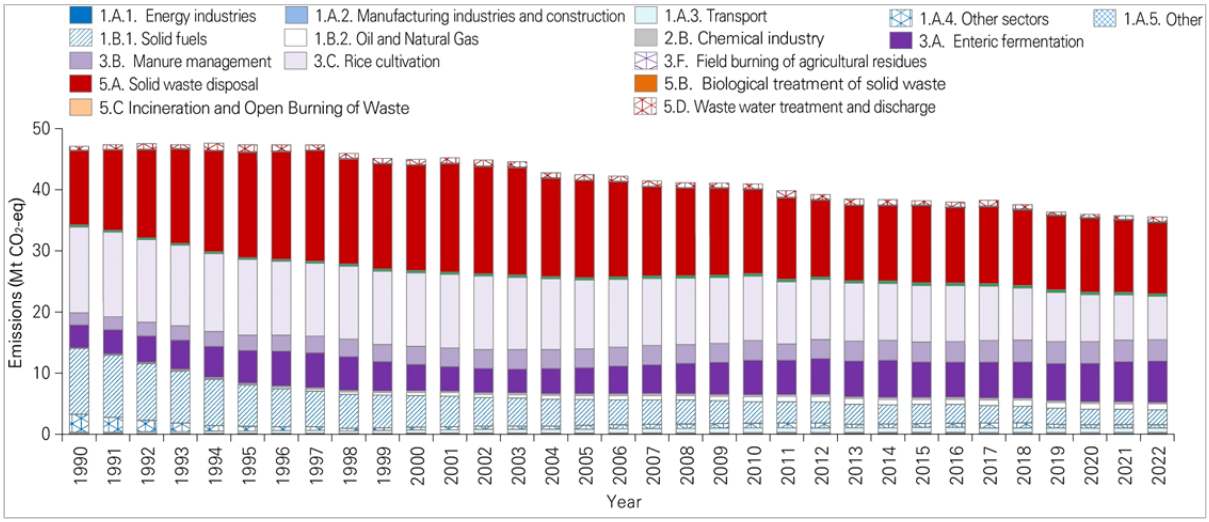
(Unit: $MtCO_2$-eq)

Sector		1990	2000	2010	2018	2020	2021	2022
1. Energy	1.A.1. Energy industries	41.9	135.8	253.7	298.5	247.0	258.7	256.2
	1.A.2. Manufacturing industries and construction	71.9	115.0	142.2	152.8	144.2	152.2	140.3
	1.A.3. Transport	35.6	70.1	84.5	96.4	94.4	97.1	96.1
	1.A.4. Other sectors	69.3	69.7	57.9	52.0	47.5	47.2	47.7
	1.A.5. Other	0.2	2.4	3.0	3.1	2.9	2.9	3.0
	1.B.1. Solid fuels	0.19	0.05	0.02	0.01	0.01	0.01	0.01
	1.B.2. Oil and Natural Gas	<0.001	<0.001	0.027	0.016	0.010	0.004	0.002
2. IPPU	2.A. Mineral industry	16.4	26.1	28.3	30.5	28.0	29.0	28.4
	2.B. Chemical industry	6.3	20.1	23.6	30.6	28.4	32.1	31.3
	2.C. Metal industry	13.1	18.5	20.3	31.6	29.1	28.0	27.8
	2.D. Non-energy products from fuels and solvent use	0.36	0.51	0.55	0.60	0.55	0.57	0.61
3. Agriculture	3.G. Liming	0.003	0.003	0.003	0.003	0.003	0.002	0.002
	3.H. Urea application	0.43	0.28	0.12	0.12	0.11	0.11	0.09
5. Waste	5.C. Incineration and open burning of waste	0.5	4.2	3.8	4.8	4.5	4.5	4.3
Total CO_2 emissions (excluding LULUCF)		256.2	462.6	618.0	701.1	626.7	652.5	635.8

2) Methane (CH_4)

Total CH_4 emissions in 2022 (excluding LULUCF) were 35.2 $MtCO_2$-eq accounting for 4.9% of total national GHG emissions (excluding LULUCF). This represents a 24.9% decrease compared to 46.8 $MtCO_2$-eq in 1990, and a 0.5% decrease compared to the previous year (35.3 $MtCO_2$-eq). CH_4 emissions have shown a continuous decreasing trend due to reduced rice cultivation area and decreased waste landfilling.

CH_4 emissions in 2022 (excluding LULUCF) was highest in the agriculture sector at 49.4%, followed by the waste sector at 35.7%, energy sector at 14.1%, and IPPU sector at 0.7%.



[Figure Ⅰ-10] CH_4 Emissions by Sector (1990-2022)

<Table Ⅰ-11> CH_4 Emissions by Sector

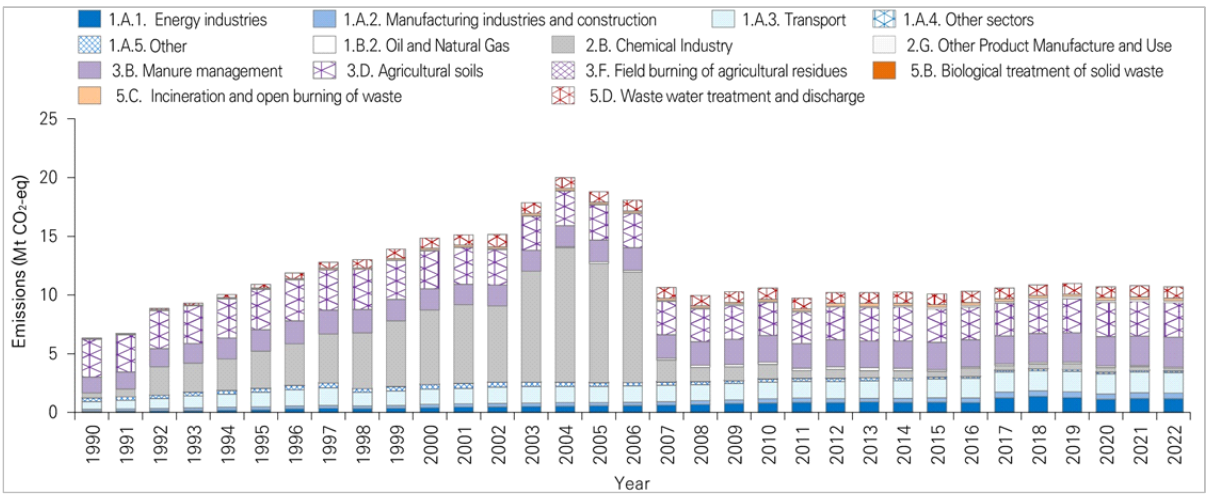
(Unit: $MtCO_2$-eq)

Sector		1990	2000	2010	2018	2020	2021	2022
1. Energy	1.A.1. Energy industries	0.03	0.06	0.10	0.07	0.07	0.08	0.09
	1.A.2. Manufacturing industries and construction	0.08	0.15	0.20	0.23	0.22	0.24	0.23
	1.A.3. Transport	0.20	0.51	0.76	0.72	0.67	0.68	0.68
	1.A.4. Other sectors	2.98	0.43	0.73	0.84	0.60	0.59	0.57
	1.A.5. Other	<0.001	0.009	0.011	0.012	0.011	0.011	0.011
	1.B.1. Solid fuels	10.7	5.2	3.5	2.7	2.6	2.5	2.4
	1.B.2. Oil and Natural Gas	0.1	0.5	0.8	1.0	0.9	0.9	1.0
2. IPPU	2.B. Chemical Industry	0.05	0.28	0.31	0.35	0.29	0.32	0.25
3. Agriculture	3.A. Enteric fermentation	3.8	4.3	5.6	6.0	6.3	6.6	6.7
	3.B. Manure management	2.0	2.9	3.2	3.5	3.5	3.5	3.5
	3.C. Rice cultivation	14.1	12.0	10.6	8.5	7.7	7.4	7.1
	3.F. Field burning of agricultural residues	0.04	0.05	0.04	0.03	0.03	0.03	0.02
5. Waste	5.A. Solid waste disposal	12.1	17.3	13.8	12.3	12.0	11.8	11.6
	5.B. Biological treatment of solid waste	-	0.005	0.02	0.11	0.13	0.13	0.11
	5.C. Incineration and open burning of waste	<0.001	0.002	0.002	0.002	0.002	0.002	0.002
	5.D. Waste water treatment and discharge	0.7	0.9	0.9	0.8	0.6	0.6	0.9
Total CH_4 emissions(excluding LULUCF)		46.8	44.6	40.6	37.2	35.6	35.3	35.2

3) Nitrous Oxide (N_2O)

Total N_2O emissions in 2022 (excluding LULUCF) were 10.7 $MtCO_2$-eq, accounting for 1.5% of total national GHG emissions (excluding LULUCF). This represents a 68.9% increase compared to 6.3 $MtCO_2$-eq in 1990, and a 0.9% decrease from 10.8 $MtCO_2$-eq in 2021. Emissions decreased significantly following the implementation of N_2O abatement by destruction in adipic acid and nitric acid production plants in the latter half of 2006.

Total N_2O emissions in 2022 (excluding LULUCF) was highest in the agriculture sector at 51.3%, followed by the energy sector at 33.1%, waste sector at 12.7%, and IPPU sector at 2.8%.



[Figure Ⅰ-11] N_2O Emissions by Sector (1990-2022)

<Table Ⅰ-12> N_2O Emissions by Sector

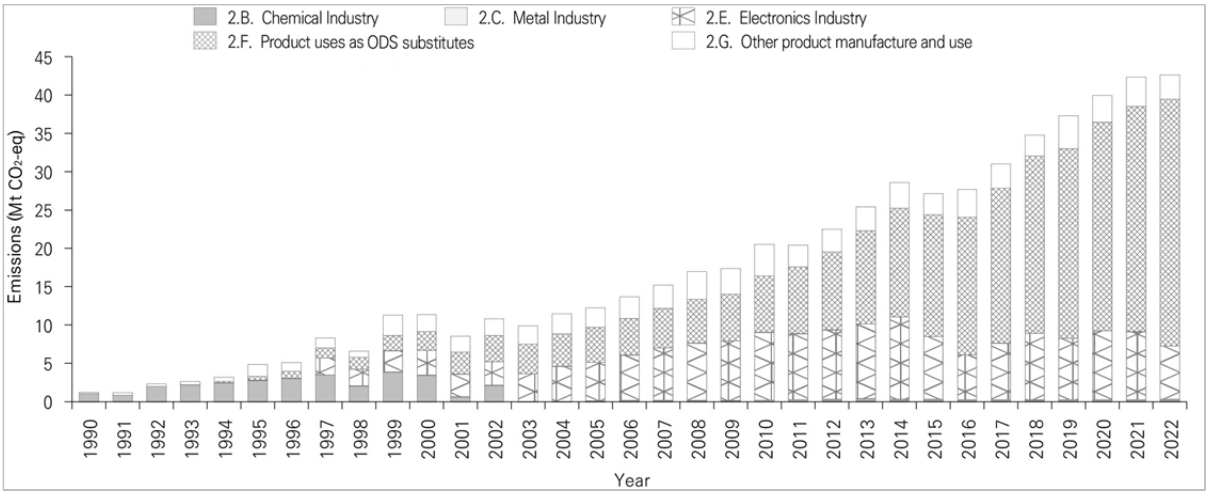
(Unit: $MtCO_2$-eq)

Sector		1990	2000	2010	2018	2020	2021	2022
1. Energy	1.A.1. Energy industries	0.1	0.4	0.8	1.4	1.1	1.2	1.2
	1.A.2. Manufacturing industries and construction	0.2	0.3	0.3	0.5	0.5	0.5	0.5
	1.A.3. Transport	0.6	1.3	1.4	1.7	1.7	1.7	1.7
	1.A.4. Other sectors	0.3	0.4	0.3	0.2	0.2	0.2	0.2
	1.A.5. Other	<0.001	0.005	0.006	0.007	0.006	0.006	0.006
	1.B.2. Oil and Natural Gas	-	-	<0.001	<0.001	<0.001	<0.001	<0.001
2. IPPU	2.B. Chemical Industry	0.4	6.3	1.2	0.4	0.4	0.3	0.2
	2.G. Other Product Manufacture and Use	-	-	0.20	0.13	0.13	0.10	0.10
3. Agriculture	3.B. Manure management	1.3	1.8	2.3	2.4	2.5	2.5	2.6
	3.D. Agricultural soils	3.2	3.3	2.8	2.8	2.9	3.0	2.9
	3.F. Field burning of agricultural residues	0.011	0.012	0.010	0.008	0.008	0.007	0.005
5. Waste	5.B. Biological treatment of solid waste	-	0.03	0.07	0.17	0.16	0.17	0.17
	5.C. Incineration and open burning of waste	0.03	0.16	0.19	0.22	0.23	0.22	0.22
	5.D. Waste water treatment and discharge	0.05	0.88	0.96	0.91	0.93	0.97	0.97
Total N_2O emissions (excluding LULUCF)		6.3	14.9	10.6	10.9	10.7	10.8	10.7

4) Fluorinated Gas (HFCs, PFCs, SF_6, and NF_3)

Fluorinated gas (HFCs, PFCs, SF_6, and NF_3) are emitted entirely from IPPU sector. Total GHG emissions in 2022 (excluding LULUCF) were 42.6 $MtCO_2$-eq, accounting for 5.9% of total national GHG emissions (excluding LULUCF). This represents a 3,420.7% increase compared to 1.2 $MtCO_2$-eq in 1990, and a 0.6% increase from 42.4 $MtCO_2$-eq in 2021.

The share of fluorinated gas in the total emissions of the IPPU sector continuously increased from 3.2% in 1990 to 32.5% in 2022. Accordingly, the share of CO_2 of IPPU sector, which was 95.6% in 1990, decreased to 67.1% in 2022.



[Figure Ⅰ-12] Fluorinated Gas Emissions by Sector (1990-2022)

<Table Ⅰ-13> Fluorinated Gas Emissions by Sector

(Unit: $MtCO_2$-eq)

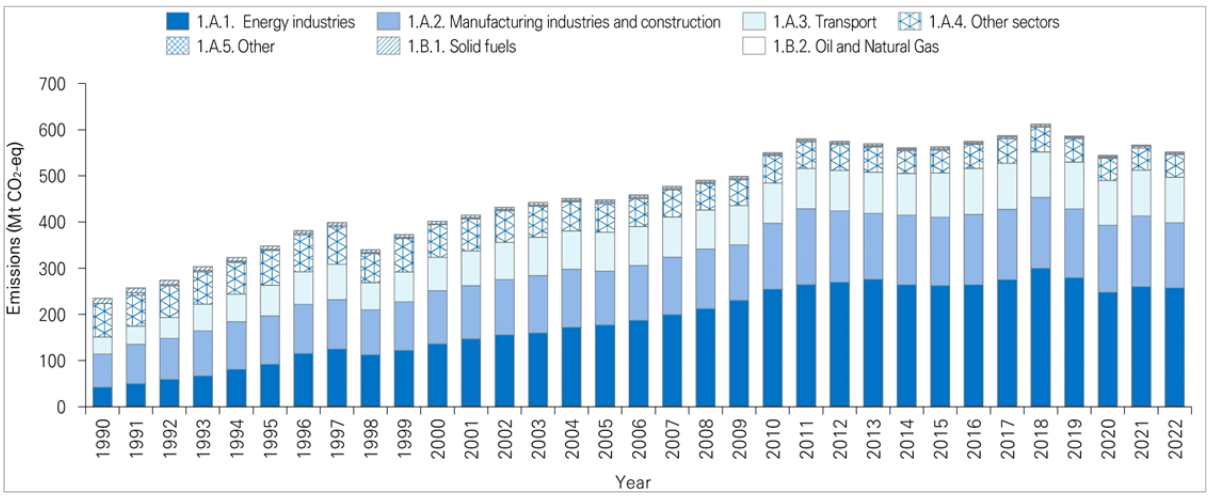
Sector		1990	2000	2010	2018	2020	2021	2022
2.IPPU	2.B. Chemical Industry	1.0	3.4	0.03	0.09	0.09	0.10	0.09
	2.C. Metal Industry	<0.001	0.02	0.10	0.15	0.17	0.15	0.20
	2.E. Electronics Industry	-	3.3	8.9	8.7	9.0	8.9	7.0
	2.F. Product uses as ODS substitutes	-	2.5	7.4	23.1	27.2	29.4	32.2
	2.G. Other Product Manufacture and Use	0.2	2.2	4.1	2.7	3.5	3.8	3.2
Total Fluorinated GHG Emissions		1.2	11.3	20.5	34.8	40.0	42.4	42.6

2.3 Trends in Emissions and Removals by Sector

1) Energy Sector

Total GHG emissions from the energy sector in 2022 were 551.9 $MtCO_2$-eq, accounting for 76.2% of total national emissions. This represents a 135.4% increase compared to 1990 (234.5 $MtCO_2$-eq) and a 2.6% decrease compared to the previous year (566.8 $MtCO_2$-eq).

Emissions in the energy sector steadily increased from 1990 to 1997, but sharply decreased in 1998 due to the economic crisis. Afterward, emissions rebounded until 2011 as the economy recovered. From then, emissions showed a slight decline until 2014, before switching to an upward trend and reaching a peak in 2018. It recovered slightly from the effects of COVID-19 pandemic in 2021, and has subsequently resumed its declining trend.



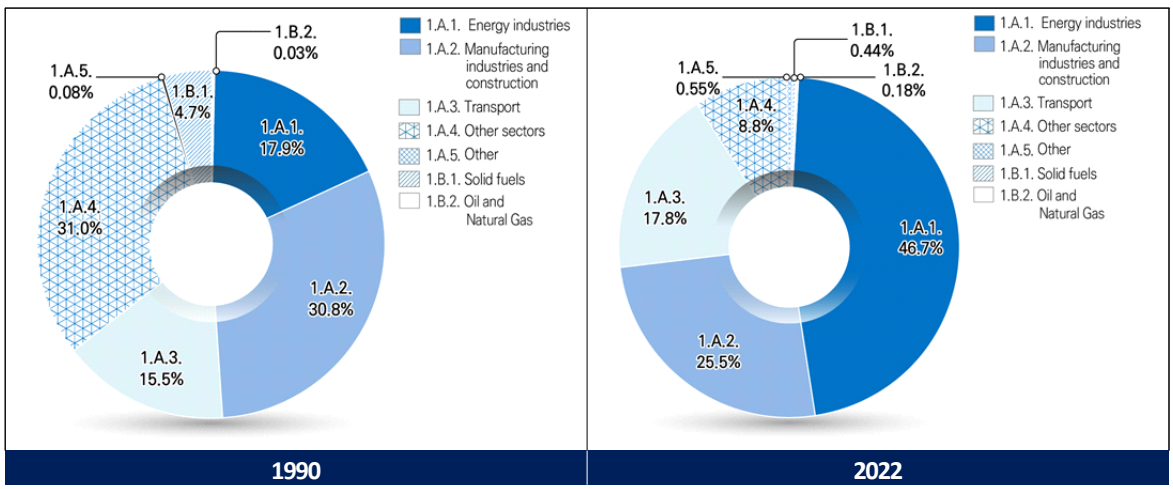
[Figure Ⅰ-13] GHG Emissions from the Energy Sector (1990-2022)

<Table Ⅰ-14> GHG Emissions from the Energy Sector

(Unit: $MtCO_2$-eq)

Category	1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
								Compared to 1990	Compared to previous year
1.A. Fuel Combustion	223.5	396.5	545.9	608.4	541.1	563.4	548.5	145.4	-2.6
1.A.1. Energy Industries	42.0	136.3	254.6	300.0	248.2	260.0	257.5	512.7	-1.0
1.A.2. Manufacturing Industries and Construction	72.2	115.4	142.8	153.5	144.9	152.9	141.0	95.4	-7.8
1.A.3. Transport	36.5	71.9	86.7	98.8	96.8	99.5	98.5	170.2	-1.0
1.A.4. Other Sectors	72.6	70.5	58.9	53.0	48.3	48.0	48.4	-33.3	0.9
1.A.5. Other	0.2	2.4	3.0	3.1	2.9	2.9	3.0	1,561.0	3.3
1.B. Fugitive Emissions from Fuels	11.0	5.7	4.4	3.7	3.5	3.4	3.4	-69.1	-0.5
1.B.1. Solid Fuels	10.9	5.2	3.6	2.7	2.6	2.5	2.4	-77.8	-2.3
1.B.2. Oil and Natural Gas	0.1	0.5	0.9	1.0	0.9	0.9	1.0	1,456.3	4.1
Total Emissions	234.5	402.2	550.3	612.1	544.6	566.8	551.9	135.4	-2.6

In Energy sector, emissions are divided into Fuel combustion and Fugitive Emissions from Fuels. As of 2022, Fuel combustion is accounted for most of energy sector at 99.4% (548.5 $MtCO_2$-eq) and the proportion of Fugitive emissions from fuels is small at 0.6% (3.4 $MtCO_2$-eq). Within the sub-sector, the share of category was: Energy Industries (46.7%), Manufacturing Industries and Construction (25.5%), Transport (17.8%), Other Sectors (8.8%), Other (0.6%), Solid fuels (0.4%), and oil and natural gas (0.2%) of the energy sector emissions.

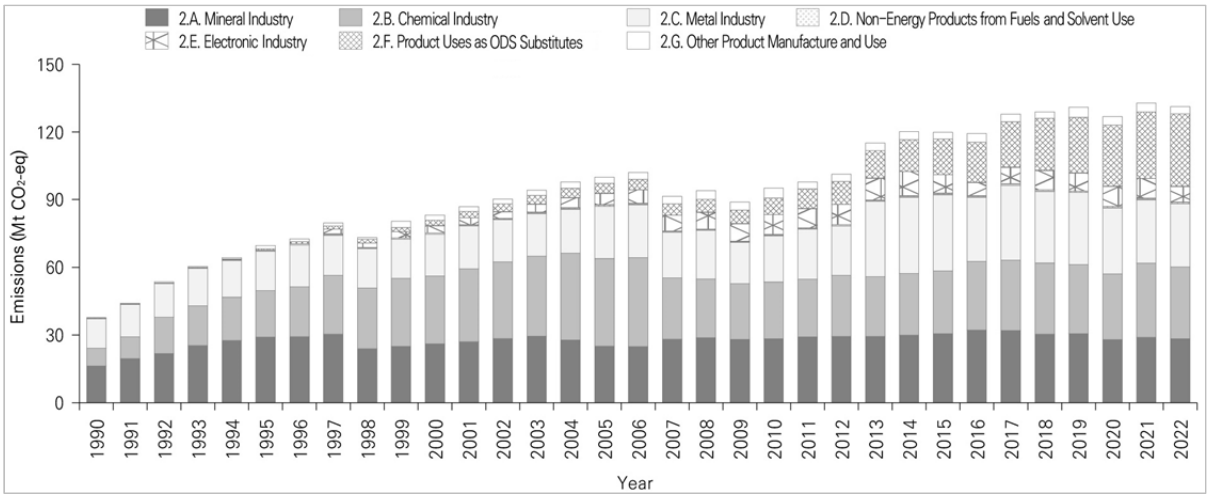


[Figure Ⅰ-14] Proportion by Categories in the Energy Sector

2) IPPU Sector

Total GHG emissions from the IPPU sector in 2022 were 131.3 $MtCO_2$-eq, accounting for 18.1% of total national emissions. In 2022, the total GHG emissions from the IPPU sector increased by 247.3% compared to 1990, and decreased by 1.1% compared to the previous year.

As of 2022, most of the sub-sectors showed decrease of emissions compared to the previous year, except for the product uses as substitutes for Ozone Depleting Substances (ODS) and non-energy products and solvent use. The emissions from the electronic industry sub-sector decreased by 21.6% (1.9 $MtCO_2$-eq) compared to the previous year due to improvement on GHG reduction efficiency of GHG emissions control technologies. The emissions from the chemical industry sub-sector decreased by 3.0% (1.0 $MtCO_2$-eq) due to a reduction of raw material input for the Naphtha Cracking Center (NCC) process.



[Figure Ⅰ-15] GHG Emissions from the IPPU sector (1990-2022)

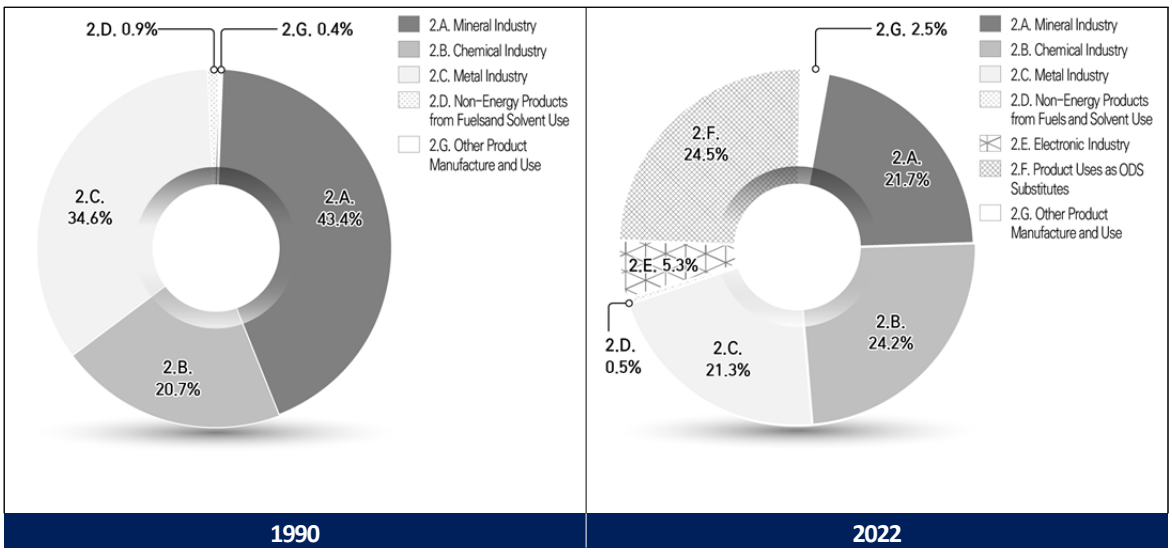
<Table Ⅰ-15> GHG Emissions from the IPPU Sector

(Unit: $MtCO_2$-eq)

Sector	1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
								Compared to 1990	Compared to previous year
2.A. Mineral Industry	16.4	26.1	28.3	30.5	28.0	29.0	28.4	73.4	-2.0
2.B. Chemical Industry	8.9	33.5	25.1	31.4	29.1	32.8	31.8	306.9	-3.0
2.C. Metal Industry	13.1	18.5	20.5	31.7	29.3	28.2	28.0	114.1	-0.8
2.D. Non-Energy Products from Fuels and Solvent Use	0.36	0.51	0.55	0.60	0.55	0.57	0.61	72.0	7.0
2.E. Electronic Industry	-	3.3	8.9	8.7	9.0	8.9	7.0	212.5*	-21.6
2.F. Product Uses as ODS Substitutes	-	2.5	7.4	23.1	27.2	29.4	32.2	2,053,154.8*	9.5
2.G. Other Product Manufacture and Use	0.2	2.2	4.3	2.9	3.7	3.9	3.3	1,835.1	-16.9
Total Emissions	37.8	83.1	95.0	128.9	126.8	132.8	131.3	247.3	-1.1

* The growth rate for the electronics industry and the product uses as substitutes for ODS sector were calculated based on the year 1997 and 1992 respectively, when the first inventory were estimated.

Within the IPPU sector in 2022, the share of emissions by sub-sector was as follows: Product Uses as ODS Substitutes had the largest share at 24.5%, followed by Chemical Industry at 24.2%, Mineral Industry at 21.7%, Metal Industry at 21.3%, Electronic Industry at 5.3%, Other Product Manufacture and Use at 2.5%, and Non-Energy Products from Fuels and Solvent Use at 0.5%.

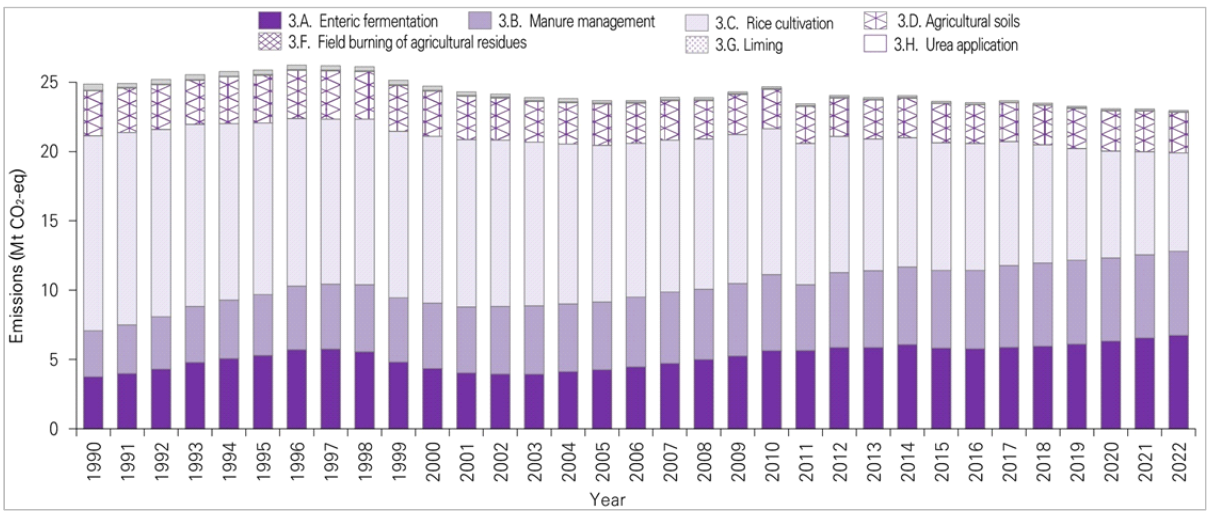


[Figure Ⅰ-16] Proportion by Categories in the IPPU Sector

The activity data sources for the IPPU sector can be broadly categorized into two periods: before and after the implementation of the TMS (2010) and the ETS (2015)[20]. For entities[21] initially designated under the TMS in 2010, emissions data verified by a third party have been reported since 2007. Before 2007, emissions were estimated using data from industry associations, national statistics, and other sources such as CDM reports and direct surveys conducted by the designated agencies. The significance of this lies in replacing parts of association and direct survey data with facility-level data verified by third parties to compile the national GHG inventory.

3) Agriculture Sector

In 2022, total GHG emissions from the Agriculture sector amounted to approximately 23.0 $MtCO_2$-eq, accounting for about 3.2% of national total emissions. Agricultural emissions in 2022 decreased by 7.7% compared to 1990 levels and by 0.5% compared to the previous year.



[Figure Ⅰ-17] GHG Emissions from the Agriculture Sector (1990-2022)

20) 「Act on the Allocation and Trading of Greenhouse Gas Emissions Allowances (May 2012)」

21) The facilities initially designated under the TMS in 2010 have been reporting their emissions since 2007 based on the most recent three years of emissions for the implementation year. Among the facilities subject to the Target Management System, high-emission facilities were incorporated into the ETS from 2015 onward, while the remaining facilities continue to report their emissions under the Target Management System.

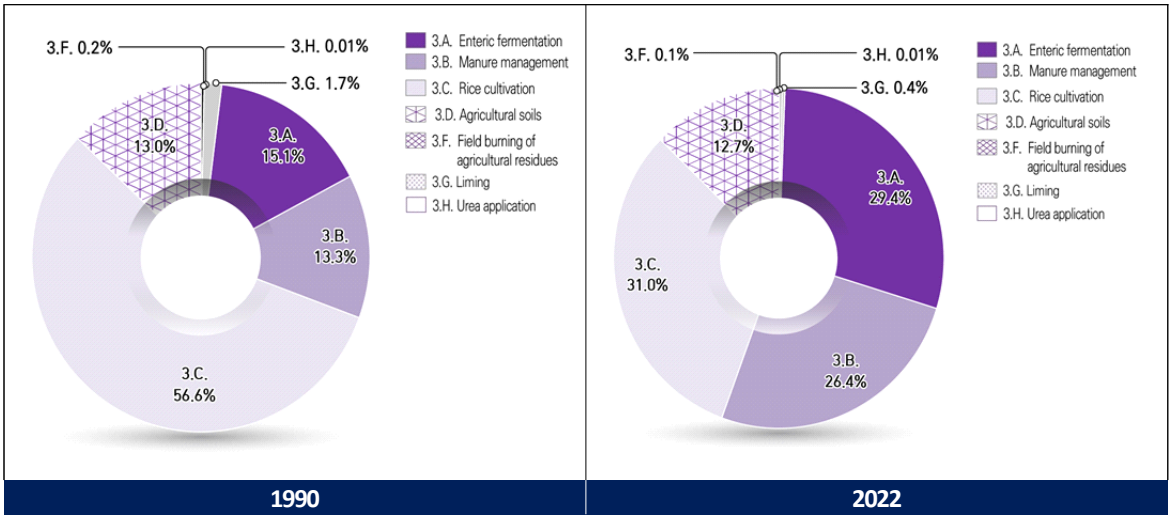
<Table Ⅰ-16> GHG Emissions from the Agriculture Sector

(Unit: $MtCO_2$-eq)

Sector	1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
								Compared to 1990	Compared to previous year
3.A. Entric Fermentation	3.8	4.3	5.6	6.0	6.3	6.6	6.7	79.7	2.8
3.B. Manure Management	3.3	4.7	5.5	6.0	6.0	6.0	6.1	82.9	0.8
3.C. Rice Cultivation	14.1	12.0	10.6	8.5	7.7	7.4	7.1	-49.5	-4.1
3.D. Agricultural Soils	3.2	3.3	2.8	2.8	2.9	3.0	2.9	-9.7	-1.0
3.F. Field Burning of Agricultural Residues	0.06	0.06	0.05	0.04	0.04	0.03	0.03	-53.2	-22.4
3.G. Liming	0.003	0.003	0.003	0.003	0.003	0.002	0.002	-2.4	0.7
3.H. Urea Application	0.4	0.3	0.12	0.12	0.11	0.11	0.09	-78.8	-16.7
Total Emissions	24.9	24.7	24.7	23.5	23.1	23.1	23.0	-7.7	-0.5

Emissions from the rice cultivation sub-sector in 2022 decreased by 4.1% (0.3 $MtCO_2$-eq) compared to the previous year. This was due to the reduction of the rice cultivation area, a decrease of the proportion of continuously flooded area in water regime and a decrease of organic amendment application. Emissions from enteric fermentation sector increased by 0.2 $MtCO_2$-eq (2.8%) compared to the previous year due to an increase of the population of non-dairy cattle.

The share of emissions within the Agriculture sector in 2022 was as follows: Rice Cultivation (31.0%), Enteric Fermentation (29.4%), Manure Management (26.4%), Agricultural Soils (12.7%), Urea Application (0.4%), Field Burning of Agricultural Residues (0.1%), and Liming (0.01%).

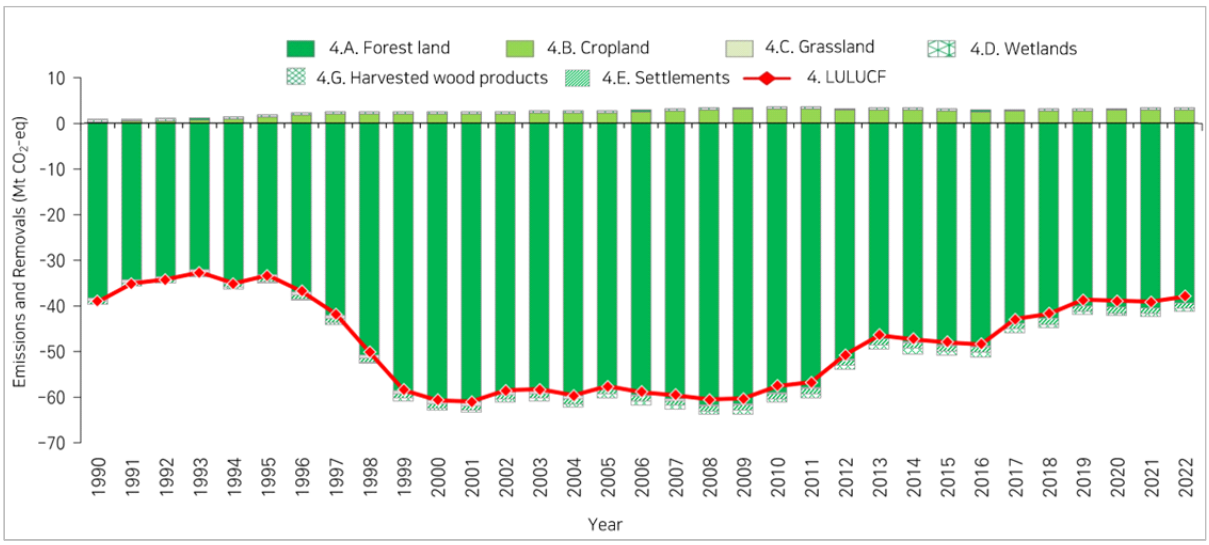


[Figure Ⅰ-18] Proportion by Categories in the Agriculture Sector

4) LULUCF Sector

In 2022, total GHG net removals from the LULUCF sector amounted to 37.8 $MtCO_2$-eq. The 2022 LULUCF sector net removals decreased by 2.9% compared to 1990 and by 3.0% compared to the previous year.

For the LULUCF sector in 2022, net removals were mostly from Forest Land (39.3 $MtCO_2$-eq, followed by the Settlements (1.2 $MtCO_2$-eq) and HWP (0.5 $MtCO_2$-eq). And the net emissions in the LULUCF sector were from the Cropland (2.9 $MtCO_2$-eq), followed by the Wetlands (0.38 $MtCO_2$-eq), and the Grassland (0.001 $MtCO_2$-eq).



[Figure Ⅰ-19] GHG Emissions and Removals from the LULUCF sector (1990-2022)

<Table Ⅰ-17> GHG Emissions and Removals from the LULUCF Sector

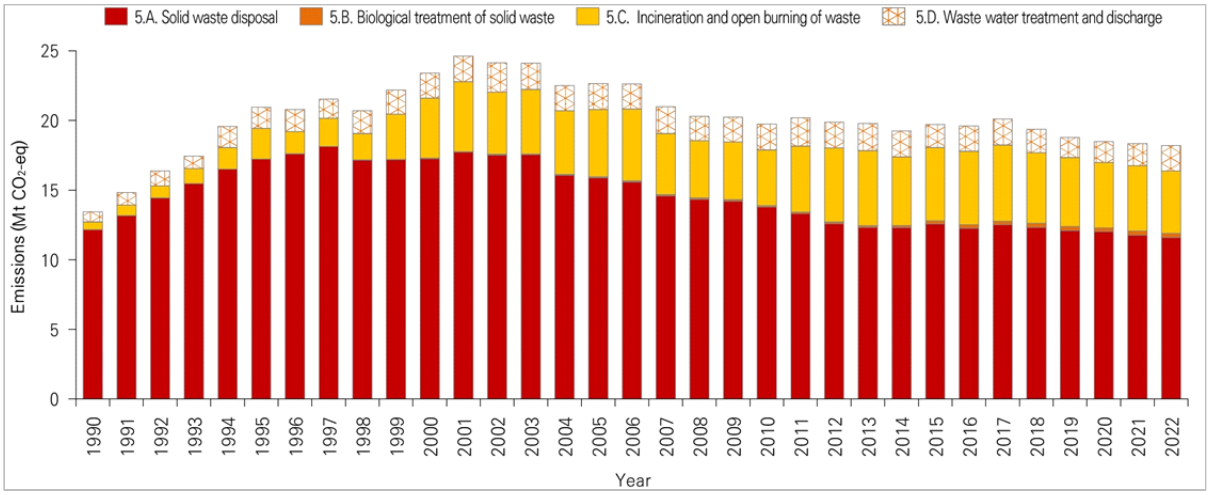
(Unit: $MtCO_2$-eq)

Sector	1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
								Compared to 1990	Compared to previous year
4.A. Forest Land	-38.2	-60.5	-58.8	-42.6	-40.2	-40.4	-39.3	2.9	-2.6
4.B. Cropland	0.1	1.9	3.0	2.6	2.7	2.9	2.9	2,449.9	-0.6
4.C. Grassland	-0.7	-0.7	-0.21	-0.04	-0.02	-0.01	0.001	-100.2	-118.0
4.D. Wetlands	0.34	0.39	0.37	0.39	0.41	0.40	0.38	9.2	-6.4
4.E. Settlements	-0.7	-0.9	-1.1	-1.21	-1.22	-1.22	-1.22	66.8	-0.4
4.G. Harvested Wood Products	0.2	-0.5	-0.6	-0.7	-0.5	-0.7	-0.5	-363.7	-20.6
Total Net missions	-39.0	-60.4	-57.4	-41.6	-38.8	-39.0	-37.8	-2.9	-3.0

The majority of the net removals is attributed to forest land. During and after the Korean War (1950-1953), significant forest degradation occurred. When forest-related statistics began to be compiled in 1953, the average timber stock was only 5.6 m^3/ha. However, over time, continuous and successful efforts, including erosion control, afforestation, and forest protection projects led by both the government and private entities, resulted in an increase in the average timber stock to 172 m^3/ha by 2022, leading to the green forests today. Due to continuous reforestation and forest management, forest sector removals began increasing after 1995, reaching a peak of 61.5 $MtCO_2$-eq in 2008, followed by a declining trend. The decrease in removals by forest land in 2022 compared to the previous year is attributed to reduced annual net growth due to aging forests and decreased forest area. Forest area in 2022 was 6,291 kha, approximately 190 kha less than in 1990 (6,476 kha).

5) Waste Sector

In 2022, GHG emissions from the waste sector amounted to 18.2 $MtCO_2$-eq, accounting for 2.5% of total national emissions. This represents a 35.3% increase compared to 1990 and a 0.8% decrease compared to the previous year. From 1990 to 2001, emissions from the waste sector have generally shown an upward trend, but after reaching a peak in 2001, emissions have been decreasing. The emission trend in the waste sector followed the same pattern of the Solid Waste Disposal sub-sector, which accounts for the largest share of waste sector emissions. The other sub-sectors except for Solid Waste Disposal, emissions have shown a continuous upward trend since 1990.



[Figure Ⅰ-20] GHG Emissions from the Waste Sector (1990-2022)

<Table Ⅰ-18> GHG Emissions from the Waste Sector

(Unit: $MtCO_2$-eq)

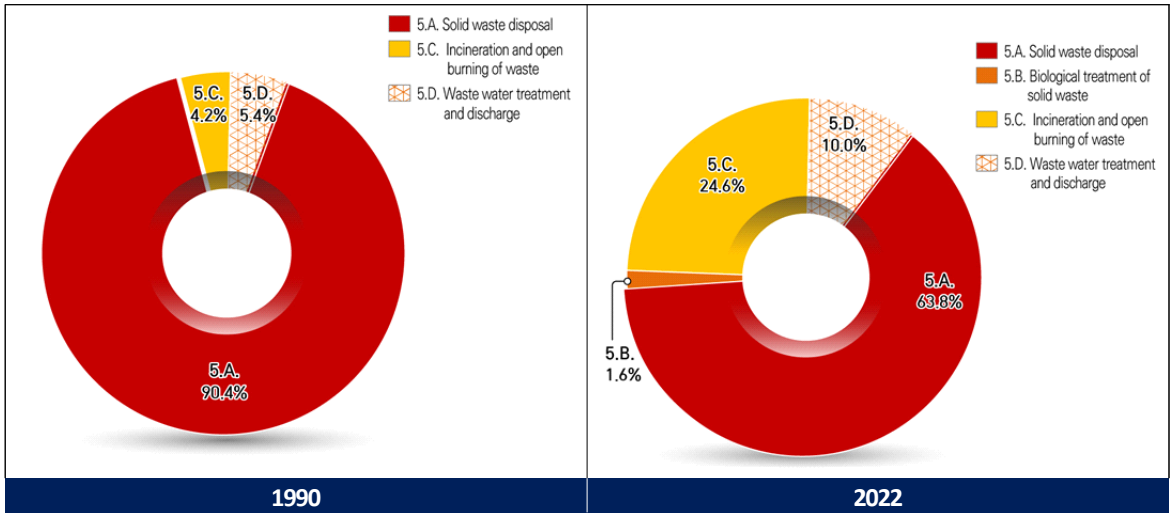
Sector	1990	2000	2010	2018	2020	2021	2022	Growth Rate (%)	
								Compared to 1990	Compared to previous year
5.A. Solid Waste Disposal	12.1	17.3	13.8	12.3	12.0	11.8	11.6	-4.5	-1.4
5.B. Biological Treatment of Solid Waste	-	0.03	0.09	0.28	0.28	0.30	0.29	6,593.4%*	-3.8
5.C. Incineration and Open Burning of Waste	0.6	4.3	4.0	5.1	4.7	4.7	4.5	699.4	-4.5
5.D. Waste water Treatment and Discharge	0.7	1.8	1.9	1.7	1.5	1.6	1.8	149.9	15.2
Total Emissions	13.4	23.4	19.7	19.4	18.5	18.3	18.2	35.3	-0.8

* The growth rate for the Biological Treatment of Solid Waste sector was calculated based on the first year data which was collected in 1994.

As of 2022, emission share by sub-sector in the waste sector was as follows: Solid Waste Disposal (63.8%), Incineration and Open Burning of Waste (24.6%), Waste water Treatment and Discharge (10.0%) and Biological Treatment of Solid Waste (1.6%)

The largest portion of emissions in the waste sector comes from Solid Waste Disposal sub-sector, which reached a peak in 1997 with 18.1 $MtCO_2$-eq and has gradually decreased since then. Notably, after the introduction of the direct landfilling prohibition of food waste in 2005, food waste has been separately recycled, leading to a continuous decrease in emissions of solid waste disposal sub-sector. While emissions from the Incineration and Open Burning of Waste sub-sector increased dramatically from 1990 to 2001, which was a

result of the increase of waste incineration due to population growth and rapid economic development.



[Figure Ⅰ-21] Proportion by Categories in the Waste Sector

Examining the changes in emission proportion by sub-sector in the waste sector, the share of Solid Waste Disposal decreased from 90.4% to 63.8% in 2022 compared to 1990, while the proportion of Incineration and Open Burning of Waste increased from 4.2% to 24.6%. Although the emissions and share of the latter have risen, energy recovery form incineration facilities of municipal waste have also increased, which contributed to slowing the growth of emissions. Energy recovery from incineration facilities began in 1998, and more than 80% of incinerated municipal waste was used for energy recovery since 2005.

II

Tracking Progress in Implementing and Achieving NDC

1. National Circumstances and Institutional Arrangements

1.1 National Circumstances

1.1.1 Government Structure

Since the enactment of its Constitution, the Republic of Korea (ROK) has maintained a system of separation of powers, with executive authority vested in the executive branch led by the President, legislative authority in the National Assembly, and judicial authority in the courts composed of judges.

The executive branch is headed by the President and consists of the Prime Minister and members of the State Council. The President serves a single five-year term and is elected by direct popular vote. The Prime Minister is appointed by the President with the consent of the National Assembly, and State Council members are appointed by the President upon the recommendation of the Prime Minister. Key government policies are deliberated in the State Council. As of 2024, the executive branch comprises 22 ministries and 20 agencies. Major ministries include the Ministry of Economy and Finance, the Ministry of Education, the Ministry of Science and ICT, the Ministry of Foreign Affairs, the Ministry of Unification, the Ministry of Justice, the Ministry of National Defense, the Ministry of the Interior and Safety, and the Ministry of Environment. Each minister serves as a State Council member.

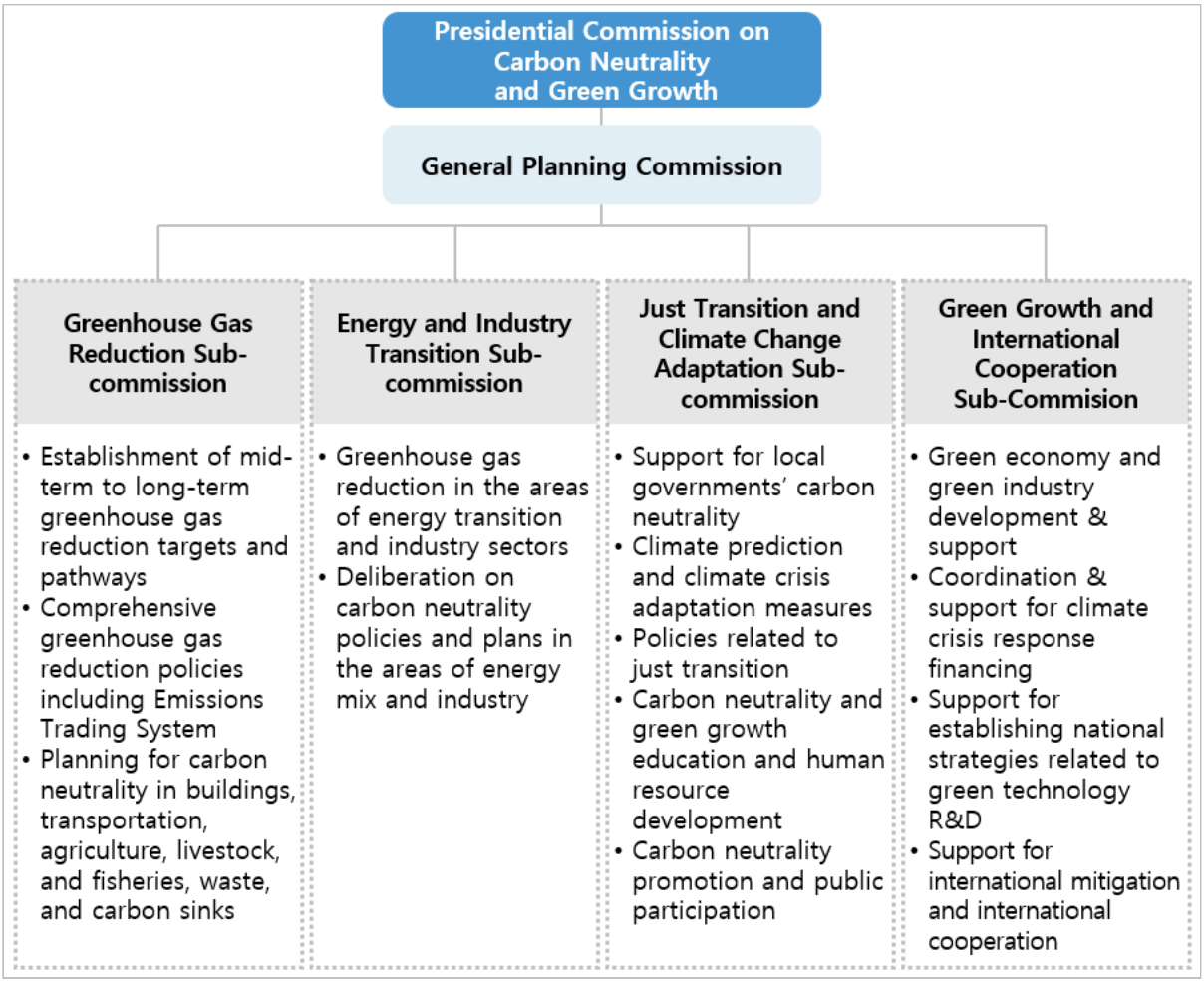
[Figure Ⅱ-1] Government Organization Chart

Source: Government Organization Chart (Government Organization Management System)

The Presidential Commission on Carbon Neutrality and Green Growth (Carbon Neutrality and Green Growth Commission) is a public-private joint governance that deliberates and decides on major policies and plans for the transition to a carbon-neutral society and the promotion of green growth. Carbon Neutrality and Green Growth Commission was established under Article 15 of the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (Carbon Neutrality Act) (September 2021) and performs the following functions in accordance with the Act:

i) Establishing the basic direction for the transition to a carbon-neutral society and the promotion of green growth
ii) Setting and monitoring the implementation status of the national vision, mid- to long-term emission reduction targets, and national framework plans
iii) Establishing, revising, and monitoring national climate crisis adaptation measures
iv) Promoting public understanding, promotion, communication, and international cooperation related to carbon neutrality

Carbon Neutrality and Green Growth Commission is divided into four Sub-commissions; Greenhouse Gas (GHG) Reduction, Energy and Industry Transition, Just Transition and Climate Adaptation, and Green Growth and International Cooperation. The chairperson is the Prime Minister and a private co-chair, and the commission members consist of 21 ex officio government members and 32 private members appointed by the President.



[Figure Ⅱ-2] Organization Chart of the Presidential Commission of Carbon Neutrality and Green Growth

Source: Organization & Composition (Presidential Commission on Carbon Neutrality and Green Growth website)

Next, the legislative branch, the National Assembly, is composed of members elected by the sovereign people and enacts laws that form the basis of national operations, reviews and confirms budgets, and decides on major policies on behalf of the people.

In August 2021, the National Assembly passed the Carbon Neutrality Act through a plenary session resolution. This made the ROK the 14th country in the world to legislate the 2050 carbon neutrality vision and implementation system, specifying carbon neutrality by 2050 as a national vision and systematizing the establishment and implementation monitoring procedures of national strategies, mid- to long-term GHG reduction targets, and basic plans to achieve it.

In December 2022, in accordance with the *National Assembly Act*, the Special Committee on Climate Crisis was established to monitor the government's climate crisis countermeasures and discuss related institutional and policy improvements and support measures. This

committee operated as an ad hoc committee for about a year, but as the climate crisis intensifies, there is a growing need to make it a standing committee. The National Assembly is discussing the establishment of a permanent Special Committee on Climate Crisis and the potential granting of deliberative authority over legislation and budget matters to enable prompt and accurate responses to the climate crisis.

The judiciary has the Supreme Court as the highest court and consists of various levels of courts, including high courts, patent courts, district courts, family courts, and administrative courts. Courts have jurisdiction over civil, criminal, and administrative cases. They also deal with climate change-related cases, such as government licensing and support issues that may affect climate change, corporate responsibility for climate change due to fossil fuel use, and green-washing.

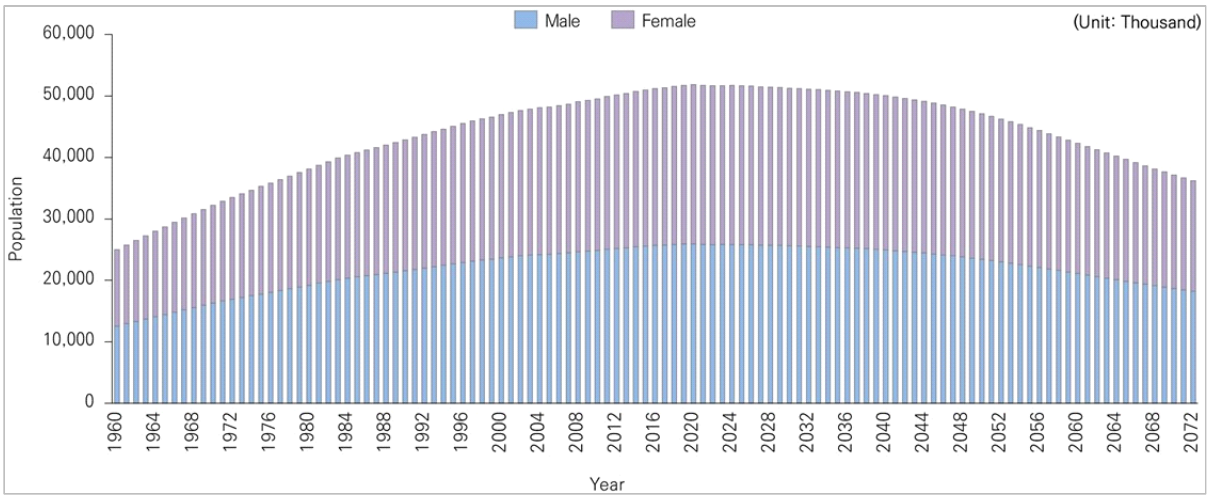
The Constitutional Court assesses whether the government is appropriately implementing efforts to reduce GHG emissions for the protection of citizens' fundamental rights under the Constitution. In March 2020, 19 youth members of Youth 4 Climate Action filed a constitutional petition asserting that the government's insufficient GHG reduction target setting violated citizens' fundamental rights. This was followed by four similar constitutional petitions, leading to the Constitutional Court's final decision in August 2024. The Constitutional Court ruled that certain provisions of the Carbon Neutrality Act were incompatible with the Constitution as they failed to establish specific reduction targets for the period from 2031 to 2049. In response to this decision, the government plans to amend the relevant provisions by 2026.

1.1.2 Population Profile

As of 2022, the total population of the ROK stood at 51.7 million, accounting for about 0.6% of the world's population. In terms of population size, it ranks 29th in the world, and its population density is about 514.6 people per square kilometer, ranking 27th among 237 countries.[22)] As of 2022, the population aged 65 and older was about 9 million, accounting for 17.5% of the total population. By 2025, this figure is expected to increase to 20.6%, transitioning the ROK into a super-aged society.

22) Source: World Population Prospects 2022 (UN, 2022)

The ROK's population growth rate was at an annual average of 3% in the 1960s, but the growth rate slowed down as population control policies were implemented until the 1980s. In 2021, the average annual rate of change compared to 2020 recorded -0.1%, and the total population declined for the first time on record. The population is expected to continue decreasing to approximately 51.7 million in 2025 and 51.3 million in 2030.



[Figure Ⅱ-3] Total Population (1960-2072)

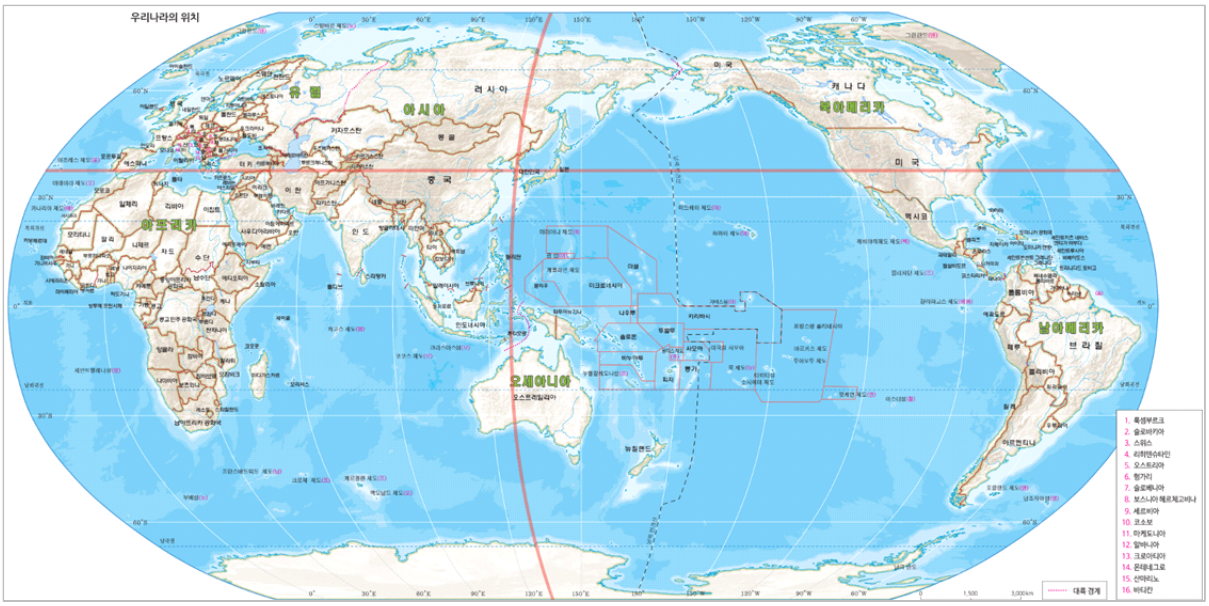
Source: Population Projections 2022-2072 (Statistics Korea, 2023)

Looking at population changes by major regions, Seoul reached its peak of 10.5 million in 1990 and decreased to 9.4 million in 2022, and Busan and Daegu also showed similar declining trends. These population declines are analyzed to be mainly due to low birth rates and population outflow due to movement to other regions. On the other hand, Gyeonggi Province, Sejong Special Self-Governing City, and Incheon Metropolitan City have steadily increased in population over the past 10 years (2013-2022), which is the result of population inflow from surrounding areas.

In terms of population distribution by major regions, as of 2022, Gyeonggi Province has the largest population nationwide with 13.690 million, accounting for 26.5% of the total national population. Seoul Metropolitan City ranks second with 9.4 million, representing 18.2% of the total population. The capital region, which includes Gyeonggi Province, Seoul Metropolitan City, and Incheon Metropolitan City (3 million, ranked 5th), has a population of 26.1 million, accounting for 50.48% of the total population. However, this region occupies only 11.8% of the national territory, highlighting severe population concentration.

1.1.3 Geographical Profile

Under the Constitution, the territory of the ROK consists of the Korean Peninsula and its adjacent islands. The total area of the Korean Peninsula is 223,663 km^2, ranking 85th among 253 countries worldwide. The Korean Peninsula is located in the eastern part of the Asian continent, between 124 and 132 degrees east longitude and between 33 and 44 degrees north latitude. The Korean Peninsula borders with the People's Republic of China and the Russian Federation to the north, and faces Japan across the Korea Strait to the east, connecting the vast Eurasian continent with the Pacific Ocean.



[Figure Ⅱ-4] The ROK in the World

Source: National Atlas of Korea (National Geographic Information Institute, 2020)

The Korean Peninsula has favorable geographical accessibility as it is adjacent to both the continent and the ocean. It is advantageous in terms of transportation and logistics due to its close proximity to major Asian cities and is linked to major cities around the world through air and sea routes. It also increases accessibility to the Eurasian continent through rail and road networks.

Geographically, the Korean Peninsula has a distinct difference in altitude between the east and west. High mountains are distributed in the east and north, centered on the Taebaek Mountains, Nangnim Mountains, and Hamgyeong Mountains, while the west is relatively low and flat. Due to these topographical characteristics, agricultural areas are mainly located in the western region, and forest areas are mainly located in the northeastern region.

The altitude of the Korean Peninsula ranges from 0m to 2,744m, with highlands over 1,600m accounting for only 5% of the total area, while lowlands under 300m account for 52%. The average altitude is 448m, which is lower than the East Asian average of 910m, but the average slope is 5.7°, and is steeper than the East Asian average of 3.9°.

[Figure Ⅱ-5] Topography of the ROK

Source: Map of the Republic of Korea (National Geographic Information Institute), Available at: https://www.ngii.go.kr/world/mapdownload05_en.html

1.1.4 Climate Profile

The ROK is located in the mid-latitude temperate zone with four distinct seasons. In spring and autumn, migratory high-pressure systems bring clear and dry weather. Summer is characterized by hot and humid conditions due to the North Pacific high-pressure system, while winter experiences cold and dry weather under the influence of the continental high-pressure system.

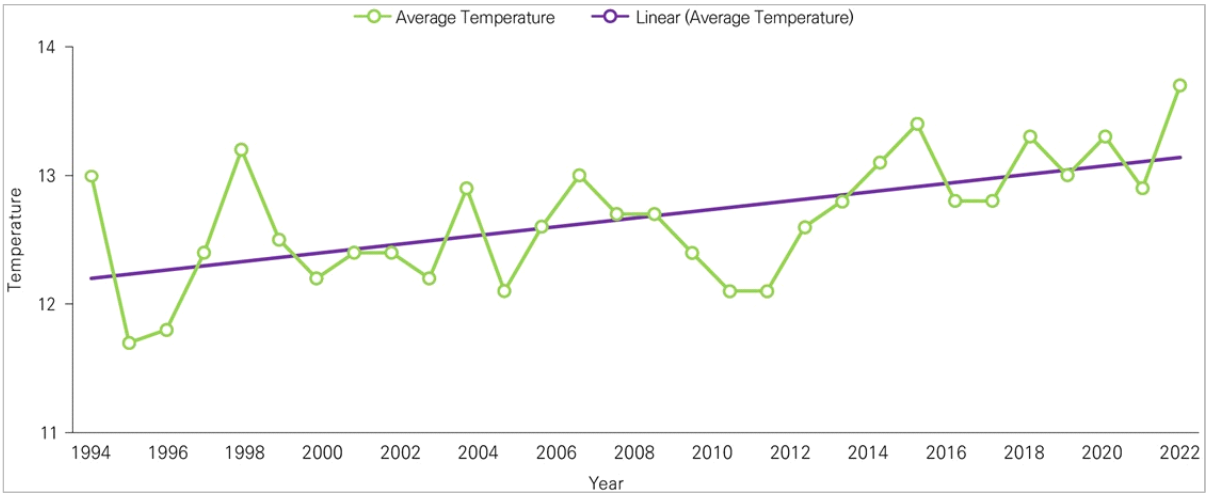
Over the past 30 years (1994-2023), the annual mean temperature of the ROK was 12.7°C, with August recording the highest monthly average at 25.4°C and January the lowest at –1.0°C. Regionally, August temperatures ranged from 19.7°C in Daegwallyeong to 26.7°C in Daegu Metropolitan City, while January temperatures varied from –6.9°C in Daegwallyeong to 3.6°C in Busan Metropolitan City.

The annual average precipitation is 1,331.7 mm, with summer precipitation accounting for 54.6% (727.3 mm) of the annual total. The monsoon season begins in mid-to-late June in Jeju Island and gradually extends to the southern region and the central region of the Korean Peninsula. The monsoon period lasts the longest in Jeju Island at 32.4 days, followed by 31.5 days in the southern region and 31.4 days in the central region.

<Table Ⅱ-1> Monthly Mean Temperature and Precipitation over the Past Three Decades

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Temperature (℃)	-1.0	1.4	6.4	12.3	17.5	21.5	24.8	25.4	20.6	14.4	7.8	1.0
Minimum Temperature (℃)	-5.8	-3.8	0.7	6.2	11.7	17.0	21.4	21.8	16.4	9.2	2.7	-3.7
Maximum Temperature (℃)	4.4	7.2	12.5	18.7	23.6	26.8	29.1	30.0	26.0	20.8	13.7	6.4
Precipitation (mm)	25.9	32.3	58.0	88.4	103.1	151.6	297.8	283.0	157.1	64.9	49.7	27.6

Source: Climate Statistics Analysis (Korea Meteorological Administration Open Data Portal)



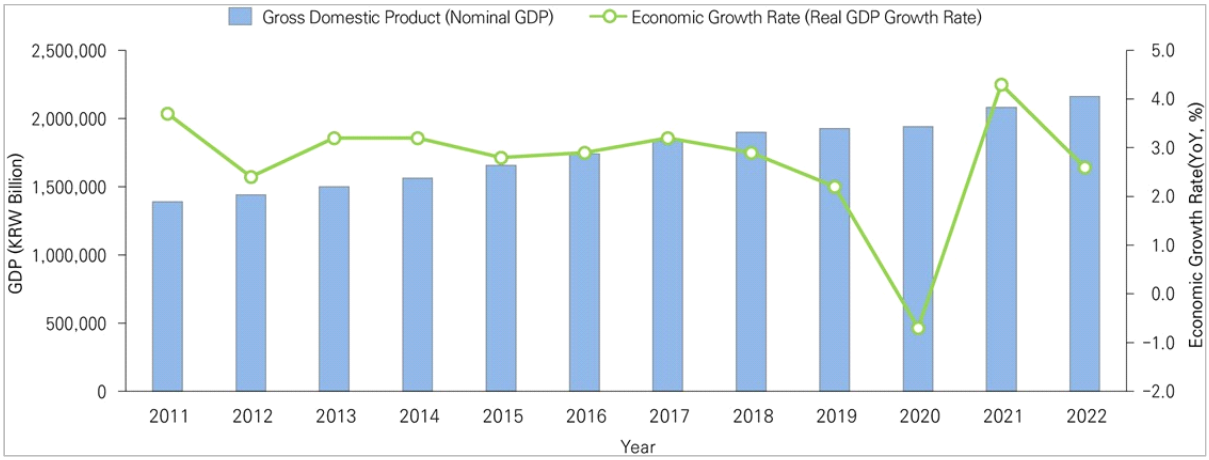
[Figure Ⅱ-6] Average Yearly Temperature of the ROK (1994-2023)

Source: Climate Statistics Analysis (Korea Meteorological Administration Open Data Portal)

Wind patterns show clear seasonal variations, with strong northwesterly winds in winter and southwesterly winds in summer. Coastal regions experience significant sea and land breezes. On average, 25.1 typhoons form annually over the Northwest Pacific, of which 3.4 typhoons directly or indirectly affect the Korean Peninsula each year. The annual average relative humidity maintains 69-75%, peaking at 78-79% in July and August and dropping to 59-60% in March and April.

1.1.5 Economic Profile

The nominal GDP of the ROK in 2021 was calculated at KRW 2,080 trillion, with the real GDP growth rate reaching 4.3%. This represents a significant recovery from the -0.7% contraction experienced in 2020 during the first year of the COVID-19 pandemic. In 2022, while the nominal GDP increased to KRW 2,162 trillion, the economic growth rate moderated to 2.6%. Notably, while the first quarter of 2022 showed a growth rate of 3.1% year-on-year, this declined to 1.4% in the fourth quarter, indicating an economic slowdown in the latter half of the year.



[Figure Ⅱ-7] Gross Domestic Product and Economic Growth Rate of the ROK

Source: National Accounts, Key Indicators (Annual Indicators, Base Year of 2015) (Bank of Korea)

The Korean economy is characterized by high dependence on manufacturing and exports. Despite fluctuations over the past decade, these sectors continue to maintain significant importance in the national economy. The manufacturing sector maintained a consistent 28.0% share of GDP in both 2021 and 2022, while export dependency recorded 33.2% and 38.0% respectively in these years.

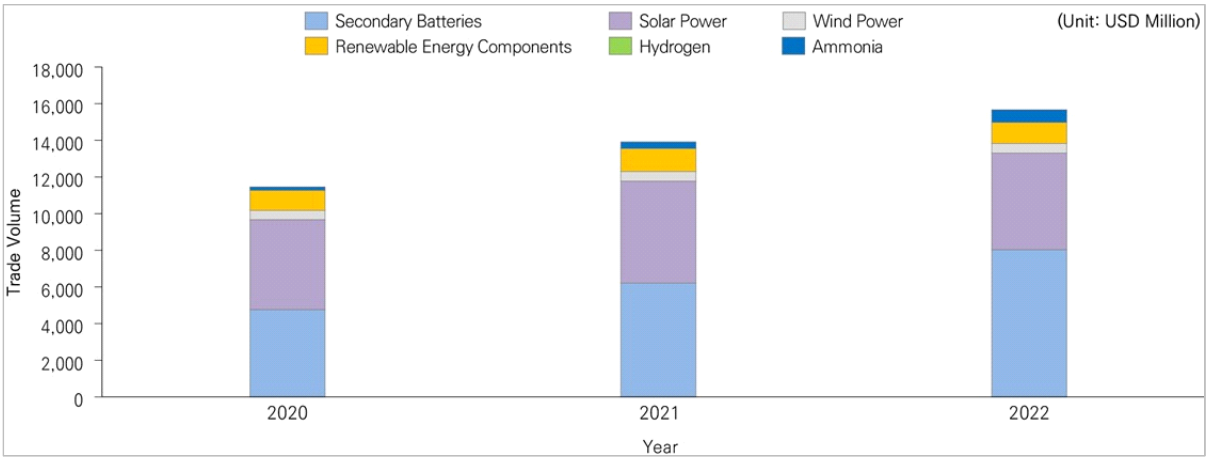
<Table Ⅱ-2> Export Dependency and Manufacturing Share of GDP

(Unit: %)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Manufacturing Industry Share[1)]	30.3	29.5	29.0	28.8	29.5	29.1	27.5	27.1	28.0	28.0
Export Dependency Ratio[2)]	39.0	36.8	34.2	31.4	33.5	33.2	31.0	29.4	33.2	38.0

1) National Accounts, Key Indicators (Annual Indicators, Base Year of 2015) (Bank of Korea)
2) Trade Dependency Ratio (Ratio of Exports and Imports to GDP) (National Statistics Portal)

Industries related to carbon neutrality have shown notable growth, particularly in secondary batteries and solar power sectors. The trade volume of the secondary battery industry increased from USD 4,756 million in 2020 to USD 8,035 million in 2022, representing an approximate 1.7-fold increase. The solar power industry continued its growth trajectory, recording a trade volume of USD 5,274 million in 2022.



[Figure Ⅱ-8] Trade Volume of the ROK's Carbon-Neutral Industries

Source: Trade Statistics (Korea International Trade Association)

The carbon neutrality-related finance sector has demonstrated substantial growth since 2021. The government established institutional frameworks through the *Green Bond Guidelines* in 2020.12 and the *K-Taxonomy Guidelines* in December 2022. Consequently, green bond issuance increased significantly from KRW 960 billion in 2020 to KRW 12.459 trillion in 2021, followed by KRW 5.861 trillion in 2022.

Furthermore, the number of companies publishing sustainability reports among listed companies on the *Korea Exchange* increased from 78 in 2021 to 129 in 2022, representing year-on-year increases of 105% and 65% respectively. The government has continued to strengthen institutional support through the release of the *K-ESG Guidelines* in December 2021 and the *Supply Chain Response K-ESG Guidelines* in December 2022, providing frameworks to support corporate ESG goal achievement and related information disclosure.

1.2 Sectoral Information

1.2.1 Power Generation

The power generation sector is an area that produces secondary energy such as electricity and heat using primary and secondary energy sources. The ROK's electricity consumption temporarily decreased during 2019-2020 due to seasonal temperature variations, economic conditions, and COVID-19. However, excluding this period, it has steadily increased over the past decade (2013-2022). Since 2013, electricity consumption has grown at an annual average rate of 1.6%, reaching 547.9 TWh in 2022, which marks a 15.4% (73.1 TWh) increase compared to 2013 level.

Electricity consumption for industrial use accounted for the largest share at 52.5% (287.9 TWh) of total consumption in 2022, followed by commercial use at 33.1% (181.4 TWh) and residential use at 14.3% (78.6 TWh). These proportions have remained relatively stable. In terms of consumption growth rates, residential use showed the highest increase at 22.8% (14.6 TWh) compared to 2013, while commercial and industrial uses increased by 17.8% (27.4 TWh) and 12.1% (31.1 TWh) respectively. The average annual growth rates (2013-2022) were 2.3% for residential, 1.8% for commercial, and 1.3% for industrial use. Recent increases in electricity consumption can be attributed primarily to the expanded adoption of eco-friendly vehicles such as electric vehicles and the proliferation of new data centers driven by Artificial Intelligence (AI) technology advancements.

<Table Ⅱ-3> Trends in Electricity Consumption by Use

(Unit: TWh)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	474.8	477.6	483.6	497.1	507.8	526.2	520.6	509.3	533.5	547.9
Residential	64.0	62.7	63.8	66.2	66.5	70.7	70.5	74.1	77.6	78.6
Commercial	154.0	150.3	154.2	160.9	164.6	174.6	172.8	168.1	173.2	181.4
Industrial	256.8	264.6	265.6	270.0	276.7	280.9	277.3	267.1	282.7	287.9

Source: 2022 Korea Electric Power Statistics (No.92) (Korea Electric Power Corporation, 2023)

The country's energy mix (based on power generation) consists of coal, nuclear, Liquefied Natural Gas (LNG), and new and renewable energy. To achieve carbon neutrality targets, the composition is gradually shifting toward reducing the share of coal while progressively expanding the proportion of carbon-free power sources. Coal power generation and its share have been steadily decreasing since 2018, with the share dropping from 41.9% in 2018 to 32.5% in 2022, marking four consecutive years of decline. Conversely, the share of zero-carbon power sources has been increasing notably. The share of new and renewable energy generation increased from 6.2% in 2018 to 8.9% in 2022, while nuclear power generation expanded from 23.4% in 2018 to 29.6% in 2022.

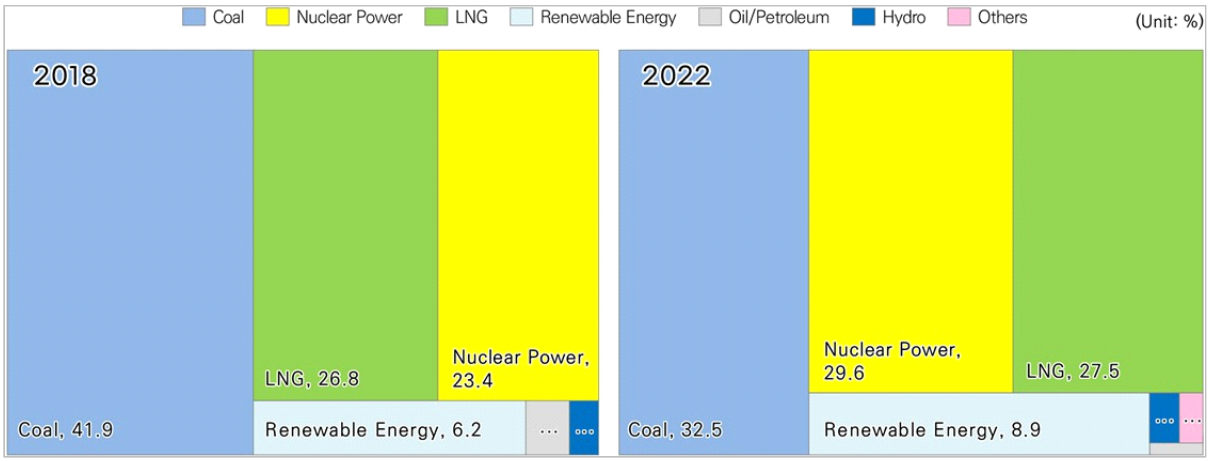
<Table Ⅱ-4> Trends in Power Generation by Energy Source

Energy Source		2018	2019	2020	2021	2022
Total	Generation (TWh)	570.6	563.0	552.2	576.8	594.4
	Share(%)	100.0	100.0	100.0	100.0	100.0
Coal	Generation(TWh)	239.0	227.4	196.3	198.0	193.2
	Share(%)	41.9	40.4	35.6	34.3	32.5
Nuclear	Generation(TWh)	133.5	145.9	160.2	158.0	176.1
	Share(%)	23.4	25.9	29.0	27.4	29.6
LNG	Generation(TWh)	152.9	144.4	145.9	168.4	163.6
	Share(%)	26.8	25.6	26.4	29.2	27.5
New & Renewable	Generation(TWh)	35.6	36.4	36.5	43.1	53.2
	Share(%)	6.2	6.5	6.6	7.5	8.9
Oil/Petroleum	Generation(TWh)	5.7	3.3	2.3	2.4	2.0
	Share(%)	1.0	0.6	0.4	0.4	0.3
Pumped Storage	Generation(TWh)	3.9	3.5	3.3	3.7	3.7
	Share(%)	0.7	0.6	0.6	0.6	0.6
Other	Generation(TWh)	0.0	2.2	7.7	3.3	2.7
	Share(%)	0.0	0.4	1.4	0.6	0.5

Source: 2022 Korea Electric Power Statistics (No.92) (Korea Electric Power Corporation, 2023)

The most notable change in the energy mix between 2018 and 2022 was the expansion of nuclear power generation. As a result, LNG, which had the second-largest share after coal power in 2018, became the third-largest source after coal and nuclear power in 2022. The

share of new and renewable energy in power generation has also steadily increased as capacity expanded through the deployment of facilities. These changes in the energy mix represent one of the processes to strengthen energy security and achieve carbon neutrality. In particular, the phase-out of aged coal power plants, substitution with LNG, and expansion of carbon-free power sources such as nuclear, and new and renewable energy are serving as key drivers for implementing the Nationally Determined Contribution (NDC).

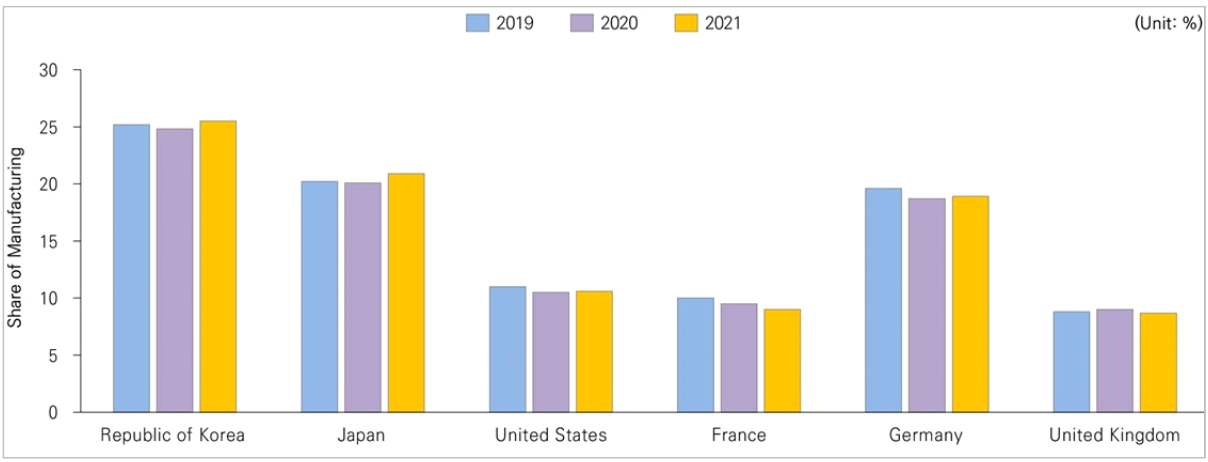


[Figure Ⅱ-9] Comparison of the Energy Mix in 2018 and 2022

Source: 2022 Korea Electric Power Statistics (No.92) (Korea Electric Power Corporation, 2023)

1.2.2 Industry

The industry sector encompasses areas that produce goods or services through processes that change the chemical or physical structure of raw materials and fuels, and through energy use. Since the 1970s, the ROK has rapidly restructured its industrial structure from primary industry-centered to secondary and tertiary industry-centered, maintaining a higher proportion of manufacturing compared to developed countries. Manufacturing accounted for 28.0% of GDP in 2021 and 2022, playing a crucial role in the national economy.



[Figure Ⅱ-10] Share of Manufacturing Sector in GDP among Major Countries

Source: Manufacturing, value added (% of GDP) (World Bank)

Manufacturing production in the ROK temporarily decreased in 2019-2020 due to the impact of COVID-19, but recovered from 2021 and recorded KRW 2,073.78 trillion in 2022, representing an increase of 31.6% (KRW 497.78 trillion) compared to 2018 level. This upward trend is primarily attributed to the expansion of production capacity in major industries responding to domestic and international demand, based on strong technological competitiveness in sectors such as semiconductors, automobiles, and petrochemicals.

By major sector in 2022, electronic components, computers, video, audio and communication equipment manufacturing, including the semiconductor industry, recorded the highest share at 16.2% (KRW 336.32 trillion). This was attributed to the increased exports of system semiconductors driven by rising global semiconductor demand. Automobile and trailer manufacturing was second highest at 12.1% (KRW 250.15 trillion), followed by chemical substances and chemical products manufacturing (10.5%), primary metal manufacturing (9.8%), and coke, briquette and petroleum refining products manufacturing (9.7%). The top five sectors accounted for 57.5% of total manufacturing production in 2021 and 58.4% in 2022.

<Table Ⅱ-5> Trends in Production Value by Major Industries

Industry		2018	2019	2020	2021	2022
Total	Value (KRW billion)	1,575,999	1,552,706	1,502,500	1,781,283	2,073,778
	Share(%)	100.0	100.0	100.0	100.0	100.0
Electronic components, computer, visual, sound, and communication equipment	Value (KRW billion)	277,829	260,743	262,540	315,513	336,323
	Share(%)	17.6	16.8	17.5	17.7	16.2
Motor vehicles and trailers	Value (KRW billion)	189,653	196,714	195,677	213,746	250,154
	Share(%)	12.0	12.7	13.0	12.0	12.1
Chemicals and chemical products (except pharmaceuticals)	Value (KRW billion)	163,826	153,925	145,350	189,319	218,750
	Share(%)	10.4	9.9	9.7	10.6	10.5
Basic metals	Value (KRW billion)	144,510	141,185	133,010	183,071	204,019
	Share(%)	9.2	9.1	8.9	10.3	9.8
Coke, briquettes and refined petroleum products	Value (KRW billion)	132,906	125,812	81,506	123,344	201,054
	Share(%)	8.4	8.1	5.4	6.9	9.7
Other machinery and equipment	Value (KRW billion)	123,319	119,087	117,841	135,757	150,320
	Share(%)	7.8	7.7	7.8	7.6	7.2
Electrical equipment	Value (KRW billion)	84,113	88,790	98,671	115,055	149,629
	Share(%)	5.3	5.7	6.6	6.5	7.2
Fabricated metal products (except machinery and furniture)	Value (KRW billion)	74,909	75,479	71,193	79,272	89,058
	Share(%)	4.8	4.9	4.7	4.5	4.3
Rubber and plastic products	Value (KRW billion)	69,626	69,272	68,201	74,044	80,404
	Share(%)	4.4	4.5	4.5	4.2	3.9
Other transport equipment	Value (KRW billion)	45,125	47,968	46,537	42,813	47,891
	Share(%)	2.9	3.1	3.1	2.4	2.3
Non-metallic mineral products	Value (KRW billion)	35,648	34,097	33,085	36,202	39,295
	Share(%)	2.3	2.2	2.2	2.0	1.9
Other manufacturing	Value (KRW billion)	234,535	239,634	248,888	273,150	306,881
	Share(%)	14.9	15.4	16.6	15.3	14.8

Source: Mining and Manufacturing Survey (Statistics Korea)

Manufacturing energy consumption also temporarily decreased in 2019-2020 due to COVID-19 but reached 133,654 ktoe in 2022. Total manufacturing consumption recovered to pre-COVID-19 levels as energy consumption increased in the petrochemical and refining industries.

By major sector in 2022, Chemical substances and chemical products manufacturing accounted for 30.5% (40,744.1 ktoe) of total consumption. Following the trend from 2021, this increase was attributed to the expansion of petrochemical facilities, which led to a rise in petroleum consumption for raw materials. Coke, briquette and petroleum refining products manufacturing was second at 25.2% (33,672.8 ktoe), followed by Primary metal manufacturing (23.5%), Non-metallic mineral products manufacturing (4.6%), and Electronic components, computers, video, audio and communication equipment manufacturing (4.4%). The top five sectors accounted for 89.0% and 88.2% of total manufacturing energy consumption in 2021 and 2022 respectively.

<Table Ⅱ-6> Trends in Energy Consumption by Major Industries

Industry		2018	2019	2020	2021	2022
Total	Energy Consumption(ktoe)	133,327.9	130,661.8	128,263.5	133,573.9	133,654.0
	Share(%)	100.0	100.0	100.0	100.0	100.0
Chemicals and chemical products (except pharmaceuticals)	Energy Consumption(ktoe)	33,472.0	33,738.7	34,800.4	42,982.5	40,744.1
	Share(%)	25.1	25.8	27.1	32.2	30.5
Coke, briquettes and refined petroleum products	Energy Consumption(ktoe)	37,075.7	36,325.1	32,661.2	30,290.0	33,672.8
	Share(%)	27.8	27.8	25.5	22.7	25.2
Basic metals	Energy Consumption(ktoe)	33,815.0	33,537.9	33,667.5	34,003.5	31,395.9
	Share(%)	25.4	25.7	26.2	25.5	23.5
Non-metallic mineral products	Energy Consumption(ktoe)	6,284.1	6,337.8	5,897.8	6,003.7	6,152.2
	Share(%)	4.7	4.9	4.6	4.5	4.6
Electronic components, computer, visual, sound, and communication equipment	Energy Consumption(ktoe)	5,054.9	5,600.3	5,541.5	5,556.2	5,933.4
	Share(%)	3.8	4.3	4.3	4.2	4.4
Food products	Energy Consumption(ktoe)	2,439.5	2,065.8	2,296.3	2,157.6	2,242.4
	Share(%)	1.8	1.6	1.8	1.6	1.7
Motor vehicles and trailers	Energy Consumption(ktoe)	2,143.8	1,979.1	1,850.2	1,808.5	2,031.8
	Share(%)	1.6	1.5	1.4	1.4	1.5
fabricated metal products (except machinery and furniture)	Energy Consumption(ktoe)	2,299.2	1,787.9	2,570.5	1,731.2	1,953.7
	Share(%)	1.7	1.4	2.0	1.3	1.5
Pulp, Paper and Paper Products	Energy Consumption(ktoe)	2,168.2	2,013.3	1,945.2	1,917.5	1,862.0
	Share(%)	1.6	1.5	1.5	1.4	1.4
Rubber and plastic products	Energy Consumption(ktoe)	2,197.1	1,811.5	1,415.9	1,670.9	1,818.8
	Share(%)	1.6	1.4	1.1	1.3	1.4
Other machinery and equipment	Energy Consumption(ktoe)	1,360.7	1,096.1	1,293.4	1,133.7	1,376.0
	Share(%)	1.0	0.8	1.0	0.8	1.0
Other manufacturing	Energy Consumption(ktoe)	4,534.2	3,867.9	3,851.3	3,829.4	3,937.1
	Share(%)	3.4	3.0	3.0	2.9	2.9

Source: Sector-specific Energy Consumption Data (National GHG Emission Total Information System)

1.2.3 Building

The buildings sector refers to areas where daily life or economic activities take place in structures with roofs, pillars, and walls. Total building energy consumption decreased slightly in 2019-2020 due to reduced energy use in non-residential buildings during COVID-19 but showed an increasing trend again from 2021. Total consumption in 2022 reached 36,362 ktoe, a 5.6% increase (1,920 ktoe) compared to 2018, influenced by increased floor area from new construction. In 2022, apartment buildings accounted for the largest share (42.6%) of building energy use, followed by detached houses and neighborhood living facilities. Residential buildings accounted for 58.0% of total consumption in 2022.[23)]

Building energy consumption per unit area showed similar trends due to COVID-19 but decreased by 4.8% compared to 2018, reaching 122 kWh/m² in 2022. This was mainly attributed to an 8.0% decrease (244 days) in heating and cooling degree-days compared to 2018, as energy consumption generally correlates with heating and cooling degree-days.[24)] Total energy consumption increased by only 5.6% despite a 10.9% increase in floor area compared to 2018, which also contributed to the decrease in energy consumption per unit area.

<Table Ⅱ-7> Trends in Building Energy Consumption

	2018	2019	2020	2021	2022
Total Floor Area(100,000m^2)	31,263	32,187	32,619	33,632	34,672
Total Energy Consumption(ktoe)	34,442	33,572	33,187	34,344	36,362
Energy Consumption per Unit Area(kWh/m^2)	128	121	118	119	122
Heating and Cooling Degree-Days	3,050	2,704	2,628	2,663	2,806

Source: Building Energy in 2022, 4.8% decrease in energy consumption per unit area compared to base year 2018 (Press Release, Ministry of Land, Infrastructure and Transport, 2023.05.31)

Aged buildings, generally defined as those over 30 years since approval for use, tend to show increased energy consumption as they age. Over the past decade (2013-2022), the number and floor area of aged buildings have steadily increased, accounting for 41.0% (3,017,299 buildings) of total buildings and 21.4% (884,101 thousand m²) of total floor area in 2022. In particular, buildings supplied through large-scale housing construction projects in the 1980s are significantly contributing to increased energy consumption as they age. As

23) Source: 'Building Energy in 2022, 4.8% decrease in energy consumption per unit area compared to base year 2018' (Press Release, Ministry of Land, Infrastructure and Transport, 2023.05.31)

24) Heating and cooling degree days refer to the sum of the monthly differences between the daily average temperature and the base temperature (18˚C for heating, 24˚C for cooling)

the number and total floor area of aged buildings rapidly increase, their share of total building energy consumption is progressively expanding.

<Table Ⅱ-8> Trends in Aged Buildings

Age		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	Number of Buildings	6,851,802	6,911,288	6,986,913	7,054,733	7,126,526	7,191,912	7,243,472	7,275,266	7,314,264	7,354,340
	Total Floor Area (Thousand m^2)	3,376,649	3,451,352	3,534,068	3,573,626	3,641,933	3,754,128	3,860,871	3,961,888	4,056,243	4,131,341
30 years or more, less than 35 years	Number of Buildings	435,088	497,313	498,813	499,448	483,941	497,285	480,131	535,672	586,505	647,083
	Total Floor Area (Thousand m^2)	147,504	159,730	169,251	181,743	199,497	216,153	241,574	287,339	359,144	418,480
35 years or more	Number of Buildings	1,922,960	1,978,819	2,013,087	2,043,769	2,117,329	2,169,438	2,258,369	2,284,186	2,310,334	2,370,216
	Total Floor Area (Thousand m^2)	223,523	245,425	263,732	280,620	306,034	336,638	365,725	392,956	420,332	465,621

Source: Annual Building Statistics (Ministry of Land, Infrastructure and Transport)

1.2.4 Transportation

The transportation sector encompasses various modes of transport, including road, railroad, maritime, and air, to carry passengers and freight. Domestic passenger transport volume sharply declined in 2020 due to the impact of COVID-19. However, excluding this anomaly, the transport volume has steadily increased over the past decade (2013-2022) at an average annual growth rate of 1.6%.

In 2021, the modal share of domestic passenger transport by mode was highest for road transport at 88.4%. Subways accounted for 8.1%, railroads for 3.4%, and aviation and

maritime transport each recorded 0.1%. In 2013, the road transportation share was 87.5%, but it declined to 84.3% by 2019 due to policies promoting public transportation, which reduced the use of private cars. During the same period, the shares of rail and subway transport rose to 4.6% and 10.9%, respectively. However, with the outbreak of COVID-19 in 2020, private car usage increased, leading to a rebound in the road transport share, while rail and subway shares declined. In the maritime transport sector, the government's *Coastal Passenger Ship Safety Management Plan* resulted in record-high performance in 2017. Meanwhile, the share of aviation transport showed an overall upward trend due to the expansion of low-cost carrier services and increasing travel demand. However, both maritime and aviation transport experienced temporary declines in 2020 due to the impact of COVID-19, followed by signs of recovery starting in 2021.

<Table Ⅱ-9> Trends in Modal Share of Passenger Transport

Modal		2013	2014	2015	2016	2017	2018	2019	2020	2021
Total	Passengers (Thousands)	30,067,308	30,507,071	31,029,472	33,158,711	33,336,713	33,595,785	33,972,470	29,197,761	34,144,138
	Share(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Road	Passengers (Thousands)	26,327,678	26,678,513	27,193,794	28,090,714	28,192,366	28,409,618	28,649,339	25,361,540	30,168,830
	Share(%)	87.5	87.4	87.6	84.7	84.6	84.6	84.3	86.9	88.4
Subway	Passengers (Thousands)	2,476,394	2,526,167	2,522,900	3,572,127	3,604,712	3,618,352	3,705,150	2,677,582	2,759,948
	Share(%)	8.2	8.3	8.1	10.8	10.8	10.8	10.9	9.2	8.1
Rail	Passengers (Thousands)	1,224,820	1,263,472	1,269,417	1,449,534	1,490,319	1,521,590	1,570,415	1,122,872	1,170,749
	Share(%)	4.1	4.1	4.1	4.4	4.5	4.5	4.6	3.8	3.4
Aviation	Passengers (Thousands)	22,353	24,648	27,980	30,913	32,406	31,600	32,981	25,164	33,147
	Share(%)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maritime	Passengers (Thousands)	16,063	14,271	15,381	15,423	16,910	14,625	14,585	10,603	11,464
	Share(%)	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0

Source: 2022 National Transportation Statistics (Domestic Edition), (Ministry of Land, Infrastructure and Transport, 2023)

Domestic freight transport volume had been steadily increasing since 2013, reaching its peak in 2018, but subsequently declined due to the impact of COVID-19. In 2021, as road freight

transport volume recovered, the overall freight transport volume also returned to an upward trend. In 2021, road transport accounted for the highest share of freight transport by mode, followed by maritime, rail, and aviation transport. However, rail and aviation transport have shown a declining trend in modal share compared to road transport.

<Table Ⅱ-10> Trends in Modal Share of Freight Transport

Modal		2013	2014	2015	2016	2017	2018	2019	2020	2021
Total	Freight (kt)	1,704,342	1,668,282	1,927,284	1,975,640	2,028,558	2,047,201	1,983,572	1,926,889	1,990,292
	Share(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Road	Freight (kt)	1,546,407	1,512,700	1,761,291	1,799,565	1,854,011	1,895,686	1,847,241	1,788,917	1,848,182
	Share(%)	90.7	90.6	91.3	91.1	91.4	92.6	93.1	92.8	92.9
Maritime	Freight (kt)	117,860	117,920	128,611	143,227	142,587	120,327	107,408	111,513	115,125
	Share(%)	6.9	7.1	6.7	7.2	7.0	5.9	5.4	5.8	5.8
Rail	Freight (kt)	39,822	37,379	37,094	32,555	31,670	30,915	28,664	26,277	26,780
	Share(%)	2.3	2.2	1.9	1.6	1.6	1.5	1.4	1.4	1.3
Aviation	Freight (kt)	253	283	288	293	290	273	259	182	205
	Share(%)	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0

Source: 2022 National Transportation Statistics (Domestic Edition), (Ministry of Land, Infrastructure and Transport, 2023)

The cumulative registered number of motor vehicles, a representative mode of transportation, steadily increased by 2-3% annually since 2013, reaching 25.5 million by the end of 2022. This growth was primarily driven by an increase in the number of vehicles per household and the rise of single-person households. By vehicle type, passenger cars accounted for the largest share, followed by vans, trucks, and special-purpose vehicles.

In 2022, the cumulative number of registered vehicles by fuel type showed that gasoline and diesel vehicles were the most prevalent, followed by LPG, hybrid, electric, and hydrogen vehicles. Compared to 2013, the number of gasoline and diesel vehicles increased by 28.4% and 31.9%, respectively, while LPG vehicles saw a decline. In contrast, eco-friendly

vehicles experienced a significant surge during the same period, particularly electric and hybrid vehicles. Hydrogen vehicles have also steadily increased since 2015, surpassing 10,000 units in 2020, and continued their growth in 2022. The rapid increase in eco-friendly vehicle registrations can be attributed to government policies promoting and supporting such vehicles, as well as growing market demand.

<Table Ⅱ-11> Trends in Registered Vehicles

(Unit: 10,000 vehicle)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total		1,940.1	2,011.8	2,099.0	2,180.3	2,252.8	2,320.3	2,367.7	2,436.6	2,491.1	2,550.3
Internal Combustion Engine	Total	1,918.7	1,986.3	2,068.8	2,143.0	2,205.1	2,259.4	2,292.3	2,338.2	2,357.7	2,373.2
	Gasoline	940.0	958.7	980.9	1,009.2	1,037.0	1,062.9	1,096.1	1,141.0	1,176.0	1,206.9
	Diesel	739.6	793.9	862.2	917.0	957.6	993.0	995.8	999.2	987.2	975.8
	LPG	239.2	233.7	225.7	216.7	210.5	203.5	200.5	197.9	194.6	190.5
Eco-friendly	Total	10.5	14.0	18.0	24.4	33.9	46.2	60.1	82.0	115.9	159.0
	Hybrid	10.4	13.8	17.5	23.3	31.4	40.5	50.6	67.4	90.8	117.1
	Electric	0.1	0.3	0.6	1.1	2.5	5.6	9.0	13.5	23.1	39.0
	Hydrogen	-	-	0.0	0.0	0.0	0.1	0.5	1.1	1.9	3.0
Other Fuels		10.8	11.5	12.1	12.9	13.8	14.7	15.3	16.4	17.5	18.1

Source: Vehicle Registration Status Report (Ministry of Land, Infrastructure and Transport)

1.2.5 Agriculture, Livestock farming and Fisheries

The agriculture, livestock farming and fisheries sector encompasses the production of food through crop cultivation, livestock breeding, and the harvesting, aquaculture, and processing of marine resources. The ROK has experienced a steady decrease in grain consumption due to increasing trends in dining out, westernization of dietary habits, and preference for convenience foods, while meat consumption has continued to rise.[25)26)] Seafood consumption has also shown an upward trend due to rising national income and growing health consciousness.

In the household sector, the annual per capita grain consumption in 2022 was 64.7kg, representing a 14.1% (10.6kg) decrease compared to 2013, with an average annual decline of 1.7% since 2013. Rice consumption, which accounts for the majority (87.7%) of total

25) Source: "Forecast of Declining Rice Consumption, Need to Implement Policies Reflecting Consumption Changes" (Press release, Korea Rural Economic Institute, 2019.06.13)
26) Source: Meat Consumption Status (Korea Meat Trade Association)

grain consumption, has been decreasing at an annual rate of 1.9% since 2013.[27)]

The total amount of chemical fertilizers used for crop cultivation in 2022 was 410 kt, showing a 10.7% (49 kt) decrease compared to 2013. The amount used per unit area was 255kg/ha, representing a 2.7% (7kg/ha) decrease from 2013. The total amount of chemical fertilizer use has continuously decreased due to reduced cultivation area following declining rice consumption, while the amount used per unit area has maintained levels similar to previous years.[28)]

Livestock excreta production in 2022 reached 139,353 tonnes/day, showing a 3.1% (4,227 tonnes/day) increase compared to 2013. By livestock type in 2022, cattle accounted for 59,174 tonnes/day (42.5%), pigs for 55,344 tonnes/day (39.7%), and other livestock (poultry, horses, sheep, goats, deer, etc.) for 24,835 tonnes/day (17.8%). The amount of livestock excreta has been continuously increasing due to growing livestock numbers in response to increased meat consumption. Of the livestock excreta produced in 2022, 79.5% was self-managed independently, with the majority being recycled into compost or liquid fertilizer.

27) Source: Grain Consumption Survey (Statistics Korea)
28) Source: Pesticide and Chemical Fertilizer Consumption (K-indicator)

<Table Ⅱ-12> Trends in Livestock Excreta Production and Management

			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number of Livestock Farms (Households)			212,794	213,599	194,823	192,982	201,745	197,026	198,229	194,665	178,197	178,069
Livestock Population (Thousands)			235,144	240,176	236,801	252,197	258,492	261,477	291,996	247,111	246,541	233,255
Livestock Excreta Production (tonnes/day)	Total		135,126	136,627	134,562	138,205	137,701	144,313	153,220	139,753	142,027	139,353
	Swine		53,322	55,227	54,268	56,291	56,229	58,614	60,883	56,270	56,439	55,344
	Cattle		40,696	40,004	39,072	39,854	39,393	42,121	45,284	44,921	46,676	47,911
	Dairy Cattle		17,230	17,075	17,101	16,292	15,562	16,772	17,324	12,411	12,765	11,263
	Other Livestock		23,878	24,321	24,120	25,769	26,517	26,805	29,730	26,152	26,148	24,835
Livestock Excreta Management (tonnes/day)	Self-Management	Total	104,315	103,922	102,488	114,035	110,810	115,779	122,319	113,520	114,239	110,744
		Composting	89,608	88,559	88,620	101,122	99,579	105,653	107,768	98,659	100,198	87,934
		Liquid Fertilizer	7,256	8,010	7,203	5,560	4,725	3,678	5,287	6,800	6,709	11,018
		Wastewater Treatment	5,623	5,595	4,771	5,725	5,032	6,060	9,129	7,966	7,274	11,758
		Untreated	1,829	1,758	1,896	1,627	1,475	388	135	94	57	33
	Outsourced Management*	Total	30,811	32,705	32,073	24,170	26,891	28,534	30,901	26,233	27,788	28,609
		Composting	-	-	-	-	-	-	9,107	6,074	5,666	6,144
		Liquid Fertilizer	-	-	-	-	-	-	10,882	10,263	11,676	11,526
		Wastewater Treatment	-	-	-	-	-	-	10,473	9,461	9,931	10,134
		Untreated	-	-	-	-	-	-	440	436	515	805

* Detailed breakdown of outsourced management methods was not surveyed prior to 2018.
Source: Livestock excreta Treatment Statistics (Ministry of Environment)

The production of compound feed in 2022 reached 21,413 kt, showing a 13% (2,477 kt) increase compared to 2013, attributed to increased demand from growing livestock numbers. By livestock type, feed for pigs and poultry accounted for the largest proportion, while feed for beef cattle showed a slight decrease. The production of dairy cattle feed decreased due to declining dairy cattle numbers, reducing its share in total compound feed production.[29)]

In the fisheries sector, the number of registered fishing vessels peaked at 95,890 vessels in 2000 but has steadily decreased to 64,385 vessels in 2022. This reduction results from the coastal

29) Source: Compound Feed Production and Raw Material Usage Statistics, Ministry of Agriculture, Food and Rural Affairs

fishing and offshore vessel reduction program aimed at protecting marine resources. As of 2022, registered coastal and offshore fishing vessel account for 60.7% of total vessels, showing a 43.1% decrease compared to 2000. Meanwhile, aged vessels over 21 years old numbered 23,103 as of 2022, accounting for 35.9% of total vessels, with this proportion continuing to increase due to restrictions on new fishing permits under the vessel reduction program.[30)]

<Table Ⅱ-13> Trends in Registered and Aged Fishing Vessels

(Unit: vessel)

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	Registered	71,287	68,417	67,226	66,970	66,736	65,906	65,835	65,744	65,531	64,385
	Aged	11,193	10,734	11,698	13,102	14,247	15,511	17,771	19,841	21,905	23,103
Distant Water	Registered	315	368	348	258	213	208	211	199	192	194
	Aged	286	337	319	230	185	182	184	173	162	168
Offshore	Registered	2,780	2,714	2,643	2,640	2,730	2,720	2,677	2,613	2,492	2,372
	Aged	682	729	765	891	952	1,002	998	957	942	891
Coastal	Registered	44,713	43,116	42,692	41,166	39,607	38,399	37,785	37,271	37,062	36,694
	Aged	5,116	5,393	6,598	7,216	7,979	8,671	9,798	10,944	12,247	13,426
Aqua-culture	Registered	16,772	16,992	16,976	17,716	18,095	18,913	19,347	18,707	18,915	19,148
	Aged	3,011	2,991	3,102	3,143	3,352	3,888	4,552	4,946	5,513	6,021
Inland	Registered	2,908	3,150	3,101	3,091	3,012	3,009	3,067	3,081	3,001	2,943
	Aged	301	407	538	684	721	826	928	1,119	1,177	1,152
Other	Registered	3,799	2,077	1,466	2,099	3,079	2,657	2,748	3,873	3,869	3,034
	Aged	1,797	877	376	938	1,058	942	1,311	1,702	1,864	1,445

Source: Registered Fishing Vessel Statistics (Ministry of Oceans and Fisheries)

30) Source: "Total number of fishing vessels in 2022 reaches 64,385. Influenced by the fishing vessel reduction program for fisheries resource management" (Press release, Ministry of Oceans and Fisheries, 2023.06.29)

1.2.6 Waste

The waste sector encompasses the treatment of waste generated from daily life and economic activities through methods such as landfilling, incineration, and recycling. the ROK's waste generation had been steadily increasing due to industrial production and construction activities before showing a slight decrease in 2022. Since 2013, waste generation has increased at an average annual rate of 3.0%, reaching 186.45 million tonnes in 2022, representing a 29.9% increase compared to 2013.

<Table Ⅱ-14> Trends in Waste Generation by Type

(Unit: 10,000 tonnes/year)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	14,348	14,660	15,265	15,663	15,678	16,283	18,149	19,546	19,738	18,645
Municipal Waste	1,778	1,822	1,871	1,962	1,952	2,045	2,115	2,254	2,269	2,304
Industrial Waste	5,418	5,591	5,669	5,918	6,018	6,122	7,396	8,087	8,490	8,106
Construction Waste	6,699	6,766	7,236	7,280	7,164	7,554	8,070	8,644	8,381	7,618
Designated Waste	453	481	489	503	544	562	568	561	598	617

Source: National Waste Generation and Treatment Status (Resource Circulation Information System)

In 2022, industrial waste, consisting of slag, dust, and sludge, accounted for the largest proportion at 43.5% of total waste generation. This was followed by construction waste at 40.9%, municipal waste at 12.4%, and designated waste[31] at 3.3%. The proportions of industrial and construction waste fluctuate according to industrial activity and construction market conditions. The average annual growth rates from 2013 to 2022 were 2.9% for municipal waste, 4.6% for industrial waste, 1.4% for construction waste, and 3.5% for designated waste. Notably, in 2020, municipal waste generation increased by 6.5% compared to 2019, primarily due to increased waste paper and plastic waste generation resulting from the expansion of non-face-to-face consumption (online shopping, food delivery, etc.) during the COVID-19 pandemic.

Waste treatment, which includes collection, transportation, storage, recycling, and disposal of generated waste, has fluctuated in accordance with waste generation volumes. While waste

31) Designated waste refers to industrial waste, such as waste oil, waste acid, or medical waste, that can harm the surrounding environment or pose risks to human health.

treatment previously relied primarily on landfilling, the introduction of the volume-based waste fee system and separate collection of recyclables has significantly expanded the proportion of recycling. As of 2022, recycling accounts for 86.8% of total waste treatment, maintaining over 80% consistently since 2013. The remaining treatment methods comprise incineration at 5.2%, landfilling at 5.1%, and other treatment methods at 2.9%,[32] with non-recycling treatment methods showing a declining trend. From 2013 to 2022, the average annual growth rate for recycling was 3.4%, while landfilling decreased by 4.2%, and incineration remained relatively stable with a 0.7% change.

<Table Ⅱ-15> Trends in Waste Treatment by Method

(Unit: 10,000 tonnes/year)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	14,348	14,660	15,265	15,663	15,678	16,283	18,149	19,546	19,738	18,645
Recycling	11,932	12,294	12,878	13,279	13,383	14,025	15,708	17,076	17,161	16,188
Ladnfill	1,386	1383	1380	1385	1297	1265	1114	1002	1046	944
Incineration	914	895	952	965	960	964	948	1015	979	977
Other	116	88	55	34	38	29	379	453	552	536

Source: National Waste Generation and Treatment Status (Resource Circulation Information System)

1.2.7 Carbon sinks

The carbon sinks sector encompasses the role of terrestrial and coastal ecosystem vegetation and soil in absorbing and storing atmospheric carbon. As of 2020, the ROK's forest area was 6,298 kha, accounting for 62.7% of the total land area, ranking fourth highest among OECD countries after Finland (73.7%), Sweden (68.7%), and Japan (68.4%). Forest area has decreased by 0.58% (36 kha) compared to 2015 due to deforestation to other uses such as road construction and housing development.

Compared to 2011, coniferous forest area decreased by 9.5% (245 kha), while deciduous forest area increased by 16.7% (287 kha). Mixed forest area decreased by 10.2% (189 kha) compared to 2011.

32) Since 2019, the calculation method for "Others" has been revised to include intermediate disposal methods (e.g., mechanical, chemical, biological treatments) excluding incineration, as well as marine emissions.

<Table Ⅱ-16> Trends in Forest Area by Type

(Unit: kha)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	6,348	6,340	6,339	6,342	6,335	6,326	6,318	6,306	6,299	6,298
Coniferous	2,569	2,562	2,557	2,552	2,339	2,333	2,329	2,321	2,314	2,324
Broadleaved	1,719	1,719	1,718	1,721	2,029	2,025	2,021	2,018	2,012	2,006
Mixed	1,855	1,844	1,838	1,830	1,706	1,703	1,699	1,693	1,688	1,666
Bamboo	7	7	7	7	22	22	22	20	20	20
Non-stocked	197	207	219	233	239	243	247	254	265	282

Source: 2020 Forest Basic Statistics (Korea Forest Service)

Forest age class distribution as of 2020 shows that age classes 4-5 (31-50 years) account for 76% of total forest area. While age class 6 and above currently accounts for only 6%, it is projected to increase to 35% by 2030 and 80% by 2050 if the current forest age structure is maintained. This concentration in specific age classes results from the large-scale national forestation efforts conducted in the 1970-1980s.

As of 2023, coastal wetland area is 2,443.3 km², accounting for approximately 2.4% of the national land area. Coastal wetland area has decreased by 1.6% (38.7 km²) compared to 2018 due to reclamation for port areas, residential areas, and industrial sites.[33] Tidal flat ecological surveys conducted from 2015 to 2022 identified 42 halophyte communities in the second cycle (2017-2018), 45 in the third cycle (2019-2020), and 38 in the fourth cycle (2021-2022). The community area was 1,501,404 m² in the first cycle (2015-2016), 1,790,954 m² in the second cycle, 3,955,715 m² in the third cycle, and 2,324,343 m² in the fourth cycle. The decrease in community area during the fourth cycle is attributed to factors such as abnormal weather conditions including high temperature, drought, and high salinity during germination periods, as well as tidal flat sedimentation patterns affecting the characteristics of halophyte vegetation.[34]

<Table Ⅱ-17> Number and Total Area of Halophyte Plant Communities

	Average	1st Cycle (2015-2016)	2nd Cycle (2017-2018)	3rd Cycle (2019-2020)	4th Cycle (2021-2022)
Number of Communities (Unit)	41.6	-	42	45	38
Total Community Area (m^2)	2,393,104	1,501,404	1,790,954	3,955,715	2,324,343

Source: National Marine Ecosystem Monitoring Program 2022 (Ministry of Oceans and Fisheries, 2022)

33) Source: Status of Coastal Wetland Area, Ministry of Oceans and Fisheries
34) Source: National Marine Ecosystem Comprehensive Survey 2022 (Ministry of Oceans and Fisheries, 2022)

1.3 Institutional Arrangement to track progress in implementing and achieving the NDC

1.3.1 Governance for Tracking NDC Progress

The ROK has operated the Presidential Committee on Green Growth since 2009, based on the Framework Act on Low Carbon, Green Growth (January 2010), which established fundamental directions for low-carbon green growth policies and implemented the *National Green Growth Strategy* (July 2009), *Basic Plan for Coping with Climate Change*, *Basic Plans for Energy*, and *Basic Plans for Sustainable Development*. In May 2021, the government integrated the National Council on Climate and Air Quality and the Presidential Committee on Green Growth to establish the 2050 Carbon Neutrality Commission (Carbon Neutrality Commission), a public-private governance body under the direct authority of the President, as the implementation system for 2050 carbon neutrality.

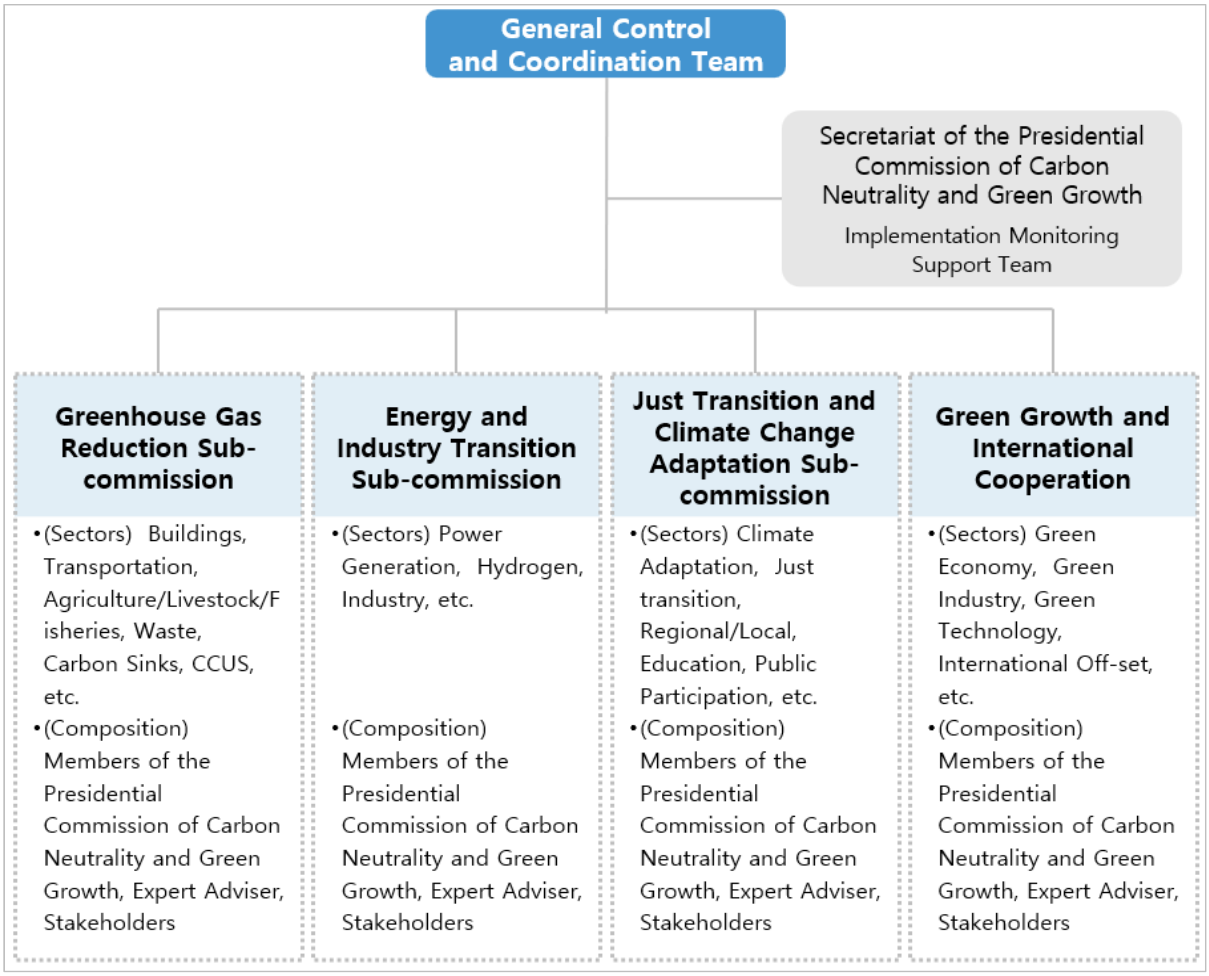
Following its establishment, Carbon Neutrality Commission developed the *2050 Carbon Neutrality Scenarios* (October 2021) and the *Enhanced Update of its First Nationally Determined Contribution* (October 2021), establishing milestones for achieving 2050 carbon neutrality. These documents present a blueprint for the ROK's economic and social transformation over 30 years.

In March 2022, with the implementation of the Carbon Neutrality Act, the CNC was renamed to the Carbon Neutrality and Green Growth Commission with expanded functions and roles. Carbon Neutrality and Green Growth Commission has reestablished its legal status as a governance body that incorporates opinions from all sectors of society and performs a pivotal role in achieving carbon neutrality.

Carbon Neutrality and Green Growth Commission serves as the key institution for tracking the ROK's implementation of the NDC through: ⅰ) establishing basic directions for transitioning to a carbon-neutral society and promoting green growth; ⅱ) setting and monitoring national vision, mid-to-long-term reduction targets, and national basic plans; ⅲ) establishing, modifying, and monitoring national climate crisis adaptation measures; ⅳ) promoting public understanding, communication, and international cooperation related to carbon neutrality.

In June 2023, the Carbon Neutrality and Green Growth Commission deliberated and approved the Plan for Implementation Review of 2023 Carbon Neutrality and Green Growth and established the Monitoring Group for Carbon Neutrality and Green Growth Implementation. This monitoring group includes committee members, expert members, youth and future generations, and civil society organizations, ensuring reliability and transparency in the transition to a carbon-neutral society by reflecting diverse stakeholder opinions. The monitoring group comprises four sectoral inspection teams and a general coordination team. The sectoral teams conduct efficient assessments through the participation of the Carbon Neutrality and Green Growth Commission-appointed members, experts, and stakeholders. After reviewing the 2022 GHG reduction achievements and the implementation of the *First National Framework Plan for Carbon Neutrality and Green Growth* (Carbon Neutrality Framework Plan) (April 2023), the inspection body presented policy recommendations and areas for improvement, and identified and highlighted best practices.[35] These assessment results are expected to serve as crucial reference material for establishing the NDC implementation roadmap.[36]

35) Source: Launch of an Inspection Team for the Implementation Management of Carbon Neutrality and Green Growth (Press Release by the Presidential Commission on Carbon Neutrality and Green Growth, 2023.07.26)
36) Source: 2022 Carbon Neutrality and Green Growth Implementation Inspection Results (Presidential Commission on Carbon Neutrality and Green Growth, 2023)



[Figure Ⅱ-11] Carbon Neutrality and Green Growth Implementation Inspection Team

Source: Launch of an Inspection Team for the Implementation Management of Carbon Neutrality and Green Growth (Press Release by the Presidential Commission on Carbon Neutrality and Green Growth, July 26, 2023)

1.3.2 Legal, Institutional, Administrative, and Procedural Arrangements

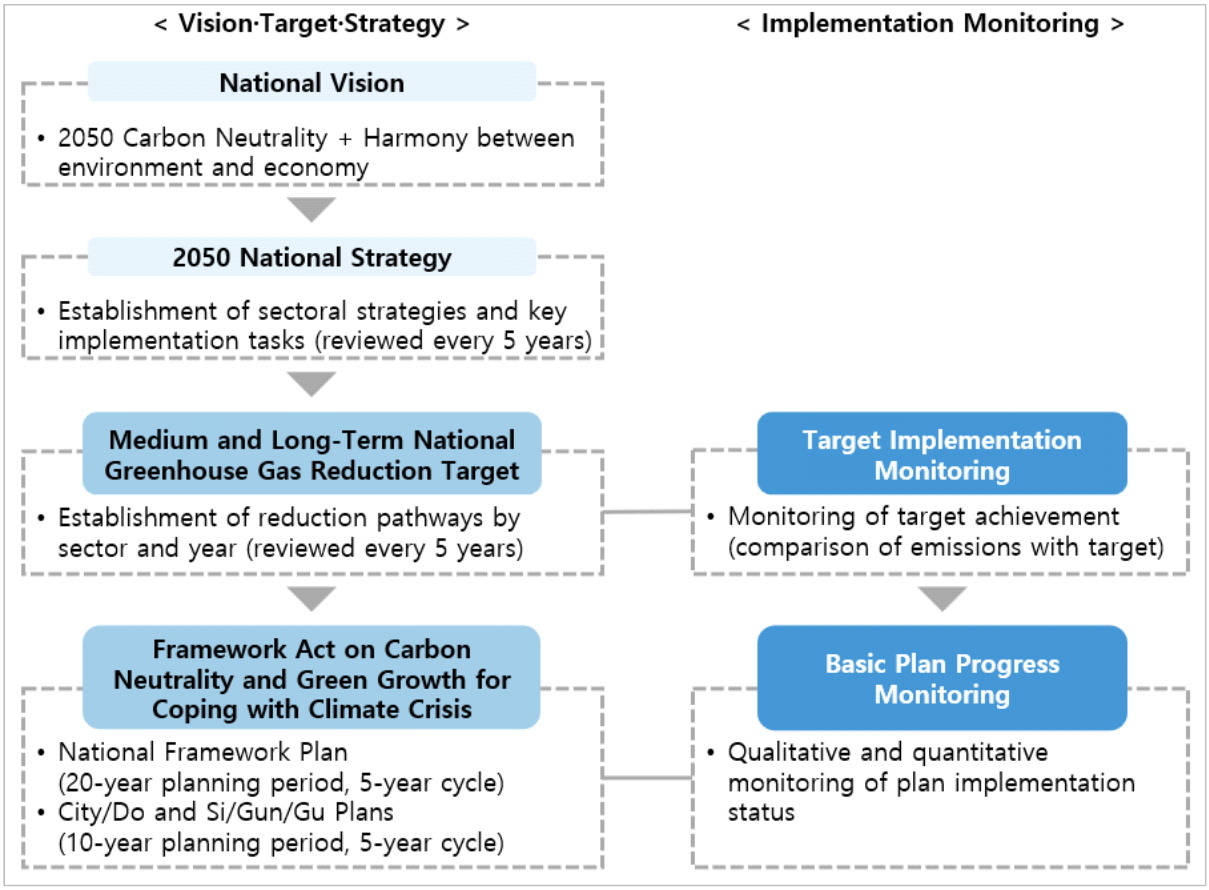
Since 1999, the ROK established a foundation for its climate change response policies. This began with the development of three iterations of the Comprehensive Strategies for Responding to the UNFCCC through the Technical Working Group Meeting on the Climate Change Convention, which operated from 1999 to 2007. Subsequently, the *Basic Plan for Climate Change Response* was introduced in September 2008. In 2014, the ROK voluntarily set a national GHG reduction target to reduce emissions by 30% compared to the Business-As-Usual (BAU) scenario by 2020,[37] thereby establishing foundation for the policy framework on climate change response.

37) The BAU scenario projects future GHG emissions assuming no additional mitigation efforts are implemented and current trends continue.

The ROK submitted its *Intended Nationally Determined Contributions* (INDC) in 2015, setting a target to reduce GHG emissions by 37% compared to the BAU scenario by 2030, and developed a detailed roadmap for achieving this target in 2016. Additionally, based on the *Plan to Strengthen Climate Change Response Systems for Effective Implementation of the Paris Agreement*, which was jointly prepared by relevant ministries under the leadership of the Office for Government Policy Coordination, the climate response framework was restructured. This involved shifting responsibility for climate action oversight from the Ministry of Environment to a system led jointly by the Prime Minister and the Deputy Prime Minister for Economic Affairs. Building on this pan-government response framework, the ROK developed the *First Basic Plan for Coping with Climate Change* in December 2016, a 20-year plan addressing climate change projections and mitigation and adaptation responses. This was followed by the *Second Basic Plan for Coping with Climate Change* in October 2019, further expanding and formalizing the national climate response system.

In line with the international community's full-scale discussions on carbon neutrality in 2020, the Carbon Neutrality Act was enacted in 2021 to replace the existing Green Growth Act.

The Carbon Neutrality Act includes the following key provisions: ⅰ) establishes the vision of achieving carbon neutrality by 2050, ensuring harmony between environmental protection and economic growth. It formalizes national strategies and mid- to long-term GHG reduction targets, including a specific goal to reduce GHG emissions by more than 35% by 2030 compared to 2018 levels. Furthermore, both the national government and local governments are also mandated to set reduction targets and plans. A system to monitor progress and assess the achievement of these goals is also in place, ⅱ) through the Carbon Neutrality and Green Growth Commission, creates the highest level of public-private governance to deliberate and decide on policies, targets, and implementation monitoring related to the climate crisis, ⅲ) mandates measures such as Climate Change Impact Assessments, Greenhouse Gas Reduction Cognitive Budget, Internationally Transferred Mitigation Outcomes, ⅳ) lays the foundation for implementing comprehensive climate crisis responses, including adaptation to climate change, just transition, and green growth, ⅴ) provides for the creation of Climate Response Fund to secure financial resources for industrial restructuring and climate crisis response initiatives.



[Figure Ⅱ-12] Framework for Carbon Neutrality Implementation

Source: Legislation of Carbon Neutrality Vision and Greenhouse Gas Reduction Commitment, Moving Towards a 2050 Carbon Neutral Society (Office for Government Policy Coordination Press Release, March 22, 2022)

2. ROK's Nationally Determined Contribution

2.1 NDC Target

2.1.1 History of Establishing and Updating NDC Targets

With the adoption of the Paris Agreement in 2015, a new climate regime was launched with participation from both developed and developing countries. Under the Paris Agreement's goal to hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C, all parties are required to submit their NDCs to the UNFCCC every five years from 2020.

The ROK established its Intended Nationally Determined Contribution (INDC) in June 2015 and announced to the international community its target to reduce GHG emissions by 37% compared to the BAU levels by 2030. In 2016, the government published the *Roadmap for the 2030 NDC* (December 2016), presenting systematic implementation measures for the achievement of the NDC. Subsequently, as energy transition and fine dust reduction measures were strengthened, the reduction strategy required modification. In 2018, the government reaffirmed its commitment through the *Revised roadmap for the 2030 NDC* (July 2018), which expanded domestic reduction shares (sectoral reduction amounts) within the existing reduction target, reaffirming the ROK's strong commitment to GHG reduction.[38)]

Recognizing the limitations of the BAU approach, the ROK initiated discussions to transition to an absolute reduction target method to enhance implementation monitoring effectiveness and international credibility. Consequently, in December 2020, the ROK submitted its update of its First NDC to the UNFCCC, targeting a 24.4% reduction from 2017 levels (26.3% from 2018 levels), and submitted it alongside the 2050 Long-term Low Greenhouse Gas Emission Development Strategy (LEDS) (December 2020). This aligned with Article 4.4 of the Paris Agreement, which states that developed country Parties should undertake absolute emission reduction targets, while developing country Parties should continue enhancing their mitigation efforts and are encouraged to move over time towards economy-wide emission reduction targets.

38) The overall reduction target remains the same, but the proportion of domestic and overseas reductions has been adjusted from 25.7% domestic and 11.3% overseas to 32.5% domestic and 4.5% overseas.

Following the ROK's declaration of carbon neutrality, a Technical Advisory Body was established to align the preparation of the 2050 Carbon Neutrality Scenarios with the updated NDC. Efforts were made to review and enhance the NDC targets, taking into account the objectives of the Carbon Neutrality Act, international trends, and domestic conditions. As a result, for the first time since the initial establishment of the INDC in 2015, the ROK significantly revised its reduction targets, finalizing its Enhanced Update of its First NDC in October 2021 to achieve a 40% reduction in GHG emissions by 2030 compared to 2018 levels. This enhanced commitment was announced to the international community during the 26th UN Climate Change Conference of the Parties (COP26) and was officially submitted to the UNFCCC in December of the same year.

<Table Ⅱ-18> NDC Formulation and Updating Process

	2030 National GHG Reduction Target (June 2015)	National Roadmap for GHG Reductions by 2030 (December 2016)	Revised National Roadmap for GHG Reductions by 2030 (July 2018)	Updated 2030 Nationally Determined Contribution (NDC) (December 2020)	Enhanced 2030 Nationally Determined Contribution (NDC) (October 2021)
Sector	-	8 sectors and 30 industries	8 sectors		7 sectors
Reduction Target	37% reduction compared to 2030 BAU* (* 850.6 million $MtCO_2$-eq)			24.4% reduction compared to 2017 total emissions* (* 709.1 $MtCO_2$-eq)	40% reduction compared to 2018 total emissions* (* 727.6 $MtCO_2$-eq)

2.1.2 NDC Description

The Enhanced NDC targets a reduction of 40% (291 $MtCO_2$-eq) from 2018 total emissions (727.6 $MtCO_2$-eq), aiming to reduce net emissions to 436.6 $MtCO_2$-eq by 2030. The reduction target is set as an absolute value, calculated by subtracting 2030 net emissions (including LULUCF) from 2018 total emissions (excluding LULUCF). The average annual reduction rate of 4.17%/year presents a more ambitious target compared to major developed countries such as the EU (1.98%/year), USA (2.81%/year), and Japan (3.56%/year).

The NDC implementation period is from 2021 to 2030, with the target year being 2030 (single year target). The target covers seven sectors - power generation, industry, building, transportation, agriculture/livestock farming/fisheries, waste, and carbon sinks (LULUCF) - and six GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6).

Following the NDC submission in 2021, the Carbon Neutrality Framework Plan was established under the Carbon Neutrality Act, defining and organizing key sectoral policy measures to achieve the NDC. Additionally, the ROK is expanding public-private cooperation projects and investments while establishing a foundation for international mitigation projects to utilize *Internationally Transferred Mitigation Outcomes* (ITMOs) under Article 6 of the Paris Agreement as a complementary measures for achieving its NDC.

<Table Ⅱ-19> Key Elements of the Enhanced NDC

	Information
Target	The Republic of Korea's updated NDC target is to reduce 40% from the total national GHG emissions in 2018, which is 727.6 $MtCO_2eq$, by 2030. The Republic of Korea plans to use voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure to its domestic mitigation efforts including LULUCF to achieve its target
Target Type	Single-year reduction target
Target Year	2030
Base Year, Reference point	2018, 727.6 $MtCO_2$-eq (excluding LULUCF)
Implementation Period	2021.01.01-2030.12.31
Sectors	Power Generation, Industry, Building, Transportation, Agriculture/Livestock Farming/Fisheries, Waste, Carbon Sinks (LULUCF)
Gases	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Use of ITMOs	Plan to utilize voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure
Update of Previously Reported Information	Strengthening the reduction target from 26.3% to 40% compared to 2018 total emissions (excluding LULUCF)
Methodologies	・The following methodologies are applied to ensure transparency, accuracy, completeness, comparability, consistency principles, and environmental integrity while preventing double counting when calculating emissions and removals [Methodologies] - Calculated based on Decision 24/CP.19 and the 1996 IPCC GL - Partial application of IPCC GPG 2000, IPCC GPG-LULUCF 2003, and 2006 IPCC GL [Common Metrics] IPCC Second Assessment Report (SAR) Global Warming Potentials (GWPs)

2.2 Information Necessary to Track Progress in Implementing and Achieving the NDC

2.2.1 Indicators

The key indicator selected in the 1st BTR to evaluate the progress in implementing and achieving the NDC is annual total GHG emissions (excluding LULUCF). This indicator is calculated as the sum of GHG emissions from energy, industrial processes, agriculture, and other sectors, excluding the Land Use, Land-Use Change and Forestry (LULUCF) sector.

2.2.2 Methodology

In accordance with Article 4, paragraphs 13 and 14 of the Paris Agreement, the *Intergovernmental Panel on Climate Change Guidelines* for National GHG Inventories (IPCC GL) were applied as the NDC estimation methodology to ensure environmental integrity, transparency, accuracy, completeness, comparability, consistency in estimating emissions and removals, and to prevent double counting.

The methodologies for calculating emissions and removals were primarily based on Decision 24/CP.19 and the 1996 IPCC GL with Global Warming Potentials (GWP) from the *IPCC Second Assessment Report* applied as common metrics. Some estimation methodologies applied the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (GPG 2000), the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (GPG-LULUCF 2003), and the 2006 IPCC GL. The sectors using the GPG 2000 are ⅰ) Energy: Civil aviation, ⅱ) Agriculture: Enteric fermentation and excreta management, ⅲ) Waste: Waste disposal in landfills, wastewater treatment, and waste incineration. The sectors applying the GPG-LULUCF 2003 include agricultural land and grassland in the LULUCF category. The detailed categories using the 2006 IPCC GL are: ⅰ) Energy: Fugitive emissions from natural gas systems, ⅱ) Industrial Processes: Nitric acid production, semiconductor and liquid crystal display manufacturing, and heavy electrical equipment, ⅲ) Agriculture: Rice cultivation and agricultural soils, ⅳ) LULUCF: Forest land and wetlands, ⅴ) Waste: Other subcategories.

Variables are applied differently according to calculation tiers, primarily using Tier 1, with Tier 2 methods applied in specific sectors. The sectors using the Tier 2 method are ⅰ) CO_2 from fuel combustion, (ⅱ) CH_4 and N_2O from public electricity and heat production, ⅲ) PFCs, HFCs, SF_6, and CO_2 from semiconductor and liquid crystal display manufacturing,

Agriculture Sector, iv) CH_4 from rice cultivation, v) N_2O from agricultural soils, vi) CO_2 from forest land (LULUCF), vii) CH_4 from waste disposal in landfills, viii) CH_4 from wastewater treatment, ix) N_2O from waste incineration.

The government systematically and continuously manages emission sources to include all possible sources in NDC estimation and maintain consistency thereafter. A Technical Advisory Body comprising sectoral experts conducts reviews by sector - power generation, industry, buildings, etc. - to ensure expertise and rationality in NDC estimation. Once established, the NDC is finalized through deliberation and resolution by the Carbon Neutrality and Green Growth Commission.

There are differences between the methodologies used for estimating the NDC and the National GHG Inventory reported in the *First Biennial Transparency Report* (BTR). According to Decision 18/CMA.1, national GHG inventories shall use the 2006 IPCC GL and the GWPs from the *IPCC Fifth Assessment Report* (AR5) for estimating emissions and removals. For the first time, the ROK included inventory information applying the 2006 IPCC GL and AR5 GWPs in Chapter 1 of its First BTR. However, the Enhanced NDC submitted in 2021 was estimated using the 1996 IPCC GL, leading to difference from the inventory information presented in Chapter 1 of the BTR and the NDC. Furthermore, information on Policies and Measures (PaMs) in this report was also calculated using the 1996 IPCC GL.

Meanwhile, ITMOs under Article 6 of the Paris Agreement are being pursued through bilateral agreements with countries such as Vietnam and Uzbekistan. However, no reduction outcomes have been generated yet. Therefore, reporting on the use of ITMOs for NDCs and measures to prevent double counting will be included in subsequent BTRs.

2.2.3 Tracking Progress in Implementing and Achieving NDC

While the ROK's enhanced NDC submitted to the UN in 2021 reported total emissions of 727.6 $MtCO_2$-eq for the base year 2018, this figure was recalculated to 732.9 $MtCO_2$-eq based on the latest statistics from December 2024. This report applies the updated figure of 732.9 $MtCO_2$-eq as the reference point.[39)]

Based on annual total GHG emissions, progress shows emissions of 690.8 $MtCO_2$-eq in 2021 and 671.2 $MtCO_2$-eq in 2022. The reduction level, based on total emissions for 2022, represents approximately 8.4% (61.7 $MtCO_2$-eq) compared to 2018, showing a 2.84% decrease from the previous year and marking two consecutive years of decline. As international mitigation projects are in their initial stages, information regarding ITMOs for NDC and measures to prevent double counting will be reported in subsequent BTRs.

<Table Ⅱ-20> Information on Tracking Progress in Implementing and Achieving NDC (CTF Ⅱ.4)

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress Status
			2021	2022			
Indicators and Related Information for Tracking Progress in Implementing and Achieving NDC							
Annual Total GHG Emissions	$MtCO_2$-eq	732.9	690.8	671.2	40%	2030	As of 2022, approx. 8.4% reduction compared to 2018
ITMOs Utilization	As international mitigation projects are at the initial stage, the ROK plans to report on NDC utilization of ITMOs and double counting prevention in its subsequent BTRs.						
NDC Achievement	As the ROK's NDC is a single-year target for 2030, achievement status cannot be verified in the First BTR						

1) Updated figures due to recalculation (727.6 → 732.9)
2) The ROK plans to use voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure to its domestic mitigation efforts including LULUCF to achieve its target.

39) Refer the comparison of criteria for estimating GHG emissions between 1996 IPCC GL and 2006 IPCC GL contained in NID.

3. Mitigation Policies and Measures

3.1 Overview

Various mitigation PaMs have been implemented based on the *Comprehensive Strategies for Responding to the UNFCCC*, the *Comprehensive Basic Plan for Climate Change Response* (September 2008), the *Basic Plan on New and Renewable Energy,* the *Master Plan for Rationalization of Energy Use, and* the *National Climate Change Adaptation Plan*. Following the establishment of the *First Basic Plan for Coping with Climate Change* (December 2016) under the *Framework Act on Low Carbon, Green Growth* (January 2010), mitigation and adaptation measures, financial support, and implementation monitoring in accordance with the Paris Agreement were comprehensively specified.

The *First Basic Plan for Coping with Climate Change* (December 2016) covers the period from 2017 to 2036 and consists of seven tasks: ⅰ) transition to low-carbon energy policy, ⅱ) cost-effective mitigation through market mechanisms, ⅲ) fostering climate response new industries and expanding investment in new technologies, ⅳ) advancing towards a climate-resilient society, ⅴ) enhancing carbon removal and circulation, ⅵ) strengthening international cooperation, and ⅶ) enhancing public participation base. Through these measures, it aims to efficiently respond to climate change and implement a low-carbon society.

The *Second Basic Plan for Coping with Climate Change* (October 2019) was formulated with the vision of implementing `a sustainable low-carbon green society. It presents sectoral mitigation PaMs by dividing GHG mitigation measures into sectors such as power generation, industry, buildings, transport, waste, public sector, agriculture and livestock farming, and carbon sinks. The main mitigation measures include: ⅰ) (Power generation) Improvement of energy mix, energy demand management, ⅱ) (Industry) Efficiency improvement, refrigerant replacement, fuel/raw material conversion, waste heat utilization, ⅲ) (Building) Enhanced insulation, facility improvement, Building Energy Management System (BEMS) expansion, ⅳ) (Transportation) Expansion of eco-friendly vehicles, fuel efficiency improvement, eco-friendly ships, biodiesel expansion, ⅴ) (Waste) Expanded recycling, methane gas recovery, ⅵ) (Public sector) Light Emitting Diode (LED) lighting replacement, expanded renewable energy use, ⅶ) (Agriculture/Livestock Farming) bio energy utilization, paddy water management, ⅷ) (Carbon Sinks) Carbon Capture, Utilization, and Storage (CCUS).

The implementation of GHG mitigation PaMs has been strengthened through institutional foundations such as the Climate Response Fund and the Greenhouse Gas Reduction Cognitive Budget with the enforcement of the Carbon Neutrality Act in April 2022. These measures have been integrated into the Carbon Neutrality Framework Plan and continue to serve as key PaMs for implementing the ROK's 2030 NDC. The following sections introduce major policies by sector.

3.2 Sectoral Mitigation Policies and Measures

3.2.1 Cross-Sector

Since the declaration of 2050 Carbon Neutrality in October 2020, which aims to achieve carbon neutrality by 2050, various measures for GHG mitigation have been pursued.

Various policies are being implemented across multiple sectors including power generation, industry, building, transportation, agriculture, livestock farming and fisheries, waste, and carbon sinks to achieve NDC. In addition to sector-specific mitigation policies, cross-sectoral policies such as the Korean Emission Trading System (K-ETS) and Target Management System have been established and implemented. The K-ETS applies to entities with average annual GHG emissions of 125 $ktCO_2$-eq or more over the recent three years, or those with at least one workplace emitting 25 $ktCO_2$-eq or more. While the K-ETS is principally operated in five-year phases, the first phase (2015-2017) and second phase (2018-2020) were set as three-year periods to closely monitor industrial impacts and improve the system in a timely manner during the initial implementation stage. From the third phase onwards, it operates in five-year periods.

The scope of the K-ETS has been continuously expanded. The first phase (2015-2017) covered 26 sectors and 591 companies, the second phase (2018-2020) included 65 sectors and 636 companies, and the third phase (2021-2025) encompasses 69 sectors and 713 companies with the addition of sectors such as railroads and shipping, covering approximately 73.5% of national GHG emissions.

The K-ETS has also expanded allocation auction and Benchmark (BM) allocation to directly and indirectly incentivize corporate GHG mitigation. During the first phase, all allowances were freely allocated to facilitate the stabilization of the system. However, starting from the second phase, 3% of allowances for business entities eligible for allocation of emission permits (business entities eligible for allocation) were auctioned, increasing to 10% in the third phase. BM allocation, which favors efficient companies within the same sector, was applied to 3 sectors in the first phase, 7 sectors in the second phase, and 12 sectors in the third phase to encourage efficiency improvements.

Corporate mitigation activities and investments have been incentivized through the activation of trading allowances market. Market liquidity has been enhanced by expanding third-party market participation, including market makers and securities firms. Additionally, auction revenues have been utilized to reduce corporate mitigation costs and achieve actual mitigation outcomes. Since 2022, the Climate Response Fund has been established using revenues from allowance auctions, supporting K-ETS participants with costs for carbon mitigation technologies and facility installation. In 2023, support was expanded from small and medium-sized enterprises (SMEs) to large companies subject to allowance auction, leading to enhanced mitigation effects.

Current system improvements are being pursued to enable the K-ETS to function as a substantial and efficient mitigation mechanism. Opinions have been widely gathered from various stakeholders including business entities eligible for allocation, academia, and civil society to identify areas for improvement. In 2022, the *K-ETS Improvement Plan* was established focusing on short-term improvements. In 2023, the *K-ETS Market Enhancement Plan* was announced to strengthen market functions. Mid- to Long-term system improvements were reviewed and reflected in the development of the *Fourth Master Plan for Emission Trading System* in 2024.

The Target Management System operates for enterprises with significant GHG emissions not covered by the K-ETS. Designated entities (controlled emitters) under this system are categorized by enterprise and relevant place of business, with the coverage of entities gradually expanding. Entities with average annual emissions of 50 $ktCO_2$-eq or more over the recent three years, or relevant place of business emitting 15 $ktCO_2$-eq or more are designated as controlled emitter. As of 2022, 355 entities are subject to the Target Management System.

<Table Ⅱ-21> Designation Criteria for Controlled Emitter

	Until 2011		From 2012		From 2014		From 2022.03	
	Entity level	Workplace level	Entity level	Workplace level	Entity level	Workplace level	Entity level	Workplace level
GHG Emissions($ktCO_2$-eq)	125	25	87.5	20	50	15	50	15
Energy Consumption(TJ)*	500	100	350	90	200	80	-	-

* Following the enactment of the Carbon Neutrality Act, energy consumption was removed from the designation criteria for controlled emitter from March 2022

Source: *The Fourth National Communication of the Republic of Korea under the UNFCCC* (Government of the Republic of Korea, 2019)

■ Emission Trading System ■

1. Overview

- The Emissions Trading System (ETS) is a market-based GHG mitigation mechanism that allocates annual emission allowances to facilities that meet the designated criteria for GHG emissions, allowing emissions only within the allocated limits.
- To implement the ETS, the ROK established a legal foundation by enacting the *Act on the Allocation and Trading of Greenhouse Gas Emission Permits* (May 2012) and its *Enforcement Decree* (November 2012).
- The ETS was launched in 2015 with the adoption of the *Master Plans for Emissions Trading System* (January 2014), which set the total emission allowances linked to NDC target, the *National Greenhouse Gas Emission Permit Allocation Plan for the First Planning Period (2015-2017)* (September 2014), and related Guidelines.

Master Plans for Emissions Trading System

	First Planning Period (2015-2017)	**Second Planning Period (2018-2020)**	**Third Planning Period (2021-2025)**
Main Objective	• Accumulating experience and stabilizing the ETS	• Achieving significant GHG reductions	• Implementation of effective mitigation measures
System Operation	• Enhancing system flexibility, including the expansion of offset recognition scope • Developing infrastructure for accurate Measurement, Reporting, and Verification (MRV)	• Expanding the trading system scope and adjusting targets upward • Strengthening standards for emissions reporting and verification	• Strengthening total allowance setting according to the roadmap • Enhancing market functions through the introduction of exchange-traded derivatives
Allocation Method	• Free allocation • Utilization of experience from the Target Management System	• Introducing auction-based allocation • Advancing allocation methodologies, including BM allocation	• Improvement of free allocation sector criteria and expansion of auctioning ratio • Expansion of BM allocation

2. Designation Criteria for ETS Facilities

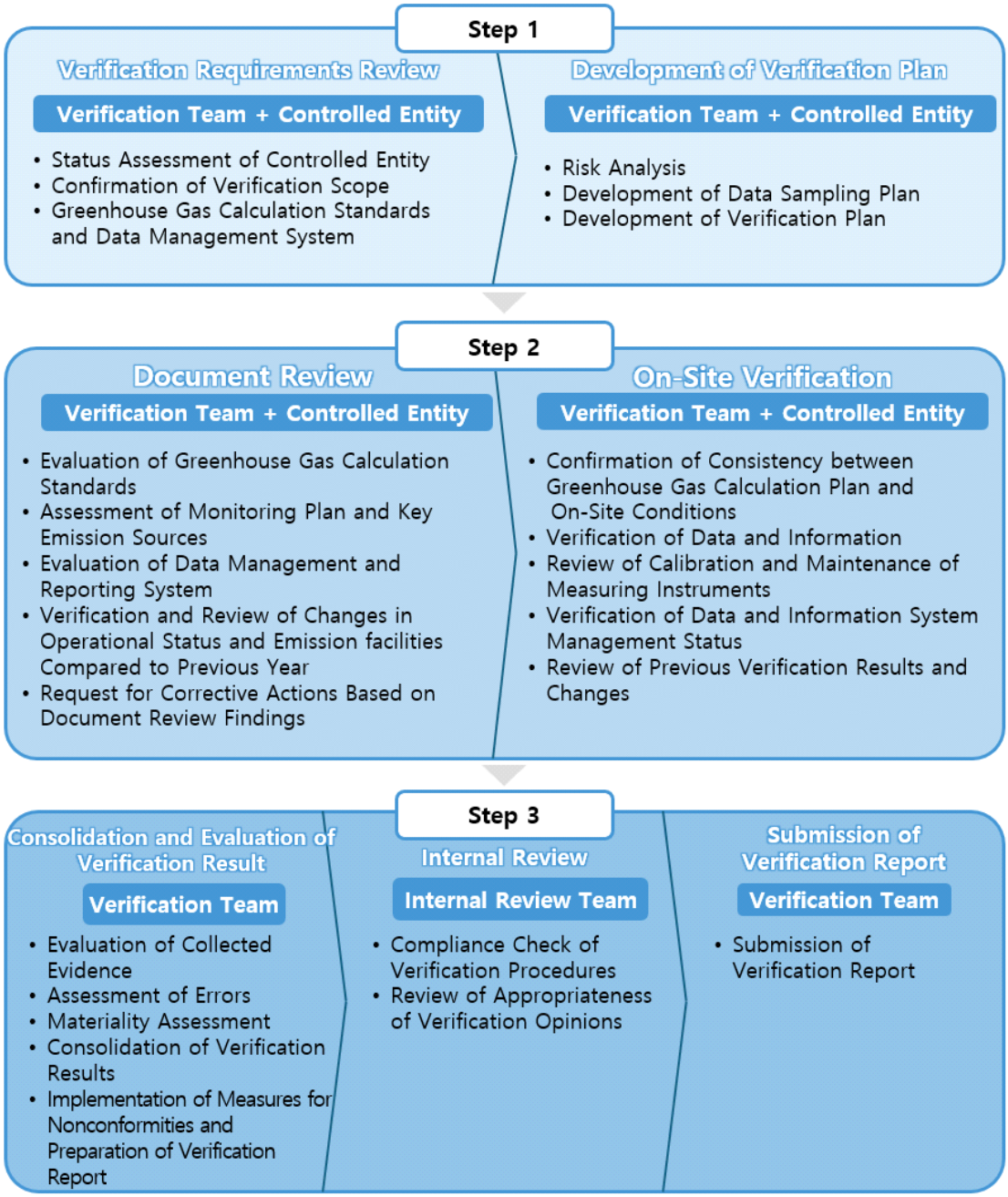
- A business entity is designated as an allocation-eligible entity if its average annual total GHG emissions over the past three years are at least 125 $ktCO_2$-eq, or if it operates at least one facility with emissions of 25 $ktCO_2$-eq or more.

Emissions Trading System Entities by Planning Period

Planning Period	Year	Certified Emissions ($MtCO_2$-eq)	Year-on-Year Change Rate (%)	Number of Entities
First period	2015	542.7	-	522
	2016	554.3	2.2	560
	2017	571.9	3.2	591
Second period	2018	601.5	5.2	586
	2019	587.9	-2.3	610
	2020	554.4	-5.7	636
Third peiod	2021	591.0	6.6	687
	2022	572.0	-3.2	713

3. Emission Measurement Standards and Verification Methods

- The measurement and verification of emissions follow the *Guidelines for Reporting and Certification of GHG Emissions Trading System* (August 2024) and the *Verification Guidelines for Management of GHG Emissions Trading System* (August 2024).
- Business entities eligible for allocation must calculate their emissions in compliance with the minimum required Tier level, based on the scale of emission facilities and detailed emission activity types.
- Emission verification is conducted through third-party verification of statements submitted by regulated entities, using verification bodies designated or announced by the Ministry of Environment.



Verification Procedures for GHG Emissions

3.2.2 Power generation

GHG mitigation in the power generation sector is being achieved through transition to clean energy systems, establishment of renewable energy supply infrastructure, and innovation in power supply and demand systems. According to the *10th Basic Plan for Electricity Supply and Demand* (January 2023) covering power supply direction and generation facility plans from 2022 to 2036, the transition to clean energy systems will be accelerated through the retirement of aging coal power plants and continued operation of nuclear power plants. Renewable energy will be actively expanded through facility expansion and the Renewable Portfolio Standard (RPS). Furthermore, GHG emissions will be gradually reduced through the establishment of future power grid systems such as High Voltage Direct Current (HVDC) and distributed energy supply.

<Table Ⅱ-22> Power Generation Capacity and Generation by Energy Source

	2020	2021	2022	2030
Total Capacity (GW)	129.2	134.0	138.2	198.0
- Coal	36.9	37.3	38.1	31.7
- Nuclear	23.3	23.3	24.7	28.9
- LNG	41.2	41.2	41.2	58.6
- New and Renewable	20.5	24.9	28.1	72.7
- Other	7.4	7.4	6.1	6.1
Total Power Generation (TWh)	552.2	576.8	594.4	621.8
- Coal	196.3	198.0	193.2	122.5
- Nuclear	160.2	158.0	176.1	201.7
- LNG	145.9	168.4	163.6	142.4
- New and Renewable	36.5	43.1	53.2	134.1
- Other	13.2	9.4	8.4	21.1

Source: 10th Basic Plan for Electricity Supply and Demand (Ministry of Trade, Industry and Energy, 2023), 2022 Korea Electric Power Statistics (No. 92) (Korea Electric Power Corporation, 2023)

1) Acceleration of Transition to Clean Energy Systems

(a) Phasing Down Aging Coal Power Plants

Efforts are being made to reduce GHG emissions while maintaining total power generation through improvements in the energy mix. A key measure is the phasing-down of aging coal power plants and their transition to facilities that emit less GHG, such as Liquefied Natural Gas (LNG) power plants of equivalent capacity. In 2020 and 2021, aging coal power plants of 1,000 MW and 1,620 MW capacity respectively were closed. From 2025, starting with Taean Units 1 and 2 (1,000 MW), aging coal power plants totaling 9,520 MW will be gradually closed by 2030. These coal power facilities will be replaced with LNG power facilities of equivalent capacity.

<Table Ⅱ-23> Phasing Down Aging Coal Power Plants

(Unit: MW)

	2020	2021	2025	2026	2027	2028	2029	2030
Coal(Phasing-down)	1,000	1,620	1,000	2,620	1,500	1,500	1,900	1,000
LNG(Replacement)	-	-	1,000	2,620	1,500	1,500	1,900	1,000

Source: 10th Basic Plan for Electricity Supply and Demand (Ministry of Trade, Industry and Energy, 2023), 2022 Korea Electric Power Statistics (No. 92) (Korea Electric Power Corporation, 2023)

(b) Continued Operation of Nuclear Power Plants

The energy mix is being improved with a focus on clean energy by expanding the proportion of nuclear power generation, which is a carbon-free power source. Major procedures including the development of continued operation plans and licensing reviews are underway for 10 nuclear power plants reaching their design life by 2030. Applications for continued operation have been submitted for 10 nuclear power units including Kori Units 2, 3, and 4, and Hanbit Units 1 and 2, which are approaching their operating license expiration. Upon approval, nuclear power facilities totaling 8,450 MW are expected to continue operation. The share of nuclear power generation is projected to reach 32.4% by 2030.

<Table Ⅱ-24> Nuclear Power Plants Subject to Continued Operation

Nuclear Power Plants		Capacity (MW)	Power Generation (MWh)	Operating License Expiration (Year)	Continued Operation Application Time (Year)	Continued Operation Extension Period (Year)
Kori	Unit 2	650	3,821,423	2023	2022	10
	Unit 3	950	8,890,860	2024	2022	10
	Unit 4	950	9,136,497	2025	2022	10
Hanbit	Unit 1	950	6,191,305	2025	2023	10
	Unit 2	950	5,576,302	2026	2023	10
Hanul	Unit 1	950	7,499,716	2027	2023	10
	Unit 2	950	8,806,282	2028	2023	10
Wolsong	Unit 2	700	2,157,103	2026	2024	10
	Unit 3	700	4,887,729	2027	2024	10
	Unit 4	700	5,310,886	2029	2024	10

Source: Korea Hydro & Nuclear Power Co., Ltd.

2) Establishment of Renewable Energy Supply Infrastructure

(a) Support for Renewable Energy Facility Deployment

Institutional foundations are being established through the development of the *10th Basic Plan for Electricity Supply and Demand* (January 2023) and *the Strategies for Expanding Supply and Strengthening Supply Chain for Renewable Energy* (March 2024). Key programs are categorized into financial supports providing long-term low-interest loans for renewable energy production facilities and utilization installations, and deployment supports subsidizing installation costs for renewable energy facilities in housing, buildings, and regions. Through financial support programs, renewable energy facilities (solar and wind power) with capacities of 412 MW and 475 MW received support in 2021 and 2022, respectively.

<Table Ⅱ-25> Performance of Financial Support for New and Renewable Energy

(Unit: MW)

	2021	2022
Total	412	475
Solar Power Capacity Supported	373	402
Wind Power Capacity Supported	39	73

Source: *2024 Greenhouse Gas Reduction Cognitive Budget Management Plan* (Government of the Republic of Korea, 2023)

(b) Renewable Energy Portfolio Standard (RPS)

To increase renewable energy generation, the RPS system operates under the *Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy* (December 2004). The system requires power generators, operating power facilities with a capacity of at least 500 MW (excluding renewable energy facilities), to supply a certain percentage of total generation from renewable energy. Accordingly, mandatory suppliers must secure Renewable Energy Certification (REC) equivalent to their mandatory ratio. REC can be self-procured by constructing renewable energy power plants or purchased from the REC trading market. Meanwhile, renewable energy suppliers can receive incentives by obtaining REC for their renewable energy generation and selling them in the REC trading market.

Annual mandatory supply targets were 7% in 2020, 9% in 2021, and 12.5% in 2022, with compliance rates of 100% and 98.1% in 2021 and 2022 respectively, nearly fulfilling the mandatory supply requirements. The mandatory supply target will be gradually increased to 25% by 2030 to expand renewable energy deployment. The RPS system will be improved to promote cost-effective expansion of renewable energy.

<Table Ⅱ-26> RPS Mandatory Supply Ratio, Mandatory Supply Volume, and Implementation Rate

	2020	2021	2022	2023	2025	after 2030
Mandatory Supply Ratio(%)	7.0	9.0	12.5	13.0	14.0	25.0
Mandatory Supply Volume (thousand REC)	35,590	47,447	78,623	-	-	-
Implementation Rate(%)	99.9	100.0	98.1	-	-	-

Source: Enforcement Decree of the Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy, Annex 3, 2024 KEA Energy Handbook (Korea Energy Agency, 2024)

(c) Support for Renewable Energy Usage Certification System (K-RE100)

Institutional foundations are being strengthened to support for voluntarily implementing the *Renewable Electricity 100%* (RE100) in the private entity. The system has been improved to allow general electricity consumers to purchase REC, which were previously limited to RPS mandatory suppliers. Various implementation methods including Green Premium and Power Purchase Agreement (PPA) are also being established.

Under the Green Premium system, electricity consumers such as enterprises can purchase renewable electricity by paying an additional premium to Korea Electric Power Corporation

(KEPCO) on top of regular electricity charges. PPAs are categorized into direct PPAs where renewable energy suppliers and electricity consumers directly conclude power purchase contracts, and third-party PPAs where contracts are concluded through KEPCO as an intermediary.

As a result of establishing institutional implementation foundations and active private entity participation, the number of enterprises participating in the renewable energy use certification system rapidly increased from 83 in 2021 to 149 in 2022. Their renewable energy consumption also surged from 1.5 TWh in 2021 to 6.3 TWh in 2022. Moving forward, implementation measures and renewable energy trading markets will be continuously improved to facilitate corporate procurement of renewable electricity through support measures such as consulting, PPA grid usage fee, and establishment of corporate renewable energy funds.

<Table Ⅱ-27> Renewable Energy Use Certification System

	2021	2022
Number of Participating Companies	83	149
Renewable Energy Usage* (TWh)	1.5	6.3

* Renewable energy usage is based on the volume of renewable energy use certificates issued
Source: 2021-2022 White paper on Trade, Industry and Energy (Energy Section) (Ministry of Trade, Industry and Energy, 2023)

Through policy efforts including renewable energy facility deployment support, RPS system, and implementation support for the renewable energy use certification system, renewable energy deployment is rapidly expanding. Cumulative renewable energy deployment reached 24.9 GW in 2021 (solar PV 18.5 GW, wind 1.7 GW, other renewables 4.5 GW) and increased to 28.1 GW in 2022. The share of renewable energy generation has also risen from 7.5% (43,096 GWh) in 2021 to 8.9% (53,182 GWh) in 2022.

<Table Ⅱ-28> New and Renewable Energy Facility Distribution

(Unit: GW)

	2020	2021	2022	2030
Total	20.5	24.9	28.1	72.7
Solar Power	14.6	18.5	21.2	46.5
Wind Power	1.6	1.7	1.9	19.3
Hydropower	1.8	1.8	1.8	2.0
Marine	0.3	0.3	0.3	0.3
Biomass	1.3	1.4	1.8	1.8
Fuel Cell	0.6	0.7	0.9	2.5
IGCC	0.3	0.3	0.3	0.3

Source: Electric Power Statistics (Korea Electric Power Corporation), 10th Basic Plan for Electricity Supply and Demand (Ministry of Trade, Industry and Energy, 2023)

3) Innovation in Power Supply and Demand System

(a) Establishment of Future Power Grid System

Efforts are being made to reduce GHG emissions through the establishment of future power grid systems to prepare for stable integration of renewable energy into the power grid and increased power demand from data centers and other sources. As the grid integration of renewable energy increases due to intermittency and regional concentration of renewable sources, the need for power grid reinforcement grows. However, establishing power grid systems faces challenges due to local residents' opposition to transmission and distribution network installation.

Policies are being implemented to proactively address issues surrounding future power grid establishment. First, to increase local acceptance of transmission and distribution networks, the proportion of community support projects in transmission facility area compensation has been expanded to over 50%. Additionally, to address the mismatch between energy supply and demand regions due to regional concentration of renewable energy, efforts are being made to foster communication through the operation of win-win councils with local residents or by promoting resident committees. The East Coast-Seoul Metropolitan Area 500 kV HVDC construction project is a representative case that has commenced through finding consensus through communication with residents.

(b) Promotion of Distributed Energy System

Promoting Distributed Energy to address power grid load issues arising from imbalances between power supply and demand regions by producing electricity near power demand locations. *The Special Act on Activation of Distributed Energy* (June 2023) has been enacted to to support its foundation and expansion. Key provisions include: ⅰ) introduction of mandatory distributed energy facility installation requirements,[40] requiring use of a certain proportion of energy consumption from distributed energy when necessary for distributed energy activation and energy supply stability, ⅱ) introduction of power grid impact assessment system for large-scale power consumption facilities (≥10 MW) to distribute power demand concentrated in grid-saturated areas (Seoul metropolitan area) and enhance power supply stability and predictability through advance review of grid capacity and system effects, ⅲ) establishment of specialized zone system for distributed energy allowing direct supply of locally produced electricity to users, ⅳ) establishment of incentive systems including cost subsidies, loans, and fund investments to promote distributed energy development and deployment.

3.2.3 Industry

Mitigation activities in the industrial sector can be largely categorized into four areas: technology development for achieving carbon neutrality, support for corporate carbon neutrality investments, establishment of foundations for strengthening corporate energy efficiency, and establishment of carbon neutrality governance between government and industry. First, *the Carbon Neutral Industry and Energy R&D Strategy* (2021.11) was established to promote technology development in sectors where GHG mitigation is essential for achieving carbon neutrality, such as steel, petrochemicals, cement, and semiconductors/displays. Additionally, support is being provided for corporate carbon neutrality investments through assistance in establishing energy Management Systems and Voluntary Energy Efficiency Target System for corporations. Furthermore, institutional foundations for improving energy efficiency, such as mandatory energy audit, are being established to encourage corporate GHG mitigation, and governance between government and industry is being built through the establishment of the Committee on Promoting Carbon Neutral Industrial Transformation.

40) In accordance with Article 10 of the Enforcement Decree of the Special Act on the Activation of Distributed Energy, this refers to projects involving the construction or major renovation of buildings expected to use more than 200,000 MWh of energy annually, or development projects such as housing site development or urban development with a project area of 1 million m2 or more.

<Table Ⅱ-29> Major Mitigation Policies in the Industrial Sector

Policy	Description
Establishment of the Committee on Promoting Carbon Neutral Industrial Transformation (March 2021)	・**(Organizer)** Co-chaired by the Minister of Trade, Industry and Energy and the Chairman of the Korea Chamber of Commerce and Industry ・**(Role)** Facilitating public-private consensus on vision and strategy for GHG mitigation in the industrial sector
Carbon Neutral Industry and Energy R&D Strategy (November 2021)	・**(Investment Expansion)** Significant increase in the carbon neutrality R&D budget, with a strong focus on 17 key areas, ensuring concentrated investment in carbon neutrality research. ・**(System Transition)** Transition to carbon neutral R&D system through active support of ⅰ) performance-oriented large-scale integrated R&D, ⅱ) field-based demonstration R&D, ⅲ) international collaborative R&D built on solidarity and cooperation ・**(Infrastructure Expansion)** Strengthening private-sector engagement in carbon neutrality R&D through the establishment of an innovation fund and the development of technology valuation models.

1) Securing Core Technologies for Carbon Neutrality

(a) Research and Development Technologies for Achieving Carbon Neutrality

The ROK has announced the *Strategy for Technology Innovation for carbon neutrality* (March 2021) and the *Carbon Neutral Industry and Energy R&D Strategy* (November 2021) as technology development roadmaps for carbon neutrality. Accordingly, priority areas and technologies for achieving carbon neutrality have been selected, and support throughout the entire cycle has been strengthened to promote public and private technology development and investment. For GHG mitigation, the focus is particularly on developing innovative technologies that realize low-carbon transition in carbon-intensive and hard-to-abate industries. Currently, the Carbon Neutrality Core Technology Development Project is being implemented as an Research and Development (R&D) project targeting four industries: steel, petrochemicals, cement, and semiconductors/displays, which are representative carbon-intensive and hard-to-abate industries.

In the steel industry, 85% of GHG emissions occur in the blast furnace-basic oxygen furnace process (BF-BOF). Accordingly, efforts are being made to develop hydrogen based ironmaking technology to mitigate GHG emissions. A total of KRW 26.9 billion is being supported from 2023 to 2025 for the development of basic technologies for hydrogen based ironmaking process design, and plans are being reviewed for supporting subsequent technology development and demonstration.

In the petrochemical industries, more than 50% of GHG emissions occur in the core naphtha cracking process. Currently, the industry aims to secure innovative technologies for substituting fuels and raw materials, with plans to provide KRW 52.4 billion for naphtha cracking process innovation and KRW 133.4 billion for petrochemical by-product gas methane conversion technology development.

In the cement industry, large amounts of carbon dioxide are emitted during the clinker manufacturing process using limestone. Accordingly, KRW 138.9 billion will be provided for developing technologies to increase the content of cement admixtures in raw materials and expand the application of blended cement, and KRW 143.7 billion for developing technologies to reduce bituminous coal and increase the use of waste synthetic resins in fuel. In the semiconductor and display industry, large amounts of fluorinated GHGs are emitted during the manufacturing process. To reduce GHGs, it is essential to develop technologies to replace high-GWP etching, deposition, and cleaning process gases with low-GWP substances. For this purpose, KRW 257.1 billion will be provided to support low-GWP alternative process gases and process efficiency improvement technologies.

(b) Support for Technology Investment in the Private Sector

Support for promoting private entity-led investment in technologies is being strengthened. In 2022, the carbon neutrality field was newly introduced in the scope of new growth and original technologies under the *Act on Eligible Tax Credit* (December 1998), incorporating 49 new GHG mitigation-related technologies including CCUS, hydrogen, and renewable energy. Through this, enterprises investing in R&D recognized as GHG mitigation technology or related facilities can receive tax credits of 20-30% and 3-12% of the investment amount, respectively. Additionally, the *Carbon Neutrality Leading Project Loan Support Program* is being implemented to support enterprises that find it difficult to invest in GHG mitigation due to financial circumstances. Loans or interest subsidies are being provided for private facility investments and R&D investments for carbon neutrality purposes, and in 2022, loans and interest subsidy totaling KRW 91.2 billion were provided to 30 projects.

2) Alleviating Corporate Investment Burdens for Carbon Neutrality

(a) Building Infrastructure for Energy Management System (EnMS)

Support is being provided for the establishment of Energy Management System (EnMS), including energy efficiency consulting and energy monitoring system implementation, to enhance corporate energy efficiency. Notably, consulting for EnMS establishment has been provided through the Support Program for Establishment of Energy Management System Infrastructure implemented since 2011. In 2022, the support program for Factory Energy Management System, which had been ongoing for Smart Green Industrial Complexes nationwide, was integrated. As a result, EnMS infrastructure has been established in 272 business sites as of 2022. The plan is to establish infrastructure at approximately 40 new business sites annually, targeting a cumulative total of 608 business sites by 2030.

<Table Ⅱ-30> Number of Business Sites with Energy Management System Infrastructure

	2020	2021	2022	2030
Number of Business Sites with Energy Management System Infrastructure (Cumulative, sites)	184	227	272	608

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(b) Voluntary Energy Efficiency Target System

Since 2020, a pilot project for the voluntary energy efficiency target system has been implemented for energy-intensive business sites with annual energy consumption of 2,000 toe or above. After the Korea Energy Agency and business sites cooperatively set energy intensity improvement targets, incentives are provided when sites achieve their targets. In 2021, 63 business sites participated, with an average energy intensity improvement rate of 3.54%. In 2022, 91 business sites participated, with an average energy intensity improvement rate of 2.06%. In 2022, the Korea Energy Efficiency Partnership (KEEP 30) was established with the top 30 companies in energy consumption, under which the participating companies plan to set and implement energy intensity improvement targets for a total of five years from 2023 to 2027. In this process, incentives such as technology development, tax benefits, and infrastructure establishment packages will be differentially provided according to companies' energy intensity improvement rates.

<Table Ⅱ-31> Voluntary Energy Efficiency Target System

	2020	2021	2022
Number of Participating Sites	44	63	91
Unit Improvement Rate (%)	1.78	3.54	2.06

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(c) Support for Energy-Saving Facility Investments

Financial and tax support systems for energy saving facility investments are being operated to assist companies experiencing difficulties in investing in energy-saving facilities. The support system is largely divided into two categories - Energy Service Company (ESCO)[41] investment projects where ESCOs invest on behalf of companies with funding difficulties, and energy-saving facility installation projects where energy users make direct investment and the government provides low-interest loans and interest subsidy for such investments. Accordingly, investment support of approximately KRW 244.5 billion in 2021 and KRW 254.0 billion in 2022 resulted in energy savings of 228 ktoe and 209 ktoe, respectively.

<Table Ⅱ-32> Investment Support Projects for Energy-Saving Facilities

		2020	2021	2022
Total	Savings Amount (ktoe)	228	228	209
	Support Amount (hundred million KRW)	2,829	2,445	2,540
ESCO Investment Project	Savings Amount (ktoe)	67	96	85
	Support Amount (hundred million KRW)	413	410	370
Savings Facility Installation Project	Savings Amount (ktoe)	161	132	124
	Support Amount (hundred million KRW)	2,416	2,035	2,170

Source: *2023 KEA Energy Handbook* (Korea Energy Agency, 2023)

41) ESCO Refers to companies registered with the Minister of Trade, Industry and Energy with equipment, assets, and technical personnel in accordance with Article 25 of the Energy Use Rationalization Act and Article 30 of its Enforcement Decree

(d) Support for Carbon-Neutral Leading Plants

The *Support for Establishing Carbon-Neutral Leading Plant* project is being implemented to establish carbon neutrality model business sites by applying optimal technologies that can dramatically mitigate GHG emissions, targeting SMEs in carbon-intensive and hard-to-abate industries such as steel, petrochemicals, and cement. This project categorizes support types into Energy Efficiency Improvement, Fuel and Raw Material Conversion, and Circular Economy, providing partial subsidies for investment amounts. First, the energy efficiency improvement category includes facilities such as load-adjustable inverters for air compressors and EnMS necessary for process operation. The fuel and raw material conversion category includes replacing B/C oil boilers with LNG facilities and, new and renewable energy facilities. Lastly, the circular economy category includes recycling facilities that reduce waste, waste heat, and waste gas within business sites. Accordingly, in 2022, funding was provided to five companies in the petrochemical, cement, machinery, paper, and non-ferrous metals industries for process improvements. Upon completion of this project in December 2023, GHG mitigation effects of approximately 30 ktCO2-eq annually are expected.

3) Enhancing Energy Efficiency

(a) Consultation for Energy Use Plan

This program requires prior consultation regarding companies' energy supply and demand, and efficiency improvement plans before implementing large-scale projects such as land development, energy development, and social infrastructure facilities. Through this, energy use plan consultation that improves corporate energy efficiency, encourages installation and introduction of renewable energy facilities, and mitigates GHG has been made mandatory. While the system initially targeted public facilities when introduced, it has now expanded to include private projects and facilities.

<Table Ⅱ-33> Energy Use Plan Consultation

	2020	2021	2022
Number of Consultations	100	98	84

Source: 2023 KEA Energy Handbook (Korea Energy Agency, 2023)

(b) Energy Supporters to Small and Medium-sized Enterprises

Energy Supporters (energy experts) provide on-site visits, technical guidance, and consulting to support energy-saving activities of SMEs lacking energy management expertise. This program is being implemented for SMEs with annual energy consumption less than 2,000 toe, and efforts are being made to reduce the burden of facility investment for aging facilities by linking with subsidy programs. As a result of dispatching Energy Supporters to 120 and 110 SMEs in 2021 and 2022 respectively, energy savings (reduction rates) of 4 ktoe (10.8%) and 2 ktoe (5.3%) were recorded.

<Table Ⅱ-34> Energy Supporter for Small and Medium-sized Enterprises

	2020	2021	2022
Number of Target Companies for Energy Supporter(sites)	200	120	110
Energy Savings Amount(ktoe)	9	4	2
Savings Rate(%)	14.3	10.8	5.3

Source: *2023 KEA Energy Handbook* (Korea Energy Agency, 2023)

(c) Mandatory Energy Audits

Excessive energy-consuming business entities must undergo energy audit at regular intervals to identify energy usage patterns and loss factors for improving energy efficiency. Excessive energy-consuming business entities with annual energy consumption of 2 ktoe or more are subject to energy audit. Energy audit companies can identify energy usage patterns of energy-intensive businesses and suggest energy-saving measures to encourage investments for improving energy efficiency and mitigating GHGs. Through energy audits of 755 business sites in 2021 and 666 business sites in 2022, GHG mitigation potentials of 1,429 $ktCO_2$-eq and 1,540 $ktCO_2$-eq respectively were identified.

<Table Ⅱ-35> Mandatory Energy Audit Projects

	2020	2021	2022
Number of Business Sites	710	755	666
GHG mitigation Potential ($ktCO_2$-eq)	1,034	1,429	1,540

Source: *2023 KEA Energy Handbook* (Korea Energy Agency, 2023)

4) Government-Industry Partnership for Carbon Neutrality

The government and industry have established carbon neutrality governance to minimize industry burden while simultaneously encouraging voluntary GHG mitigation. To support decarbonization of industry, the government and industry jointly launched the Committee on Promoting Carbon Neutral Industrial Transformation in 2021. Through this, industry-specific councils and technology innovation and standardization councils have been established and operated, centered on carbon-intensive industries,[42] to encourage voluntary GHG mitigation by industry. Through the establishment of this carbon neutrality governance, voluntary practices of GHG mitigation in the private entity are being promoted while continuing discussions on laws and institutional arrangements that hinder carbon neutrality achievement in private entity.

3.2.4 Building

In accordance with the *Second Master Plans for Green buildings* (December 2019) and the *Land, Infrastructure and Transport Carbon Neutral Roadmap* (December 2021), the ROK is encouraging GHG mitigation by certifying new buildings as Zero Energy Buildings (ZEB). Additionally, support is being provided for green remodeling, which improves energy efficiency by renovating existing buildings. Finally, to improve building energy efficiency, the efficiency of gas-using equipment is being enhanced and Advanced Metering Infrastructure (AMI) is being distributed. Furthermore, various institutional measures are being prepared to facilitate the spread of renewable energy in the building sector.

<Table Ⅱ-36> Major Mitigation Policies in the Building Sector

Policy	Description
The Second Master Plans for Green buildings (December 2019)	・Strengthen Energy Performance of New Buildings (Accelerate ZEB Adoption, Advanced Energy Performance Standards) ・Promote Green Transformation of Existing Buildings (Activate Green Remodeling of Aging Buildings, Energy-Efficient Operation and Management)
The Land, Infrastructure and Transport Carbon Neutral Roadmap (December 2021)	・**(Key Task)** ZEB for New Buildings, Green Remodeling of Existing Buildings ・**(ZEB for New Buildings)** Expand Mandatory Implementation, Enhance Existing Incentives ・**(Green Remodeling of Existing Buildings)** Broaden Public Facility Support Systems and Regulations, Increase Private Entity Support

42) Refers to oil refining, shipbuilding, machinery, steel, cement, automotive, bio, petrochemicals, non-ferrous metals, electrical and electronics, paper and textile, and semiconductor and display industries.

1) Measures for New Buildings

(a) Promotion of Zero Energy Building (ZEB)

The government grants certification levels 1-5 to Zero Energy Buildings (ZEB) based on energy independence rates according to the ZEB certification system. A ZEB refers to a building that minimizes energy consumption by reducing the required energy load and utilizing renewable energy. ZEB certification has been mandatory for public buildings since 2020. Through the revision of the *Green Buildings Construction Support Act* (February 2012) from 2023, the mandatory certification targets have been expanded to include public buildings with total floor area of 500 m^2 or more (previously 1,000 m^2 or more) and public apartment buildings with 30 or more households. From 2025, the mandatory certification grade for public buildings with total floor area of 1,000 m^2 or more in 17 building uses including office facilities will be raised from grade 5 to grade 4. For private buildings, research and legal revisions to improve minimum performance requirements will be pursued in 2025.

In 2021, ZEB achieved total floor area and GHG mitigation of 5,937.8 thousand m^2 and 100.9 $ktCO_2$-eq, respectively, while in 2022, they achieved 6,708.1 thousand m^2 and 114.0 $ktCO_2$-eq. Considering ZEB construction performance and GHG mitigation over the past three years, the target for 2030 is set at 20,830 thousand m^2 and 354.1 $ktCO_2$-eq of ZEB construction and GHG mitigation.

<Table Ⅱ-37> Floor Area of Zero-Energy Buildings

	2020	2021	2022	2030
Total Floor Area (Cumulative, Thousand m^2)	2,652.4	5,937.8	6,708.1	20,830
GHG mitigation ($ktCO_2$-eq)	45.1	100.9	114.0	354.1

(b) Promotion of Building Energy Management Systems (BEMS)

To encourage building owners or managers to continuously reduce building energy use, since 2017, the installation of Building Energy Management System (BEMS) has been mandated for public buildings with total floor area of 10 thousand m^2 or more that are newly constructed or expanded as separate buildings, promoting efficient energy management and control of new buildings. In 2021 and 2022, BEMS were installed in 73 and 65 new buildings, respectively.

BEMS or electronic remote metering devices are required as ZEB certification requirements. To promote the ZEB certification system, certification agency meetings and policy briefings were conducted in 2023. Plans are in place to integrate the ZEB certification system with the Building Energy Efficiency Rating Certification System. Additionally, mandatory certification of ZEB for public buildings will be implemented in phases.

<Table Ⅱ-38> Number of Building Energy Management System Installations

(Unit: installation)

	2020	2021	2022
Public Building	39	72	63
Private Building	1	1	2

Source: *KEA Energy Handbook 2023*(Korea Energy Agency, 2023)

2) Green Remodeling for Existing Buildings

Green remodeling is a project to convert existing buildings into green buildings to minimize environmental impact and provide comfortable living environments. In accordance with Article 27 of the *Green Buildings Construction Support Act*, support is provided for insulation, window replacement, and new and renewable energy facility construction to improve energy performance and efficiency of existing buildings.

Interest support for green remodeling is being provided to promote green remodeling of private buildings. In 2021, the scale of interest support and target buildings were expanded, and support procedures were simplified to encourage active private entity participation in green remodeling. Additionally, the method for calculating energy performance improvement rate has been changed from using a separate program to a simplified evaluation table, encouraging active participation from the private entity.

To lead GHG mitigation in the public entity, green remodeling is being implemented for public buildings (senior citizen centers, health centers, daycare centers, etc.). Support is provided according to priority after evaluating urgency and effectiveness among buildings applied for by public institutions and local governments. The scope of support is being expanded to include high energy-consuming and large-scale buildings. Project sites are selected based on a scoring system that quantifies energy-saving elements such as insulation, windows, high-efficiency equipment, new and renewable energy, and institutional

commitment to project implementation. Among these, buildings expected to have high energy-saving effects and promotional value are selected as signature projects to encourage expansion of green remodeling projects. Sites selected as signature projects receive up to double the support compared to general support targets to drive regional expansion of the project and enable the introduction of innovative technologies.

In 2021, the total floor area and GHG mitigation through green remodeling in private and public entities were 1,951.6 thousand m^2 and 36.5 $ktCO_2$-eq, respectively, while in 2022, they achieved 1,289.4 thousand m^2 and 22.2 $ktCO_2$-eq.

<Table Ⅱ-39> Green Remodeling: Floor Area and GHG Reductions

	2020	2021	2022
Total Floor Area(Thousand m^2)	1949.2	1,951.6	1,289.4
GHG mitigation($ktCO_2$-eq)	36.4	36.5	22.2

3) Improving Energy Efficiency in Buildings

(a) Improving the Efficiency of Household Appliances

City gas is the energy source with the highest proportion among fossil fuels consumed in the building sector. Therefore, improving the efficiency of water heating and cooking equipment that primarily use city gas can reduce GHG emissions by decreasing fossil fuel use in the building sector. To this end, in large buildings, energy-efficient equipment is widely distributed, with grade 1 and 2 registered models of gas water heaters accounting for approximately 56.1% of the market, and energy efficiency is continuously being improved through setting energy efficiency targets and evaluating energy consumption. In the private entity, the increasing use of household induction cooking appliances is contributing to improved energy efficiency and reduced fossil fuel consumption.

(b) Development of Energy Efficiency Indicators by Building Type

An energy efficiency evaluation system was introduced for public buildings in 2022, and plans are in place to expand the evaluation to commercial buildings of 3,000 m^2 or larger from 2024. In accordance with the *Second Master Plans for Green Buildings* (December 2019), operation efficiency indicators by building use are being developed to enable comparative evaluation of energy use levels in existing buildings for establishing an efficient energy

operation and management system. In 2022, accommodation facility types were classified, and factors affecting energy consumption such as total floor area, number of facility users, and room occupancy rates were analyzed. Additionally, based on data from pilot projects for medical, educational, office, and retail facilities, existing indicators were supplemented and operational efficiency reports were prepared. In 2023, building operation efficiency analysis methods were developed by analyzing cultural facility types and energy impact factors, and model verification is currently in progress. Furthermore, based on pilot project data for medical, educational, office, retail, and cultural facilities, existing indicators were supplemented by analyzing building type classifications and energy impact factors. Development of building operation efficiency improvement methods and verification models is ongoing.

(c) Advanced Metering Infrastructure (AMI)

AMI is core infrastructure for managing real-time energy consumption using wired and wireless communications. It consists of bidirectional communication-based digital meters, electricity usage information transmission devices, and power control devices. Using wired and wireless communications, AMI enables demand response for consumers and demand prediction and load management for suppliers by transmitting real-time energy consumption and electricity prices. AMI distribution has steadily increased, with 10,200 thousand units in 2020, 10,720 thousand units in 2021, and 12,400 thousand units in 2022. The target is to distribute 22,500 thousand units by 2030.

<Table Ⅱ-40> Number of Advanced Metering Infrastructure Installations

	2020	2021	2022	2030
Distribution of AMI (Cumulative, thousand)	10,200	10,720	12,400	22,500

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(d) Deploying New and Renewable Energy in Buildings

Significant GHG mitigation can be expected in the building sector by utilizing various new and renewable energy sources such as Building Integrated PhotoVoltaic (BIPV), solar thermal, geothermal heat pumps, and building fuel cells. In response, the ROK has formulated the *Strategies for Activating the Building-Integrated PhotoVoltaic Industry Ecosystem* (October 2022) to expand the deployment of solar photovoltaic technology for buildings. To promote renewable energy, the government provides annual subsidies for self-consumption renewable

energy facilities through the *Support Program for New and Renewable Energy Distribution*. Furthermore, the *R&D Project for Establishment of Building-type Solar Power Demonstration Center* (2022-2024) is being implemented to establish demonstration and standardization foundations for building-type solar power technology.

3.2.5 Transportation

In transportation sector, GHG mitigation policies are categorized into eco-friendly vehicle, public transportation, internal combustion engine demand management, and eco-friendly railroad, aviation, and maritime policies. Recently, the *Fourth Master Plans for Development of Environment-Friendly Motor Vehicles* (February 2021) was established, which includes support for subsidies and tax benefits for eco-friendly vehicles and related infrastructure construction, focusing on establishing a foundation for eco-friendly vehicles. Additionally, demand management for internal combustion engine vehicles is being pursued through reduction of private travel distance or in logistics. Along with this, GHG and fuel efficiency standards for passenger vehicles are being strengthened, and support is being provided for early scrapping of old diesel vehicles to progress low-carbonization of internal combustion engines. Beyond the road sector, policies for sector-specific low-carbonization are being pursued in the maritime sectors through the establishment of the *First National Plan for the Development and popularization of green ship* (December 2020).

<Table Ⅱ-41> Major Mitigation Policies in the Transportation Sector

Policy	Description
The Fourth Master Plans for Development of Environment-Friendly Motor Vehicles (February 2021)	・Achievement of 51% new eco-friendly vehicle sales by 2025 and 83% by 2030, reducing GHG emissions by 5.9 $MtCO_2$-eq by 2025 and 17.3 $MtCO_2$-eq by 2030
The First National Plan for the Development and popularization of green ship (December 2020)	・Assessing the current status and outlining detailed implementation strategies to promote the adoption of eco-friendly ships ・Facilitating the early transition in the public sector and expanding adoption in the private sector ・Encouraging the transition to eco-friendly ships through tailored financial support for private shipping companies

1) Promotion of Eco-friendly Vehicle Distribution

(a) Support for Eco-friendly Vehicle Purchases

Electric and hydrogen vehicles use electricity and hydrogen fuel cells as power sources respectively, contributing to GHG mitigation through lower fossil fuel usage compared to internal combustion engine vehicles. To promote the transition from internal combustion engine vehicles to eco-friendly vehicles, purchase subsidies and tax reductions for electric and hydrogen vehicles are being implemented with the goal of distributing a cumulative 4.5 million eco-friendly vehicles by 2030. Additionally, when private entities purchase eco-friendly vehicles, both national and local governments provide subsidies. In particular, to increase GHG mitigation effects by raising the distribution rate of vehicles with excellent electricity efficiency, electric vehicle subsidy guidelines were revised in 2021 to expand subsidy payments. Along with this, individual consumption tax and acquisition tax reductions for eco-friendly vehicle purchases are being implemented to encourage active private entity purchase of eco-friendly vehicles.

(b) Zero-Emission Vehicle Charging Infrastructure

Charging infrastructure is being established nationwide to promote eco-friendly vehicle distribution. Electric Vehicle Charging Infrastructure Information System has been established to improve public accessibility to charging infrastructure and electric vehicle charger installation support projects have been implemented since 2011. As of 2022, there are 194,081 electric vehicle charging stations. Government holds briefing sessions on national funding support for electric vehicle charging operators to share the latest information. Support is being provided for hydrogen charging station construction centered around transportation and logistics hubs to promote hydrogen vehicle distribution. As of 2022, a total of 229 hydrogen charging stations have been constructed, and plans are in place to expand hydrogen charging station infrastructure through streamlining permitting procedures and spread of leading cases of hydrogen charging station installation.

(c) Mandatory Purchase and Lease of Low-Emission Vehicles by Public Institutions

In accordance with the *Clean Air Conservation Act* (August 1990) and the *Act on Promotion of Development and Distribution of Environment-Friendly Motor Vehicles* (October 2004), the *Public agency low-emission vehicle mandatory purchase and lease system* is being implemented. This system is requiring national institutions, local governments, and public institutions to purchase or lease a certain percentage of new vehicles as low-emission vehicles. Under the system, low-emission vehicles are categorized into Type 1 electric and hydrogen vehicles (zero-emission vehicles), Type 2 hybrid vehicles, and Type 3 LPG and gasoline vehicles meeting low-emission vehicle emission standards. In 2022, the system applied to a total of 766 institutions, including 50 national institutions, 262 local governments, and 454 public institutions.

The achievement rate for mandatory purchase and lease by public institutions has steadily increased from 69.3% in 2020 to 83.7% in 2021 and 92.0% in 2022. In 2022, low-emission vehicles accounted for 90.2% of the total 8,072 vehicles purchased or leased by public institutions, with electric and hydrogen vehicles in particular showing continued performance growth with an increase of 881 units compared to the previous year.

<Table Ⅱ-42> Achievement of Mandatory Purchase and Lease of Low-emission Vehicle by Public Institutions

	2020	2021	2022	2030
Proportion of institutions achieving mandatory purchase/lease ratio(%)	69.3	83.7	92.0	100

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

Through such support for eco-friendly vehicles, establishment of eco-friendly vehicle charging infrastructure, and mandatory purchase and lease system for public institutions, eco-friendly vehicle distribution is being expanded. As a result, 108,959 zero-emission vehicles were distributed in 2021 and 174,742 in 2022, reaching a cumulative total of 432,282 zero-emission vehicles by 2022, achieving GHG mitigation of 274 $ktCO_2$-eq in 2021 and 413 $ktCO_2$-eq in 2022.

<Table Ⅱ-43> Distribution Status of Zero-Emission Vehicles

(Unit: Vehicle)

		Until 2019	2020	2021	2022	2023	Total (Cumulative)
Total		96,025	52,556	108,959	174,742	167,277	599,559
Electric Vehicles	Subtotal	90,923	46,713	100,427	164,486	162,605	565,154
	Passenger	88,909	31,329	71,517	123,920	115,817	431,492
	Van	840	1,016	1,290	2,074	2,820	8,040
	Truck	1,150	14,320	27,566	38,471	43,940	125,447
	Other	24	48	54	21	28	175
Hydrogen Vehicle	Subtotal	5,102	5,843	8,532	10,256	4,672	34,405
	Passenger	5,085	5,783	8,473	10,104	4,294	33,739
	Van	17	60	54	152	367	650
	Truck	-	-	5	-	11	16

2) Promoting Public Transportation and Managing Demand for Private Internal Combustion Engine Vehicles

(a) Reduction of Private Vehicle Kilometers Traveled (VKT)

Policies are being implemented to reduce private vehicle travel distance through initiatives such as the Carbon Neutral Point System, which provides incentives for reduced vehicle use, and the expansion of public transportation networks, including metropolitan express buses and bus rapid transit (BRT). The goal is to reduce the total travel distance of private passenger vehicles by 4.5% by 2030. The average daily travel distance of private passenger vehicles has shown a decrease, reaching 35.6 km in 2021 and 31.1 km in 2022.

<Table Ⅱ-44> Travel Distance of Non-Business Passenger Vehicles

	2020	2021	2022
Non-business passenger vehicles (Km/day·vehicle)	32.8	35.6	31.1

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(b) Intelligent Transport System (ITS) Infrastructure

The Intelligent Transport System (ITS) is a transportation system that integrates cutting-edge Information and Communications Technology (ICT) to mitigate traffic congestion, enhance user safety and convenience, and automate and optimize the operation and management of

transportation networks. Representative applications of ITS include bus arrival information systems at bus stops, optimal route guidance via navigation systems, and adaptive traffic signal systems reflecting intersection characteristics. The deployment of ITS is also closely linked to carbon neutrality. By improving fuel efficiency in vehicles, ITS contributes to reducing fossil fuel consumption and mitigating GHG emissions. Additionally, ITS enhances energy efficiency in the transportation sector by providing demand-responsive mobility services. Accordingly, the government plans to expand ITS infrastructure nationwide by 2025 to alleviate traffic congestion, prevent secondary accidents, and establish the foundations for autonomous and cooperative driving. The total length of roads equipped with ITS nationwide has steadily increased, from 18,036 km in 2020 to 22,236 km in 2021 and 26,919 km in 2022, accounting for 27% of the total paved road length as of 2022.

<Table Ⅱ-45> Expansion of Intelligent Transportation System (ITS) in Roads

	2020	2021	2022
ITS-Equipped Roads (km)	18,036	22,236	26,919

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(c) Modal-Shift for Freight Transportation

To mitigate GHG emissions, freight transportation is being shifted from roads, which produce relatively high emissions, to railroads and coastal shipping, which are more environmentally friendly. The *Support Program for Freight Modal-Shift to Railroads and Coastal Shipping* provides subsidies to cargo owners transitioning from road transport to lower-emission alternatives. In 2021, the railroad modal shift subsidy system was restructured to encourage greater participation by cargo owners. As a result of these policies, freight volume shifted from roads to railroads totaled 2.59 million tonnes in 2021 and 2.21 million tonnes in 2022, while freight volume shifted from roads to shipping totaled 2.73 million tonnes in 2021 and 2.84 million tonnes in 2022.

<Table Ⅱ-46> Volume of Freight Transported by Road Modal Shift

(Unit: million tonnes)

	2020	2021	2022
Freight Volume Shifted from Road to Rail	1.66	2.59	2.21
Freight Volume Shifted from Road to Shipping	2.62	2.73	2.84

3) Reducing Emissions from Internal Combustion Engines

(a) Vehicle GHG Emission and Fuel Efficiency Standards

GHG and fuel efficiency standards are established separately for passenger cars, small vans and trucks, and medium-heavy vans and trucks. Vehicles with 15 or fewer seats and a gross vehicle weight under 3.5 tonnes, including passenger cars, small vans, and trucks, must comply with either the average energy consumption efficiency standard or the GHG emission allowance standard. Fuel efficiency requirements are determined by considering electric and hydrogen vehicle sales incentives and eco-innovation performance. In contrast, medium-heavy vans and trucks are not currently subject to direct regulation under energy consumption efficiency standards or GHG emission allowance standards. However, a voluntary mitigation system is in place, targeting GHG reductions of 2% in 2023, 4.5% in 2024, and 7.5% in 2025 compared to 2021-2022 levels. Moving forward, plans are in place to gradually mandate GHG emission and fuel efficiency standards for medium-heavy vans and trucks.

<Table Ⅱ-47> Average Fuel Economy and GHG Emissions of Vehicles

		2021		2022	
		Results (Including incentives)	Target (Reflecting curb weight)	Results (Including incentives)	Target (Reflecting curb weight)
Average Fuel Economy (km/L)	Passenger	17.67(20.77)	24.8(21.21)	17.35(20.47)	24.8(21.06)
	Small Vans/Trucks	12.55(13.68)	15.6(15.39)	12.41(13.60)	15.6(15.04)
GHG Emissions (g/km)	Passenger	135.9(106.1)	97(107.6)	130.6(97.4)	97(108.1)
	Small Vans/Trucks	177.4(130.9)	166(167.9)	170.5(116.9)	166(164.7)

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(b) Early Scrapping and Operation Restrictions of Old Diesel Vehicles

To fundamentally reduce old diesel vehicles, which are major sources of GHG emissions in the transportation sector, early scrapping support and operation restriction programs are being implemented as key policies. Support for early scrapping of old diesel vehicles has

been in place since 2005. Until 2022, support was provided only for the early scrapping of Grade 5 diesel vehicles, but starting in 2023, the scope has been gradually expanded to include Grade 4 diesel vehicles, forklifts, and excavators.

Additionally, operation restrictions on old vehicles are being implemented under the *Special Act on the Improvement of Air Quality in Air* (April 2019) and the *Special Act on the Reduction and Management of Fine Dust* (August 2018). Since 2018, the Seoul Metropolitan Area has enforced a permanent operation restriction system for Grade 5 diesel vehicles that have not undergone low-emission modifications. During the seasonal management program period (December to March of the following year), when high concentrations of fine dust frequently occur, operation restrictions for all Grade 5 vehicles are expanded beyond the Seoul Metropolitan Area to include Busan, Daegu, Gwangju, Daejeon, Ulsan, and Sejong Special Self-Governing City.

(c) Increasing Mandatory Biodiesel Blend Ratio

Petroleum refiners and importers are required to blend a certain percentage of new and renewable energy fuel into transportation fuel annually. The mandatory new and renewable energy fuel blend ratio refers to the required percentage of new and renewable energy fuel that must be mixed into transportation fuel. The ratio was increased through amendments to the *Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy* and its enforcement decree from July 2021. Accordingly, the biodiesel blend ratio has been gradually increased by 0.5% and is expected to expand to 5.0% by 2030. This resulted in GHG mitigation of 1,942 $ktCO_2$-eq in 2021 and 1,880 $ktCO_2$-eq in 2022.

<Table Ⅱ-48> Biodiesel Blending

	2021	2022	2030
Biodiesel blend ratio (%)	3.27	3.54	5.0
GHG mitigation amount ($ktCO_2$-eq)	1,942	1,880	-

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

4) Eco-friendly Railroad, Aviation, and Maritime Transportation

(a) Railroad Network Extension

GHG mitigation is being pursued through increasing the utilization rate of railroad, which are low-carbon transportation means, by extending the railroad network and developing hydrogen fuel cell-based railroad vehicles. Currently, Based on the *Fourth Construction Plans for National Railroad Networks* implemented from June 2021, early commencement of new high-speed and conventional railroad construction is underway for expansion of major arterial networks including railroads and roads. The goal is to construct a total railroad network of 5,341km by 2030. In 2021, 4,307km of railroad network was constructed, and in 2022, 4,313.4km was constructed.

<Table Ⅱ-49> Length of Railroad Network

	2020	2021	2022	2030
Railroad network extension (km)	4,281.1	4,307	4,313.4	5,341

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(b) Improvement of Aircraft Operation Efficiency

GHG mitigation from aircraft operations is being pursued by improving the operational efficiency of aircraft from domestic airlines in the ROK. Currently, aircraft operational efficiency is being improved through aircraft engine cleaning, weight and operation management, and when introducing new aircraft, airlines are encouraged to prioritize the introduction of the latest aircraft with superior fuel efficiency to promote GHG mitigation in the aviation sector. Through these efforts, aircraft efficiency improved by 0.87% and 0.84% compared to the previous year in 2021 and 2022, respectively.

(c) Eco-friendly Ships and Alternative Maritime Power (AMP) Deployment

GHG mitigation in the maritime sector is being promoted through the expansion of eco-friendly ships and Alternative Maritime Power supply (AMP). Currently, through the eco-friendly ship certification system, certification is granted to ships using eco-friendly energy or fuels, such as LNG-powered bulk carriers and battery-electric powered ship for cars and cargos, or applying marine pollution reduction technology or ship energy efficiency improvement technology, thereby expanding the supply of eco-friendly coastal vessels in the private entity.

Furthermore, GHG mitigation is being promoted through improving ship fuel efficiency by supplying AMP to vessels. AMP is a device that supplies power from shore to ships berthed at ports. With the goal of installing AMP at 248 berths across 13 ports by 2030, pilot projects began at 8 berths in Busan, Incheon, and Gwangyang ports from August 2018, and by 2023, AMP has been installed at 25 berths across 10 ports including Busan Port.

<Table Ⅱ-50> Eco-friendly Ship Certification and AMP Distribution

	2020	2021	2022
Number of certified vessels*	-	6	10
AMP distribution (units)	11	21	22

* Excluding international navigation vessels

3.2.6 Agriculture, Livestock Farming, and Fisheries

GHG mitigation in the agriculture, livestock farming, and fisheries sector can be largely divided into reductions in cultivation, livestock farming, and fisheries sectors. According to the *2050 Net-zero Strategy in The Agri-Food Sector* (December 2021) and the *2030 Strategic Plan to Reduce Greenhouse Gas Emissions and Achieve Green Growth in the Livestock Industry* (January 2024) established for national GHG mitigation in the agriculture and livestock farming sector, GHG mitigation is being pursued through the spread of GHG mitigation farming methods such as mid-season drainage in rice cultivation and appropriate fertilization, and low-carbon livestock practices including low-nitrogen feed supply and energy conversion of livestock excreta. Additionally, according to the *2050 Carbon Neutrality Roadmap for the Marine and Fisheries Sector* (December 2021) and the *Fourth Comprehensive Plan for Climate Change Response in the Marine and Fisheries Sector* (September 2022), GHG emissions in the fisheries sector will be reduced through the conversion of existing fishing vessels to eco-friendly vessels and the introduction of energy-efficient fishing facilities.

<Table Ⅱ-51> Major Mitigation Policies in the Agriculture, Livestock Farming, and Fisheries Sector

Policy	Description
2050 Net-zero Strategy in Agri-Food Sector (December 2021)	· Transition to an Optimized Agricultural Input Structure · Implementation of GHG emission mitigation through paddy water management and low-methane feed · Promotion of energy use and efficiency in facility horticulture
2030 Strategic Plan to Reduce Greenhouse Gas Emissions and Achieve Green Growth in the Livestock Farming Sector (January 2024)	· Expansion of GHG mitigation processes in composting and liquid fertilizer facilities · Energy generation from excreta utilization and biochar production · Expansion of low-methane feed and low-nitrogen feed distribution
2050 Carbon Neutrality Roadmap for the Marine and Fisheries Sector (December 2021)	· Replacement construction of aging fishing vessels and replacement of aging fishing vessels engine · Distribution of energy-efficient equipment in fishery processing industry
Fourth Comprehensive Plan for Climate Change Response in the Marine and Fisheries Sector (Septermber 2022)	· Expansion of energy-saving facilities in fisheries sector · Support for replacement construction of aging fishing vessels

1) Agriculture Sector

(a) Water Management Technology

Mitigation of methane emissions, which occur when organic matter decomposes anaerobically in flooded rice paddies, is being pursued through mid-season drainage, a paddy water management technique that maintains paddy fields in a dry state by suspending water supply for more than two weeks starting one month after dibbling of rice seedling and opening drainage channels. The mid-season drainage technology is being distributed to farmers through pilot projects for paddy water management technology distribution and continuous farmer education. As a result, the ratio of mid-season drainage area has continuously increased from 41.0% in 2020 to 41.7% in 2021 and 45.5% in 2022, while GHG emissions from rice cultivation have steadily decreased from 5.6 $MtCO_2$-eq in 2020 to 5.2 $MtCO_2$-eq in 2022.

<Table Ⅱ-52> Mid-season Drainage in Rice Paddies

	2020	2021	2022
Mid-season drainage area ratio (%)	41.0	41.7	45.5
GHG emissions from rice cultivation ($MtCO_2$-eq)	5.6	5.4	5.2

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(b) Fertilizer Prescription Based on Soil-Testing

Fertilizer prescription based on soil-testing,[43] which presents appropriate fertilizer amounts for each cultivation area based on scientific analysis of agricultural land, is being used to induce GHG mitigation in the agricultural sector. After collecting soil samples from agricultural areas, prescribing fertilizer application according to the soil characteristics of the region can prevent excessive use of nitrogen fertilizer in areas unsuitable for the soil, thereby reducing N_2O emissions that can occur from agricultural land. Fertilizer prescriptions based on soil-testing were issued 677 thousand cases in 2021 and 739 thousand cases in 2022.

<Table Ⅱ-53> Number of issued Fertilizer Prescriptions

	2020	2021	2022
Number of fertilizer prescriptions issued (thousand cases)	611	677	739

Source: *2022 Greenhouse Gas Reduction Implementation Status* (Greenhouse Gas Inventory and Research Center, 2023)

(c) Biochar

GHG mitigation in the agricultural sector is being pursued through the development and distribution of biochar,[44] which enhances soil carbon storage function. In 2022, plans were established for the production and utilization of livestock excreta biochar, and in 2023, the N_2O mitigation effect of biochar was evaluated by analyzing agricultural land where biochar was applied, and research was conducted on biochar usage standards and usage models. In the medium to long term, by 2027, plans are in place to establish biochar usage standards, publish crop-specific manuals, develop business models, and diversify treatment methods including biochar utilizing livestock excreta.

(d) Energy-Saving and Renewable Energy Facilities in the Agriculture Sector

In agricultural sector, the energy efficiency of agricultural facilities is being enhanced through the expansion of energy-saving facilities such as multi-layered thermal curtains and automatic thermal covers to prevent heat loss from greenhouses. The cumulative area of energy-saving facilities reached 14,665 ha in 2021 and 15,300 ha in 2022.

43) Information calculating the amount of liquid fertilizer to be applied per hectare considering the fertilizer (nitrogen, phosphoric acid, potassium) demand of crops, fertilizer content in agricultural land, and fertilizer content in livestock excreta liquid fertilizer

44) A compound word of biomass and charcoal, referring to a porous carbonized material manufactured by pyrolyzing (carbonizing) biomass at temperatures above 350 degrees Celsius under oxygen-limited conditions

Furthermore, GHG mitigation is being pursued through the production of renewable energy-based electricity by utilizing agricultural infrastructure facilities such as reservoirs, pumping stations, and idle land for renewable energy generation projects such as solar power. The distribution of renewable energy facilities utilizing agricultural infrastructure is being pursued at around 10 locations annually, with cumulative distributions reaching 105 locations in 2021 and 114 locations in 2022.

2) Livestock Farming Sector

(a) Low-Methane and Low-Nitrogen Feed

To reduce methane emissions from the digestive process of ruminant livestock, the development of feed materials for methane mitigation such as synthetic compounds and microbial agents has been pursued through government and private initiatives since 2021. Additionally, with the revision of the *Standards and Specifications for Feed* (December 2014) in October 2023, definitions and evaluation methods for low-methane feed were newly established, laying the foundation for the distribution of low-methane feed. Furthermore, policies are being pursued to reduce methane emissions from livestock processes by lowering crude protein content standards in pig feed by 1-3%p and newly establishing crude protein upper limits for chicken, duck, and cattle feed to reduce surplus nitrogen in excreta and thereby reduce N_2O emissions from livestock excreta treatment processes. Through these efforts, plans are in place to mitigate GHG emissions by 308 ktCO2-eq through low-methane feed and 443 $ktCO_2$-eq through low-nitrogen feed by 2030.

(b) Energy Recovery in Livestock Excreta Treatment Facilities

To improve the treatment method of livestock excreta, which accounts for a significant portion of GHG emissions in the livestock farming sector, GHG mitigation is being pursued through the establishment of livestock excreta energy recovery facilities that can convert livestock excreta from traditional composting and liquid fertilizer treatment to resources such as biogas and biochar. Through related institutional reforms in 2022, eligibility for participation in joint resource recovery facilities that convert livestock excreta into energy was expanded, while project periods were extended to increase public acceptance. Additionally, plans are in place to expand the distribution of agitation-type ventilation facilities in composting and liquid fertilizer facilities, utilizing the fact that introducing mechanical agitation and forced ventilation processes during compost fermentation reduces

GHG emissions by approximately 39%. Through such energy recovery and purification treatment of livestock excreta, approximately 792 $ktCO_2$-eq of GHGs were reduced in 2022, with plans to reduce 2,058 $ktCO_2$-eq by 2030.

3) Fishery Sector

(a) Replacement of Aging Fishing Vessels

Support is being provided for the replacement of aging engines or the construction of new vessels for coastal and offshore fishing vessels. This increases the energy efficiency of fishing vessels, reducing fossil fuel consumption and thereby lowering GHG emissions from fishing activities. Currently, when coastal and offshore fishing vessels replace aging engines, 60% of the replacement cost is covered through national and local government funds. When aging fishing vessels are replaced with newly constructed vessels, an interest subsidy is provided. As a result, GHG emissions were reduced by 1,483 tCO_2-eq in 2021 and 1,376 tCO_2-eq in 2022.

<Table Ⅱ-54> Replacement of Aging Fishing Vessels and Engines

	2020	2021	2022
Engine replacement(vessels)	350	311	300
Vessel replacement (cumulative, vessels)	21	32	34
GHG mitigation amount ($ktCO_2$-eq)	1,605	1,483	1,376

(b) Energy-Saving Facilities and Equipment in Aquaculture Farms

GHG mitigation is being pursued by distributing energy-saving facilities such as heat pumps and inverters to fish farms with high energy consumption. Marine aquaculture farms and fishery processing facilities require heating and cooling to maintain constant temperatures (aquaculture farms) or heat for drying (fishery processing facilities). When installing equipment with good heating efficiency such as heat pumps and inverters in these facilities, energy efficiency can be improved and GHG emissions can be reduced. Heat pumps and inverters are being distributed to the aquaculture sector, and heat pumps to the fishery processing facilities to pursue GHG mitigation. Additionally, heat pumps were distributed to a cumulative total of 17 and 24 fishery processing facilities in 2021 and 2022 respectively, and the heat pump distribution project is ongoing with the goal of supporting a cumulative total of 50 facilities by 2050.

3.2.7 Waste

GHG mitigation in the waste sector can be broadly divided into source reduction of waste, stable supply of recyclable waste resources as raw materials, and expansion of high value-added recycling.

In accordance with the *First Master Plans for Resources Circulation (2018-2027)*, policies such as disposable product reduction are being implemented to reduce waste generation at the source, and efforts are being made to establish collection systems for stable supply of waste resources as recycling raw materials, and to expand high value-added recycling including electric vehicle waste batteries. Additionally, according to the *Act on Promotion of Production and Use of Biogas from Organic Waste Resources* (Biogas Act) enacted in December 2022, plans are in place to expand biogas utilization by imposing biogas production obligations on public and private businesses that emit and dispose of organic waste from 2025, while simultaneously providing government support for the installation of biogas facilities.

<Table Ⅱ-55> Major Mitigation Policies in the Waste Sector

Policy	Description
First Master Plans for Resources Circulation (September 2018)	・Establishment of resource circulation system throughout production -consumption-management-regeneration ・Prioritization of waste generation reduction and promotion of high-quality material recycling ・Optimization of regional waste treatment based on public participation governance
Korean(K)-Circular Economy Implementation Plan (December 2021)	・Mitigation of net GHG emissions in waste reduction and resource circulation sector to achieve 2050 national carbon neutrality goal ・Establishment of circulation system throughout production -consumption-regeneration process for transition to circular economy society
Comprehensive Plastic-free Measures (October 2022)	・Establishment of foundation for expansion of plastic recycled materials and alternative materials/services ・Advanced recycling industry and strengthening competitiveness
Act on Promotion of Production and Use of Biogas from Organic Waste Resources (December 2022)	・Mandatory biogas production by local governments ・Mandatory biogas production by massive private organic waste producers ・Support for mandatory biogas producers and promotion of biogas utilization

1) Reduction of Waste at Production, Distribution, Consumption and Disposal Stages

(a) Imposition of Waste Incineration and Landfill Charges

The government is promoting GHG mitigation policies by imposing waste disposal charges on those who incinerate or landfill recyclable waste, thereby maximizing the inducement of waste recycling. Currently, waste disposal charges are imposed on those who incinerate or landfill recyclable waste, and an economic incentive policy is being implemented to exempt waste disposal charges when recycling such resources. From 2018, when the system was implemented, to 2023, a total of KRW 912.4 billion in waste disposal charges was collected. Furthermore, the imposed waste disposal charges are utilized to establish waste circular resource-related infrastructure and to promote waste circular resource-related projects, thereby creating a virtuous cycle structure that reduces national waste generation.

(b) Expansion of Landfill Methane Capture

GHG mitigation in the waste sector is being promoted through the expansion of methane capture at landfills. GHGs are being reduced through landfill methane capture facilities that recover methane gas generated from biological treatment facilities at large-scale landfills and utilize it as an energy source for gas power generation, thereby reducing fossil fuel use. As of 2022, there are 13 landfill methane capture facilities, through which 93 kt of methane were collected in 2021 and 91 kt in 2022, resulting in GHG mitigation of 1,953 $ktCO_2$-eq and 1,911 $ktCO_2$-eq, respectively.

<Table Ⅱ-56> Methane Gas Collection Facilities in Public Landfills and Methane Collection Performance

	2020	2021	2022
Methane Capture Facility (sites)	13	13	13
Amount of GHG Mitigation ($ktCO_2$-eq)	1,869	1,953	1,911

Source: 2022 Greenhouse Gas Reduction Implementation Status (Greenhouse Gas Inventory and Research Center, 2023)

2) Stable Supply of Waste Resources as Recycling Raw Materials

(a) Extended Producer Responsibility (EPR) System

To strengthen producer recycling responsibility, the *Extended Producer Responsibility (EPR) system* was introduced in 2003 to replace the existing waste deposit system. Unlike the

Deposit-Refund System where deposits for waste are made during the production of packaging materials and products and returned upon recycling, the EPR system fundamentally assigns responsibility to companies (producers) to collect and recycle waste generated from packaging materials and products they manufacture or import. As of 2023, EPR target items include a total of 28 types (4 types of packaging materials, 24 types of products) under the *Act on the Promotion of Saving and Recycling of Resources* (December 1992), and through the EPR system in 2022, 1,949 kt of waste was reduced, resulting in a GHG mitigation of 1,086 $ktCO_2$-eq.

<Table Ⅱ-57> Recycling Rates for EPR Targets and Waste Reduction Performance

	2020	2021	2022
Recycling Rates of EPR Obligators (%)	71.9	73.8	72.9
Amount of Waste Reduction (kt)	1,820	1,859	1,949
Amount of GHG Mitigation ($ktCO_2$-eq)	1,016	1,036	1,086

(b) Installation of Community Recycling Centers

Since 2015, the government has been promoting the installation of permanent collection facilities (community recycling centers) in rural areas to improve recycling rates through enhanced recyclable resource separation. From 2015 to 2023, a total of 2,136 community recycling centers were installed, resulting in reduced waste incineration and landfill volumes. This led to waste reductions of approximately 7.79 kt in 2021 and 10.59 kt in 2022, resulting in GHG mitigation of approximately 4.34 $ktCO_2$-eq in 2021 and 5.90 $ktCO_2$-eq in 2022.

<Table Ⅱ-58> Number of Neighborhood Recycling Center Installed

	2020	2021	2022	2030
Number of Community Recycling Center (Cumulative)	1,003	1,248	1,697	4,713
Amount of Waste Reduction (kt)	6.26	7.79	10.59	29.41
Amount of GHG Mitigation ($ktCO_2$-eq)	3.49	4.34	5.90	16.39

(c) Modernization of Public Sorting Facilities

Local governments is promoting projects to enhance public recycling sorting rates and establish a foundation for transition to a circular economy by supporting costs needed for expanding public sorting facilities (waste treatment facilities) and replacing with modernized facilities

(automated sorting facilities). As a result of these policies, the residual material generation rate at public sorting facilities has continuously decreased from 35.1% in 2022 to 34.4% in 2023. During the two years 2021-2022, through the public sorting facility expansion and modernization project, a capacity of 877 tonnes/day was secured, and the resulting GHG mitigation is estimated at 151 ktCO_2-eq.

<Table Ⅱ-59> Recycled Waste at Public Sorting Facilities

	2021	2022
Amount of Recycling (kt)	82.8	180.3
Amount of GHG Mitigation (ktCO_2-eq)	47	103

3) High Value-Added Recycling

(a) Public Procurement of Recycled Products

The government is making efforts to provide stable demand through the promotion of recycled material products and utilization of recyclable resources, as expanding the use of recycled materials can contribute to achieving carbon neutrality and transitioning to a circular economy. Through the public institutions' obligation to purchase green products, public institutions are creating demand for green products, including recycled products, thereby promoting GHG mitigation. As a result of this demand by public institutions, the purchase amount of green products by public institutions reached approximately KRW 4 trillion in 2022.

(b) High Value-Added Waste Recycling

The government is promoting mitigation while simultaneously activating the circular economy by actively encouraging the recycling of high value-added waste such as electric vehicle batteries and construction waste. Through the creation of a circular economy ecosystem, including securing minerals through battery recycling, the government is promoting battery recycling and establishing a domestic battery supply chain. To this end, institutional improvements are being pursued, such as expanding battery storage periods and designating remanufactured and reused batteries as resources, while infrastructure construction is being promoted through creating resource recycling clusters for post-use electric vehicle batteries. Through these policies, waste reduction through electric vehicle battery recycling achieved 82 tonnes in 2022, with GHG mitigation of 125 tCO_2-eq, which is expected to expand to

1,795 tonnes and 2,810 tCO_2-eq respectively by 2030. In April 2019, the selective demolition system was introduced to ensure that waste that can be recycled as recycled aggregate is not mixed with waste that cannot be recycled. One should remove combustible waste during demolition works where large amounts of construction waste are generated. The system encourages construction waste to be recycled into high-quality recycled aggregate.

<Table Ⅱ-60> GHG Reductions from Electric Vehicle Battery Recycling

	2022	2030
Sale Performance (Unit)	183 (reuse 129, recycling 54)	3,989 (reuse 2,274, recycling 1,715)
Amount of Waste Reduction (tonne)	82.4	1,795.1
Amount of GHG Mitigation (tCO_2-eq)	125.22	2,810.21

(c) Organic Waste Biogas Facilities

GHG mitigation is being pursued through the installation of organic waste biogas facilities that produce biogas from organic waste resources such as food waste, livestock excreta, and sewage sludge. The installation of biogas facilities not only prevents methane generation from organic waste resources but also enables its use as an alternative fuel through biogasification, thereby reducing GHGs. The cumulative number of biogas facility installations was 110 as of 2022, and the government is pursuing the installation of a cumulative 140 biogas facilities by 2030. Additionally, in accordance with the *Biogas Act*, a biogas center will be established by 2024 as a dedicated operating organization for the biogas production target system, which will provide continued momentum for biogas support. Through these biogas facility installations, it is expected that 96,291 Nm^3/year of biogas can be produced, and if this amount of biogas replaces city gas, it is projected to reduce GHGs by 114.9 $ktCO_2$-eq.

<Table Ⅱ-61> Installation of Biogas Facilities for Organic Waste Resources

	2022	2030
Installation of Biogas Facilities (Cumulative, sites)	110	140

3.2.8 Carbon Sinks, Carbon Capture, and Hydrogen sector

To expand forest and marine carbon sinks, the government is working to reduce GHG emissions by enhancing the absorption capacities through afforestation and forest tending, and the creation of blue carbon such as coastal wetlands, in accordance with the *Third Comprehensive Plans for Improvement of Carbon Sinks* (June 2023) and the *Blue Carbon Strategy* (May 2023).

In addition, the government aims to establish a support system and institutional foundation for R&D on carbon dioxide capture, utilization and storage, build an effective implementation system, secure technological competitiveness in CCUS, and achieve price competitiveness to activate carbon capture and reduce GHG emissions. This is in line with the *Technology Innovation Roadmap for Carbon Dioxide Capture and Utilization* (June 2021), *CCUS Sector Carbon Neutrality Technology Innovation Strategic Roadmap* (November 2022), and *Carbon Dioxide Capture and Utilization Technology Advancement Strategy* (December 2023).

To promote the hydrogen economy, the government plans to support the establishment of a clean ecosystem through creating large-scale hydrogen demand and preparing infrastructure while transitioning from the existing gray hydrogen-centered approach, as outlined in the *First Hydrogen Economy Transition Basic Plan* (June 2021) and *Plan for Creating a Clean Hydrogen Ecosystem* (June 2021).

<Table Ⅱ-62> Major Mitigation Policies in the Carbon Sinks, Carbon Capture, and Hydrogen Sector

Policy	Description
Third Comprehensive Plans for Carbon Sinks (June 2023)	・Strengthening forest carbon absorption capacity through sustainable forest cycle management ・Expanding new forest carbon sinks and preserving/restoring existing forest carbon sinks
Blue Carbon Strategy (May 2023)	・Strengthening marine carbon absorption capacity through marine vegetation creation and proactive protection of new blue carbon ・Establishing long-term implementation foundations including new blue carbon certification and regional research base infrastructure
Carbon Dioxide Capture and Utilization Technology Advancement Strategy (December 2023)	・Establishing customized technology advancement strategies by categorizing key carbon capture and utilization (CCU) technologies based on current domestic technology securing levels and domestic corporate demand ・Customizing CCU technology deployment strategies through evaluation and analysis of major issues and technology deployment barriers by technology type
Plan for Creating a Clean Hydrogen Ecosystem (June 2021)	・Expanding hydrogen demand through hydrogen commercial vehicle distribution and fuel conversion at thermal power plants ・Stable hydrogen supply through the development of a clean hydrogen supply chain and expansion of distribution infrastructure

1) Enhancement of Carbon Sink and Storage Functions through Sustainable Forest Management

(a) Enhancement of Carbon Storage through Reforestation and Forest Tending

Since the implementation of large-scale national reforestation projects to restore degraded forests in the 1970s-1980s, various types of reforestation projects have been pursued, including commercial forest creation, large tree planting, and forest fire damage restoration, considering management objectives and conditions. The reforestation performance in 2021 and 2022 was 20,532 ha and 19,114 ha respectively, resulting in mitigation of 117.4 $ktCO_2$-eq and 228.0 $ktCO_2$-eq. Additionally, the forest's carbon sink function is being strengthened through forest tending projects that improve forest growth environments to enhance forest health and timber value after reforestation operations. Forest tending projects are being implemented by categorizing them according to tree growth stages, including plantation management, young tree tending, and mature forest management.

<Table Ⅱ-63> Progress of Reforestation

	2021	2022
Reforestation Area* (cumulative ha)	20,532	39,646
Amount of GHG Removal ($ktCO_2$-eq)	117.4	228.0

* Reforestation area excludes natural seeding and sprout regeneration areas
Source: 2022 Greenhouse Gas Reduction Implementation Status (Greenhouse Gas Inventory and Research Center, 2023)

(b) High Value-Added Timber Utilization

GHG removal is being pursued by actively promoting timber utilization in buildings and facilities, utilizing timber's carbon storage capacity. Pioneering projects are being implemented to create wooden urban architecture, streets, and living environments through timber-friendly cities and wooden building demonstration projects to expand private entity timber demand. To private timber utilization, restrictions on wooden structure height and scale in the *Building Act* (January 1962) that limited wooden construction were lifted in 2020. Furthermore, to reduce GHGs through timber utilization, the timber carbon storage labeling system has been operated since 2013, through diverse incentives for timber utilization and infrastructure construction are being pursued. Through these measures, timber utilization performance in 2021 and 2022 was 2,189 thousand m^3 and 2,077 thousand m^3 respectively, resulting in GHG mitigation of 2,106 $ktCO_2$-eq and 1,744 $ktCO_2$-eq.

2) Systematic Restoration and Management of Forest and Marine Carbon Sinks

(a) Urban Forests for Coping with Climate Crisis

The government is working to establish carbon sinks for GHG mitigation by creating various urban forests in urban areas and living zones. Urban forests are being created in urban and residential areas through the establishment of village forests for improving the living environment of local residents, landscape forests for preserving local scenery, and school forests for enhancing students' learning environment. The systematic support for urban forest creation by local governments is provided through the selection of outstanding urban forest cases and the establishment of urban forest support centers. Moving forward, efforts will be made to establish new carbon sinks in urban areas by creating an additional 17 kha of urban forests by 2050.

(b) Expansion of New Carbon Sinks

GHG removal is being pursued by establishing carbon sinks through the creation of new green spaces and ecological spaces. The inclusion of green spaces has been mandated in housing development and redevelopment plans, and urban carbon sinks are being expanded by creating green spaces in long-term unexecuted urban parks that have been neglected. Additionally, GHG mitigation is being induced through the creation of green spaces via restoration projects of damaged areas in green belt, and GHG mitigation is being pursued through the creation of ecological zones capable of absorbing GHGs in waterfront areas such as dam flood plains and rivers.

(c) Carbon Sinks through Inland Wetlands Conservation

Wetlands can store carbon in plants and soil. Expanding wetland areas leads to GHG removal. In this context, projects are being implemented to expand wetland protected areas, purchase private land within protected areas, and restore damaged areas for ecosystem conservation and systematic management of wetland protected areas. Since 1999, wetlands with high ecological value have been designated as protected areas to expand carbon sinks, and storage capacity is being improved through annually expanded restoration projects. According to the *4th Master Plans for Wetland Conservation* announced in December 2022, Goseong Madong Lake and Suncheon Waryong Mountain wetlands were newly designated as wetland protected areas in 2022, and the area of existing protected areas such as Gimhae

Hwapo Stream and Gwangju Jangrok Wetland was expanded. Additionally, damaged areas of four protected areas including Ungok Wetland were restored across 221,303 m^2, resulting in a wetland protected area of 13.5 kha as of 2022. Moving forward, plans are in place to designate a certain area of wetland protected areas annually and implement restoration projects for damaged areas within expanded protected areas, with the goal of increasing wetland protected areas to 16 kha by 2030.

(d) Prevention of Forest Disasters

Policies are being implemented to strengthen forests' carbon sequestration function by preventing forest disasters such as forest fires and restoring forests damaged by disasters. The ICT platform project that detects and interprets forest fire occurrence in real-time using AI is being expanded, and forest disaster damage is being prevented through the elimination of blind spots in firefighting by utilizing drones for firefighting operations during forest fires. Additionally, ecological restoration is being carried out centered on core ecological axes such as Baekdu Mountain Range and DMZ areas to restore forests damaged by disasters. In 2021 and 2022, 87 ha and 165 ha of forests were restored respectively, resulting in GHG removals of 0.6 $ktCO_2$-eq and 1.7 $ktCO_2$-eq.

(e) Restoration and Protection of Coastal Wetlands and Management of Marine Protected Areas

To expand marine carbon sinks, coastal wetlands are being restored and protected while managing marine protected areas. Project for restoration of tidal flats have been conducted since 2010 to expand blue carbon absorption, and vegetation restoration projects for salt marsh creation have also been pursued since 2022. Additionally, areas requiring protection of coastal wetlands and marine ecosystems are being designated as marine protected areas to strengthen the ocean's carbon absorption capacity. In 2021, Hwaseong Maehyangri Tidal Flat in Gyeonggi Province and Homi Peninsula in Pohang, North Gyeongsang Province were newly designated as marine protected areas (2 sites, 14.33 km^2). In 2022, Yeoja Bay Tidal Flat in Goheung Gun, South Jeolla Province and Nagok-ri Coastal Waters in Uljin, North Gyeongsang Province were designated (2 sites, 63.23 km^2), and in 2023, Sacheon Gwangpo Bay Tidal Flat and Jeju Ojo-ri Tidal Flat were newly designated as marine protected areas (2 sites, 3.7 km^2), demonstrating continuous efforts for coastal wetland protection.

(f) Marine Forest Creation

Marine forests are areas where seaweed or seagrass grow densely within marine ecosystems, and they have the effect of reducing GHG by converting CO_2 into organic matter and storing it in the ocean. Through the marine forest creation project, the goal is to create a cumulative 387.5 km^2 of marine forests from 2018 to 2030 (2009-2017, 152.5 km^2), and 164.7 km^2 of marine forests have been created from 2018 to 2023. Starting from new marine forest creation in 2023, the government and local governments are cooperating to implement marine forest creation projects, and from 2024, private companies are also participating in marine forest creation projects, demonstrating efforts to accelerate the realization of carbon neutrality.

3) Technology Development and Infrastructure Construction for Carbon Capture, Utilization, and Storage (CCUS)

(a) Establishment of Institutional Framework for Carbon Capture, Utilization, and Storage (CCUS)

CCUS is a carbon mitigation technology that captures CO_2 from emission sources or the atmosphere and either converts it into usable materials or stores it stably underground. The ROK is implementing a mid to long-term roadmap based on the *National CCS Comprehensive Implementation Plan* (July 2010) for CCUS technology development and utilization. In 2024, the *Act on the Capture, Transportation, Storage and Utilization of Carbon Dioxide* (February 2024) was enacted to establish the legal foundation for CCUS utilization, and plans are in place to establish institutional foundations for CCUS activation through the development of subordinate regulations and detailed standards.

(b) Technology Development and Infrastructure Construction for Carbon Capture and Storage (CCS)

Carbon capture and storage (CCS) is a technology that reduces atmospheric GHGs by capturing and storing CO_2 from the atmosphere. CCS can reduce atmospheric GHGs by separating and capturing CO_2 from exhaust gases or the air in carbon-intensive industries such as coal or LNG power generation, steel, cement, and petrochemicals, and then storing it in supercritical form in onshore or undersea locations such as depleted oil or gas fields, saline aquifers, and unmineable coal seams. Currently, in accordance with the mid to long-term plans such as the *CCUS Sector Carbon Neutrality Technology Innovation Strategic*

Roadmap (November 2022) and *Carbon Dioxide Capture and Utilization Technology Advancement Strategy* (December 2023), R&D for CO_2 capture, transportation, and storage technology development is being conducted while simultaneously evaluating the suitability of locations such as the East Sea gas field as CCS storage sites through exploratory drilling. Furthermore, cooperation projects for securing and joint use of overseas CCS storage sites are being actively pursued through collaboration with private companies and major foreign countries including Australia, Malaysia, and Indonesia.

(c) Technology Development and Infrastructure Construction for Carbon Capture and Utilization (CCU)

CCU is a technology that reduces atmospheric GHG by capturing CO_2 from emission sources or the atmosphere and utilizing it as other materials. CCU generally involves capturing CO_2 and then reducing atmospheric CO_2 while simultaneously utilizing it as useful materials by producing substances such as CO, formic acid, and biodegradable polymer plastics through chemical and biological conversion processes. Development of core source technologies through company-led demonstrations has been pursued since 2023, aiming for commercialization after 2030 for carbon dioxide capture and utilization technology development. A representative case is the CO_2 dry reforming plant completed in June 2023, and various R&D and pilot projects are planned for the future. Additionally, plans are in place to pursue the CCU Mega Project, a large-scale industrial cluster creation project connecting CO_2 carbon-intensive companies (upstream industry) with CCU product demand companies (downstream industry) to secure CCU business models through the application of CCU technology to existing industrial processes.

4) Creation of Clean Hydrogen Ecosystem

(a) Hydrogen Technology Development and Infrastructure Construction

Hydrogen technology development and infrastructure construction are currently underway. As water electrolysis technology using renewable energy-based power is necessary to reduce GHG emissions in the hydrogen sector, demonstration projects are being pursued with the goal of constructing and operating 30MW scale water electrolysis facilities by 2030. As of 2022, based on operating capacity, the water electrolysis facility demonstration scale was 2MW with an efficiency level of 55%. Additionally, to establish the institutional foundation for clean hydrogen production and utilization, the *Hydrogen Economy Promotion and*

Hydrogen Safety Management Act (February 2020) was amended in 2022 to establish legal grounds for the scope of clean hydrogen eligible for administrative and financial support and clean hydrogen certification. Moving forward, plans are in place to establish a clean hydrogen ecosystem through continuous technology development and administrative and financial incentives for clean hydrogen.

(b) Establishment of Stable Hydrogen Supply Base

To promote GHG mitigation through hydrogen economy activation, the establishment of a stable hydrogen supply base is being pursued. The *First Hydrogen Economy Transition Basic Plan* in November 2021 set hydrogen demand and supply targets of 27.9 million tonnes by 2050 as a major milestone for national GHG mitigation, and through the *Plan for Creating a Clean Hydrogen Ecosystem* in November 2022, hydrogen production demonstration and commercialization in connection with nuclear power plants is being pursued. According to these policies, four water electrolysis-based hydrogen production bases (Buan City in North Jeolla Province, Pyeongchang City and Donghae City in Gangwon Province, and Boryeong City in South Chungcheong Province) will be constructed with the capacity to produce approximately 330 tonnes of electrolysis hydrogen annually each, and a carbon capture-type hydrogen production base with an annual capacity of 990 tonnes will be constructed in Cheongju City, North Chungcheong Province.

(c) Expansion of Hydrogen Demand and Utilization

The creation of continuous demand for clean hydrogen is essential for a clean hydrogen ecosystem. First, to create continuous hydrogen demand by expanding the distribution of hydrogen vehicles, a target of distributing 300 thousand hydrogen vehicles by 2030 has been set, and technology development and demonstration research for hydrogen and ammonia co-firing power generation is also being pursued. Additionally, to create continuous hydrogen demand, R&D on hydrogen based ironmaking is being conducted in the steel industry, with plans to pursue 1 million tonne-scale demonstration by 2030. In the petrochemical industry, plans are in place to gradually pursue technology development and demonstration to convert fuel input to hydrogen in petrochemical facilities such as Naphtha Cracking Centers (NCC).

3.3 Other Mitigation Policies and Measures

3.3.1 Mitigation Policies and Measures in Local Government

Local governments' climate change and green growth policies began began with voluntary participation from 2018. In May 2021, at the Partnering for Green Growth and the Global Goals 2030 (P4G) Summit held in Seoul Metropolitan City, all 243 local governments declared 2050 carbon neutrality, which became an opportunity for regional action for carbon neutrality are. Regional carbon neutrality support centers were established to support regional carbon neutrality and green growth, with the Carbon Neutrality Act of 2022 making basic plans mandatory for local governments.

On May 9, 2024, 17 metropolitan local governments submitted their *First Master Plan for Carbon Neutrality and Green Growth*, which serves as their regional carbon neutrality implementation strategy. Each local government planned carbon neutrality policies reflecting local conditions and citizen opinions, and established regional carbon neutrality action guidelines through deliberation by the *2050 Local Carbon Neutrality and Green Growth Committee*. Most local governments demonstrated their active commitment to regional carbon neutrality practice by presenting GHG mitigation targets of more than 40% by 2030 compared to 2018, in line with NDC. The plan is scheduled to be established and implemented as a rolling plan every five years from 2024 to 2033, and this plan aims for practical actions by local governments.

Carbon neutrality involves changes across society, and the role of local governments is crucial in this regard. Local governments are the implementing bodies of carbon neutrality, possessing GHG mitigation measures such as residential and commercial building management, land use, transportation policy, and waste management. As of 2018, total GHG emissions of metropolitan governmnets amounted to 728.1 $MtCO_2$-eq (based on 2006 IPCC GL). Among theses emissions, the amount that local government can actively manage is 316.6 $MtCO_2$-eq accounting for approximately 43% of the total emissions. The emission proportions by sector are in the order of buildings, transportation, waste, and agriculture, livestock farming and fisheries, with emissions concentrated in the building and transportation sectors.

Mitigation PaMs being promoted by each region will continue to be planned and implemented in various forms tailored to regional characteristics. The major distinctive projects of each local government are as follows.

<Table Ⅱ-64> Major Cases of Local Government Mitigation Policies and Measures

<table>
<tr><th>Region</th><th>Sector</th><th>Case</th></tr>
<tr><td>Seoul</td><td rowspan="2">Building</td><td>○ Building Energy Reporting and Rating System
· (Description) Reporting energy consumption, disclosing ratings, and displaying ratings based on building type. High-performing buildings receive low-carbon certification, while underperforming buildings are given priority support for energy audits and building energy efficiency improvements
* Public: Total floor area 1,000 m^2 or more / Private: Total floor area 3,000 m^2 or more
· (Status) Establishment of building energy evaluation and audit system(2023) ⇒ Energy rating evaluation and public disclosure for public buildings(2024) ⇒ Energy rating evaluation and public disclosure for private buildings(from 2024 onward)
· (Expected Outcome) This initiative aims to significantly reduce emissions from the building sector, which accounts for 67% of Seoul Metropolitan City's total GHG emissions</td></tr>
<tr><td>Gwangju</td><td>○ Low-Carbon Apartment Complex Incentive Program
· (Description) GHG reduction performance of apartment complexes with 100 or more households is evaluated*, and incentives are provided based on the results
* Criteria : (Quantitative) Reduction performance in electricity, water, gas, food waste consumption (Qualitative) Campaign and promotion activities, resident participation efforts for creating green residential environments
· (Status) Outstanding complexes have been selected annually, with incentives provided since 2010
<table>
<tr><th></th><th>Participating Complexes (locations)</th><th>Outstanding Complexes (locations)</th><th>Incentive Support (KRW million)</th><th>Energy Savings (electricity conversion, toe)</th><th>GHG Mitigation (tCO_2-eq)</th></tr>
<tr><td>Total</td><td>636</td><td>384</td><td>1,868</td><td>14,030</td><td>28,147</td></tr>
</table>
· (Major Achievement) About 28,147 tCO_2 -eq reduced from 2010 to 2023, the same impact as planting 427,331 pine trees</td></tr>
<tr><td>Daejeon</td><td>Transportation</td><td>○ Establishment of Advanced Traffic Management System
· (Description) The advanced traffic management system is being optimized by analyzing data collected from detection devices (e.g., smart signal control systems and section detectors) installed on roads and vehicles
· (Status) Introduction of ITS and selection as advanced transportation model city (2002) ⇒ Implementation of ITS Phase 2 project (2012) ⇒ Advancement of ITS (-2023) ⇒ Establishment of an Advanced traffic management system (2024)
· (Expected Outcome) Achieving low-carbon transportation in the sector by optimizing traffic flow, managing traffic demand, and creating an efficient mobility environment</td></tr>
</table>

Region	Sector	Case
Ulsan	Waste	○ **Steam Supply from Waste Heat Recovery in Incineration Plants** · **(Description)** Waste heat generated during the municipal waste incineration process is recovered and used to produce steam, which is then supplied as industrial energy to businesses. This system helps improve energy efficiency, lower fuel costs, and reduce GHG emissions by utilizing heat that would otherwise be wasted · **(Status)** Operation of Seongam incineration plant municipal waste incineration facilities Units 1 and 2 (2000) ⇒ Start of waste heat steam production and supply to businesses (2008) ⇒ Operation of incineration facility Unit 3 (2012) ⇒ Reconstruction of incineration facilities Units 1 and 2 (2016-present) · **(Major Achievements)** Supplying 406,407 tons of steam energy from waste heat has led to lower GHG emissions and significant cost reductions for businesses - **(Mitigation)** As of the end of 2023, GHG emissions reduced by 64,619 tCO-eq, equivalent to planting 452,333 pine trees - **(Cost)** Generated KRW 14.3 billion in non-tax revenue and saved KRW 6.1 billion in business energy costs
Jeollanam-do	Agriculture, Livestock Farming, and Fisheries	○ **Achieving Low-Carbon Livestock Farming through Technology** · **(Description)** Transition to a low-carbon livestock industry, technologies and management techniques are being introduced to enhance feeding efficiency and reduce emissions from cattle farming. Farmers are supported in adopting optimized feeding strategies that improve productivity while minimizing environmental impact. Additionally, the low-carbon livestock certification system encourages the adoption of sustainable practices in the livestock farming sector · **(Status)** Newly established according to the *First Jeollanam-do Master Plan for Carbon Neutrality and Green Growth* (2024-2033) in 2023 · **(Expected Effect)** By reducing feed costs, this initiative is expected to improve livestock farm profitability while also cutting carbon emissions from cattle farming

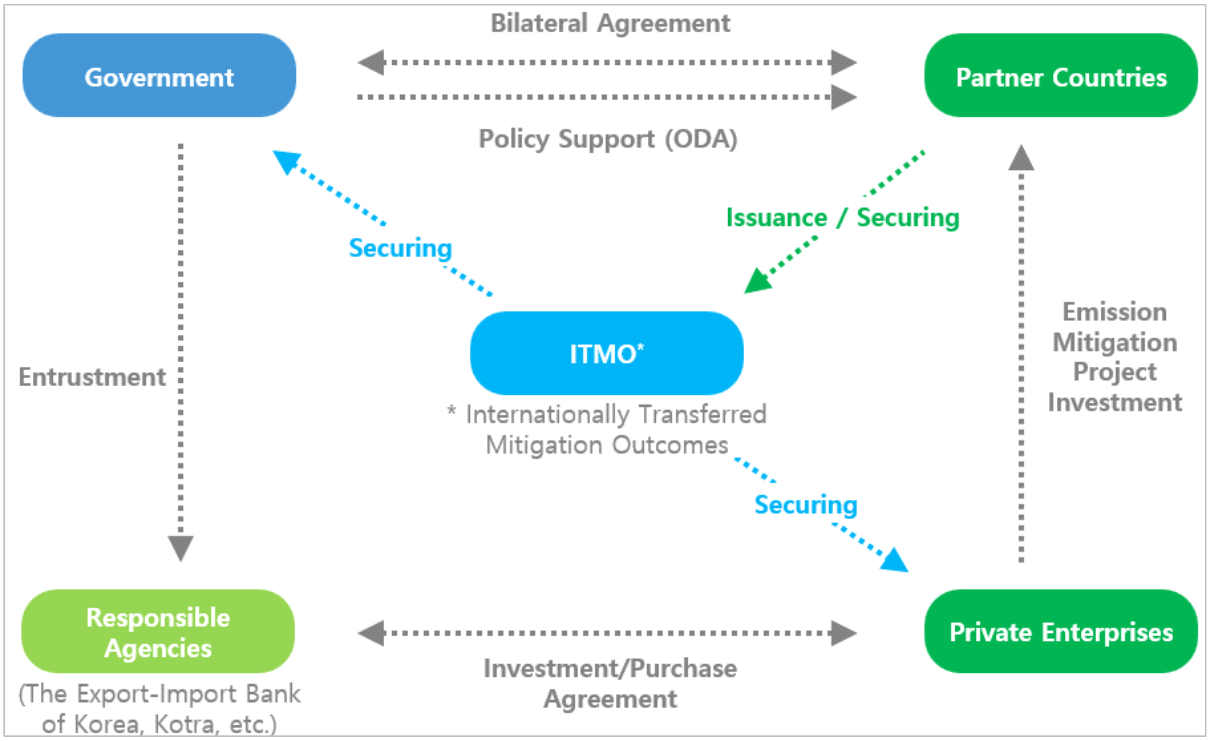
<table>
<tr><th>Region</th><th>Sector</th><th>Case</th></tr>
<tr><td>Daegu</td><td>Carbon Sinks</td><td>○ Green Forest Low-Carbon NET Initiative (Forest Daegu Project)
· (Description) A 25 ha Daegu Green Healing Belt has been established along the Geumho River and surrounding forests. Additionally, a 189 ha climate-responsive forest is being managed, and a 45 ha Second Arboretum has been constructed. Urban greening projects, including rooftop gardens covering 20,000m^2 annually, are also underway
· (Status)
- (Forest Management) Annual maintenance of 1,000–2,000 ha of forest through projects such as fine dust reduction forests, young tree care, and afforestation site maintenance.
- (Tree Planting) As part of the Green Daegu Project, 10.93 million trees were planted from 1996 to 2006, making Daegu the first local city to achieve the milestone of planting 10 million trees.
- (Gardens/Arboretum) Plans are in place to establish the Geumho River National Garden (from 2025 onward) and expand forest welfare infrastructure, including the construction of the Second Arboretum (45 ha) by 2025.
· (Major Achievement) From 2019 to 2023, approximately 15,698.5 tCO-eq of GHG emissions were reduced.
* Tree Planting: 15,576 tCO_2-eq / Rooftop Greening: 122.5 tCO_2-eq</td></tr>
<tr><td>Gyeonggi</td><td>Other Sectors</td><td>○ Achieving RE100 in Public Institutions
· (Description) Efforts are underway to expand renewable energy adoption in Gyeonggi Province and its affiliated public institutions through the installation of solar power facilities and community-driven solar power plants.
- (Goal) Increase the renewable energy share to 100% for all public institutions by 2026 (currently 4.1% as of 2023) and expand renewable energy by 84 MW
· (Status) Expansion of solar power generation in public institutions and public property
- (Public Institutions) Installation of 18.8 MW of solar power facilities at 68 sites is in progress.
<table>
<tr><th></th><th>Total</th><th>Site Discovery</th><th>Consulting</th><th>Permission</th><th>Construction Progress</th><th>Construction Complete</th></tr>
<tr><td>Target Sites (location)</td><td>68</td><td>42</td><td>7</td><td>7</td><td>11</td><td>1</td></tr>
<tr><td>Generation Capacity (kW)</td><td>18,776</td><td>10,549</td><td>2,518</td><td>2,334</td><td>2,597</td><td>778</td></tr>
</table>
- (Public Property) Installation of 12.7 MW of community-driven solar power plants at 44 locations is in progress.
<table>
<tr><th></th><th>Total</th><th>Consulting</th><th>Use Approval</th><th>Paid Permission</th><th>Construction Progress</th><th>Construction Complete</th></tr>
<tr><td>Public property (location)</td><td>44</td><td>20</td><td>15</td><td>4</td><td>1</td><td>4</td></tr>
<tr><td>Generation Capacity (kW)</td><td>12,718</td><td>5,194</td><td>4,276</td><td>1,680</td><td>300</td><td>1,268</td></tr>
</table>
· (Expected Outcome) Expanding energy transition by increasing renewable energy adoption and improving inefficient energy consumption patterns, contributing to Gyeonggi Province’s carbon neutrality and driving the expansion of RE100 in the private sector.</td></tr>
</table>

3.3.2 International Mitigation Project

Articles 6.2 and 6.4 of the Paris Agreement specify market mechanisms to induce cost-effective carbon mitigation from a global perspective. In particular, Article 6.2, which is designed for countries to voluntarily cooperate to reduce carbon emissions, is receiving attention as an important means for solving climate change issues.

The ROK is utilizing international mitigation project as a supplementary means to achieve its NDC. According to the Carbon Neutrality Act, the Presidential Commission on Carbon Neutrality and Green Growth oversees international mitigation projects, while sector-specific ministries including the Ministry of Land, Infrastructure and Transport, Ministry of Agriculture, Food and Rural Affairs, Ministry of Trade, Industry and Energy, Ministry of Environment, and Ministry of Oceans and Fisheries manage the overall implementation of mitigation projects in their respective sectors. The Ministry of Environment operates the international mitigation register and is responsible for approving the ITMOs.

Many countries, including the ROK, plan to actively pursue international mitigation projects based on cooperative approaches under Articles 6.2 and 6.4 of the Paris Agreement. To this end, countries are concluding bilateral agreements to establish cooperation systems for project approval, issuance and transfer of mitigation outcomes with partner country governments. To strengthen comprehensive climate change response cooperation, including international mitigation projects, the ROK is pursuing bilateral climate change cooperation agreements with major partner countries, and as of December 2024, has concluded agreements with nine countries including Vietnam, Mongolia, Gabon, Uzbekistan, UAE, Morocco, Peru, Laos, and Kyrgyzstan. Additionally, to expedite international mitigation projects, cooperation systems are being established and strengthened through institutional arrangements as needed according to partner countries' circumstances.



[Figure Ⅱ-13] Procedure of International Mitigation Project Implementation

Through these international mitigation projects, the ROK plans to promote GHG emissions reduction that will contribute to achieving its NDC. Additionally, by distributing mitigation facilities and stimulating private investment in green sectors, the ROK aims to support sustainable development in developing countries. By pursuing these initiatives, the ROK will establish a mutually beneficial cooperation framework and assume a leading role in international climate change response efforts. Major examples of international mitigation projects being pursued by various ministries are as follows:

<Table Ⅱ-65> Major Cases of International Mitigation Project by Relevant Ministries

Ministry	Case
Ministry of Land, Infrastructure and Transport	○ **Memorandum of Understanding for Cooperation on GHG Mitigation and Climate Change Response in Land and Transport Sector** · On September 19, 2023, a Memorandum of Understanding (MOU) was signed with the Global Green Growth Institute (GGGI) for "cooperation on carbon mitigation and climate change response in the land and transport sector." Under this agreement, both parties plan to pursue cooperation for generating ITMOs, including identifying potential partner countries for cooperation in the land and transportation sector. · The Ministry has been conducting bilateral meetings for international mitigation project cooperation by inviting relevant high-level officials through the annual Global Infrastructure Cooperation Conference (GICC) (2023-2024). At GICC 2024, it co-hosted the "Land and Transport Carbon Neutrality Cooperation Seminar: First Steps toward a Sustainable Future" with GGGI. ○ **Establishment of Domestic Foundation for Promoting International Mitigation Projects in Land and Transport Sector** · To enhance understanding among relevant domestic industries and institutions, the Ministry is developing and publishing the 2024 Implementation Guidelines for International Mitigation Projects for Business Operators, providing free consulting for companies and institutions interested in international mitigation projects, and operating basic and advanced training programs to establish a domestic foundation for promoting international mitigation projects. · Furthermore, in 2024, the Ministry plans to identify international mitigation items through supporting feasibility studies for international mitigation projects in the land and transport sector pursued by private companies. From 2025, it plans to secure GHG mitigation results by fully implementing pilot installation support projects with partner countries.
Korea Forest Service	○ **Establishment of the Legislative Framework for International Mitigation REDD+ Programs in Forest Sector** · To contribute to achieving NDC and responding to climate change through Reducing emissions from deforestation and forest degradation plus in developing countries (REDD+) activities as encouraged in accordance with paragraph 2, Article 5 of the Paris Agreement, *the Act on Support for Reducing Greenhouse Gas Emissions and Enhancing Carbon Accumulation Through Forest in Developing Countries* (REDD+ Act) which is supporting GHG emission mitigation and enhancement of carbon stocks from forests in developing countries was enacted (August 2023) and implemented (February 2024). · Korea Forest Service plans to establish a bilateral cooperation system for national and/or sub-national REDD+ under Article 6.2 and REDD+ activities under Article 6.4 based on the UNFCCC Warsaw REDD+ Framework and utilize ITMOs from REDD+ for achieving 2030 NDC. To systematically implement this, operational standards for REDD+ and a master plan (2025-2029) will be formulated.

Ministry	Case
Ministry of Environment	○ **Landfill Gas Capture and Combustion in Ulaanbaatar, Mongolia** ・In May 2022, a bilateral meeting was held with Mongolia's Ministry of Environment and Tourism, resulting in the signing of an Implementation Arrangement on Cooperative Approaches under Article 6 of the Paris Agreement (International GHG Mitigation Implementation Arrangement) (May 2022) and MOU on Environmental Cooperation. ・Based on the International GHG Mitigation Implementation Arrangement, a project to capture and combust methane gas generated from the Narangiin landfill in Ulaanbaatar, Mongolia, is being implemented. The project is expected to reduce approximately 540 $ktCO_2$-eq of GHGs over the 10-year project period. ○ **MOU with Kazakhstan for Mitigation Projects** ・In June 2024, a MOU for GHG Mitigation Projects was signed with Kazakhstan's Ministry of Ecology and Natural Resources, establishing a legal foundation for implementing international mitigation projects between governments under the Paris Agreement. ・A Korean business consortium (ROEN Consulting consortium) is reviewing the feasibility of a project to capture methane gas from the Almaty landfill, Kazakhstan's largest city, for power generation. If implemented, this project is expected to reduce total GHG emissions by 6.17 $MtCO_2$-eq over 15 years and improve the local environment.
Ministry of Oceans and Fisheries	○ **MOU on Collaboration on the Cooperative Approaches for NDC Implementation** ・In November 2022, a MOU was signed with the GGGI for cooperation on NDC implementation support and international mitigation projects under the Paris Agreement. ・Under this agreement, both parties plan to identify potential partner countries for cooperation in the marine sector, including blue carbon, and implement international mitigation projects for strengthening partner countries' MRV capacity and generating ITMOs based on Articles 6 and 13 of the Paris Agreement. ・Furthermore, from 2024, the Ministry plans to identify international mitigation items through supporting feasibility studies for marine sector international mitigation projects pursued by private companies, such as mangrove restoration and coastal solar power facility distribution. From 2025, it plans to secure GHG mitigation results by fully implementing pilot installation support projects with partner countries.

3.3.3 International Transportation

The ROK participates in international community efforts to reduce GHG emissions from international transport, such as aviation and shipping, and has established domestic implementation measures and specific plans.

Regarding international aviation, in February 2024, the *Act on Management of International Aviation Carbon Emissions* was enacted to contribute to the sound development and sustainable growth of the aviation industry by systematically managing carbon emissions from international aircraft operations according to the standards and methods specified in the Convention on International Civil Aviation and its Annex XVI. Furthermore, actively supporting the International Civil Aviation Organization (ICAO)'s global framework for achieving 2050 carbon neutrality, the ROK established the *Strategies for SAF Diffusion* in August 2024 to reduce international aviation carbon emission through the use of Sustainable Aviation Fuel (SAF). Among 11 national airlines, commercial operations began in August 2024 by mixing a certain amount of domestic SAF for short-distance international flights with nine airlines, including Korean Air, who voluntarily wished to participate. Additionally, plans are in place to implement a mandatory SAF mixing system from 2027, requiring domestic refineries to comply with SAF mixing ratios for airport supply and requiring SAF fueling for all flights departing internationally.

Furthermore, the ROK has expressed its commitment to lead the decarbonization of international shipping and promote eco-friendly transition, establishing specific implementation plans. At the COP27, the ROK and the United States jointly announced the *Collaboration on Green Shipping Corridors* to achieve zero-carbon emissions by applying carbon-free fuels or technologies. According to this declaration, both countries selected specific routes through joint research on establishing green shipping corridors between major ports, and are currently pursuing roadmap development. In February 2023, to proactively respond to strengthened GHG mitigation regulatory requirements in the international shipping sector, the ROK established the *Strategy for Decarbonization of International Shipping* (February 2023) targeting the conversion of all international navigation vessels to eco-friendly ships by 2050. According to this strategy, plans are in place to first convert to dual-fuel propulsion vessels capable of using eco-friendly fuels by 2030, and then introduce carbon-free ships using ammonia and hydrogen according to technological development progress to achieve carbon neutrality in international shipping by 2050.

Furthermore, in July 2023, the ROK submitted its *Toward Green Shipping by 2050* to the International Maritime Organization (IMO), which comprehensively covers the ROK's shipping and port sector decarbonization policies, including the *Strategy for Decarbonization of International Shipping* (February 2023)*, Carbon Neutrality Roadmap for the Oceans and Fisheries Sector* (December 2021) *and Carbon Neutral Port Roadmap,* expressing the ROK's commitment to realizing decarbonized shipping to the world.

4. Projection of GHG Emissions and Removals

4.1 Introduction

This chapter presents GHG emissions projection up to 2040. This projection results represent a With Measures scenario (WM scenario), which reflects the effects of climate and energy PaMs implemented up to 2021. Policies proposed or planned before 2021 but not implemented, unconfirmed bills, unallocated funds, and policies and measures without demonstrated reduction effects are not included in the scenario analysis. However, large-scale projects confirmed to be operated in the near future, regardless of their reduction effects, are included in the projection.

The GHG emissions data up to 2021 presented is based on the *2023 National Greenhouse Gas Inventory* (1990-2021), which was prepared according to the 2006 IPCC GL. It should be noted that this differs from the 2024 National Greenhouse Gas Inventory (1990-2022) presented in Chapter 1.

Projection result is presented by gas type. The gases are categorized into seven gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Emissions are presented as carbon dioxide equivalent (CO_2-eq) values using the GWP conversion factors from the *IPCC Fifth Assessment Report* (AR5), which are consistent with the GWP values used in Chapter 1 of the BTR for the National GHG Inventory. Projection related to international transportation and indirect GHGs is excluded from this analysis.

4.2 Total GHG Emissions Projection

Total GHG emissions projection does not include reduction effects from mitigation PaMs introduced after 2021. Reduction effects from PaMs adopted before 2021 are assumed to be already reflected in historical energy use and GHG emissions. Projection is based on the WM scenario, which analyzes the relationship between total GHG emissions and macroeconomic variables such as population changes, economic growth, and energy prices, as described in Section 4.4. The WM scenario assumes that the level of mitigation PaMs reflected in emissions up to 2021 will continue into the future.

According to the WM scenario, total GHG emissions (excluding net GHG removals from the LULUCF sector) in 2040 are expected to be 798.0 $MtCO_2$-eq, increasing at an annual average rate of 1.9% since 1990. However, while GHG emissions increased at an annual average rate of 3.3% from 1990 to 2018 (the base year for the 2030 NDC), the annual average increase rate is projected to decline significantly to 0.3% from 2018 to 2040.

The GHG removals from the LULUCF sector in 2040 are projected to be 12.5 $MtCO_2$-eq, continuing a consistent decline since 2000. Net GHG emissions, including the LULUCF sector, are projected to reach 785.5 $MtCO_2$-eq in 2040.

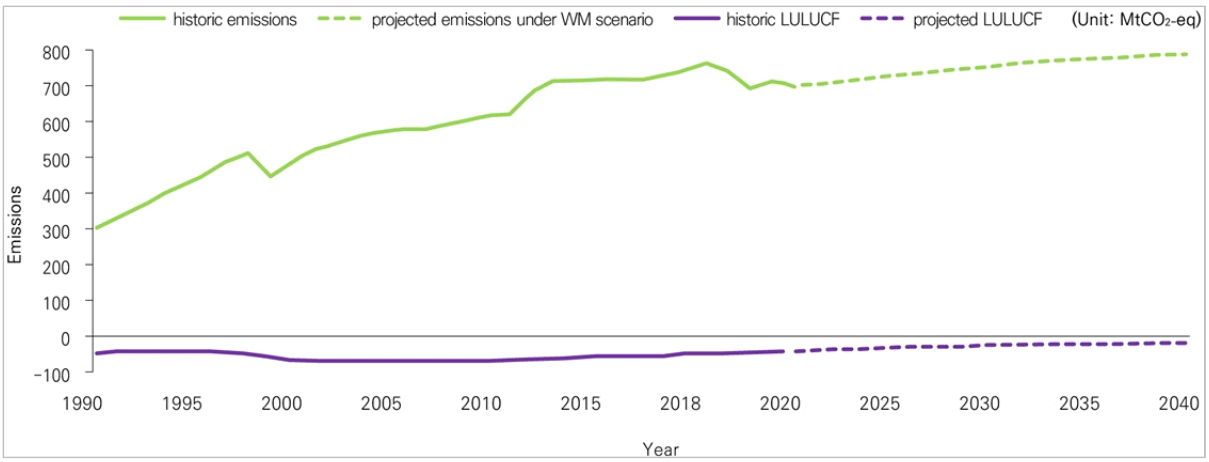
It should be noted that this projection result does not take into account PaMs for updated GHG reduction targets introduced after 2021. When emissions projection is updated based on the most recent year, reflecting new PaMs, emissions are expected to decrease compared to this projection. However, given that the ROK's economy is significantly influenced by global factors such as export supply chains and energy prices, these changes may have substantial effects on the ROK's economic development and corresponding GHG emissions levels. Therefore, like all predictions, it is necessary to consider that emissions projection also involves considerable uncertainty.

<Table Ⅱ-66> GHG Emissions and Projection: WM Scenario

(Unit: $MtCO_2$-eq)

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
Total Emissions	309.8	461.2	529.8	587.1	690.6	727.0	773.0	701.6	728.0	757.1	783.3	798.0
LULUCF	-38.2	-32.4	-60.3	-56.5	-56.3	-46.6	-40.4	-37.9	-26.6	-19.9	-14.9	-12.5
Net Emissions	271.6	428.8	469.5	530.6	634.3	680.4	732.6	663.7	701.5	737.2	768.4	785.5

Note: 1. Data for 1990-2021 corresponds with the inventory data in Chapter 1 of the BTR
2. For 2018, Korea's 2030 NDC base year, the reference value used for target setting was based on the inventory prepared in 2022 according to the 1996 inventory guidelines, thus differing from the 2018 value above



[Figure Ⅱ-14] GHG Emissions and Projection: WM Scenario

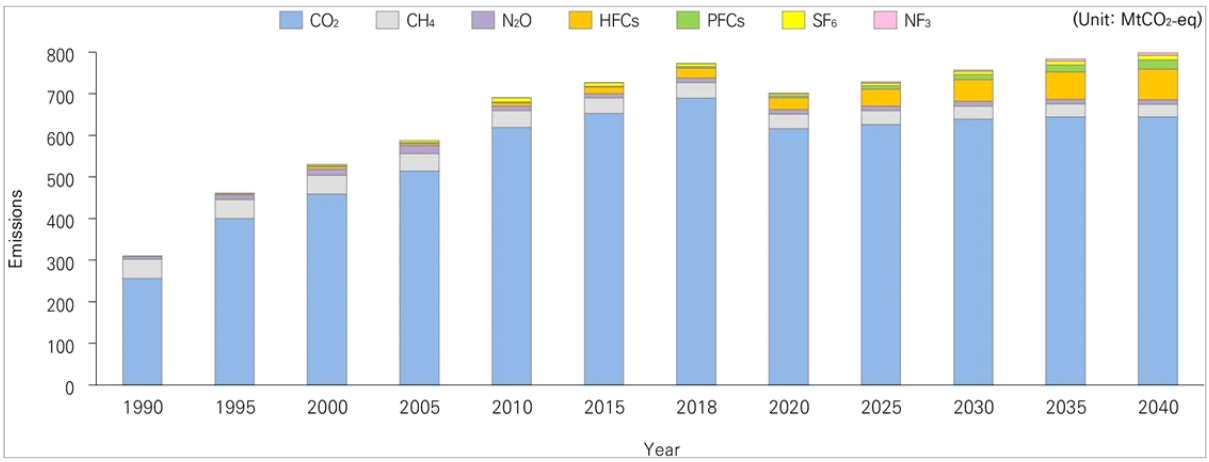
4.3 Projection by Gas

Historical emissions by gas and projected GHG emission trends are shown in Table II-67.

<Table Ⅱ-67> GHG Emissions by Gas: Trends and Projection

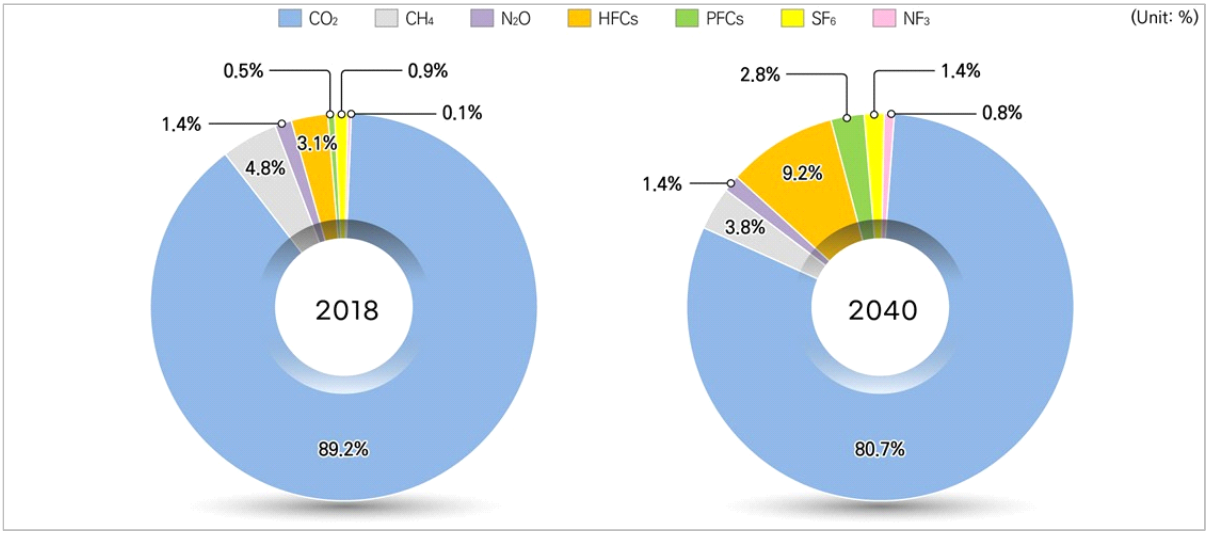
(Unit: $MtCO_2$-eq)

		1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
CO_2		255.4	399.4	459.0	513.9	618.7	652.2	689.4	615.5	625.5	638.5	644.2	644.3
CH_4		46.9	46.4	44.6	42.3	40.8	37.7	37.4	35.8	33.6	32.0	31.1	30.1
N_2O		6.3	10.6	14.8	18.8	10.6	10.0	10.8	10.6	10.7	10.9	11.1	11.2
HFCs		1.0	3.3	6.0	4.7	7.6	16.1	23.6	27.9	40.7	52.1	65.8	73.6
PFCs		0.0	0.0	2.5	3.2	2.5	1.8	3.9	4.5	8.8	12.3	16.6	22.0
SF_6		0.2	1.5	2.8	4.3	10.0	8.4	6.9	5.2	6.0	7.6	9.6	10.8
NF_3		0.0	0.0	0.0	0.0	0.4	0.8	1.0	2.1	2.8	3.7	4.9	6.1
Total Emissions		309.8	461.2	529.8	587.1	690.6	727.0	773.0	701.6	728.0	757.1	783.3	798.0
LULUCF	CO_2	-38.6	-32.7	-60.7	-56.9	-56.7	-47.0	-40.8	-38.3	-27.0	-20.3	-15.3	-12.9
	CH_4	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	N_2O	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.02	0.01	0.02
	Total	-38.2	-32.4	-60.3	-56.5	-56.3	-46.6	-40.4	-37.9	-26.6	-19.9	-14.9	-12.5
Net Emissions		271.6	428.8	469.5	530.6	634.3	680.4	732.6	663.7	701.5	737.2	768.4	785.5



[Figure Ⅱ-15] GHG Emissions by Gas: Trend and Projection

Figure II-16 shows the emission ratio by gas in 2018 and projected ratio in 2040. Under the WM scenario, the order of gases by proportion is expected to change from CO_2 > CH_4 > HFCs > N_2O > SF_6 > PFCs > NF_3 in 2018 to CO_2 > HFCs > CH_4 > PFCs > N_2O > SF_6 > NF_3 in 2040.



[Figure Ⅱ-16] Emissions Ratio by Gas in 2018 and Projected Emissions Ratio in 2040

4.3.1 Carbon Dioxide (CO_2)

Based on total emissions, CO_2 emissions are projected to reach 644.3 $MtCO_2$-eq in 2040, a 6.5% decrease compared to 2018, the NDC base year. CO_2 emissions accounted for 89.2% of the ROK's total emissions in 2018 and are projected to gradually decrease to 80.7% by 2040.

CO_2 emissions from all sectors increased at an average of 3.6% anually from 1990 to 2018. However, they are projected to decrease by an average of 0.3% annually until 2040 due to short-term factors such as the pandemic and global economic recession, and long-term improvements in carbon intensity resulting from decreased coal and oil/petroleum usage and increased use of gas and renewable energy.

4.3.2 Methane (CH_4)

CH_4 emissions are projected to decrease by 19.5% to 30.1 MtCO2-eq in 2040 compared to 2018 based on total emissions. CH_4 emissions accounted for 4.8% of the ROK's total emissions in 2018 and are projected to gradually decrease to 3.8% by 2040.

The decrease in CH_4 is expected to be primarily due to the continuous reduction in rice cultivation area in the agricultural sector, the ban on food waste landfill disposal, and increased recycling rates in the waste landfill sector.

4.3.3 Nitrous Oxide (N_2O)

N_2O emissions are projected to increase by 3.2% to 11.2 MtCO2-eq in 2040 compared to 2018 based on total emissions, showing little change. N_2O emissions accounted for 1.4% of total emissions in 2018 and are projected to remain at the same level of 1.4% in 2040.

4.3.4 Fluorinated Gas (HFCs, PFCs, SF_6, NF_3)

Emissions of fluorinated gases (HFCs, PFCs, SF_6, NF_3) reflect trends in the electronics industry, improvements in activity data for Ozone Depleting Substances (ODS) alternatives, and methodology enhancements in calculating actual emissions from production, use, and disposal. Accordingly, fluorinated gases accounted for 4.6% of total emissions in 2018 and are projected to increase to 14.1% by 2040.

Among fluorinated gases, emissions of HFCs, which constitute the majority of ODS alternative use, show an increasing trend. Since the ROK is classified as Group I of Article 5 under the Amendment to the Montreal Protocol on Substances That Deplete the Ozone Layer Kigali (Kigali Amendment) and freezes HFCs production and consumption starting in 2024, this effect is not reflected in the WM scenario. An increasing trend is anticipated due to the assumed partial transition to HFCs following the Montreal Protocol on Substances that Deplete the Ozone Layer's phase-out of HCFC production and use by 2030. However, emissions are expected to gradually decrease through additional reduction efforts such as compliance with the Kigali Amendment, replacement with low-GWP refrigerants, expanded use of recycled refrigerants, and increased recovery during use and disposal phases.

4.4 Methodology

The GHG emissions data presented in this report is based on the 2023 National Greenhouse Gas Inventory (1990–2021), prepared according to the IPCC 2006 GL. To develop the WM scenario for the ROK's first BTR submission, technical working groups comprising experts from relevant government agencies for each sector were formed to conduct emissions projection. Sector-specific technical working groups reviewed various econometric models and other projection methodologies, selected the most appropriate methods, and conducted emission projection. The results were finalized after consulting with industry, external experts, relevant ministries, the Carbon Neutrality and Green Growth Commission, and other stakeholders to gather diverse opinions.

The projection of major activity data for GHG emissions utilizes econometric models that best explain the relationship with socioeconomic macroeconomic variables and preconditions.

The projection results of key macroeconomic variables used in emissions projection are shown in Table II-68. The projection utilizes results from relevant institutions responsible for key variables such as the ROK's population, economic growth, oil prices, and industrial structure.

For key assumptions, population projection uses the medium population projection scenario among various scenarios projected by Statistics Korea. Economic growth utilizes long-term economic projection by the Korea Development Institute (KDI) based on actual figures from the Bank of Korea's Economic Statistics System. Oil prices utilize projection from the Korea Energy Economics Institute (KEEI) based on data from the International Energy Agency's (IEA) World Energy Outlook.

<Table Ⅱ-68> Key Variables and Assumptions

Variable	Unit	2018	2020	2025	2030	2035	2040
Population	Million	51.6	51.8	51.7	51.3	50.8	50.1
GDP	KRW Trillion	1,812.0	1,839.5	2,077	2,231	2,351	2,447
Oil Price	USD/bbl	69.0	43.6	92.1	89.4	89.0	88.6

4.5 Uncertainty (Sensitivity Analysis)

The ROK has included baseline emissions projection under the WM scenario in its first BTR for the first time, as submitted to the international community under the Paris Agreement. The development of a With Additional Measures (WAM) scenario, which reflects the effects of additional reduction measures, and sensitivity analyses on uncertainties in future values of key variables such as demographics, economic growth, and fuel prices, will be developed in detail and included in subsequent BTRs.

III

Climate Change Impacts and Adaptation

1. National Circumstances, Institutional Arrangements and Legal Frameworks

1.1 National Circumstances

1.1.1 Observed Changes in Climate Patterns

The Republic of Korea (ROK) is experiencing a more rapid increase in temperature compared to the global average. Over the past 109 years (1912-2020), the ROK's annual mean temperature increased by 0.20°C per decade, and the mean temperature over the recent 30 years (1991-2020) rose by 1.60°C compared to the previous 30-year period (1912-1940). This is a significantly larger increase than the global mean temperature rise of 1.09°C from pre-industrial levels (1850-1900) to the last decade (2011-2020).

Over the past 109 years (1912–2020), the annual mean precipitation in the ROK has increased, although the number of rainy days has shown a decreasing trend. Total precipitation rose by 17.71 mm per decade, while the number of rainy days declined by 2.73 days per decade. The frequency of extreme rainfall events has also increased significantly.

Other extreme climate indicators, such as the number of heatwave days and tropical nights, have surged in recent years. During the last decade (2011-2020), heatwave days increased by 2.8 days, and tropical nights by 4.6 days, compared to the previous 30-year period (1991-2020). Conversely, indicators of cold extremes, such as cold days and frost days, have declined over the past 109 years. Cold days decreased by 1.91 days per decade, and frost days by 0.61 days per decade.

The annual mean sea surface temperature has also risen sharply, increasing by 1.44°C over the past 56 years (1968-2023), which is more than double the global average increase of 0.70°C. In 2023, the annual mean sea surface temperature, as observed by satellite, reached 19.8°C, marking the highest temperature since sea surface temperature observations began in the ROK in 1990.

Additionally, the mean sea level around the ROK's coastal areas has risen by approximately 3.06 mm annually over the past 35 years (1989-2023), resulting in a total increase of around 10.7 cm. The rate of sea level rise has accelerated in recent years, with an average annual increase of 3.88 mm recorded over the last decade (2014-2023).

1.1.2 Projections of Future Climate Change and Impacts

Climate change in Korea is projected to intensify over time. According to the Shared Socioeconomic Pathways (SSP) scenarios by the Intergovernmental Panel on Climate Change (IPCC), the ROK's annual mean temperature by the late 2 century (2081-2100) is expected to increase by approximately 2.3°C to 6.3°C from present levels, depending on the level of greenhouse gas (GHG) emissions.

The annual mean precipitation is also anticipated to rise. Under all scenarios, the ROK's annual precipitation in the late 2 century is projected to increase by about 4% to 16% from current levels, while the number of precipitation days is expected to decrease by approximately 10 to 14 days.

The frequency of heatwave days and tropical nights is also expected to surge. Across all scenarios, the ROK's heatwave days are projected to increase by an estimated 15.4 to 70.7 days, and tropical nights by 19.1 to 65.2 days by the late 2 century. Under the high-emission scenario (SSP5-8.5), which assumes rapid economic growth based on fossil fuels, heatwave days and tropical nights are projected to increase sharply after the mid-2 century (2041-2060), potentially doubling by the late 21st century compared to the mid-21st century.

The annual mean sea surface temperature around the ROK is expected to rise steadily, with projections under the high-emission scenario (SSP5-8.5) indicating an increase of up to 4°C by 2100. The mean sea level rise in the ROK's surrounding waters is projected to vary across emission scenarios, with rates ranging from 5.44 mm/year to 9.51 mm/year, resulting in a total projected rise of 46.8 cm to 81.8 cm by the end of the century.

1.2 Institutional Arrangements and Legal Framework

1.2.1 Legal Basis and Policies

The ROK recognizes climate change as a serious threat and is making its best efforts to adapt to it. Climate change adaptation in the ROK was first legalized in 2010 with the enactment of the *Framework Act on Low Carbon, Green Growth* (January 2010). Currently, the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (Carbon Neutrality Act) (September 2021), mandates nationwide climate change adaptation initiatives. Regarding climate adaptation, the Act mandates the monitoring and forecasting of climate change, the development and implementation of the National Climate Change Adaptation Plan, and regular assessments of its progress. The Act also requires not only the central government but also local governments and public institutions to develop and implement adaptation plans, while providing a legal foundation for establishing and operating specialized adaptation institutions.

In 2020, the ROK presented the 2050 Carbon Neutral Vision, aiming for carbon neutrality by 2050. In 2023, the ROK adopted the *National Carbon Neutral Green Growth Strategy* (April 2023) and the *First National Basic Plan for Carbon Neutral Green Growth* (April 2023) to enhance climate change response efforts. As for adaptation-specific policies, the ROK has been developing and implementing *National Climate Change Adaptation Plans* (NCCAP) (December 2020) on a five-year basis since 2010 and is currently implementing the *Enhanced Third National Climate Change Adaptation Plan* (Enhanced 3rd NCCAP) (2023–2025) (June 2023), an updated and enhanced version of the previous 3rd NCCAP (December 2020).

In 2022, the National Human Rights Commission of Korea stated that it is a fundamental duty of the government to protect and promote the human rights of all people under climate change. The Commission recommended improvements to relevant laws and systems to address climate change from a human rights perspective. This has led to the progressive strengthening of the ROK's climate change adaptation policies, encompassing all citizens, including vulnerable populations.

1.2.2 Governance

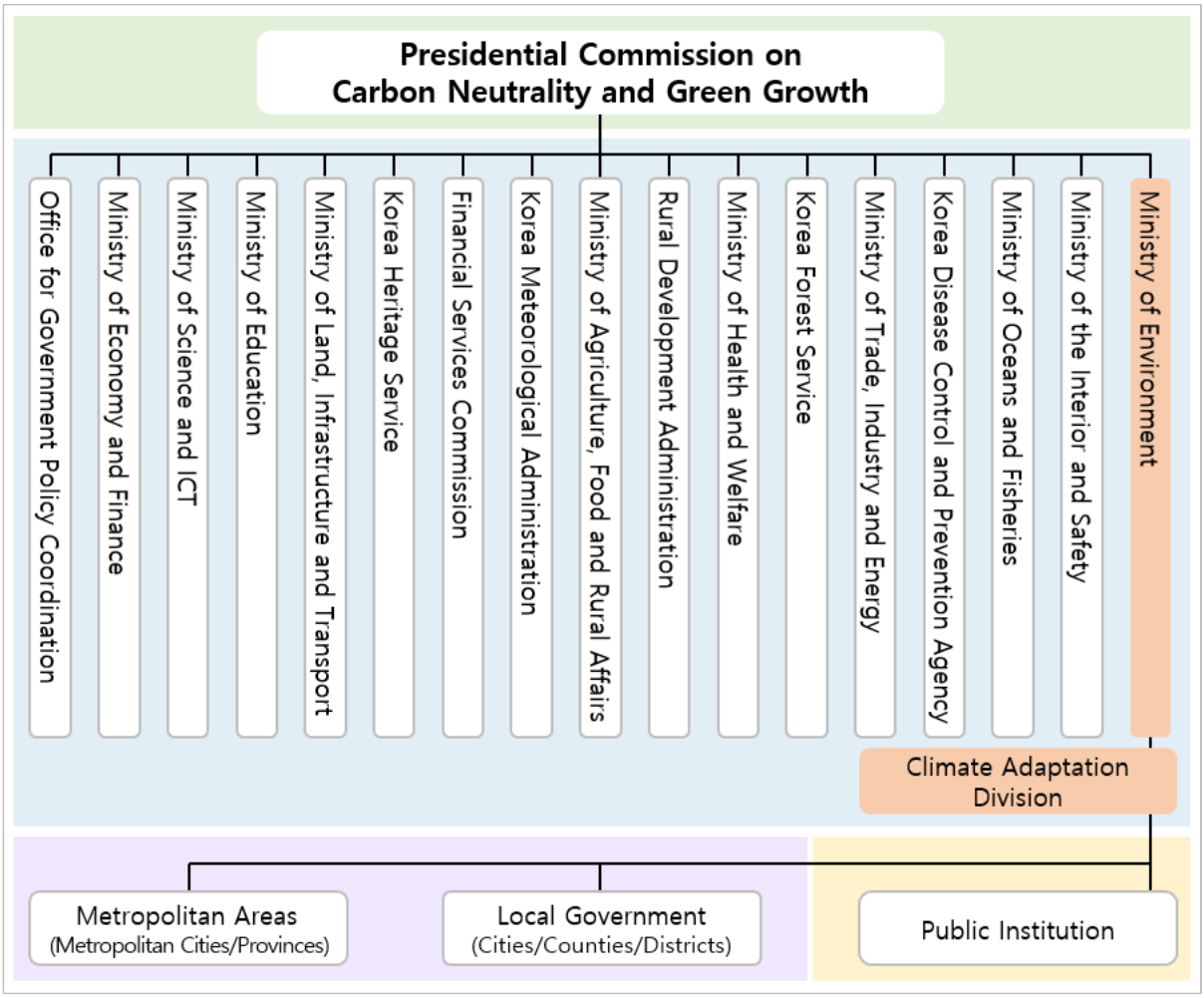
The ROK has established a comprehensive governance framework to support climate change adaptation. Horizontally, 15 ministries are involved in developing and implementing the NCCAP. Vertically, the framework encompasses adaptation policies implemented by the central government, sub-national governments at both metropolitan and municipal levels, as well as public institutions. The ROK also collaborates with various stakeholders, including the private sector and the public, and provides targeted adaptation support to climate-vulnerable populations.

At the central government level, the Ministry of Environment serves as the lead agency for climate change adaptation, overseeing the entire process of formulating the NCCAP every five years and conducting annual assessments and comprehensive evaluations. Currently, a total of 15 ministries are participating in the Enhanced 3rd NCCAP. Each ministry develops and implements specific action plans and submits updates on implementation progress.

Sub-national governments, including 17 metropolitan and provincial governments, and 226 city, county, and district-level administrations, are required to develop and implement *Sub-National Climate Change Adaptation Plans* (SNCCAPs) every five years. Additionally, 62 public institutions responsible for critical infrastructure, such as transportation and electricity, are mandated to formulate and implement their own adaptation plans every five years.

The *Presidential Commission on Carbon Neutrality and Green Growth* (Carbon Neutrality and Green Growth Commission) was established to deliberate and decide on major policies, plans, and implementation measures, including adaptation, for transitioning to a carbon-neutral society and promoting green growth.

The ROK recognizes industry and the general public as key stakeholders in climate change adaptation and actively engages with them. It also provides dedicated support programs for climate-vulnerable populations, such as the elderly and low-income households.



[Figure Ⅲ-1] Organizational Framework for Climate Change Adaptation in the ROK

To support research, policy, and projects related to climate change adaptation, the Ministry of Environment has established and designated adaptation-supporting institutions. In 2009, the Korea Adaptation Center for Climate Change (KACCC) was established within the Korea Environment Institute (KEI). The KACCC has led research on adaptation, the development and implementation of adaptation plans, international cooperation, scientific assessment tools development, and public education on adaptation. Additionally, in 2021, the National Adaptation Center for Climate Change (NACCC) was established within the National Institute of Environmental Research (NIER) to strengthen the scientific basis for climate change adaptation.

2. Impacts, Risks and Vulnerabilities

2.1 Scientific Assessment

The ROK conducts various scientific assessments to evaluate the current and future impacts of climate change, aiming to establish effective and efficient adaptation strategies.

The ROK periodically publishes the *Korea Climate Change Assessment Report*, which compiles domestic and international research findings on climate change to support decision-makers.

To establish the NCCAP, the Ministry of Environment conducts a national climate change risk assessment every five years and develops adaptation measures based on the identified major risks. Recently, the ME conducted the 2023 national climate change risk assessment to reassess previously identified risks and incorporated these findings into the Enhanced 3rd NCCAP (2023-2025) (June 2023).

The Ministry of Environment, in collaboration with relevant ministries, has developed the Model Of InTegrated Impact and Vulnerability Evaluation of Climate Change (MOTIVE) to assess the impacts and vulnerabilities related to climate change across seven sectors: water management, forestry, health, agriculture, fisheries, oceans, and ecosystems. As a scientific support tool for climate change impact and vulnerability assessment, MOTIVE has been enhanced since 2022 to strengthen its decision-making support functions for adaptation measures across six sectors: water management, forestry, health, agriculture, industry, and ecosystems.

The Ministry of Environment has also developed the web-based Vulnerability Assessment Tool to Build Climate Change Adaptation Plan (VESTAP), which is provided to local governments, public institutions, and other key stakeholders. VESTAP supports local climate change adaptation planning by identifying priority climate-vulnerable areas, reducing uncertainty in policy decisions, and providing scientific decision support. Based on indicators of climate exposure, sensitivity, and adaptive capacity, VESTAP provides vulnerability assessments for six sectors - water management, health, agriculture and fisheries, land and coastal areas, industry and energy, and ecosystems - at the administrative levels of si (cities), gun (counties), and gu (districts), or eup (towns), myeon (townships), and dong (neighborhoods).

2.2 Climate Change Impacts

The ROK regularly publishes the Korea Climate Change Assessment Report to comprehensively analyze climate change impacts. The following presents a summary of major climate change impacts by sector and recent cases of extreme weather events in the ROK.[45)]

1) Water Resources

Climate change impacts on water resources in the ROK include observed increases in summer precipitation and a higher frequency of heavy rainfall days, defined by thresholds of 30 mm, 50 mm, 80 mm, and 100 mm per day. Over the 106-year period from 1912 to 2017, summer precipitation increased by 11.6 mm per decade. During the 30-year period from 1981 to 2010, the frequency of days exceeding heavy rainfall thresholds across eight major cities in the ROK increased by 3.1% to 15%. From June to September 2023, unprecedented heavy rainfall resulted in 50 fatalities, 3 missing persons, and property damage estimated at approximately KRW 807.1 billion.

2) Forest

In the forest sector, rising temperatures and increased frequency and intensity of extreme weather events - including droughts, monsoon, heatwaves, and strong winds - have been observed to affect forest growth, species distribution, and disaster patterns. Key coniferous species, such as Big-Cone pine tree and Korean red pine tree, have exhibited reduced growth rates due to climate change. Subalpine coniferous forests, which provide habitats for endangered species like the Korean fir, have experienced a 25% decline in area over the 20-year period (1990 to 2010).

Additionally, spring dry weather, severe droughts in the southern regions, and strong winds have contributed to an increase in forest fires. In 2023, the frequency of forest fires increased by 5%, and the affected areas expanded by 25% compared to the 10-year average (2014 to 2023).

45) The information on climate change impacts is sourced from the *Korea Climate Change Assessment Report 2020*, which provides trends and projections of climate change impacts in the ROK. This report is based on a comprehensive analysis of approximately 1,900 domestic and international research papers and reports published between 2014 and 2020, conducted by 120 experts. Additionally, some information originates from climate change impact assessment reports issued by various ministries.

3) Public Health

In the public health sector, climate change impacts include an increased risk of heat-related mortality and illnesses, as well as risks from extreme weather events such as typhoons, heatwaves, and heavy snow. A 1°C rise in temperature increases the mortality risk by 5%, and during heatwave periods, this risk rises to 8%. During the summer heatwave monitoring period in 2023, a total of 2,818 cases of heat-related illnesses were reported, reflecting an 80.2% increase compared to the previous year.

4) Marine and Fisheries

In the marine and fisheries sector, sea surface temperatures and ocean acidification around the Korean Peninsula are progressing more rapidly than the global average. Over the past 56 years (1968–2023), the sea surface temperature increase in waters surrounding the Korean Peninsula has reached approximately 1.44°C, which is about twice the global average increase of 0.70°C.

Over the past 40 years, the rise in sea surface temperatures has caused the catch of subtropical pelagic fishes, such as Spanish mackerel and yellowtail, has increased, and their fishing grounds have been moving northward. In September 2023, the sea surface temperature around the Korean Peninsula reached 19.8°C, the highest temperature since observations began. This extreme temperature resulted in mass mortality of aquaculture species, including flatfish, abalone, and sea squirts, with estimated losses of KRW 43.8 billion.

5) Ecosystems

In the ecosystem sector, shifts in animal habitats have been observed, with the spread of vector pests, such as mosquitoes and ticks, becoming increasingly evident nationwide. In 2022, cases of tick-borne diseases increased by 55.7% compared to 2019, raising concerns about the potential endemic transmission of severe malaria.

6) Agriculture

In the agricultural sector, climate change has caused a northward shift in cultivation areas, an increase in overwintering pests and invasive species, and a rise in herbicide-resistant weeds. Rising temperatures have significantly reduced the cultivation areas for high-altitude

grown Nappa cabbage and radish, which have consistently decreased since the 2000s, shrinking to half their previous size.

7) Industry, Energy, and Human Settlements

In the industry, energy, and human settlements sector, heatwaves and tropical nights have resulted in increasing electricity consumption in buildings during the summer months (July to August). Additionally, rural areas, which have lower population density and income levels, less developed infrastructure, and higher proportions of elderly residents compared to urban areas, experience adverse conditions such as reduced heating and cooling efficiency in homes, inadequate water and sewage systems, aging housing, and insufficient public transportation.

2.3 Risk Assessment

The ROK conducts national climate risk assessments to identify climate change-related risks and to develop adaptation plans aimed at addressing these risks. For the Enhanced 3rd NCCAP (2023-2025), previous risks were reassessed through consultation with 36 experts, identifying 72 risks across seven sectors. The primary risks for each sector are as follows.

1) Water Management

The assessment indicates three key risks: facility maintenance challenges from extreme rainfall, water scarcity from severe droughts, and environmental impacts from climate change. Infrastructure faces risks to structural integrity and maintenance of dams, reservoirs, and rivers when rainfall exceeds design specifications. Water scarcity risks affect residential, industrial, and agricultural supplies, with elevated temperatures impacting productivity. Environmental risks include increased waterborne pollutant movement during heavy rainfall and ecosystem impacts such as riverbed desiccation and insufficient environmental flows during droughts.

2) Forest

The assessment shows that forests face risks from wildfires, landslides, and damage to forest species and habitats. ROK's forests, with their high proportion of coniferous trees and seasonal winds along the eastern coast, are vulnerable to wildfires, while heavy rainfall during monsoon seasons creates significant landslide risks. Additionally, high temperatures and droughts increase forest pest damage, reduce tree growth, and contribute to tree mortality, leading to degraded forest ecosystem health and biodiversity loss.

3) Public Health

The assessment indicates elevated risks in the public health sector from temperature-related illnesses (both heat- and cold-induced) and vector-borne diseases transmitted by insects and animals, exacerbated by rising temperatures and increased international movement. Additional risks include potential emergence of new infectious diseases and mental health impacts from climate-related disasters.

4) Housing, Urban, and Infrastructure

The assessment indicates risks to residential areas and vulnerable populations from urban flooding caused by increased extreme weather events, particularly heavy rainfall and typhoons. Land transportation infrastructure, including railways and roads, shows increasing vulnerability to extreme weather impacts.

5) Port and Coastal Areas

The assessment indicates increasing risks of coastal disasters and saline damage in ports and coastal areas due to sea level rise. Coastal risks include flooding and inundation of coastal areas, damage to coastal infrastructure, and erosion of beaches and tidal flats. Additional risks involve damage to port facilities and reduced operational functionality due to extreme weather events.

6) Agriculture and Fisheries

The assessment indicates key risks in agriculture and fisheries from changing production conditions and food supply instability. These include agricultural water scarcity from droughts and heatwaves, shifts in suitable cultivation areas, and reduced productivity due to temperature rise.

7) Ecosystems

The assessment indicates risks to ecosystem changes, particularly in species populations and habitats. These include reductions in native species populations, expansions of invasive species, and wildlife disease emergence linked to temperature rise and precipitation changes.

3. Adaptation Strategies, Policies, Plans, Goals and Actions

3.1 National Level

ROK's national climate adaptation is guided by five-year National Climate Change Adaptation Plans. The current Enhanced 3rd NCCAP (2023-2025) (June 2023), established in 2023, strengthens the previous 3rd NCCAP (2021-2025) (December 2020) by incorporating the latest IPCC climate projections and enhanced responses to extreme weather events, along with actionable implementation plans. Fifteen ministries participate, with the Ministry of Environment leading overall coordination, implementation monitoring, and evaluation.

3.1.1 Enhanced Third National Climate Change Adaptation Plan

The Enhanced 3rd NCCAP (2023–2025) (June 2023) envisions a safe and resilient Republic of Korea amidst the challenges posed by climate change. The plan is structured around three primary objectives and four strategic directions, aiming to strengthen the ROK’s adaptive capacity and resilience.

Vision	**A Safe and Climate-Resilient Republic of Korea**		
Goals	• Support for adaptation measures based on scientific predictions • Minimizing public damage through climate disaster prevention • Enhancement of capacities through the collective efforts of all adaptation stakeholders		
4 Major Policies	1	Enhancement of Scientific Climate Monitoring, Prediction and Adaptation Foundation	- Strengthen climate crisis monitoring systems and projections - Promote the production of climate adaptation information and technology development
	2	Realization of a Safe Society Resilient to Climate Disasters and Risks	- Enhance water management system to prepare for floods and drought - Prevent forest disasters such as wildfires and landslides - Strengthen preventive measures for health impacts caused by extreme weather events like heatwaves and cold waves
	3	Building Social Infrastructure Adapting to Climate Crisis	- Strengthen disaster resilience of housing, urban areas, and infrastructure in response to the climate crisis - Develop climate-adaptive ports and marine spaces - Create a sustainable agricultural and fisheries environment - Maintain ecosystem stability
	4	Promoting Climate Adaptation Implementation with All Stakeholders	- Strengthen national protection for vulnerable groups facing the climate crisis - Improve disaster response capabilities - Establish adaptation governance with public participation

[Figure Ⅲ-2] Framework of the Enhanced Third National Climate Change Adaptation Plan

The first strategic direction focuses on improving climate forecast accuracy and enhancing public access to adaptation information. To achieve this, the plan incorporates socioeconomic factors, such as population growth and economic development, into future climate projections. It also aims to provide public-oriented climate information through the integration of adaptation data produced by various ministries, visualized in the form of climate risk maps, and accessible through a comprehensive digital platform.

The second strategic direction aims to adapt critical infrastructure to future climate risks and strengthen disaster response capabilities. Key initiatives under this direction include the redesign of infrastructure such as dams and drainage systems to account for future climate risks and the enhancement of early warning systems for floods, heatwaves, cold spells, and forest fires to ensure timely responses to climate-induced disasters.

The third strategic direction emphasizes strengthening the resilience of living spaces and infrastructure while enhancing adaptation in agriculture, fisheries, and ecosystems. This includes improving disaster-prone housing, upgrading urban planning and transportation infrastructure, developing climate-adaptive agricultural practices, and expanding biodiversity monitoring to ensure ecosystem stability and sustainability.

The fourth strategic direction aims to strengthen legal frameworks and foster collaboration among stakeholders, including national and local governments, industry, and the financial sector. This direction also focuses on providing targeted support for climate-vulnerable populations, thereby enhancing cooperation among government agencies, businesses, and civil society to build a more resilient society.

<Table Ⅲ-1> Tasks of the Enhanced Third National Climate Change Adaptation Plan

Policy Objectives	Implementation Tasks
Strengthening Climate Change Monitoring and Forecasting Systems	Diversifying and Strengthening Comprehensive Climate Change Monitoring and Collaboration Systems
	Developing Advanced Climate Projection Technologies and Preparing for Future Scenarios
	Advancing Early Warning Systems for Climate Risks and Supporting Decision-Making
Promoting Climate Change Adaptation Information and Technological Development	Establishing a Comprehensive Adaptation Information Platform with User-Friendly Information
	Enhancing Visualization of Climate Adaptation Information and Evaluation Methods
	Promoting Adaptation Technology Development Across Monitoring, Forecasting, and Response Phases
Enhancing Water Resource Management for Flood and Drought Preparedness	Securing Critical Response Time for Extreme Floods and Improving Related Infrastructure
	Enhancing Drought Response Capabilities and Advancing Water Resource Management
	Building a Healthy and Stable Water Environment Amid Climate Change
Preventing Forest Disasters, Including Wildfires and Landslides	Establishing a Proactive Response System for Increasing and Intensifying Wildfires
	Strengthening Damage Mitigation and Recovery in Landslide-Prone Areas
	Protecting Forest Ecosystems from Climate Change Impacts
Strengthening Public Health Measures for Extreme Temperature Events (Heatwaves and Cold Waves)	Monitoring Extreme Temperatures and Minimizing Related Damages
	Advancing Research, Surveillance, and Response Capacity for Climate-Related Diseases
	Strengthening Protective Frameworks for Vulnerable populations Facing Increased Health Risks

Policy Objectives	Implementation Tasks
Enhancing Disaster Resilience of Housing, Urban Areas, and Infrastructure	Improving Disaster-Prone Housing and Enhancing Building Resilience
	Strengthening Management of Social Infrastructure to Respond to Extreme Climate Events
	Developing Climate Adaptation-Focused Urban Planning at the Sub-National Level
Developing Climate-Resilient Ports and Marine Spaces	Enhancing Information Dissemination to Prevent Coastal Disasters
	Reinforcing Port Infrastructure and Improving Design Standards to Address Coastal Disasters
	Developing Korea-Specific Coastal Disaster Response Technologies and Building Expertise
Fostering Sustainable Agricultural and Fisheries Practices	Enhancing Agricultural and Fisheries Production Information for Climate Disaster Preparedness
	Strengthening Climate Adaptation Capacity in Production Infrastructure
	Developing Climate-Resilient Technologies and Varieties, and Upgrading Smart Infrastructure
	Enhancing Food Security and Reforming Response Systems for Climate Change
Maintaining Ecosystem Stability and Biodiversity	Strengthening Monitoring and Information Dissemination to Protect Ecosystems from Climate Change
	Enhancing Response to Ecological Disasters, Such as Mass Species Proliferation
	Protecting Vulnerable Species and Promoting Biodiversity and Ecosystem Stability
Strengthening National Protection for Climate Vulnerable Populations	Identifying Climate Vulnerable Populations and Developing Targeted Adaptation Measures
	Improving Health Management and Reducing Energy Burden for Climate Vulnerable Populations
	Enhancing Living Conditions and Assessing Support Needs for Vulnerable Residential Areas
Enhancing Response Capabilities for Climate-Related Disasters	Establishing a Rapid and Accurate Disaster Information Dissemination System
	Strengthening Measures and Support for Field Response and Recovery
	Promoting a Culture of Safety Through Inclusive Collaboration
Implementing Inclusive Adaptation Governance with Public Participation	Enhancing Institutional and Cooperative Foundations for an Adaptive Society, and Developing Decision-Support Systems
	Strengthening and Consolidating Adaptation Capacity for All Stakeholders
	Enhancing Public Outreach, Education, and International Cooperation in Alignment with Public Needs

3.1.2 Performance Indicators of the Plan

From the planning stages of the NCCAP, monitoring and evaluation have been integrated by developing performance indicators within the Plan. The Enhanced 3rd NCCAP (2023-2025) (June 2023) includes 18 policy indicators and 15 public-oriented indicators, which are used for monitoring and evaluation of the Plan.

<Table Ⅲ-2> Performance Indicators for the Enhanced Third National Climate Change Adaptation Plan

Policy Objectives	Indicator Names	
	Policy Indicators	Public-Oriented Indicators
Strengthening Climate Change Monitoring and Forecasting Systems	Climate Change Situation Map	-
	Establishment of GHG Ground Observation Network	-
Promoting Climate Change Adaptation Information and Technological Development	Development of a Standard Classification System for Adaptation Information	-
Enhancing Water Resource Management for Flood and Drought Preparedness	Expansion of Flood Forecasting Locations (units)	Expansion of Small-Scale Rain Radar Systems (units)
	National Drought Vulnerability Map Service	Designation of Priority Areas for Sewerage Management (units)
	-	Users of National Drought Information Service (persons/year)
	-	Provision of Drought Meteorological Forecasts
Preventing Forest Disasters, Including Wildfires and Landslides	Advanced Wildfire Prediction System	Advanced Landslide Early Warning System
	Precision of Landslide Hazard Map	Establishment of Mountain Meteorological Observation Network (units)
Strengthening Public Health Measures for Extreme Temperature Events (Heatwaves and Cold Waves)	Development of Methodology for Estimating Climate-Related Disease Burden	-
Enhancing Disaster Resilience of Housing, Urban Areas, and Infrastructure	Support for Relocation of Households in Non-Standard Residences to Public and Private Rental Housing (households)	-
	Green Remodeling of Public Rental Housing Units (units)	-
Developing Climate-Resilient Ports and Marine Spaces	Reinforcement of External Port and Fishing Port Facilities (units)	-
Fostering Sustainable Agricultural and Fisheries Practices	Expansion of Crop Disaster Insurance Coverage	Development of Climate-Resilient Crop Varieties (varieties)
	Expansion of Real-Time Sea Temperature Observation Network (units)	Provision of Farm-Specific Early Warning System Information (sub-national governments)

Policy Objectives	Indicator Names	
	Policy Indicators	Public-Oriented Indicators
Maintaining Ecosystem Stability and Biodiversity	Designation of National Protected Areas (km²)	Database of Species Experiencing and Likely to Experience Mass Proliferation Events
	Urban Ecological Corridor Restoration Projects (projects)	Eco-Friendly Pest Control Guidelines
Strengthening National Protection for Climate Vulnerable Populations	Standard Model for Adaptation Infrastructure (units)	Survey and Guidelines for Climate Vulnerable Populations
	-	Support for Adaptation Infrastructure Development (sub-national governments)
Enhancing Response Capabilities for Climate-Related Disasters	Publication of Korea Climate Change Assessment Report	Selection Plan for Climate Risk Priority Management Areas
Implementing Inclusive Adaptation Governance with Public Participation	Operation of Adaptation Research Institution Consultation Network	Operation of Adaptation Academy (cumulative/persons)
	-	Operation of Regional Expert and Resident Support Groups for Sub-National Government Adaptation Plans (sub-national governments)

3.1.3 Monitoring and Evaluation of the Plan

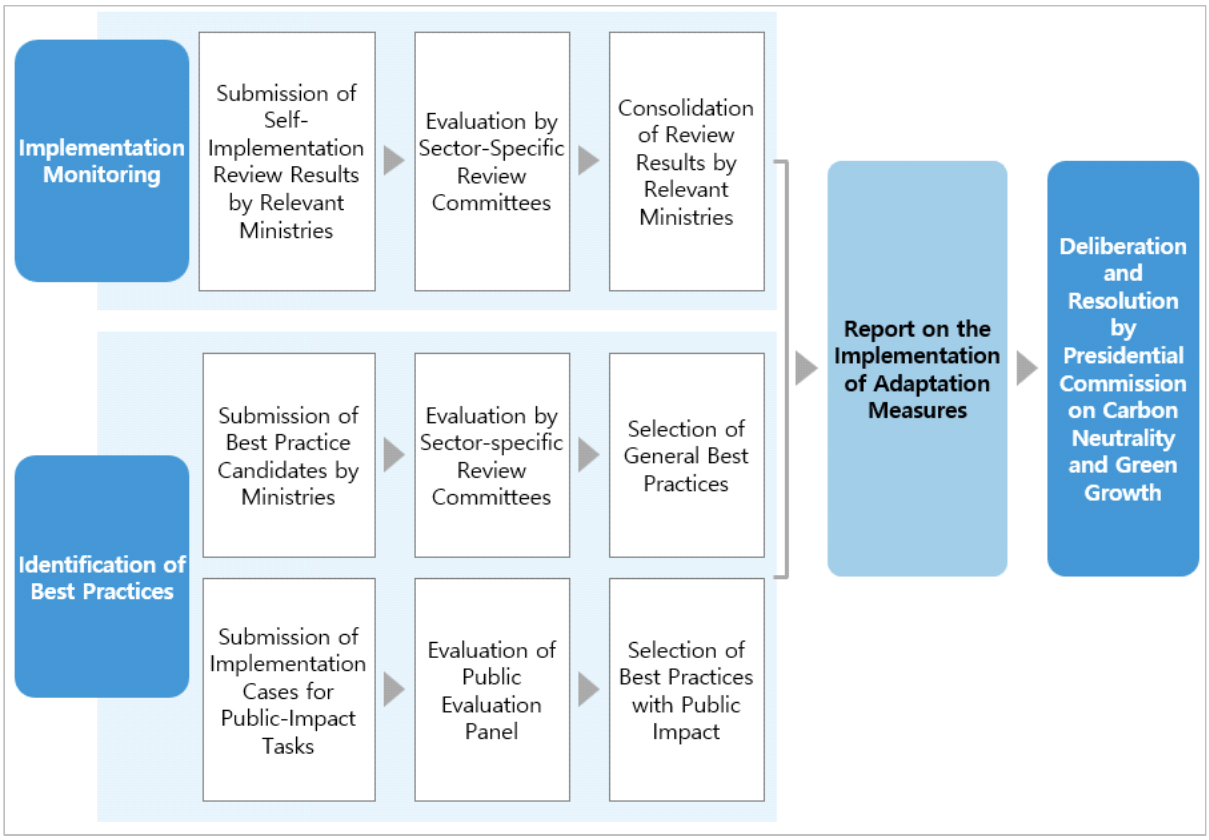
The NCCAP has a comprehensive system for monitoring and evaluation that consists of annual progress assessments, and interim and comprehensive evaluations conducted in the third and fifth years, respectively.

The annual progress assessment of each ministry consists of two tracks: self-assessment and best practice evaluation. Each ministry submits annual progress reports on the previous year's implementation results and self-selected best practice cases, including public-oriented project outcomes, to the Ministry of Environment. The Ministry of Environment compiles and reviews these reports with the Expert Review Panel to draft an overall progress report, which is then submitted to the Carbon Neutrality and Green Growth Commission for consideration. The reviewed results are circulated to each ministry to be reflected in the following year's action plan.

The annual progress assessment is conducted based on each ministry's annual progress reports. The Ministry of Environment compiles these reports and analyzes the overall outcomes with the Expert Review Panel to produce the overall progress report.

The best practice assessment is conducted in two categories: best practices recommended

by ministries and public-oriented best practices. For best practices recommended by ministries, final selections are made through evaluation by the Expert Review Panel from the cases self-selected and submitted by each ministry. For public-oriented best practices, final best practices are selected through evaluation by the Public Review Panel from all public-oriented practices that have been selected as citizen-friendly practices that significantly impact daily lives.



[Figure Ⅲ-3] Progress Monitoring System for the Enhanced Third National Climate Change Adaptation Plan

3.2 Sub-National level

3.2.1 Sub-National Climate Change Adaptation Plans

The Carbon Neutrality Act mandates each sub-national government in Korea to establish and implement SNCCAPs every five years, tailored to the climate change impacts specific to their regions.

Metropolitan governments (17 metropolitan and provincial government) began with the First Regional Climate Change Adaptation Plan (1st RCCAP) (2012–2016) in 2012 and are currently implementing the Third Regional Climate Change Adaptation Plan (3rd RCCAP) (2022–2026).

Local governments (226 cities, counties, and districts) began formulating their adaptation plans with the First Local Climate Change Adaptation Plan (1st LCCAP) in 2013. Since the formulation of the Plan became mandatory in 2015, local governments have been developing the plans every five years according to their local conditions. In 2024, local governments began establishing the *Third Local Climate Change Adaptation Plan* (3rd LCCAP).

3.2.2 Monitoring and Evaluation of the Plans

The RCCAP has a comprehensive system for monitoring and evaluation. Each year, metropolitan city and provincial governments submit self-assessment reports on the previous year's implementation results to the Ministry of Environment. The Ministry of Environment compiles these reports and prepares an overall progress report to submit to the Carbon Neutrality and Green Growth Commission for consideration. The reviewed results are then circulated to metropolitan and local governments and reflected in the following year's implementation plans.

The progress assessment comprehensively evaluates the preparedness of implementation, achievements, areas for improvement, and government efforts. The preparedness assessment examines measures taken for insufficient or underperforming areas identified in the previous year's assessment, the operation of regional expert and citizen advisory groups and efforts to strengthen local adaptation capacity.

The implementation assessment evaluates the appropriateness of the implementation process and outcomes using both quantitative and qualitative indicators. The appropriateness of the

implementation process is evaluated based on the level of goal achievement and budget execution, while outcomes are assessed on the level of best practice identification and its application.

Since 2023, metropolitan governments have been establishing and operating regional expert and citizen advisory groups. These groups aim to enhance public awareness of adaptation policies being implemented by the governments and identify practices that reflect regional characteristics. The groups operate across six sectors - i) water management, ii) forestry and ecosystems, iii) health, iv) agriculture and fisheries, v) land and coastal areas, and vi) industry and energy - with distinct roles for regional experts and residents.

4. Progress on Implementation of Adaptation

4.1 Best Practices of Climate Change Adaptation in ROK

4.1.1 Best Practices of National Climate Change Adaptation Plan

The ROK identifies and publishes best practices through the annual progress assessment of the NCCAP. From 2021 to 2023, the central government identified the following best practices, which were selected by Expert Review Panels based on self-assessment reports submitted by each ministry.

1) Best Practices from Internal Review by Ministries

The Ministry of Land, Infrastructure, and Transport initiated the "Gradual and Phased Improvement of Disaster-Prone Housing, including Semi-Basement" project in 2023. This project aims to mitigate flood risks in vulnerable housing, such as semi-basement and underground parking facilities, in preparation for increasingly intense summer rainfall due to climate change. Flood prevention facilities, including flood barriers, drainage pumps, and backflow prevention devices, were installed. As of November 2023, installations were completed for 4,440 units in areas prone to recurrent flooding, with plans to inspect the functionality of flood prevention equipment during annual maintenance checks.

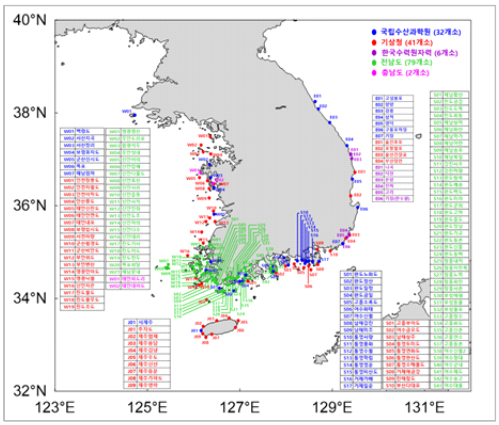
[Figure Ⅲ-4] Renovation for Climate Vulnerable Housing

[Figure Ⅲ-5] Flood Prevention Facilities in Pohang

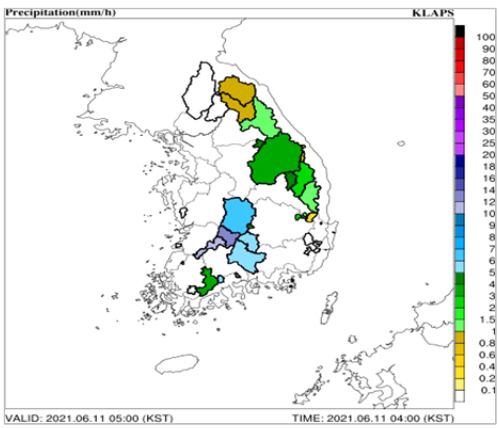
The Ministry of Oceans and Fisheries has been working on the "Improvement of Port Design Standards and Infrastructure Reinforcement for Climate Change Adaptation" project. This initiative raised the design wave recurrence interval from 50 years to 100 years in 2021 to protect port facilities and hinterlands from rising sea levels. In 2023, applying these

enhanced design standards, the Ministry of Oceans and Fisheries assessed the safety and flood vulnerability of outer port facilities nationwide. Based on this assessment, reinforcement projects are being carried out until 2032, including reinforcing outer facilities such as breakwaters at 43 locations across 30 ports, and implementing improvements at 22 locations across 16 ports in flood-prone areas through installations such as protective walls.

In 2022, the Ministry of Oceans and Fisheries led the “Monitoring of Fisheries Resources and Aquaculture Species, and Real-Time Marine Observation Data Production Based on IoT” project. To reduce aquaculture damage caused by climate change, this project provides real-time marine observation data. Advanced equipment and an IoT-based real-time marine observation network were established, expanding real-time sea temperature monitoring to track ecological changes in fisheries resources. By providing fishermen with timely information, sufficient time was secured to respond to high sea temperatures, helping to reduce damage. The ministry also developed an aerial surveillance system for harmful organisms and implemented an algorithm to predict red tide concentrations.



[Figure Ⅲ-6] Real-time Water Temperature Monitoring Network



[Figure Ⅲ-7] Dam Basin Precipitation Forecast Map

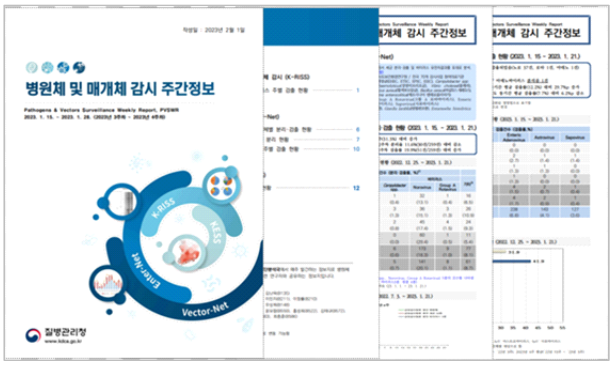
The Korea Meteorological Administration implemented the “Strengthening Collaboration with Relevant Agencies to Improve Flood Forecasting Accuracy” project in 2021. This project enhanced communication and collaboration among the ME, the River Flood Control Office (RFCO), and the Korea Water Resources Corporation (K-water). Customized weather forecasting data was provided, and meteorological data was shared to support flood forecasting and dam operation decision-making. Additionally, an inter-agency coordination system and tailored training programs were established, while the observation data collection interval was shortened, and the KMA observation equipment was installed to share precise monitoring information.

2) Best Practices Selected by Public

The following cases highlight best practices selected by the Public Review Panel from ongoing ministry initiatives that focus on public impact.

The National Institute of Biological Resources (NIBR) implemented the project “Expanding Citizen Participation in Climate Change Adaptation Monitoring” in 2023. This project established a collaborative framework among various stakeholders, including the general public, para-taxonomists, and experts, to promote biodiversity conservation and management policies. General citizens and citizen scientists worked together as teams to conduct research in their local areas. Through monitoring efforts, over 100 national climate change bioindicator species were observed, and 73,491 verified data points were collected using a nature observation app. The collected data was utilized to monitor the impacts of climate change on national bioindicator species and predict future distributional changes.

[Figure Ⅲ-8] Climate Change Adaptation Monitoring



[Figure Ⅲ-9] Climate Change Infectious Disease Information

The Korea Disease Control and Prevention Agency (KDCA) implemented the project “Strengthening Surveillance and Response to Climate Change-Induced Infectious Diseases” in 2023. To raise public awareness of climate-related public health issues, the KDCA collaborated with over 70 hospitals and provincial Public Health and Environment Research Institutes (PHERI). The KDCA provided weekly updates to the public on its website, including analysis results of pathogens causing waterborne and foodborne infectious diseases and outbreak trends.

The Rural Development Administration (RDA) implemented the project “Quantifying Extreme Weather Damage to Major Crops and Developing Damage Reduction Technologies” in 2023.

This project quantified damage from extreme weather events, such as heavy rainfall, drought, and abnormal temperatures, to address increasing crop damage caused by climate change. The RDA developed damage reduction technologies for various crops, including horticultural specialty crops, Nappa cabbages, fruits, and ginseng, and successfully bred a total of 337 climate-resilient crop varieties.

[Figure Ⅲ-10] Development of Climate-Adaptive Apple Varieties

[Figure Ⅲ-11] Public-Friendly Drought Information

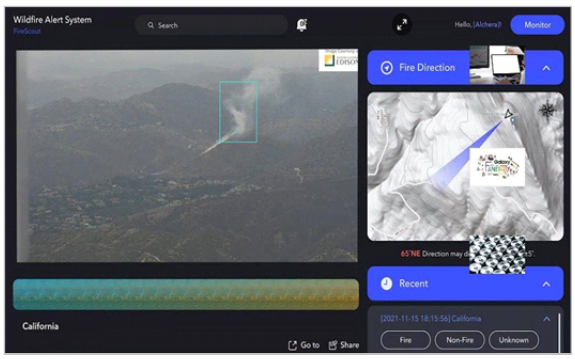
The Ministry of Environment implemented the project “Publication of Public-Friendly Drought Information and Enhancement of Public Awareness” in 2021. This project provided customized drought information and established a virtual reality-based drought education experience center. Additionally, a National Drought Information Portal was created to facilitate public access. Educational and experiential programs were also offered to children and elementary school teachers to raise awareness and understanding of drought issues.

3) Other Best Practices

In addition to the best practices mentioned above, various adaptation projects are being implemented by relevant ministries. In particular, there is a growing trend of utilizing advanced Information and Communication Technologies (ICT), such as artificial intelligence (AI), to promote climate change adaptation.

The Korea Forest Service (KFS) implemented the project “Strengthening Forest Fire Prevention and Response Capabilities through Advanced ICT” in 2023. This project enhanced response capabilities to address increasingly large and frequent forest fires caused by climate change through advanced technology. The KFS established an AI-based Intelligent Forest Fire Prevention ICT Platform, enabling automatic detection and 24-hour monitoring of forest fires through AI deep learning. Monitoring was strengthened by integrating forest fire

surveillance cameras with CCTV systems from forest and related agencies. To enhance firefighting capabilities in nighttime and rugged terrain, the KFS operates drone firefighting teams and drone surveillance units.



[Figure Ⅲ-12] ICT Platform for Forest Fire Prevention

[Figure Ⅲ-13] Mobile Rest Areas for Outdoor Workers

Efforts to support climate-vulnerable populations in adapting to climate change have also been expanded.

The Ministry of Environment consistently implements adaptation support projects for climate-vulnerable populations, such as installing cooling facilities in local children's centers and homes of elderly people living alone to mitigate heatwave impacts. In 2023, the Ministry of Environment examined the characteristics of priority climate-vulnerable populations by comprehensively analyzing climate exposure, socioeconomic factors, and housing conditions. A survey on damage cases, vulnerabilities, and adaptation needs among vulnerable populations was conducted to strengthen targeted support.

The Ministry of Trade, Industry, and Energy has improved energy efficiency in the living environments of climate-vulnerable populations. From 2021 to 2023, the MTIE supported 98,149 low-income households and social welfare facilities by implementing insulation work, window installations, flooring renovations, and replacing high-efficiency heating and cooling systems. These efforts aimed to enhance adaptive capacity while achieving co-benefits in reducing GHG emissions.

The Korea Forest Service is also implementing ecological restoration of fire-damaged forests based on local governance. In 2022, a large-scale forest fire in Uljin-gun devastated approximately 4,800 ha of protected areas, including forest genetic resource reserves. The

KFS established a governance structure comprising local residents, experts, and NGOs to develop a basic restoration plan and launched a Donors' Forest Campaign to enable direct participation from local communities and the public. In 2023, the Korea Forest Service restored 220 ha of forest using ecological techniques, including the use of native plants collected and propagated from areas surrounding the damaged forest, natural materials, and sprouts from damaged trees.

4.1.2 Best Practices of Sub-National Climate Change Adaptation Plans

The following are best practices among adaptation projects implemented at the sub-national level from 2021 to 2023. These projects were tailored to address the major risks and specific conditions of each region.

Gyeonggi Province has been promoting nature-based solutions through eco-friendly inland fisheries in response to declining marine and inland fishery resources and ecosystem changes caused by climate change. In 2023, the province stocked 2 million juvenile fish of five native species and 5.9 million marine species seedlings of seven varieties. In particular, for smelt, which has a low hatching rate, the province improved the method from attaching fertilized eggs to directly stocking hatched juvenile fish. Additionally, the province achieved mass production and stable productivity by implementing a high-density seawater spray system for species such as manila clams and ark shells.

[Figure Ⅲ-14] Native Fish Stocking

[Figure Ⅲ-15] Climate-Resilient Rice Varieties

South Chungcheong Province conducted research to develop climate-adaptive rice varieties. While rice varieties with shorter growing periods typically have inferior taste, this research successfully improved taste quality by introducing medium-glutinous characteristics to extra-early maturing varieties for the first time in the ROK. By shortening the growing period, this variety helps reduce methane emissions during cultivation. Furthermore, to

address increasing risks of extreme weather events and diseases due to climate change, the province developed high-yielding varieties with blast resistance through multiple selections of superior breeding lines.

Daegu Metropolitan City, one of the hottest cities in the ROK, implemented various measures in 2022 to minimize heatwave damage caused by climate change. The city established a *Mid-term and Long-term Comprehensive Plan for Addressing Heatwaves and Urban Heat Island Effect* (2020–2024) and developed an integrated disaster management platform, the 'Ansim High-so (Stay Safe)' app. Additionally, the city installed heat response facilities such as cooling fog systems at bus stops and climate-controlled bus shelters, while promoting citizen participation campaigns, including the regular use of parasols.

[Figure Ⅲ-16] Cooling Fog Installed in Parks

[Figure Ⅲ-17] Automatic Drip Irrigation System

North Chungcheong Province implemented the "Pilot Project for Stable Open-Field Grown Pepper Production in Response to Extreme Weather" in 2021. This project developed a technical support package for pepper cultivation to address weather anomalies such as drought and frost, which was applied to 25 farms covering 5.74 ha. The project introduced technologies, including simple rain shelters and automatic drip irrigation systems with soil tension sensors, while providing necessary technical support to farmers. As a result, pepper production increased by 20%, and farm income rose by 19%.

Gyeyang District, Incheon Metropolitan City, implemented the project "Operation of Cooling Centers and Mobile Health Care Services for Vulnerable Populations" in 2021 to protect residents from heatwaves and support vulnerable populations. As part of this project, cooling expenses were subsidized for 26 facilities serving vulnerable populations, and shade structures were installed at 28 cooling centers. The project also provided 36 thousand health education sessions for vulnerable populations, along with mobile healthcare services and free shuttle services.

[Figure Ⅲ-18] Visiting Healthcare for Vulnerable Populations

[Figure Ⅲ-19] 'Companion Partners' for Vulnerable Residents in Semi-basement Housing

In addition to existing adaptation projects under the SNCCAPs, new projects have been established and implemented to address emerging needs caused by extreme weather events.

The Seoul Metropolitan Government launched the "Companion Partner Program for Vulnerable Residents in Semi-basement Housing" in 2023. Residents with severe disabilities living in semi-basement or flood-prone housing often lack sufficient time to evacuate during heavy rainfall. To address this issue, the program paired nearby residents and public officials with at-risk individuals to act as "Companion Partners". These partners monitored 954 households with vulnerable residents, including those with disabilities and the elderly, to provide evacuation support during emergencies and disseminate situational updates.

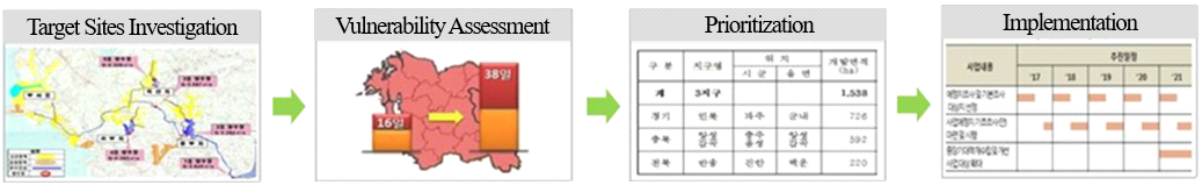
4.1.3 Best Practices of Climate Change Adaptation Plans from Public Institutions

Public institutions responsible for key infrastructure, such as transportation, began developing their *institutional climate change adaptation plans* in 2022 as mandated by law and have been implementing these plans since 2023. The following are best practices from public institutions.

The Korea Water Resources Corporation (K-water) has been developing and operating a Digital Twin and AI-based Urban Flood Forecasting Platform since 2023 as part of the Ministry of Environment‘s urban flood prevention project. This platform, piloted in the Dorimcheon Stream area, combines a virtual modeling system using high-precision spatial data with real-time monitoring through IoT sensors and Closed Circuit Television (CCTV). The platform provides timely flood risk information to nearby residents during flood events. Furthermore, K-water is collaborating with NAVER, a domestic internet service company, to explore international applications of this platform technology as part of Saudi Arabia’s Digital Transformation Project.

[Figure Ⅲ-20] Urban Flooding Forecast Platform

The Korea Rural Community Corporation (KRC) revised its design guidelines to ensure the stable operation of agricultural production infrastructure in response to climate change. Under the revised guidelines, climate change impact and vulnerability assessments must be conducted when establishing master plans for agricultural infrastructure. The design frequencies for critical facilities, such as dams and irrigation systems, can now be adjusted based on their climate change vulnerability and importance. Additionally, the revised guidelines mandate the use of standardized scenarios based on future meteorological data to calculate water supply and design capacities for agricultural dams, drainage systems, and irrigation facilities. These revisions aim to enhance the resilience of agricultural infrastructure to climate risks and improve productivity.



[Figure Ⅲ-21] Climate Change Vulnerability Assessment

4.2 Partnerships and Cooperation Cases in Climate Change Adaptation

4.2.1 Domestic Partnerships and Cooperation Cases in Climate Change Adaptation

The ROK is actively promoting domestic cooperation to strengthen climate change adaptation efforts. The following are notable examples of domestic collaboration:

The Ministry of Environment hosted the "2023 Korea Local Government Climate Adaptation Declaration Ceremony" during the Korea Global Adaptation Week 2023 (KGAW 2023) to encourage adaptation commitments from sub-national governments. Held as part of the 2023 United Nations Framework Convention on Climate Change (UNFCCC) Adaptation Week, the event saw participation from 96% of sub-national governments, demonstrating a strong commitment to adaptation. Sub-national government leaders pledged through the declaration to prioritize climate adaptation policies, establish implementation systems, protect climate-vulnerable populations, promote local economies and job creation, and encourage public participation in climate change adaptation.

[Figure Ⅲ-22] 2023 Climate Adaptation Declaration Ceremony for Local Governments

[Figure Ⅲ-23] Climate Change Adaptation Research Network

[Figure Ⅲ-24] Forum on the IPCC Sixth Assessment Report

The Ministry of Environment has been operating the Climate Change Adaptation Research Network since 2022 to support science-based decision-making. This network includes 10 research institutions producing adaptation-related information in diverse fields, such as marine science, fisheries, water management, ecosystems, meteorology, agriculture, forestry, and public health, working collaboratively to strengthen research on climate change adaptation.

The Korea Meteorological Administration has strengthened its engagement with the Intergovernmental Panel on Climate Change (IPCC) through the Korean IPCC Response Council (K-IPCC). Recognizing the increasing importance of IPCC reports as scientific evidence

for climate change, the K-IPCC supported the Sixth Assessment Report and began addressing the Seventh Assessment Report in 2023. The council, led by the Korea Meteorological Administration and involving 14 relevant ministries, operates through five subcouncils: four specialized ones - Physical Science Basis (Working Group I), Climate Change Impacts, Adaptation, and Vulnerability (Working Group II), Climate Change Mitigation (Working Group III), and the Task Force on National Greenhouse Gas Inventories (TFI) - along with a General Coordination Committee to strengthen integration across working groups. Additionally, the KMA, in collaboration with the council, translates IPCC reports into Korean and organizes forums to raise public awareness about climate change issue.

4.2.2 International Partnerships and Cooperation Cases in Climate Change Adaptation

The ROK is actively participating in global efforts to address climate change and share its knowledge and experience in climate change adaptation. The following are notable examples of international partnership and cooperation projects in climate change adaptation.

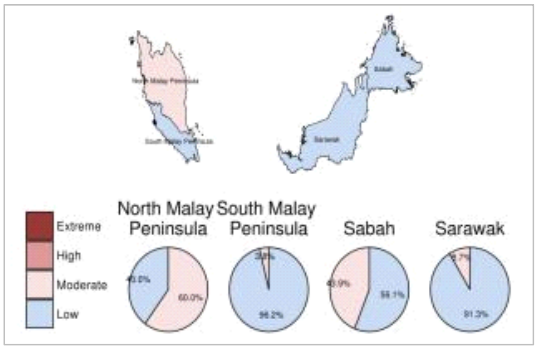
The Ministry of Environment, in collaboration with the UNFCCC Secretariat and other international organizations, hosted the “Korea Global Adaptation Week 2023 (KGAW 2023)” under the theme “A New Era for Adaptation: Scaling Up and Transformation in Adaptation.” The event attracted 1,223 participants from 70 countries to discuss diverse adaptation topics. Comprising 24 events and 86 sessions, this was the first Global Adaptation Week co-hosted with the United Nations Environment Programme (UNEP), significantly expanding its scope and content. Held in anticipation of the 28th Conference of the Parties, the event contributed significantly to advancing adaptation discussions.

[Figure Ⅲ-25] Korea Global Adaptation Week 2023

[Figure Ⅲ-26] Biodiversity Field Books for Cambodia, Laos, and Vietnam

The Ministry of Environment is implementing the "International Joint Research and Cooperation Framework for Biodiversity Conservation" project to support biodiversity conservation and the sustainable use of biological resources in developing countries vulnerable to climate change. This project involves joint research with 10 countries across Southeast Asia, Africa, and Latin America and includes publishing and donating biodiversity field guides for protected areas. Field guides on mushrooms and plants were published for Cambodia, Laos, and Myanmar in 2021, followed by guides on fish, moths, butterflies, and medicinal plants for Cambodia, Laos, and Vietnam in 2022. In 2023, a flora guide for Micronesia was published to commemorate the Korea-Pacific Islands Summit.

The Korea Meteorological Administration has been developing climate prediction technologies for the Asia-Pacific Economic Cooperation (APEC) region to enhance climate resilience. In 2023, the KMA expanded its wildfire prediction service from Indonesia to Malaysia and established a dynamic climate information service system to improve user-centered services.



[Figure Ⅲ-27] Forest Fire Prediction System for Malaysia

[Figure Ⅲ-28] 2022 UNFCCC-CASTT Adaptation Academy

The Ministry of Environment, in collaboration with the UNFCCC Secretariat and international organizations, operates the UNFCCC Climate Action and Support Transparency Training (UNFCCC-CASTT) Adaptation Academy to help developing countries meet new adaptation-related reporting requirements under the Paris Agreement. Since 2021, the academy has trained 30 participants from 15 Asia-Pacific countries, expanded globally in 2022 to educate 23 participants from 23 countries, and conducted online training for 129 participants from 48 countries in 2023 in preparation for the Biennial Transparency Report (BTR), required to submit every two years from 2024.

The ROK has also expanded its adaptation efforts through Official Development Assistance (ODA) projects. Over the past three years, the Ministry of Environment has implemented 10 international cooperation projects across 9 countries, with about half focusing on water resource management to address intensifying floods and droughts. Key projects include establishing a Flood Forecasting and Warning System in Laos, developing a Smart Water Management System in Cambodia, constructing Carbon-neutral Water Infrastructure for Indonesia's new capital Nusantara, and implementing Smart Irrigation Systems for drought preparedness in Uzbekistan and Kyrgyzstan.

IV

Supporting the Global Community

The Republic of Korea (ROK), as an "Other Party" providing support under the Paris Agreement,[46] recognizes that the Agreement simultaneously pursues both climate action and support for developing countries. While setting and implementing targets for greenhouse gas (GHG) emissions reductions and climate change adaptation, the ROK is also making voluntary efforts to assist developing countries in addressing climate change.

In September 2021, the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (Carbon Neutrality Act) was enacted, legislating the 2050 carbon neutrality target and its implementation framework, thereby demonstrating a national commitment to international cooperation in supporting climate change responses in developing countries.[47] Furthermore, the *First National Framework Plan for Carbon Neutrality and Green Growth* (Carbon Neutrality Framework Plan) was established in April 2023, incorporating enhanced cooperation to facilitate green transitions in developing countries as a detailed policy initiative. Under these legal and planning frameworks, various ministries are actively engaged in providing financial, technological and capacity-building support to developing countries. Ministries either implement specialized policies tailored to climate change responses or integrate climate change considerations into general support programs.

Efforts to assist developing countries are also being actively pursued through collaboration between government and private entity. Notably, through the Partnering for Green Growth and the Global Goals 2030 (P4G) platform, a global public-private partnership launched in 2018, the government has contributed over USD 4 million to date. Building upon this financial support, international cooperation projects leveraging resources and technologies from private enterprises, public enterprises, and public institutions are being conducted in the areas of technology development and transfer and capacity-building.

However, tracking information on private sector support activities presents challenges, particularly in terms of methodologies for measuring and reporting mobilized resources through public interventions. This difficulty is further compounded by the confidentiality required for enterprise-driven voluntary support activities. Accordingly, this First Biennial Transparency Report (BTR) focuses on government-led activities, which are relatively more traceable quantitatively, while providing qualitative descriptions of experiences, lessons learned, and best practices to promote engagement of private entity.

46) Paragraph 118 of the Annex to Decision 18/CMA.1

47) Article 3 (Basic Principles) Paragraph 8, Article 4 (Responsibilities of State and Local Governments) Paragraph 8, and Article 75 (Promotion of International Cooperation) Paragraph 2 emphasize international cooperation to support developing countries' response to the climate crisis as a member of the international community.

1. Financial Support

The international community has adopted “Take Urgent Action to Combat Climate Change and Its Impacts” as Goal 13 of the Sustainable Development Goals (SDGs), emphasizing the importance of achieving Nationally Determined Contribution (NDC) in developing countries.

In this regard, The ROK has been significantly enhanced financial support for climate change response in developing countries. In May 2021, the 2nd P4G Summit was held in Seoul, and the ROK, as the host country and chair (2021–2023), declared its commitment to support green recovery in developing countries through expanded Official Development Assistance (ODA). The ROK also pledged to provide a new contribution of USD 4 million to P4G, which aims to support climate change response in developing countries through public-private partnership projects. Subsequently, in November 2022, the ROK announced the "Busan Initiative," focusing on enhancing cooperation with developing countries in five key areas: climate change, the digital divide, health crisis, food security, and future workforce development.

Furthermore, in alignment with international efforts towards carbon neutrality, global discussions on climate change response have intensified through multilateral cooperation. As part of such efforts, ROK has led the establishment of specialized international organizations in the environmental sector, including the Global Green Growth Institute (GGGI) and the Asian Forest Cooperation Organization (AFoCO), while also hosting the headquarter of the Green Climate Fund (GCF) in Songdo, Incheon Metropolitan City.

1.1 National Circumstances and Institutional Arrangements

1.1.1 Institutional Arrangements and Implementation Strategy

1) Institutional Arrangements

The ROK's ODA framework is structured as a three-tier system, comprising a coordinating organization, supervising ministries, and implementing agencies, as instituted under the *Framework Act on International Development Cooperation* (January 2010). The Committee for International Development Cooperation, chaired by the Prime Minister, functions as the primary coordination mechanism for all ODA activities, with operational support rendered by the Working Committee for International Development Cooperation and the Expert Committee for Evaluation.

The Ministry of Economy and Finance and the Ministry of Foreign Affairs function as supervising ministries for bilateral concessional loans and grants, respectively, formulating and conducting surveillance of annual implementation plans for each sector. The Ministry of Economy and Finance has designated the Economic Development Cooperation Fund (EDCF) as the implementing agency for concessional loans, which facilitates large-scale projects in transportation, health, water resources, and energy sectors. As of December 2022, 503 projects were being executed across 58 countries, with cumulative approvals amounting to KRW 27.7 trillion. The Ministry of Foreign Affairs executes grant aid through the Korea International Cooperation Agency (KOICA) and coordinates grant aid projects through the Grant Related Consultative Council and the Strategic Meeting for Grant Development Cooperation.

Regarding multilateral cooperation, the Ministry of Economy and Finance oversees engagements with Multilateral Development Banks (MDBs), whereas the Ministry of Foreign Affairs administers cooperation with the United Nations (UN) and other international organizations.

2) Implementation Strategy

The *3rd Mid-term Strategy for International Development Cooperation*, covering the period 2021–2025, envisions "Realizing Global Values and Mutual Benefits through Cooperation and Solidarity." To effectuate this vision, it delineates four strategic objectives: ⅰ) Inclusive ODA, ⅱ) Mutually Beneficial ODA, ⅲ) Innovative ODA, and ⅳ) Collaborative ODA.

Notably, "Leading Green Transition" has been introduced as a key implementation task under Mutually Beneficial ODA, which establishes specific measures to facilitate climate change response in developing countries. In July 2021, the *Green ODA Strategy* was formulated, which aims to augment the proportion of green sectors, including projects with Rio and environmental markers in bilateral ODA, to exceed the average proportion of the Organization for Economic Cooperation and Development (OECD) by 2025, thereby reinforcing support for the green transition and carbon neutrality in developing countries.

Furthermore, through the *Strategic Plan for Official Development Assistance under the Yoon Administration and the Carbon Neutrality Framework Plan*, the ROK continues to strengthen its global climate change response system predicated on ODA. The ROK is enhancing international cooperation in carbon neutrality and green growth by increasing contributions to international organizations specializing in green sectors, thereby fostering more robust international collaboration in achieving climate-related goals.

<Table Ⅳ-1> Key Policies Related to the ROK's Green ODA

Policy	Description
Mid-term Strategy for International Development Cooperation (From 2011, 5-year intervals)	・ Presents mid to long-term ODA vision and goals as the highest national comprehensive strategy for ODA (3rd Mid-term Strategy prepared in January 2021) ・ Promotes expansion of Green ODA proportion to support developing countries' green transition, implementation of recipient country-tailored Green ODA, promotion of bilateral climate change cooperation agreements, and R&D support, etc.
Annual Comprehensive Implementation Plan for International Development Cooperation (From 2011, Annually)	・ Specifies annual and ministry-wise detailed implementation tasks (based on confirmed amounts) to realize the 'Comprehensive Basic Plan for International Development Cooperation' ・ Reflects strategic ODA implementation strategies such as giving additional points to Green sector ODA projects, GCF contribution commitment (USD 300 million), etc.
Green ODA Strategy (July 2021)	・ Presents vision and implementation strategies for Green ODA environmental response ・ Prepares detailed tasks for strengthening support for developing countries' green transition, leading global cooperation, and building win-win partnerships with developing countries
The Strategic Plan for Official Development Assistance under the Yoon Administration (June 2022)	・ Prepares ODA directions and tasks under the Yoon administration ・ Presents directions for climate change response through ODA to realize SDGs and global values
First National Framework Plan for Carbon Neutrality and Green Growth (April 2023)	・ Presents international cooperation directions and tasks in the field of carbon neutrality and green growth ・ Prepares detailed tasks for 'Expanding Green ODA to promote green transition in developing countries' and 'Strengthening cooperation with the international community for global ODA expansion' to expand cross-ministerial Green ODA

1.1.2 Enhancing Support Effectiveness

1) Country-Driven Approach

The ROK has introduced a customized support framework to meet the specific needs and priorities of developing countries. Since 2010, the ROK has been implementing a priority partner country system, which designates target countries based on comprehensive evaluations of their development levels, support needs, and effectiveness of aid. Country Partnership Strategies (CPS) are formulated for each priority partner country to establish specific focus areas and support directions aligned with their development needs.

Priority areas are determined through detailed analysis of medium- and long-term national development strategies and sectoral plans, in consultation with partner country governments to identify cooperation needs. The CPS development and revision process involves thorough examination of partner countries' progress towards SDGs and medium-term national strategies. Priority areas are adjusted to reflect evolving needs, with key sectors including climate change (environment), water management, health and sanitation, transportation, regional development, education, public administration, and energy.

<Table Ⅳ-2> Climate Change and Environmental Mainstreaming in Country Partnership Strategies

Partner Country	Sector	Key Contents
Nepal	Energy	Scaling up development finance through diversification of funding methods, including MDB co-financing and private sector mobilization in energy and water resources
Indonesia	Environmental Protection	Diversification of support areas beyond forest conservation to include climate change adaptation and disaster risk management
Mongolia	Climate Change (Environment)	Strengthening comprehensive environmental management capacity: addressing air pollution from residential solid fuel combustion

Source: Green ODA Strategy (Joint Ministries, 2021)

2) Climate Risk Management and Performance Monitoring

The ROK implements systematic assessment and performance monitoring frameworks incorporating climate risk considerations across all ODA projects to enhance project quality. At the government-wide level, the *2022 International Development Cooperation Evaluation Plan* introduced an ODA Project Performance Indicator Model, defining objectives and indicators for the climate change sector. Indicators include GHG emissions reduction, hydrogen production capacity, and the number of adopted climate change-related laws and regulations. The model also outlines outputs such as improved access to low-carbon energy sources, increases in climate-resilient crop production, and beneficiaries of capacity-building initiatives.

Implementing agencies are reinforcing performance monitoring through project-specific objectives and indicators. The Export-Import Bank of Korea has introduced a Climate Change Impact Response Framework, encompassing pre-implementation climate risk analyses, mitigation measures, and post-project evaluations. The framework is applied per the EDCF *Climate Change Impact Response Guideline* and *EDCF Performance Management Framework Guideline*, ensuring systematic climate risk management in concessional loan ODA projects. KOICA applies the Carbon Neutral ODA Program Performance Framework, aligning its approach with the *Climate Action Mid-term Strategy* and *Low-Carbon Transition ODA Program Implementation Plan*.

1.2 Support Detail

1.2.1 Bilateral Channel

The ROK uses the Rio markers of the OECD Development Assistance Committee (DAC) to calculate the scale of climate-related financial support. The Rio markers were designed in 1998 as a methodology to identify resources allocated to projects that aim to achieve the objectives of the Rio Conventions in biodiversity, climate change, and desertification prevention, and to evaluate their achievements. The system comprises four policy markers: ⅰ) GHG mitigation, ⅱ) climate change adaptation (added in 2010), ⅲ) biodiversity, and ⅳ) desertification prevention. For the First BTR, the scale of support was measured based on all bilateral projects marked with both mitigation and adaptation markers.

The ROK has significantly enhanced its financial resources to support climate action and carbon neutrality in developing countries, thereby emphasizing its strategic importance. The volume of bilateral support incorporating climate elements amounted to approximately USD 1,439 million in 2021, and approximately USD 2,156 million in 2022. Regarding trends in climate-related financial support, the ROK has concentrated its support particularly in the climate change adaptation sector. The proportion of support allocated to the adaptation sector constituted approximately 79.5% in 2021 and 61.8% in 2022.

<Table Ⅳ-3> Amount of Financial Support through Bilateral Channel by Type

	2021		2022	
	Amount Provided (USD million)	Proportion (%)	Amount Provided (USD million)	Proportion (%)
Total	1,438.5	100.0	2,156.4	100.0
Mitigation	152.9	10.6	532.0	24.7
Adaptation	1,143.2	79.5	1,332.2	61.8
Cross-Cutting	142.4	9.9	292.1	13.5

Source: OECD DAC Statistics (status: committed)

1.2.2 Multilateral Channel

The ROK is strengthening policy coordination mechanisms to facilitate a global green transition to effectively address climate change as a shared global challenge. Leveraging its experience and technical expertise in green growth, the ROK functions as a 'green ladder' bridging climate gaps within the international community. Furthermore, the ROK demonstrates active engagement in global climate action through substantial enhancement of multilateral cooperation funds dedicated to climate change response.

1) Climate Funds

(a) Contribution to Climate Funds

The ROK has been actively participating in international climate actions, including hosting the headquarter of GCF in Songdo, Incheon Metropolitan City, in December 2013. The ROK contributed USD 100 million to the GCF's initial resource mobilization and USD 200 million to the GCF's first replenishment by 2023, and has committed an additional USD 300 million to the second replenishment commencing in 2024. GCF cooperation projects have been actively developed through domestic GCF-accredited entities, namely the Korea Development Bank (KDB) and KOICA. In 2022, the GCF Board approved the first nationally proposed project, the Indonesia Industrial Energy Efficiency Enhancement Project, which facilitates loans through local financial institutions to Indonesian small and medium-sized enterprises (SMEs) to improve energy efficiency in aging industrial facilities. Furthermore, in 2024, the GCF approved the Cambodia Climate Financing Facility, supporting the transformation of the Agricultural and Rural Development Bank of Cambodia into a national climate bank.

The ROK has provided financial contributions to the Global Environment Facility (GEF), which serves as the Financial Mechanism for major Multilateral Environmental Agreements (MEAs) such as the United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD), UN Convention to Combat Desertification (UNCCD), Stockholm Convention on Persistent Organic Pollutants, and Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). The ROK contributed KRW 2,230 million in 2022 and KRW 2,420 million in 2023. These funds have been utilized for initiatives in developing countries across five areas: biodiversity, climate change, water resources, land degradation, and chemicals and waste.

The ROK has maintained active engagement in various funds that aim to support climate change adaptation and address loss and damage in developing countries. At the 27th Conference of the Parties (COP) in November 2022, the ROK announced its commitment to provide an additional KRW 3,600 million to the Adaptation Fund for the period 2023-2025. Subsequently, with the formal launch of the Loss and Damage Fund at the COP28 in Dubai in 2023, the ROK committed USD 7 million to this fund.

(b) Mobilizing Voluntary Funds

The Korea Green Growth Trust Fund (KGGTF) has served as the World Bank's sole trust fund dedicated to the green growth sector since its establishment in 2012, sharing the ROK's experience and technical expertise in green growth. The ROK contributed a total of USD 123.37 million by 2022 to enable the transfer of its green technology-based infrastructure development experience to developing countries. The ROK has enhanced cooperation particularly in its areas of expertise, including renewable energy, smart cities, intelligent transportation systems (ITS), eco-industrial parks, waste management, water resource management, and next-generation power grids.

In March 2022, the GGGI Trust Fund was established, with the ROK committing to provide KRW 6,000 million annually through 2026 to support climate response project development and capacity-building in developing countries. By 2022, the Ministry of Economy and Finance approved 17 initiatives (USD 3.26 million) for climate project preparation, including feasibility studies, investment mobilization, and advisory services; 4 initiatives (USD 580 thousand) for preparation of climate funds including the GCF; and 1 initiative (USD 200 thousand) focusing on capacity-building and knowledge sharing.

2) International Organizations and Networks

(a) United Nations Framework Convention on Climate Change (UNFCCC)

The Ministry of Economy and Finance committed a total of KRW 3,000 million for the period 2022–2024 to support the Need-Based Climate Finance Project of the UNFCCC Secretariat. This initiative evaluates project needs based on regional climate conditions, formulates strategic approaches including prioritization mechanisms, and identifies potential capacity-building projects to enhance climate response capabilities in developing countries. To ensure project implementation, the initiative also provides financial mobilization strategies through training sessions, workshops, and investment forums.

(b) Intergovernmental Panel on Climate Change (IPCC)

The Korea Meteorological Administration contributed a total of KRW 2,400 million from 2019 to 2023 as the host country for the 6th IPCC Chair, supporting the operations of the Technical Support Unit for the preparation of the *IPCC Sixth Assessment Report* (AR6) Synthesis Report. The AR6 Synthesis Report was utilized as a key input to the First global stocktake (GST), completed in December 2023, and has become a cornerstone document for global climate change policies and strategies.

(c) Climate Technology Center & Network (CTCN)

The Ministry of Science and ICT provided voluntary contributions totaling KRW 1,000 million for the period 2017–2020 to support the CTCN Technical Assistance (TA) projects. Recognizing the significance of technological innovation and collaborative Research, Development, and Demonstration (RD&D) emphasized in the Paris Agreement, the Ministry proposed the establishment of the CTCN Partnership & Liaison Office (CTCN PALO) in Songdo District, Korea in 2021 to enhance TA projects for developing countries. Since its establishment in July 2022, the Ministry has implemented three TA projects using the contributed resources and has committed an additional KRW 2,000 million annually until 2025 to ensure the sustainable operation of the CTCN PALO.

(d) World Meteorological Organization (WMO)

The Korea Meteorological Administration contributed approximately KRW 4,000 million for the period 2021–2022 to support the World Meteorological Organization (WMO), a specialized agency of the United Nations for meteorology and climate. These contributions advanced significant initiatives such as the Early Warning for All (EW4ALL) and the Global GHG Watch (G3W). Additionally, since 2022, the Korea Meteorological Administration has been contributing to the WMO Regional Training Centre Trust Fund to reduce disparities in climate response capabilities between developed and developing countries by supporting capacity-building programs in Asia, Africa, and the Southwest Pacific.

(e) International Maritime Organization (IMO)

The Ministry of Oceans and Fisheries has been implementing a capacity-building program on maritime GHG reduction policies targeting Least Developed Countries (LDCs) and Small Island Developing States (SIDS) since 2022, pursuant to a memorandum of understanding concluded with the International Maritime Organization (IMO). This initiative receives financial support through the Voyage Together Trust Fund established by the ROK. Program participants receive technical guidance from experts regarding the IMO's GHG reduction policies and enhance their capabilities to formulate national action plans and mobilize required financial resources.

(f) Asian Forest Cooperation Organization (AFoCO)

The ROK proposed the establishment of the AFoCO at the 2009 Korea-ASEAN Special Summit to promote sustainable forest management and climate change mitigation in the forest sector. Following the establishment of its Secretariat in Seoul in 2018, the Korea Forest Service has provided an annual mandatory contribution of KRW 4,250 million to facilitate Asia's forest sector contributions to carbon neutrality through knowledge-sharing and capacity-building initiatives. AFoCO developed a *Climate Action Plan* (2025–2034) to restore 10 million ha of forest over a decade, with the goal of addressing climate-related challenges through forest interventions.

(g) Partnering for Green Growth and the Global Goals 2030 (P4G)

The P4G launched in 2018 under Denmark's leadership to promote climate action and the achievement of SDGs through public-private partnerships. Since its inception, the ROK has been an active member, hosting the 2nd P4G Summit in 2021 and continuing voluntary contributions thereafter. The ROK plans to actively support the 2025 P4G Vietnam Summit and facilitate international expansion opportunities for Korean eco-friendly startups through P4G partnerships.

<Table Ⅳ-4> Major Cases of Support through Multilateral Channel by Institutions

	Major Case
P4G	▪ **1st Phase of P4G Partnership (2018-2022)** During the period 2018-2022, P4G provided support for 75 projects in 8 ODA recipient countries through contributions totaling USD 29 million. These interventions mobilized additional investments of USD 98.8 million and resulted in estimated GHG emission reduction of 10.9 $MtCO_2$-eq
GCF	▪ **Indonesia Industrial Energy Efficiency Enhancement Project (USD 247.7 million, approved in 2022)** The project supports the transformation of Indonesia's energy market through provision of loan guarantees via local financial institutions and implementation of knowledge sharing and capacity building for Energy Service Companies (ESCOs). The intervention is expected to result in GHG emissions reductions of 3.1 $MtCO_2$-eq
GGGI	▪ **Turkmenistan Methane Gas Flaring Project (USD 300,000, approved in 2023)** This project aims to support Turkmenistan's national methane reduction roadmap implementation through direct mitigation of methane emissions from refinery operations
CTCN	▪ **Establishment and Operation Support for CTCN PALO (KRW 2,000 million per annum)** ⅰ) enhancing Cooperation between CTCN and GCF, ⅱ) delivering innovative climate technology and collaborative RD&D services, ⅲ) strengthening TA implementation, and ⅳ) building capacity of regional developing country NDEs while enhancing member institution networks.
WMO	▪ **Capacity-Building for Climate Service and Climate Action in Developing Countries (2020-2023)** This initiative implements comprehensive capacity-building through development of online training modules for enhanced climate service delivery, and conducts regional workshops for experts from developing countries in Asia, North and Central America, and the Caribbean region.
IMO	▪ **Maritime GHG Emissions Reduction Policy Capacity Building Program** Supported by the Voyage Together Trust Fund, the program strengthens capacity of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) in developing and implementing national action plans, focusing on policy formulation and finance mobilization for maritime emission reduction.

1.2.3 Best Practices by Sector

In the implementation of ODA projects addressing climate crisis in developing countries, the ROK is executing tailored support initiatives that comprehensively consider each country's specific characteristics, climate vulnerability sectors, and national green growth strategies.

1) Mitigation Sector

A representative GHG reduction project through grant aid is the Establishment of PAK-KOREA Testing Laboratory for PV Modules and Allied, implemented during the period 2019-2023. Pakistan faces significant challenges in electricity quality and electrification rates, with more than 30 thousand households lacking access to electricity, of which approximately 80% are concentrated in rural areas. In response, the Government of Pakistan designated the energy sector as a priority area for national development. Considering the region's extended sunshine duration and abundant solar radiation, the potential for solar power generation was recognized, prioritizing renewable energy utilization in rural electrification projects. In this context, KOICA established a solar cell module certification laboratory, enhancing the quality of solar products in Pakistan through the acquisition of advanced certification standards. This project contributed to both the development of the solar industry and the improvement of income levels and living conditions in Pakistan's rural regions.

Additionally, concessional loans were also provided to facilitate energy policy improvement in developing countries. The Export-Import Bank of Korea, in collaboration with the Asian Development Bank (ADB), implemented the Indonesia Energy Sector Reform Program Loan III for Sustainable and Inclusive Growth ODA. Through this program, the Government of Indonesia identified three priority areas requiring energy sector enhancement and formulated and executed 16 policy measures across these areas. These initiatives contributed significantly to establishing an energy market framework that is sustainable, efficient, and conducive to private sector participation. Specifically: ⅰ) Previously excessively low electricity tariffs were recalculated to reflect generation costs, with targeted subsidies provided to vulnerable groups. ⅱ) Licensing procedures between central and local governments were integrated, and fiscal and financial incentives were provided to the renewable energy sector to attract private investment. ⅲ) Policies were improved to include financial support mechanisms for promoting clean energy sources and strengthening GHG emission standards.

Furthermore, as an example of multilateral cooperation, Korea implemented the Accelerating Clean Energy Access to Reduce Inequality (Korea-Indonesia-Timor-Leste Solar Energy Access Project) during 2020-2022. The Government of Indonesia established a national energy strategy targeting a 23% renewable energy deployment rate by 2025, with corresponding budgetary allocations to enhance energy welfare. Through this project, triangular cooperation among KOICA, Indonesia, and Timor-Leste contributed to addressing climate change and reducing energy disparities by establishing village-level independent solar power facilities, solar water pumps, high-efficiency solar lamps, and providing maintenance education. This initiative promoted clean energy utilization in rural areas, catalyzing reduction efforts.

2) Adaptation Sector

A key case through grant aid is the Establishment of an Integrated Platform for Typhoon Monitoring and Forecasting for Weather and Climate Disaster Prevention Based on Information and Communication Technology (ICT), under implementation in Vietnam since 2023. This project enhances Vietnam's disaster risk reduction and management capabilities and strengthens its climate resilience through the establishment of an integrated platform for natural disaster monitoring and forecasting. The platform utilizes ICT, including big data analytics, to collect and analyze meteorological and climate information, thereby enhancing the protection of Vietnamese citizens' lives and property.

Furthermore, significant achievements have been realized in water resource infrastructure construction projects for disaster response, including dams and water/sewage systems through concessional loan. In particular, the Indonesia Karian Water Supply Project has been recognized as an exemplary case of successful large-scale infrastructure construction through Public-Private Partnership (PPP). This project involves the construction of the Karian Dam through EDCF since 2010, and the construction of water conveyance facilities utilizing the Economic Development Promotion Facility (EDPF) since 2022. The subsequent development of water treatment facilities is scheduled for implementation through PPP and is being executed successfully through blended finance, ensuring the project's overall success.

2. Technology Development and Transfer

The ROK recognizes technology development and transfer as a key means of implementation for both mitigation and adaptation actions, and has been working to fulfill its international cooperation obligations under Article 10 of the Paris Agreement. The ROK maintains that stable and enhanced operation of the Technology Mechanism, which supports Parties' technology cooperation actions under the UNFCCC and Paris Agreement, will serve as a significant driver for cooperation among Parties and advancement of global climate action. Despite its status as an 'Other Parties' under the Paris Agreement, the ROK continues to undertake voluntary contribution activities to strengthen the Technology Mechanism.

2.1 National Circumstances and Institutional Arrangements

The ROK has designated and registered the Ministry of Science and ICT as its National Designated Entity (NDE) for technology development and transfer under the UNFCCC, supporting the establishment and implementation of relevant policies and strategies to advance international cooperation in climate technology. The ROK has established legal and policy foundations for climate technology development and innovation domestically, while formulating comprehensive strategies for global climate technology cooperation to facilitate projects with developing countries.

The ROK established the *Global Technology Cooperation Strategy for Climate Change Response* (September 2015), committing to active participation in the Technology Mechanism, which serves as the technology support framework for developing countries under the UNFCCC and Paris Agreement. The ROK subsequently developed detailed strategies through the *Mid to Long Term Plan for Climate Technology Cooperation* (April 2018), comprising: ⅰ) Support for innovation technology-based R&D, ⅱ) Systematization of global climate technology cooperation projects, ⅲ) Establishment of foundations for climate technology cooperation, ⅳ) Enhancement of participation in the Technology Mechanism, and ⅴ) government-wide cooperation.

Following the 2050 Carbon Neutrality declaration in 2020, the ROK initiated the development of government-wide technology innovation strategies. The ROK established the *Carbon Neutral Technology Innovation Promotion Strategy* (March 2021), setting forth specific technology innovation measures. This strategy identified the 10 Key Carbon Neutral

Technologies, considering the linkages with domestic Green policy and *Long-term Low Greenhouse Gas Emission Development Strategy* (LEDS) (December 2020), contribution to GHG emissions reduction, and advancement of low-carbon technologies in industry. The strategy established mid-to-long-term innovation strategies for each sector while presenting measures to strengthen research capabilities and infrastructure, including international cooperation and human resource development. In particular, the strategy includes plans to advance overseas demonstration and commercialization of new carbon neutrality technologies through CTCN, which serves as the implementing body of the technology support system for developing countries under the UNFCCC and Paris Agreement.

Following the enactment of the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (September 2021), which legislated the 2050 Carbon Neutrality goal, the ROK established the *Strategy for Technology Innovation for Carbon Neutrality* (October 2022), setting forth the direction for carbon neutrality technology development at the government-wide level. Under this strategy, the ROK identified the 100 Core Technologies across 17 key areas essential for achieving carbon neutrality. The ROK has been establishing a technology innovation ecosystem based on these technologies to ensure continuous supply of innovative carbon reduction solutions through large-scale R&D projects. The strategy incorporates plans to assess technological needs of developing countries through CTCN and strengthens technology cooperation support utilizing both domestic and international resources. The Carbon Neutrality Framework Plan also incorporates measures to achieve carbon neutrality through technological innovation and explicitly sets the key objective of enhancing cooperation with CTCN.

The *Act on Promotion of Technology Development for Coping with Climate Change* (April 2021), provides a legal framework for systematically expanding technology development and transfer, thereby strengthening technology development across various societal sectors and international collaboration. Based on this law, the *First Master Plan for Development of Technology for Coping with Climate Change* (December 2022), sets forth the R&D direction for technologies essential for GHG reduction and climate change adaptation, outlining methods to contribute to the international community through cooperation with CTCN. Notably, the plan includes initiatives to support climate technology localization projects tailored to the needs of developing countries, enabling the pursuit of customized climate technology cooperation that addresses these specific needs.

<Table Ⅳ-5> Global Climate Technology Cooperation and R&D: Main Laws and Policies

Date of Establishment	Laws and Policies	
September 2015	Global Technology Cooperation Strategy for Climate Change Response	
July 2016	Climate Technology Roadmap	
April 2018	Mid to Long Term Plan for Climate Technology Cooperation	
March 2021	Carbon Neutral Technology Innovation Promotion Strategy	
October 2022	Strategy for Technology Innovation for Carbon Neutrality	Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis (September 2021)
April 2023	First National Framework Plan for Carbon Neutrality and Green Growth	
December 2022	First Master Plan for Development of Technology for Coping with Climate Change	Act on Promotion of Technology Development for Coping with Climate Change (April 2021)
September 2023	Implementation Plan for the 1st Master Plan for Development of Technology for Coping with Climate Change	

2.2 Support Detail

The ROK has been conducting various activities for climate technology cooperation based on its international cooperation policies and strategies. In particular, the ROK has actively participated in CTCN TA projects to support capacity building in developing countries, thereby strengthening international cooperation for addressing climate change.

Since 2016, the ROK has worked with CTCN to identify technology needs of developing countries and implemented Pro-bono TA projects leveraging its domestic resources. This initiative represents one of the official tracks proposed by the ROK to expand TA support for developing countries, particularly to address situations where CTCN receives numerous TA requests but faces resource constraints in responding to all requests. Once TA requests are received from developing countries via CTCN, the ROK then provides TA by matching these requests with domestic private entities possessing relevant technologies and capabilities. Through this approach, the ROK has developed various measures to broaden its TA activities under CTCN.

<Table Ⅳ-6> Overview of Climate Technology Center and Network Technical Assistance

Sector	Field	Number of Cases
Total		18
Mitigation	Energy	12
	Agriculture	1
	Forestry	1
Adaptation	Water and Sanitation	2
Cross-cutting	Cross-Sectoral	2

During the period 2021-2022, the ROK implemented 18 CTCN Pro-bono TA projects, 9 of which were in progress in 2022. By field, the majority of projects were conducted in the mitigation area, and by sector, the greatest number of projects focused on mitigation (energy), followed by cross-cutting and adaptation (water and sanitation). The public sector demonstrated the most active participation in these projects, and an additional 5 climate technology cooperation projects were supported through PPP. By TA type, projects primarily focused on 'sectoral roadmaps and strategies,' 'piloting and deploying technologies in local conditions', and 'feasibility of technology options.'[48)]

<Table Ⅳ-7> Status of Climate Technology Center and Network Technical Assistance

Field	Country	Period	Project Name	Sector	TA Type	Status	Entity
Mitigation	Sri Lanka	2019-2021	Development of Kurunegala as a climate smart city	Energy	Technology identification and prioritization	Completed	Private
	Togo	2019-2021	Development of solar energy technology in Togo's rural areas	Energy	Feasibility of technology options	Completed	Public
	Bhutan	2019-2021	Establishment of master plan for improving urban solid waste management system in Thimphu City	Energy	Recommendations for law, policy and regulations	Completed	PPP
	Honduras	2021	Green Energy Island Project in Guanja, Bay Islands, Honduras	Energy	Piloting and deployment of technology in local conditions	Completed	PPP
	Indonesia	2019-2022	Establishment of low-carbon integrated waste management appropriate technology hub center	Energy	Piloting and deployment of technology in local conditions	Completed	Public
	Vietnam	2022-2023	Technical support project for eco-friendly composting and biogas power generation using livestock excreta in agriculture	Agriculture	Technology identification and prioritization	In progress	Private
	Laos	2022-2023	Technical Capacity Enhancement for Planning an Urban Public Transport System in Vientiane, Lao PDR	Energy	Sectoral roadmaps and strategies	In progress	PPP
	Uzbekistan	2022-2023	Feasibility study on biogas potential using human waste	Energy	Feasibility of technology options	In progress	PPP
	Thailand	2022-2024	Development of national hydrogen strategy and action plan for accelerating Thailand's net-zero target	Energy	Sectoral roadmaps and strategies	In progress	Public
	Samoa	2022-2024	Development of framework and methodology for measuring carbon sinks from the forest sector using Earth observation in Samoa	Forestry	Recommendations for law, policy and regulations	In progress	Public
	Bangladesh	2022-2023	Development of Framework for Real-Time Transport Information Systems for Public Transport in Greater Dhaka	Energy	Feasibility of technology options	In progress	Public
	Cambodia	2020-2023	Establishment of a Sustainable e-Mobility Ecosystem for Carbon Emissions Reduction in Cambodia	Energy	Sectoral roadmaps and strategies	In progress	Public

Field	Country	Period	Project Name	Sector	TA Type	Status	Entity
	Sri Lanka	2020-2023	Research on rural energy business model discovery and funding linkage plan	Energy	Private sector engagement and market creation	In progress	Public
	Serbia	2021-2023	Establishment of smart monitoring system based on IoT for district heating and establishment of renewable energy network plan in Belgrade city, Serbia	Energy	Piloting and deployment of technology in local conditions	In progress	PPP
Adaptation	Cambodia	2020-2021	Application of the gravity-driven membrane(GDM) technology for supplying sustainable drinking water to rural communities	Water and Sanitation	Piloting and deployment of technology in local conditions	Completed	Public
	Mozambique	2021-2022	Development of an action plan for rainwater harvesting system and financing proposals for Mozambique	Water and Sanitation	Financing facilitation	Completed	Private
Cross-Cutting	Tanzania	2020-2021	Technical support for dissemination of sustainable household solar water pump	Cross-Sectoral	Feasibility of technology options	Completed	Private
	Zambia	2022	Development of a framework and roadmap for a National Innovation System to foster low-carbon and climate resilient economic development in Zambia	Cross-Sectoral	Sectoral roadmaps and strategies	Completed	Public

In addition to CTCN TA projects, the ROK regularly organizes workshops and conferences for knowledge sharing and capacity building related to climate technology. Since 2016, the ROK has held a total of 13 meetings CTCN members in Korea to enhance their capacity for supporting developing countries. In July 2022, the Ministry of Science and ICT and CTCN jointly organized a conference for Korean CTCN network members, coinciding with the opening ceremony of the CTCN PALO in Songdo, Incheon. Furthermore, the ROK hosted the 26th Technology Executive Committee (TEC) meeting and the 21st CTCN Board meeting in Songdo, Incheon, demonstrating its commitment to activating the Technology Mechanism.

48) Supported technology assistance types are classified according to the TA project types under CTCN, the implementation body of the Technology Mechanism under UNFCCC

2.3 Best Practice of Support

In 2019, the ROK implemented the “Introduction of Low-Carbon Transportation Technology in Cambodia” as a CTCN Pro-bono TA project. The Cambodian’s government requested TA from CTCN to meet its NDC target, focusing on addressing high emissions in the transportation sector. In response, the Ministry of Science and ICT, CTCN, and the Cambodian‘s government agreed to proceed with the project as a Pro-bono TA track, selecting ‘Envelops,’ a private company, as the implementer to develop a policy implementation plan for introducing low-carbon transportation technology in Cambodia.

Following the completion of the CTCN Pro-bono TA project, the Ministry of Science and ICT and the Cambodian’s government discussed expanding the project through the GCF Preparatory and Readiness Programme. The National Institute of Green Technology (NIGT) utilized the financial proposal, which was an outcome of the CTCN project, to plan and apply for a GCF capacity-building project, which was subsequently approved.

The primary objective of this expanded project was to establish a climate technology dissemination roadmap for Cambodia’s e-mobility industry ecosystem. This roadmap included strategies to address challenges in e-mobility adoption, incorporating supportive policies and mid-to-long-term implementation plans for ecosystem development.

This project demonstrates significant progress in linking Technology Mechanism with Financial Mechanism. It serves as an outstanding case where outcomes from the CTCN Pro-bono TA project were successfully expanded and applied to the GCF Preparatory and Readiness Programme, establishing effective linkage between Technology Mechanism and Financial Mechanism from a TA perspective.

3. Capacity-Building

In accordance with the Carbon Neutrality Act, the ROK has been actively promoting international cooperation to address the climate crisis by providing policy, technological and financial support to developing countries. These efforts encompass a range of activities supporting mitigation, adaptation, and transparency, including the sharing of climate change-related development experiences and knowledge, capacity-building in forest and GHG management, and supporting the establishment of environmental improvement master plans.

3.1 Sharing of Experience and Knowledge

The ROK, leveraging its unique development experience, has actively implemented the Knowledge Sharing Program (KSP) to provide development experiences tailored to partner countries' circumstances. To drive meaningful changes, the ROK has supported policy diagnostics, experience sharing, and institutional and technical capacity development based on the needs of partner countries. Among the 89 KSP projects conducted during 2021 and 2022, 21 projects focused on sharing knowledge related to climate change in the fields of environment, water resources, and energy.

In the mitigation sector, the ROK collaborated with the Rwandan’s government to conduct the Enhancing Institutional Capacities for Facilitating the Use of Internationally Transferred Mitigation Outcomes (ITMOs) through Electric Mobility in Rwanda project from 2022 to 2023. The Rwandan’s government, aiming to achieve a green transformation in its transportation sector, which accounts for 13% of the country’s total GHG emissions, received policy recommendations and capacity-building training for expanding electric bus adoption. The project identified institutional prerequisites for the recognition of ITMOs and developed specific e-mobility implementation initiatives.

In the adaptation sector, the ROK implemented the Efficient Management Program for the Treatment of Drinking and Wastewaters in the Systems of the National Institute of Drinking Waters and Sewers in collaboration with the Dominican Republic from 2022 to 2023. Addressing the urgent need for enhanced water treatment infrastructure, the ROK provided consultations on establishing automated water and sewage treatment systems, utilizing renewable energy, and applying energy-saving technologies. Training programs were proposed for stakeholders to effectively operate these systems. Institutional and technical factors

critical for sustainable infrastructure development were identified, and the ROK shared its expertise through partnerships with the Korea Water Partnership (KWP), Korea Environment Institute (KEI), and Korea Environment Corporation (K-eco). These partnerships promoted the practical implementation of knowledge-sharing outcomes and suggested implementation plans aligned with international organization loan projects.

3.2 Support for Transparency

The Greenhouse Gas Inventory and Research Center of Korea (GIR) has been operating the UNFCCC-GIR-CASTT Programme on GHGs, an international GHG expert training program, annually since 2011. The program runs for 3–4 weeks and aims to enhance the GHG management capacity of developing countries.

Since 2017, GIR has collaborated with the UNFCCC Secretariat under a MOU, jointly planning and implementing the promotion, participant selection, lectures, and practical training. Participants, including government officials, representatives from GHG inventory institutions, and experts from international organizations, receive technical training on GHG measurement and reduction while sharing their experiences and challenges in building national inventories. The curriculum covers: ⅰ) National reporting and review obligations, ⅱ) Methodologies for Measurement, Reporting, and Verification (MRV), ⅲ) Utilization of Intergovernmental Panel on Climate Change Guidelines for National GHG Inventories (IPCC GL), ⅳ) Preparation of National GHG Inventory Report (NIR), and ⅴ) GHG emissions projections.

Between 2011 and 2023, a total of 442 participants completed the training program, many of whom have applied the knowledge gained to improve GHG inventory management in their respective countries. Consequently, the demand for participation in the program has been steadily increasing. At COP28, the UNFCCC Secretariat highlighted the training program jointly planned and operated with GIR as a representative best practice for capacity-building support for developing countries. The program was commended for its effectiveness, and developing countries were encouraged to continue their interest and participation.

<Table Ⅳ-8> Status of Participated Countries of UNFCCC-GIR-CASTT Program on GHGs

Phase	Period	Participating Countries	Participants	Phase	Period	Participating Countries	Participants
1st	2011.6.27-7.22	21	44	8th	2018.6.25-7.19	30	30
2nd	2012.7.2-7.25	22	42	9th	2019.7.22-8.14	32	32
3rd	2013.7.8-7.30	28	38	10th	2020.8.20-11.10	32	34
4th	2014.7.3-7.25	29	34	11th	2021.8.2-10.8	31	41
5th	2015.6.29-7.21	27	37	12th	2022.7.25-8.12	21	25
6th	2016.7.4-7.21	24	31	13th	2023.7.10-7.28	26	26
7th	2017.6.26-7.20	28	28	Total			442

3.3 Best Practices by Sector

3.3.1 Energy

The ROK, with its technological strengths in the energy sector, has been increasingly sought as a cooperation partner by numerous developing countries. The Smart Multi-Micro Grid R&D Capacity Building Project, conducted in Morocco from 2019 to 2022, supported Morocco's goal of achieving 52% renewable energy by 2030. This project aimed to establish a research and development environment in the multi-micro grid field, enhance research capabilities, and contribute to the power supply in rural areas. Essential equipment and facilities, skilled personnel, and infrastructure support were provided to help Morocco develop an independent research foundation.

Additionally, the Ministry of Environment supported the Master Plan for Improving Waste Management for the Cairo Governorate, Egypt, from 2021 to 2022. Policies for waste recycling and energy conversion were introduced, moving beyond simple landfilling practices. A follow-up project, commencing in 2024, involves the construction of waste resource facilities and technology transfer to strengthen local technical capabilities. The Export-Import Bank of Korea has also been conducting feasibility studies for the Waste Fuel Facility Distribution Project across Egypt.

3.3.2 Agriculture

The ROK, having demonstrated success in post-war recovery and agricultural production enhancement, has become an effective partner in addressing climate change-induced food crises in developing countries. Since 2021, KOICA has been implementing the Climate Resilience Enhancement Project in Central and Eastern Rural Areas of Guatemala in cooperation with the GCF. This project builds capacity for low-income farmers in Guatemala's climate-vulnerable regions, enabling them to adopt climate-adaptive farming methods, thereby increasing coffee and cocoa production. Additionally, it provides infrastructure and market channel development, enhancing resident income and improving food security.

The Rural Development Administration operates the Food & Agriculture Cooperation Initiative across Asia, Africa, and Latin America. Since 2018, it has been conducting research on climate-resilient rice and vegetable varieties. Participating countries have secured drought-

and flood-resistant rice strains and developed climate-adapted crops like peppers and tomatoes. Through the Korea-Latin America Food & Agricultural Cooperative Initiative, countries have enhanced soil fertility and crop productivity while reducing GHG emissions by implementing eco-friendly composting methods.

The Korea Partnership for Innovation of Agriculture (KOPIA) has supported countries where agriculture constitutes a significant portion of GDP. In Uganda, droughts were mitigated by introducing rainwater harvesting and individual tree reservoirs. In Ecuador, a no-till potato cultivation technique was developed, enabling high-yield potato farming on steep slopes without carbon emissions. This technique was selected as one of the top five solutions in the 2022 Solution Bank contest hosted by the Platform of Latin America and the Caribbean for Climate Action on Agriculture (PLACA) under the Food and Agriculture Organization of the United Nations (FAO).

3.3.3 Forestry

Building on its successful reforestation experiences, the ROK has implemented forest cooperation projects to strengthen developing countries' capacities for climate change mitigation and adaptation.

From 2019 to 2022, the Restoration of Burnt Peatland and Enhancing Resilience to Climate Change Project in Jambi, Indonesia achieved reforestation of 200 ha and re-wetting of 1,000 ha. This project targeted peatlands severely damaged by forest fires in 2015 and 2017, which had emitted significant amounts of GHGs. The restoration efforts have prevented further peatland degradation and desertification, contributing to carbon emission reduction. Additionally, local communities were engaged in awareness-raising programs and technical training for sustainable peatland management. The project also improved livelihoods by providing training in agroforestry, aquaculture, and product processing, creating jobs for vulnerable groups, including women, in 10 surrounding villages. These activities enhanced household incomes and improved quality of life for local residents.

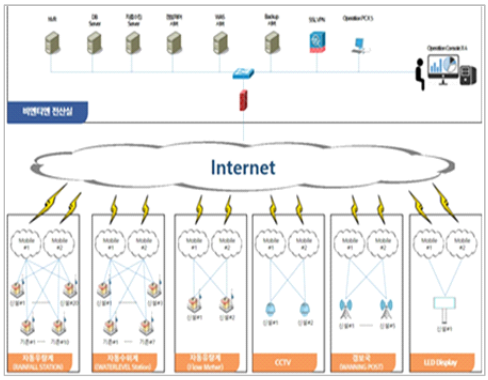
Since 2012, the Korea Forest Service has been operating a capacity-building program on Reducing emissions from deforestation and forest degradation in developing countries (REDD+). This program focuses on enhancing the capacity of developing countries' officials to manage forests using ICT, improving forest disaster management, and strengthening MRV

systems. In 2022, the program trained 9 participants from 5 countries, including the Dominican Republic, Ecuador, and Paraguay. In 2023, the program expanded to include 17 participants from 7 countries, including Cambodia, Laos, Myanmar, Vietnam, East Timor, Bhutan, and Indonesia. To date, the program has graduated over 250 participants through 19 sessions, contributing to the global effort to combat deforestation and forest degradation.

3.3.4 Water Management

The ROK has actively supported developing countries in adapting to the increasing frequency and severity of natural disasters through comprehensive interventions, including policy consultations, establishment of water resource management platforms, and construction of critical infrastructure such as dams and water supply systems. Since 2007, the Master Plan Development Support Project has identified environmental management needs and established foundational plans for cooperation in various sectors. From 2020 onward, the ROK has expanded its support for climate change adaptation in Asian countries, including Laos and the Philippines, to address heightened risks of floods and droughts intensified by climate change.

A notable project is the Laos Water Resource Management Capacity Building Program, jointly implemented by KOICA, Korea Meteorological Administration, and the Ministry of Environment. As Laos faced growing risks from natural disasters such as typhoons, heavy rainfall, and droughts, the need for enhanced water resource management capabilities became urgent. KOICA has been developing water resource management systems in the Nam Ngum River basin since 2020, including river monitoring and dam operation systems. From 2020 to 2023, Korea Meteorological Administration established an integrated typhoon monitoring and prediction platform, enhancing Laos' disaster preparedness. The Ministry of Environment supported the Master Plan for Establishing a National Flood Forecasting and Warning System in Laos (2020-2021), helping strengthen the Laotian government's flood response capabilities. As a follow-up project, the Ministry launched the Establishment of Climate Change Adaptive Flood Forecasting and Warning System in Xe Banghieng River Basin, Laos in 2022, contributing to the prevention of property damage and loss of lives from floods. This initiative marked a significant improvement for local residents, who previously relied on weather forecasts from neighboring Thailand. Following the project, residents noted greater accuracy in local weather and flood forecasts, increasing their reliance on Laos' own forecasting systems.[49)]



[Figure Ⅳ-1] Flood Forecasting and Warning System in Laos

[Figure Ⅳ-2] Carbon-Neutral Water Supply Infrastructure Development Project in Nusantara, Indonesia's New Capital

49) Source: 'Evaluation of Climate Change Response ODA Projects' Research Report (Korea Institute for International Economic Policy and Korea Environment Institute, 2023)

Annex I

Fifth National Communication

Ⅰ. Research and Systematic Observation

1. Research and Technology Development

1.1 Institutional Framework

The Republic of Korea (ROK) is focusing on research and development (R&D) of technologies essential for addressing the global climate crisis. To this end, the ROK has established a robust institutional framework to support both national and private research efforts, particularly in areas where private investment is limited. Through national R&D projects, the ROK actively promotes technological innovation not only as a response to the climate crisis but also as a core driver of new economic growth. Comprehensive support is provided for basic, applied, and demonstration research, with systematic monitoring of research activities and their outcomes.

1.1.1 Legal and Institutional Foundation

The *Act on Promotion of Technology Development for Coping with Climate Change* (April 2021) provides a legal foundation for the systematic development of technologies aimed at greenhouse gas (GHG) mitigation and climate change adaptation. This law enables coordinated national support for climate technology development. Additionally, the Carbon Neutral Technology Special Committee, established under the Presidential Advisory Council on Science and Technology, plays a pivotal role in overseeing and aligning government-wide policies on carbon neutrality R&D. This ensures the integration of policy objectives and efficient progress in technology development.

In October 2022, the ROK announced the *Strategy for Technology Innovation for carbon neutrality*, which outline the R&D directions necessary to achieve the 2030 Nationally Determined Contribution (NDC) and carbon neutrality by 2050. This strategy prioritizes private sector-led mission-oriented innovation, increased investment in R&D, and the establishment of a supportive foundation for pioneering technologies. The strategy identifies ROK's 100 Core Technologies for Carbon Neutrality across 17 key areas, including power generation, industry, transportation, building, waste, and carbon sinks, which are essential for implementing the national carbon neutrality objectives.

<Table Annex Ⅰ-1> 100 Core Technologies for Carbon Neutrality

Sector		Core Technology	Sector		Core Technology
Solar Power		Ultra-high Efficiency Solar Cells	Petro chemical	New Process	Conversion of Fuel Oil and Its By-products to Basic Chemical Raw Materials
		Multi-purpose Solar Power Systems			Low-energy Reaction Process
		Solar Panel Recycling			Low-energy Separation Materials and Processes
Wind Power		Ultra-large Wind Turbines			Smart Plant Conversion
		Floating Structure Systems for Offshore Wind Farm	Cement		Non-carbonate Raw Material Substitution
		Operation and Management of Offshore Wind Power			Increased Mixed Material Content
		Vertical-axis Floating Wind Power Generation			New Mixed Material Production
		Offshore Wind Installation and Construction			Recycled Resource Fuel Substitution
Hydrogen supply	Production	Alkaline Water Electrolysis			Utilization of Low-carbon New Heat Sources
		PEM Water Electrolysis	CCUS	Capture	Wet Capture
		Next-generation Water Electrolysis			Dry Capture
	Storage and Transportation	Gaseous Hydrogen Storage and Transportation			Membrane Separation Capture
		Liquid Hydrogen Storage and Transportation			Next-generation Capture
		Hydrogen-dedicated Pipeline Network		Storage	Storage Site Exploration, Evaluation and Selection
	Overseas Import	Large-scale Overseas Ammonia and Hydrogen Storage and Transportation			Storage Facility and Equipment Design and Construction
		Next-generation Overseas Hydrogen Storage and Transportation			CO_2 Injection and Operation of Storage Sites
		Liquid Hydrogen Transport Vessels			CO_2 Storage Monitoring
		Liquid Hydrogen Receiving Terminal		Utilization	Chemical Conversion
Zero-carbon New Power Sources		Hydrogen Co-firing Gas Turbine Power Generation			Mineral Carbonation
		Hydrogen-only Gas Turbine Power Generation			Biological Conversion
		Ammonia Co-firing in Coal Boilers			
		Ultra-high Efficiency Fuel Cell Combined Cycle			
		High-efficiency Fuel Cell Combined Heat and Power System			

Sector		Core Technology	Sector	Core Technology
Power Storage		Short-term Energy Storage Systems	General Industry	Industrial Process Hydrogen and Ammonia Utilization
		Long-term Energy Storage Systems		Process Gas Substitution (Semiconductor and Display)
		Used Battery ESS Systems		Process Gas Treatment (Semiconductor and Display)
Power Grid		Intelligent Power Transmission and Distribution Systems		Eco-friendly Refrigerants
		Real-time Power Trading Platform		Motor and Power Converter Efficiency Enhancement
		Integrated Operation of Distributed Power Sources and Flexible Resources		Green Data Centers
Energy Integration Systems		Industrial High-temperature and Ultra-low Temperature Heat Pumps		Carbon Emission Reduction Monitoring
		Complex Energy Systems	Eco-friendly Vehicles	Advanced Secondary Battery Cells
		Thermal Energy Storage Systems		Advanced Secondary Battery Systems
Nuclear Power		Small Modular Reactor (SMR)		Enhanced Drive Motor Performance
		Advanced Nuclear Systems		Advanced Power Conversion Devices
		Nuclear Waste Management		High-speed Wired Charging
Steel		Blast Furnace Fuel and Raw Material Substitution		High-capacity Wireless Charging
		Basic Oxygen Furnace Raw Material Substitution		Advanced Fuel Cell Systems
		Carbon-reduced Electric Arc Furnace		Vehicle Hydrogen Storage Systems
		Korean Hydrogen-Based Ironmaking		Hydrogen Refueling Stations
		Zero-carbon Fuel Conversion for Steel Industry Secondary Processes	Ship Carbon Neutrality	Carbon Neutral Internal Combustion Engine
		Steel By-product Resource Recovery		Ship Fuel Cell and Battery Systems
Petro chemical	Fuel Substitution	Electric Heating NCC Systems		Ship Electric Propulsion Systems
		Zero-carbon Fuel NCC Process		Fuel Post-treatment and Energy Efficiency Improvement
		By-product Gas High Value-added Conversion	Building Zero Energy	High-performance Multi-functional Envelope
	Raw Material Substitution	Bio-naphtha and Olefin		Building Equipment Electrification and High Efficiency
		Bio-PEF		Building Renewable Energy and Energy Integration Systems
		Bio-polyol		Building Energy Management, Control and Data Utilization
	Resource Circulation	Automatic Sorting of Waste Plastics	Environment	Biodegradable Bio-plastics
		Waste Plastic Solvent Extraction		Renewable Plastics
		Waste Plastic Depolymerization		Metal Resource Recovery
		Thermal Pyrolysis of Waste Plastics		Enhancement of Carbon Absorption by Land Space Type
		Waste Plastic Gasification		

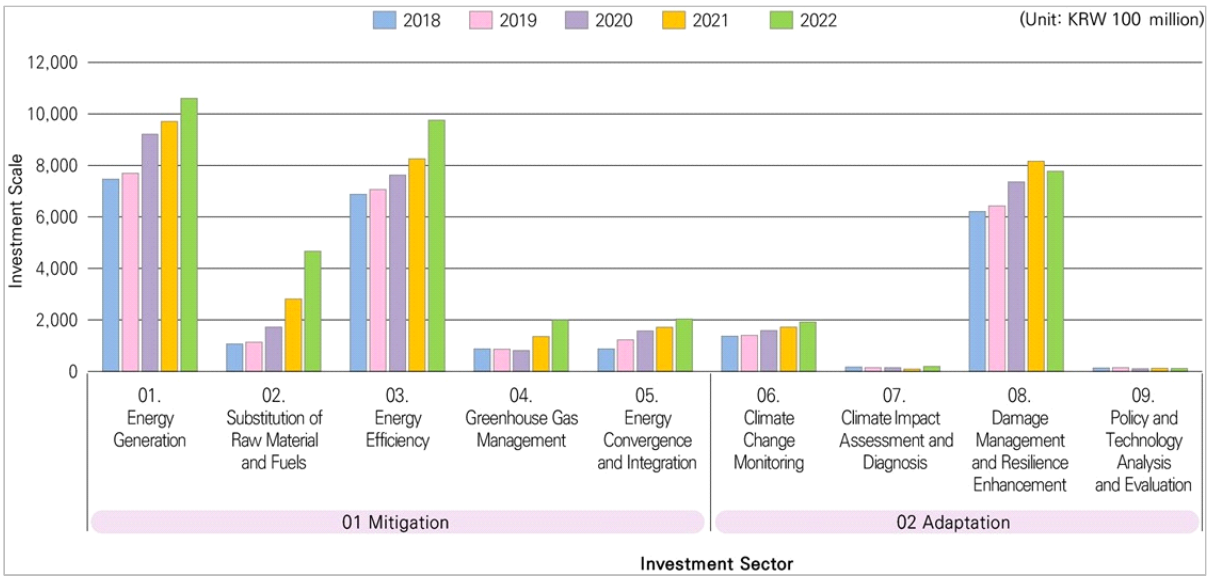
1.1.2 Status of Research and Development Investment

Following these policy trends, the total investment in national climate technology R&D projects in 2022 amounted to KRW 3,907.3 billion, accounting for approximately 12.9% of total national R&D. Of the total climate technology R&D investment, KRW 2,907.2 billion (74.4%) was invested in GHG reduction, and KRW 1 trillion (25.6%) in adaptation. In the mitigation sector, energy production received the highest investment at KRW 1,061.1 billion, followed by energy efficiency at KRW 976.1 billion, and fuel/feedstock replacement at KRW 466.6 billion. In the climate change adaptation sector, damage control and resilience enhancement received the highest investment at KRW 777.9 billion, followed by climate change monitoring at KRW 191.3 billion, and climate impact assessment and diagnosis at KRW 19.6 billion.

<Table Annex Ⅰ-2> Scale of Climate Technology R&D Investment in 2022

Category	2022 Climate Technology R&D Investment Status by Sectors			National Total R&D
	Mitigation	Adaptation	Total	
Investment Amount (KRW)	2.9072 trillion	1 trillion	3.9073 trillion	28.6801 trillion
Percentage (%)	74.4	25.6	100	-

Source: *Analysis of National R&D Investment in Climate Technology* (2018-2022) (National Institute of Green Technology, 2022)



[Figure Annex Ⅰ-1] Scale of Climate Technology R&D Investment

Source: *Analysis of National R&D Investment in Climate Technology (2018-2022)* (National Institute of Green Technology, 2022)

1.2 Major Research and Development Cases

1.2.1 Mitigation Sector

1) Power Generation

(a) Solar, Wind, and Wave Power Generation

The ROK is focusing on advancing technologies to expand deployment in the new and renewable energy sector. In the solar energy field, the ROK has succeeded in developing high-efficiency, large-area perovskite and silicon tandem solar cell manufacturing technology aiming for ultra-high efficiency. Additionally, technologies suitable for commercialization, such as urban solar cells and mobile device solar cells, are being developed to promote climate industry growth and expansion of deployment.

Wind power technology focuses on ultra-large scale and securing offshore wind technology to enhance economic feasibility. The ROK has successfully developed an 8 MW domestic offshore wind system and is pursuing the development of a 10 MW large-scale offshore wind system. In the long term, the goal is to develop components and systems for vertical-axis floating wind power generation and commercialize substructure technology and offshore wind farm operation and management technology. Fuel cell technology is also being developed proactively to prepare for increasing power storage demands, with active development of short- and long-term storage systems, used battery recycling technology, and solid oxide fuel cells.

<Table Annex Ⅰ-3> Research and Development Progress in Solar and Fuel Cells

Sector	R&D Progress
Solar Cell	· World's highest module efficiency certification for organic solar cells using non-halogen solvents
	· Development of high-efficiency, large-area perovskite and silicon tandem solar cell manufacturing technology for commercialization
Fuel Cell	· Development of high-performance oxygen electrode materials for tube-type materials
	· Development of optimal design technology for bipolar recirculation system of high-performance double-stack proton exchange membrane fuel cells

Technology development for commercializing eco-friendly marine energy such as wave power and marine green hydrogen is actively ongoing. A wave power demonstration plant utilizing breakwaters has been constructed at Jeju Island's coast, successfully achieving pilot power generation and demonstration operation, and this technology has been transferred to the private entity. Currently, technology development is underway to enhance the performance of multi-module wave power generation in connection with breakwaters under construction. Additionally, onshore performance testing is being conducted to establish a fixed offshore green hydrogen production system connected to marine renewable energy, and research is being conducted from various angles to secure offshore green hydrogen production technology that produces green hydrogen using generated power from wave power plant and electrolyze using desalinated seawater.

(b) Hydrogen Supply

The ROK actively supports the development of full-cycle technologies for the hydrogen industry, encompassing production, storage, transportation, and utilization. Water electrolysis technology has been secured for hydrogen production, with ongoing efforts to enhance economic feasibility through large-capacity and efficiency improvements in storage and transportation. Plans are also in place to expand support for creating new hydrogen markets. The Ministry of Science and ICT advanced eco-friendly, high-efficiency hydrogen energy source technologies through the Hydrogen Energy Innovation Technology Development Project (2019–2023) and is now promoting the Future Hydrogen Original Technology Development Project, focusing on future-oriented technologies since 2021.

Research on hydrogen production and storage has already yielded significant outcomes. Intensive investment in water electrolysis has led to the development of durable electrodes and separation membranes in alkaline electrolysis and high-performance oxygen electrodes in polymer electrolyte membrane electrolysis. Future-oriented technologies under development include hydrogen production through solar, thermochemical, and biochemical methods, with technology transfer ongoing from 2021 to 2024. Additionally, efforts are focused on developing porous adsorption materials and optimal structure designs for hydrogen storage, alongside large-capacity storage and hydrogen extraction technologies using ammonia. The development of high-efficiency hydrogen storage and release technologies using liquid organic hydrogen carriers has also successfully secured original technologies.

(c) Nuclear Energy

The ROK is actively advancing R&D to build a sustainable nuclear energy ecosystem. Key areas of focus include securing and enhancing core technologies for innovative Small Modular Reactors (i-SMR), nuclear power plant decommissioning, and radioactive waste management. Ongoing initiatives include the development of standard design technology for i-SMR and economically viable innovative manufacturing technologies. Research on safety technologies aims to minimize operational failures and accidents, ensuring long-term operational safety for nuclear power plants, alongside accident prevention technologies tailored for extreme environments.

Decommissioning technologies, such as cutting and decontamination, have been successfully demonstrated for the safe dismantling of decommissioned nuclear plants, with supporting infrastructure currently under construction. In radioactive waste management, the ROK aims to develop high-level radioactive waste safety management technologies and publish a Comprehensive Safety Verification Report to ensure the safe handling of nuclear waste.

(d) Energy Utilization and Management

The ROK is developing technologies to ensure stable energy supply system management and efficient utilization. Research efforts focus on advancing power grid technologies to expand renewable energy integration and promote distributed power sources. Large-scale power conversion devices and High-Voltage Direct Current (HVDC) transmission technologies are under development and being applied to stabilize metropolitan power grids. Additionally, fire safety assessment technology for large-capacity energy storage systems has been developed, leading to the establishment of the world's largest secondary battery verification center.

In the industrial, building, and transportation sectors, the ROK is driving a transition toward high-efficiency, low-energy consumption structures through active technology development. Achievements include low-loss power converters, high-efficiency motor designs, smart farm heating and cooling energy-saving technologies, and ultra-fast charger developments. Looking ahead, plans include enhancing energy efficiency in high-energy-consuming industries and expanding the low-carbon industrial ecosystem by implementing demand management technologies for peak power reduction.

2) Industry

The ROK is pursuing research for energy efficiency and fuel/raw material substitution in carbon-intensive industries such as steel, petrochemical, and cement. In the steel industry, medium- to long-term efforts are focused on developing Korean hydrogen-based ironmaking technology, while the petrochemical sector is concentrating on developing energy-efficient new processes. The cement industry has plans to develop technologies aimed at raw material substitution and process emission reduction.

Additionally, the development of Carbon Capture and Utilization (CCU) technologies is being actively pursued. Based on previously secured core technologies, the goal is to achieve early commercialization through medium- and large-scale demonstration projects, while also supporting the development of next-generation core technologies. The Carbon Resource Platform Chemical Manufacturing Technology Development Project is ongoing to develop product production technologies using CO_2 from GHG, by-product gases, and organic waste resources. Simultaneously, innovative raw material production technologies are being developed by capturing CO_2 from coal-fired power plant emissions. Furthermore, large-scale processes are being developed to capture CO_2 generated during hydrogen production.

Moreover, active support for technology development is being provided to enhance the climate change response capabilities of small and medium-sized enterprises (SMEs). The Ministry of SMEs and Startups has established a foundation for promoting low-carbon practices in SMEs by developing carbon-neutral technologies commonly applicable to processes in carbon-intensive industries, and is promoting technology dissemination through process expansion measures. Since 2022, 16 projects reflecting SMEs' technological needs have been selected for development, with plans to link completed technologies to support programs for commercialization. Additionally, through the *Strategic Technology Roadmap* that supports SMEs' technology development, the ROK is facilitating collaboration between research institutions with expertise in eco-friendly and low-carbon technologies and SMEs. Furthermore, GHG emission calculation and verification methodologies tailored to small- and medium-scale processes are being developed and supported.

<Table Annex Ⅰ-4> Research and Development Progress in Carbon Capture and Utilization Technology

Sector	Field	R&D Progress
By-product Gas and CO_2 Simultaneous Utilization	By-product Gas and CO_2 Simultaneous Conversion	· Development of technology to produce syngas, olefins, etc. through simultaneous conversion of by-product gas and CO_2 · Pilot-scale demonstration of integrated process of separation, conversion, and purification
	Separation of Carbon Resources from By-product Gas	· Development of membrane separation-adsorption hybrid process for recovery of high value-added chemical raw gas (carbon monoxide, carbon dioxide, hydrogen) from by-product gas · Scale-up of membrane and adsorbent, and demonstration of hybrid process
Renewable Energy-linked CO_2 Conversion	Hydrocarbon Production through Hydrogenation	· Production of liquid hydrocarbons such as naphtha from captured CO_2 or CO_2-rich by-product gas using renewable energy-based hydrogen · Pilot-scale demonstration of Power-to-Liquid core process
	CO_2 Conversion Using Renewable Energy Power	· Development of electrochemical conversion technology to produce olefins from captured CO_2 using renewable energy power directly using renewable energy power directly · Pilot-scale demonstration of integrated electrochemical CO_2 conversion process
Organic Waste/CO_2 Simultaneous Utilization	Simultaneous Conversion of CO_2 and Biomass By-products	· Development of technology to produce polymer platform compounds through simultaneous conversion of CO_2 and biomass by-products · Pilot-scale demonstration of integrated process linked to green polymer production
	Development of Integrated Biogas Conversion Process	· Development of integrated process linking biogas production, purification, and conversion to bio-naphtha and lubricating oil · Pilot-scale demonstration of integrated process for bio-naphtha and lubricating oil production

3) Building

Efforts are being made to advance building energy consumption statistics and management technologies to reduce energy use in buildings. Nationwide total energy consumption by source for buildings is being measured and analyzed, with research focused on identifying various factors influencing energy use. A data foundation is being established by linking building information to energy use analysis. Furthermore, building energy diagnosis and management technologies utilizing Information and Communication Technology (ICT) are being developed, alongside research for rapidly diagnosing the energy performance of aging buildings. Future plans include analyzing the effects of green remodeling to propose strategies for improving building energy efficiency and reducing carbon emissions.

4) Transportation

The ROK is developing diverse technologies to reduce GHG emissions in aviation and marine transportation sectors. In aviation, the Korea Augmentation Satellite System (KASS) has been operational since 2022, after its initial establishment in 2014. KASS provides highly precise location information in accordance with International Civil Aviation Organization (ICAO) standards, significantly reducing CO_2 emissions during aircraft approach operations. Each approach utilizing KASS achieves an average reduction of approximately 31.6 kg of CO_2.

In the shipping sector, eco-friendly vessel technology development and demonstration projects are advancing decarbonization efforts. Since 2022, technologies for waste heat recovery power generation systems and ammonia fuel for vessels have been under development. Shore-based test facilities for electric propulsion systems and eco-friendly fuel supply chains are being established. Moreover, an electric propulsion vessel powered by mobile batteries, rechargeable at ports, has been constructed and is undergoing demonstration operations. Additionally, emission reduction technologies for small- and medium-sized vessels are being developed, including performance evaluations of dry GHG reduction devices and feasibility studies for their application in smaller vessels.

5) Waste

The ROK is focusing on technology development for waste management and the promotion of resource reuse and recycling for environmental protection. The Ministry of Environment initiated research on livestock excreta energy conversion in 2019, demonstrating anaerobic digestion wastewater treatment technology to recover energy from livestock excreta mixed with wastewater. Additionally, technologies are being developed to recover and recycle valuable resources, such as nitrogen and phosphorus. Field performance evaluation of technologies utilizing methane from livestock excreta is also underway, with plans to introduce a GHG reduction certification system for the livestock industry and landfill sites to commercialize organic swine waste treatment systems and landfill microbial activation technology.

Efforts to maximize resource recycling are also ongoing. Initiatives include thermal decomposition of waste plastics, development of waste conversion process systems, and hydrogen production technology using mixed waste plastics. Proper treatment technologies

for new waste resources, such as solar panel waste and waste secondary batteries from electric vehicles, are being developed. Lifecycle technology development from design to treatment is being pursued to improve the circularity of waste secondary batteries, including the recovery and recycling of valuable resources. Additionally, technologies for converting organic waste and industrial waste gases into energy through thermochemical and biological methods are actively under development.

The ROK is also enhancing technology development to reduce marine waste. In 2021, the Ministry of Oceans and Fisheries formulated the *First Master Plan for the Management of Marine Garbage and Contaminated Marine Sediment* and has since been pursuing various R&D initiatives for lifecycle management of marine waste, from prevention to collection and treatment. Equipment, such as amphibious vehicles deployable in hard-to-reach coastal areas, is being developed to collect marine plastics. Space-time data-based technologies for estimating marine waste generation and predicting movement patterns are also being developed. Small-scale marine waste thermal decomposition systems tailored to island and fishing village areas are in progress. Research on the inflow and source-specific characteristics of marine microplastics is being conducted, analyzing their environmental behavior and ecological risks to secure scientific baseline data for addressing marine microplastics. Additionally, ceramic-based eco-friendly buoys are being developed to prevent microplastic generation from styrofoam buoys.

6) Carbon Sinks

Research on the management and development of carbon sinks is actively underway.

The Korea Forest Service is conducting R&D to maximize the GHG reduction effects of forest carbon sinks. Since 2022, the Foundation for Carbon Neutrality Implementation and Demonstration Technology in the Forest Sector has been initiated to identify and cultivate promising species to enhance forest carbon absorption and storage capacity. Technologies for sustainable forest management, such as forest tending and timber harvesting, are being developed. Research is also being conducted to evaluate carbon absorption effects in diverse areas such as urban forests and mangroves and to calculate forest soil carbon storage in line with international standards.

The Ministry of Environment has been quantitatively evaluating the carbon absorption and emission functions of inland wetlands since 2022 and developing technologies to enhance absorption capacity through inland wetland restoration. In 2023, research was initiated to improve the measurement and evaluation methods of carbon absorption by ecosystem type, aiming to align with the recommendations of the Intergovernmental Panel on Climate Change (IPCC). This research is expected to establish scientific evidence for maintaining biodiversity and enhancing carbon absorption capacity.

Additionally, technology development for the protection and expansion of carbon sinks in marine ecosystems is being actively pursued. The Ministry of Oceans and Fisheries is developing technologies to enhance blue carbon storage capacity through nature-based solutions (NbS), conducting research on the international certification of new blue carbon sources, and developing technologies for creating carbon-absorbing coastal wetlands. Notably, international certification research is underway for non-vegetated tidal flats, seaweed, and continental shelf sediments, which are recognized for their excellent carbon absorption and storage capabilities. Plans are also in place to expand alternative carbon sinks, such as artificial reefs.

1.2.2 Adaptation Sector

1) Vulnerability Assessment

To implement science-based adaptation policies, the ROK has been enhancing disaster management since 2014 through the use of the Vulnerability assessment tool To build climate change Adaptation Plan (VESTAP). This tool measures vulnerability across seven key sectors - health, land/coastal areas, agriculture and livestock farming, forests/ecosystems, marine/fisheries, water, and industry/energy - by administrative district. Since 2022, research has been underway to improve the technical capabilities of VESTAP. Additionally, research efforts to diversify adaptation policies include climate and atmospheric projections, development of future social and economic scenarios, analysis of adaptation effects, and disaster response measures using NbS.

2) Climate Change Prediction

To minimize flood damage, the ROK is advancing scientific flood management technologies utilizing Artificial Intelligence (AI). In 2020, research commenced on developing an AI-based flood forecasting system. Since its implementation in 2024, the number of forecasting points expanded from 75 to 223 locations, significantly enhancing the accuracy and promptness of flood responses.

The Korea Forest Service has been improving monitoring and prediction technologies to address forest disasters, such as wildfires and landslides, which are increasing due to climate change. Since 2023, it has utilized an ICT platform incorporating AI and sensors for wildfire monitoring and prediction. Additionally, plans are in place to provide real-time risk assessments for wildfires and landslides by advancing the wildfire spread prediction system and establishing a forest flow observation network.

The Ministry of Oceans and Fisheries is addressing sea level rise caused by global warming through the Land-Ice/Ocean Network Exploration with Semiautonomous Systems (LIONESS), a consortium of 21 institutions from 10 countries, including the United States, New Zealand, and Italy. Research on cryosphere changes in the Terra Nova Bay, East Antarctica and the Thwaites Glacier, West Antarctica has improved sea level prediction models and identified mechanisms to slow ice shelf collapse. These advancements contribute to more accurate global sea level predictions. Additionally, since 2023, research has been underway to enhance the adaptability of the fisheries industry to climate change. Efforts include establishing a high-resolution marine climate model with projections up to 2100, analyzing vulnerabilities in the fisheries sector, and developing long-term response measures based on predictions.

The Ministry of Science and ICT has been conducting research since 2021 to deepen understanding of global carbon dynamics for the fundamental comprehension of climate change. Through basic research into CO_2 behavior and associated phenomena in ocean, land, and atmosphere, this initiative aims to improve national climate change response capabilities by monitoring changes in carbon budget within the Korean Peninsula and laying the groundwork for enhanced climate change prediction.

3) Climate Change Scenarios

(a) National Climate Change Scenarios

The Korea Meteorological Administration participated in the IPCC international project from 2019 to 2021 and produced global and East Asian region national climate change scenarios. Based on its independently developed model, the Korea Meteorological Administration submitted climate change prediction information as evidence for the IPCC 6th Assessment Report, contributing to the production of international multi-ensemble scenarios. In 2021, the Korea Meteorological Administration collaborated with academia to produce four additional scenarios for the East Asian region. The future projection information derived from these scenarios was included in the Revised Edition of the Korean Peninsula Climate Change Projections Report 2020.

In 2022, high-resolution 'South Korea Detailed Scenarios' (1 km horizontal resolution) were produced to support national and local climate crisis adaptation measures and carbon neutrality policy development. These scenarios were created using statistical downscaling techniques based on four types of Shared Socio-economic Pathways (SSP). In addition to temperature and precipitation, variables such as wind speed, humidity, and solar radiation were included to enhance policy applicability. Based on these, the Revised Edition of South Korea Detailed Climate Change Projections Report was published, and data along with projection reports were made publicly available through the Korea Meteorological Administration's Climate Information Portal.

In 2023, climate change prediction information was produced based on national climate change scenarios for 17 metropolitan cities and provinces, over 260 cities, counties, and districts, and more than 3,500 towns, townships, and neighborhoods. This information was announced through the Climate Information Portal and Climate change situation maps. Additionally, between 2022 and 2024, various climate change impact information was analyzed and provided, including application indices for agriculture, forest, health, disaster prevention, water resources, and animal ecology, as well as data on the frequency and intensity of extreme climate events, projections for high-concentration fine dust and ozone occurrences, extreme precipitation projections by watershed, and summer heat stress projections. In 2024, new future projection information, such as climate extreme indices, was produced to respond to complex extreme climate phenomena.

(b) Marine Sector Scenarios

In 2022, the Korea Meteorological Administration provided four types of global ocean climate change scenarios, covering sea surface height, sea surface temperature, sea ice area, and surface salinity. Starting in 2023, the Korea Meteorological Administration began developing high-resolution ocean climate change scenarios (8 km horizontal resolution) to produce two types of temperature and salinity scenarios. In 2024, it plans to provide wave and storm surge scenarios and marine heatwave impact information to address marine climate change.

The Ministry of Oceans and Fisheries produced ocean climate change scenarios in 2023 for sea surface height, water temperature, salinity, and ocean currents with 3–5 km horizontal resolution for waters around the Korean Peninsula. From 2022 to 2026, research and development projects are underway to produce scenarios for approximately 10 parameters, including temperature, salinity, and nutrients, for the waters around the Korean Peninsula (5 km horizontal resolution) and the North Pacific (13 km horizontal resolution), to enhance ocean climate change response capabilities.

The Korea Hydrographic and Oceanographic Agency annually provides sea level rise rates by analyzing sea level height observation data from tide gauge stations with over 30 years of records to assess long-term sea level trends. Additionally, by applying SSP scenarios, it produces sea level, water temperature, and ocean circulation projections for the Northwest Pacific until 2100 and shares this information through the Ocean Data in Grid System on its website.

The National Institute of Fisheries Science has been providing abnormal water temperature prediction information, including high water temperature, low water temperature, and East Sea cold water mass in Korean coastal waters, through the Abnormal Water Temperature Prediction System established in 2017 to mitigate marine fisheries disasters caused by climate change. It has also analyzed the impact of climate change on the fisheries industry through reports such as the *Assessment Report on Fisheries Impacts in a Changing Climate* in 2019 and the *Annual Report for Climate Change Trends in Fisheries* in 2022 and 2023. Since 2022, it has also been providing prediction information on hypoxic water mass variations occurring in coastal waters.

2. Systematic Observation

2.1 Institutional Framework

2.1.1 Legal and Institutional Foundation

The ROK is strengthening its monitoring and prediction systems for climate change to protect ecosystems and climate systems and promote public welfare. A three-dimensional observation network connecting ground, marine, aviation, polar, and satellite systems has been established to efficiently observe climate phenomena, and the diversification of the utilization of information produced through the comprehensive monitoring system is underway. Through these efforts, the ROK is protecting citizens from climate disasters and preventing damage to the agriculture, forestry, and fisheries sectors.

The Carbon Neutrality Act, enacted In September 2021, specifies scientific monitoring and prediction of climate change. As a follow-up measure, the Act on Monitoring and Prediction of Climate and Climate Change was enacted in October 2023. Based on this, the Framework Plan for Monitoring and Prediction of Climate and Climate Change is being prepared. Additionally, relevant ministries, including the Korea Meteorological Administration, Ministry of Environment, Ministry of Oceans and Fisheries, Ministry of Agriculture, Food and Rural Affairs, and Korea Forest Service, are establishing mid- to long-term plans to systematically provide climate observation and prediction information.

2.1.2 Implementation Status by Ministry

The Korea Meteorological Administration is gradually advancing its climate crisis monitoring and analysis system through the Master Plan for Meteorological Services. The *Third Master Plan for Meteorological Services* (December 2016) adopted the strategy of supporting climate change response policy and expanding cooperation, and the *Fourth Master Plan for Meteorological Services* (December 2022) continues to implement the strategy of enhancing climate and climate change information as a key focus.

The Ministry of Environment is strengthening the GHG monitoring systems of national and local governments in accordance with the *First National Framework Plan for Carbon Neutrality and Green Growth* (Carbon Neutrality Framework Plan) (April 2023). To improve the accuracy and timeliness of the GHG inventory, ground- and satellite-based real-time

GHG monitoring and analysis systems are being gradually expanded.

The Ministry of Oceans and Fisheries formulated the *2050 Carbon Neutrality Roadmap for the Marine and Fisheries Sector* (December 2021) and developed the *Fourth Comprehensive Plan for Climate Change Response in the Marine and Fisheries Sector* (September 2022) for policy implementation. Through this plan, it is pursuing improvements to the marine climate change observation system, strengthening domestic and international cooperation governance, and enhancing polar and oceanic ecosystem research.

The Ministry of Agriculture, Food and Rural Affairs has developed the *Climate Change Adaptation Plan for the Agriculture Sector* and *Enhanced Measures for Climate Crisis Adaptation* to enhance climate change impact surveys and vulnerability assessments for agriculture, rural communities, agricultural water, and agricultural production infrastructure, while expanding private sector access to climate change impact information.

The Korea Forest Service established the *2050 Carbon Neutral Strategy for the Forestry Sector* (December 2021) and developed the *Third Comprehensive Plan for Improvement of Carbon Sinks* (June 2023) for implementing major policies over five years from 2023. Subsequently, it has been strengthening climate change observation infrastructure and promoting related technology R&D through forest meteorological and ecosystem monitoring, and forest disaster prediction and response.

2.2 Observation Systems

2.2.1 Atmospheric Observation System

The ROK initiated background atmospheric observations at the Sobaeksan Meteorological Observatory in 1987 to monitor atmospheric changes in substances contributing to climate change. Following its participation in the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) Programme in 1989, the ROK has aligned its observations with international climate monitoring standards. As of 2024, climate change monitoring stations are operational in Anmyeondo, Gosan-Ri (Jeju Island), Pohang City, and Ulleungdo-Dokdo. Additionally, seven universities and research institutions have been designated as commissioned observation stations to measure various climate change elements. The four main monitoring stations measure 37 substances across six key climate change monitoring areas - GHG, reactive gases, aerosols, stratospheric ozone/ultraviolet radiation, atmospheric radiation, and total atmospheric deposition - following WMO recommendations. Observation data are annually published in the Global Atmosphere Watch Report and shared with international organizations, governments, and researchers through the WMO GAW World Data Center for use in climate policy development and research. Notably, the GHG background levels observed at these stations are included in the WMO global average and serve as the national standard for the ROK.

Efforts to broaden the utilization of climate monitoring data have advanced significantly. Since 2021, the Climate Information Portal has provided real-time displays of observational data, starting with CO_2 measurements. By 2023, this expanded to 12 types of data, and a total of 20 data types are now available in time-series format, enabling timely information provision on substances influencing climate change.

Surface meteorological observations are conducted at 98 automated synoptic observing stations, 539 disaster prevention meteorological observation equipment stations, and 36 yellow dust observation stations. Upper-air meteorological observations are carried out at 7 rawinsonde stations and 13 wind profiler stations. Additionally, 10 operational weather radar observation stations and 3 small weather radar stations are operational, with airport weather radar networks established at major airports to support safe aircraft operations. High-quality meteorological information is provided using independently developed radar data quality control, precipitation estimation, and nowcasting technologies. Radar data are actively

exchanged with 43 observation stations in neighboring countries, including Japan, China, and Russia, for monitoring and forecasting meteorological phenomena in East Asia.

Efforts to identify the causes of increasing GHG concentrations are ongoing.[50] Since 2020, a three-dimensional monitoring network has been established, utilizing ground monitoring stations, meteorological aircraft, meteorological observation vessels, ground remote sensing equipment, high-rise towers, and satellites. In 2021, INVERSE-KOREA, Asia's first WMO-approved GHG source tracking system, was launched. This system combines observational results with atmospheric transport models to produce top-down GHG emission and absorption data. By 2023, the development of the source tracking model was completed, and in 2024, system construction began to quantify national-scale GHG absorption and emission processes, supporting climate crisis response policies.

High-resolution GHG observation data are also being produced for major emission sources and sink regions nationwide through ground and satellite observation networks. As of 2024, 10 national GHG observation network stations are operational, with plans to construct 96 additional stations by 2042. The expanded network will monitor aerosols and reactive gases in addition to GHGs. This observation data will be publicly accessible through Air Korea and the Comprehensive Platform for National Climate Crisis Adaptation Information for use in various fields.

2.2.2 Ocean Observation System

The National Ocean Observing Network has been established and is being operated for systematic management of jurisdictional waters and long-term collection of oceanographic observation data. As of 2024, the National Ocean Observing Network consists of 139 stations, including 56 tide stations, 36 marine observation buoys, 44 ocean current observation stations, and 3 ocean science stations. Tide stations are installed along the coast for long-term observation of tide levels, water temperature, salinity, and marine meteorology, while marine observation buoys monitor ocean currents and marine weather in coastal waters and open seas. Surface ocean currents in coastal waters are observed through ocean current observation stations using radio waves, and ocean science stations conduct comprehensive oceanographic observations and research in open seas. In particular,

50) The Anmyeondo Climate Change Monitoring Station, holding the ROK's longest continuous GHG observation records, observed an average concentration of 369.2 ppm in 1999, which rose to 400.3 ppm in 2012 and 427.6 ppm in 2023, showing a consistent upward trend.

the Ieodo Ocean Research Station plays a critical role in providing information for disaster prevention as it is located along typhoon paths.

Observation data collected from the National Ocean Observing Network is provided in real time through the Ocean Data in Grid Framework platform. This data is utilized in various fields, including climate change, navigation safety, fisheries, marine leisure, and maritime rescue operations. Notably, long-term accumulated tide information serves as crucial data for analyzing and responding to climate change impacts such as sea level rise, and efforts continue to expand the observation network and improve data quality.

Polar research is also being actively conducted. Core climate data is being produced using the Antarctic King Sejong Station, the Antarctic Jang Bogo Station, the ice-breaking research vessel Araon, the Arctic Dasan Station, and observation bases, while sea ice monitoring information is provided through satellite observation systems. The Antarctic King Sejong Station observes various global atmospheric monitoring substances, including CH_4, N_2O, SF_6, halogen compounds, NF_3, and CO_2. The Jang Bogo Station collects data on total ozone and organic aerosols, along with continuous monitoring of CO_2 and N_2O. The icebreaking research vessel Araon observes key climate elements related to the environment and ecosystems in the polar regions of both the Arctic and Antarctic. Plans are underway to collect additional observational data on core climate elements, including atmosphere, ocean physics, and biogeochemistry. Additionally, at Arctic observation bases established in permafrost regions of six Arctic Council member countries, including the Arctic Dasan Station in Norway, ongoing research is being conducted on climate environmental changes utilizing observational data from the atmosphere, land (permafrost), and fjord coastal areas.

Furthermore, 11 types of marine physical, chemical, and biological elements, including water temperature, salinity, dissolved oxygen, marine carbon dioxide, nutrients, and zooplankton, are being observed at 207 points in coastal waters of the East, West, and South Seas and the East China Sea. This information is provided through the National Institute of Fisheries Science website and the Annual Report of Oceanographic Observations, and long-term data analysis is used to assess climate change impacts on marine environments and ecosystems. Starting in 2023, this content is included in the Annual Report for Climate Change Trends in Fisheries, and continuous research on climate change impact assessment and adaptation in the marine fisheries sector is being conducted.

Oceanic meteorological observation is also being strengthened. As of 2023, a total of 258 observation facilities of eight types are in operation, including 31 marine meteorological buoys, 73 wave buoys, 18 coastal meteorological observation equipment stations, one meteorological observation vessel, 22 vessel-based meteorological observation equipment stations, 100 marine fog observation equipment stations, nine lighthouse meteorological observation equipment stations, and four port meteorological observation equipment stations. Additionally, to analyze surrounding ocean variability and collect regular marine observation data, the ROK has been participating in the International Argo Program, a real-time global ocean observation project jointly promoted by WMO and the Intergovernmental Oceanographic Commission (IOC) since 2001. Ocean observation instruments are deployed in waters around the Korean Peninsula and the Northwest Pacific to collect temperature and salinity observation data. The collected data is shared with the Global Data Assembly Center (GDAC), with the Korea Meteorological Administration serving as an internationally recognized Regional Data Assembly Center (RDAC).

Since 2005, the West Sea Comprehensive Ocean Observation (First Marine Observatory) has been operating on Bukgeoryelbi Island, the westernmost uninhabited island, to detect dangerous weather phenomena such as heavy rain, heavy snow, and typhoons approaching the Korean Peninsula in advance. Since 2022, the Base Station of Oceanic-Meteorological Observation (Second Marine Observatory) has been operating on Deokjeok Island for the metropolitan area, and starting in 2024, the Third Comprehensive Ocean Observation will be installed on Anma Island to proactively monitor dangerous weather in the Honam region.

2.2.3 Agricultural Observation System

Agricultural meteorological observations are conducted in accordance with WMO technical regulations at 10 subsidiary agricultural meteorological observation stations nationwide, including the Metropolitan Area Meteorological Administration. Since the late 1990s, local rural development institutions have also begun installing automatic weather observation equipment for agricultural technology dissemination. As of December 2023, there are 212 agricultural meteorological observation points. The main observation elements include 11 types, such as temperature, humidity, precipitation, wind speed and direction, soil moisture, solar radiation, and sunshine duration, with data collected on a minute-by-minute basis.

The collected observation information is processed into detailed agricultural meteorological information for major crop production areas and provided to farmers, policymakers, and researchers. This information is utilized for pest and disease forecasting, determining fertilizer application, and predicting crop conditions. Additionally, the agricultural meteorological information service is tailored to four distinct purposes: for farmers, agricultural meteorology staff, agricultural meteorological control, and researchers, meeting the diverse needs of users.

2.2.4 Forest Observation System

To prevent forest disasters caused by climate change and strengthen forest management systems, a mountain meteorological observation network has been established. Initiated in 2012, 479 stations are currently operating in mountainous regions nationwide as of 2023, with plans to expand to 620 stations by 2032. The mountain meteorological observation network monitors key meteorological elements such as temperature, humidity, wind direction, wind speed, atmospheric pressure, ground temperature, and precipitation on a minute-by-minute basis. Some stations also collect forest-specific data, including fuel moisture, soil moisture, and solar radiation.

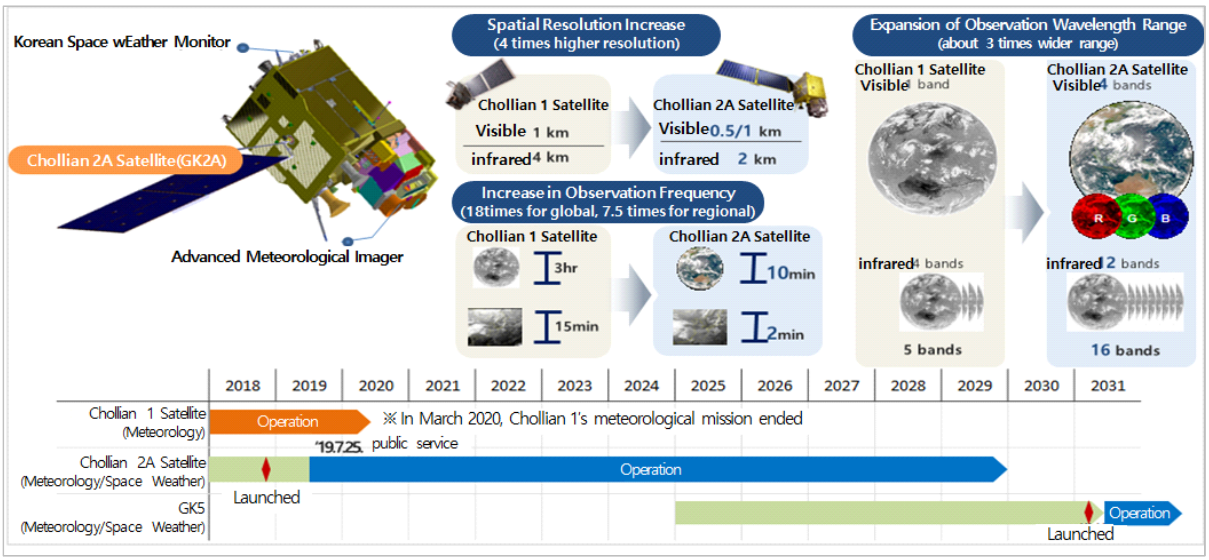
The collected mountain meteorological observation data is widely utilized. Real-time weather information is provided through the Mountain Meteorological Information System and the Public Data Portal, along with 3-day forecasts for 162 locations, including ROK's top 100 mountains and forest recreation areas. Additionally, public-friendly content such as flowering and autumn foliage timing predictions for major forest areas and hiking comfort indices enrich the dissemination of forest information. During summer heavy rain periods, rainfall and landslide risk information is provided, and forest fires danger indices are issued during spring and autumn fire prevention periods.

Efforts to advance forest disaster prediction using big data and AI technologies are ongoing. Mountain meteorological big data is widely utilized in various services, including the Korea Meteorological Administration's cloud disaster prevention meteorological information system, the Ministry of the Interior and Safety's life safety map, the Ministry of National Defense's DMZ mountain meteorological observation network, and Open-API-based information services.

2.2.5 Satellite Observation System

The ROK's first satellite observation system, Chollian Satellite 1, operated from 2010 to 2020, and subsequently, Chollian Satellite 2A, launched in 2018, observes and collects weather and climate-related satellite data and provides it to domestic and international users. Currently, the system receives and utilizes data from over 30 satellites worldwide, playing a crucial role in climate monitoring.

Chollian Satellite 2A is equipped with the Advanced Meteorological Imager (AMI) and the Korean Space wEather Monitor (KSEM). Compared to the meteorological imager of Chollian Satellite 1, spatial resolution has improved fourfold, observation frequency eighteenfold, and observation wavelength bands threefold, enabling more precise observation of dangerous weather phenomena. This satellite provides 52 types of meteorological products classified into four groups (scene analysis/surface, cloud/precipitation, radiation/aerosol, atmosphere/aviation), and its applications are divided into four areas: very short-term forecasting, typhoon/ocean monitoring, data convergence, and climate/environmental monitoring. To continue the mission of Chollian Satellite 2A, Chollian Satellite 5 is planned to be developed from 2025 to 2031.



[Figure Annex Ⅰ-2] Chollian 2A Satellite Observation System

Source: Satellite Meteorological Observation (Korea Meteorological Administration website)

Additionally, atmospheric and oceanic information is observed and data collected through Chollian Satellite 2B's Geostationary Environment Monitoring Spectrometer (GEMS) and Geostationary Ocean Color Imager-II (GOCI-II). The GEMS, the world's first geostationary

environmental satellite, observes air pollutants and short-lived climate forcers in about 20 countries, spanning east to west from Japan to India and north to south from Mongolia to Indonesia, including the Korean Peninsula. Through this, satellite observation data is provided in real-time to improve both domestic and international air quality forecast accuracy and to contribute to public health protection. The GOCI-II produces 26 types of marine satellite information with high spatial and temporal resolution regarding red tide, green tide, salinity concentration, marine pollution, ocean circulation, fishing ground environment changes, coastal water quality, sea fog, and sea ice in waters around the Korean Peninsula. This supports marine environment monitoring and facilitates early response to marine disasters.

2.3 Observation Research

2.3.1 Satellite Development and Utilization

1) Development of Ultra-small GHG Observation Satellite

The ROK is pursuing the development of ultra-small satellites for GHG observation. In June 2023, expert opinions were gathered, and the necessity of satellite development for GHG monitoring and emissions calculation/verification was confirmed. Through planning research in 2023, a strategy to develop and operate five ultra-small satellites with high spatial resolution (below 100 m) capable of observing facility-level GHG in low Earth orbit (below 600 km) was established. Development began in 2024 through contracts with domestic companies. These satellites plan to observe methane using short-wave infrared sensors, with CO_2 also to be observed to secure technology for follow-up satellite (low Earth orbit and geostationary orbit) development. Observation data obtained through these satellites will be utilized for GHG emission management, reduction strategies, and climate crisis adaptation planning.

Additionally, the ROK is pursuing the development of small satellites (100 kg class, low Earth orbit operation) to understand the global spatial-temporal distribution and movement characteristics of CO_2, a representative GHG. To develop these satellites with domestic independent technology, analysis of user requirements, key technologies by development phase, and satellite development strategies is underway.

2) Research on Satellite Development and Utilization

The ROK plans to develop and operate a satellite for forest and agricultural sector observation. This satellite is being developed from 2020 to 2024 and is scheduled for launch in 2025. It will collect wide-area Earth observation images, jointly utilized by the Korea Forest Service and Rural Development Administration. Thus far, algorithm development for utilization products, such as forest disaster response, forest resource assessment, and forest ecosystem monitoring, has been conducted.

In the future, the satellite will reduce response times by detecting forest fires and landslides in near real-time and will secure essential data for sustainable forest management, such as forest area, species, biomass, and carbon content. Additionally, it plans to improve public services by enabling early detection of forest anomalies and monitoring forest ecosystem health.

3) Environmental Satellite Utilization Research

Research is being conducted to maximize the utilization of the world's first geostationary environmental satellite. Since GHGs and air pollutants are often emitted simultaneously, the Ministry of Environment plans to convert NO_2 observed from environmental satellites into emission information, such as CO_2 concentrations, for enhanced usability. Separately, since 2023, the Ministry has been utilizing observation data from international satellites to develop a national GHG inventory (CO_2, CH_4) and high-resolution spatial display technologies. This initiative aims to improve the accuracy of national GHG inventories and support the evaluation of carbon neutrality implementation by national and local governments.

4) Marine Satellite Research

The Korea Hydrographic and Oceanographic Agency has established and is operating satellite information validation and calibration stations to enhance the accuracy of marine satellite products. Since 2022, research has been continuously conducted to improve marine satellite algorithms, and by 2024, a quality verification system covering five validation and calibration stations and 12 basic products was established.

Through research on developing application products based on data from multiple satellites, 11 new products have been developed, including sea surface temperature, Sargassum horneri detection, and ocean current maps. To further enhance the utilization of marine satellite information, the Korea Hydrographic and Oceanographic Agency is cooperating with the U.S. National Oceanic and Atmospheric Administration (NOAA) on validation and calibration projects and data fusion related to ocean conditions.

2.3.2 International Joint Research

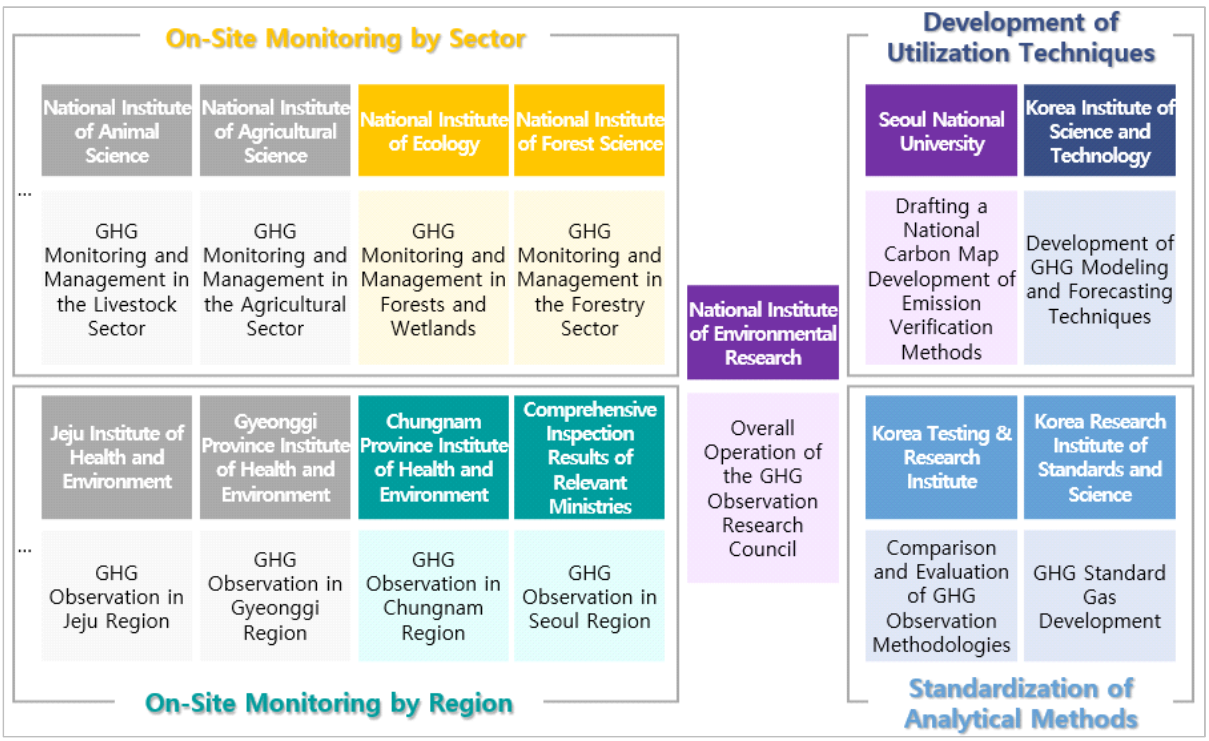
1) Strengthening GHG Monitoring Capacity

The ROK plays a critical role in strengthening the global community's GHG monitoring capabilities. In 2012, it was officially designated as the "World Calibration Center for SF_6" by the World Meteorological Organization (WMO). Leveraging this designation, the ROK published standardized observation techniques for sulfur hexafluoride as a WMO report (WMO GAW No.239). Additionally, it operates annual training programs for global GHG observation personnel, enhancing their understanding of GHG monitoring and supporting precise observation practices.

The ROK also conducts suitability assessments at observation stations within the WMO GAW network, evaluating equipment performance, optimization of analysis techniques, operator proficiency, and observation environments. Through these efforts, the World Calibration Center for Sulfur Hexafluoride transfers GHG data quality improvement technologies worldwide.

2) GHG Emissions Analysis Consortium

The ROK is advancing academic collaboration in the field of GHG observation through various initiatives. Following the 2019 IPCC National Greenhouse Gas Inventory Guidelines revision, the National Institute of Environmental Research has conducted ongoing studies on national and local GHG inventory verification and regional emissions measurements. Since 2021, it has been operating a GHG observation research consortium, comprising nine participating institutions, including the Korea Research Institute of Standards and Science, along with multiple observing institutions. This consortium fosters the sharing of regional and sectoral GHG observation and research infrastructure domestically and promotes joint research and technical cooperation to enhance data quality and expand its utilization. In 2024, the ROK led the international collaborative campaign, "An International Collaborative Study of Air Quality in Asia (Asia-AQ)", in partnership with NASA, using ground, aircraft, and satellite observations to investigate air pollution and GHG emission sources.



[Figure Annex Ⅰ-3] GHG Observation Research Consortium

3) Pandora Asia Network

Following the launch of the world's first geostationary environmental satellite in February 2020, the ROK is implementing the construction of the Pandora Asia Network (PAN) jointly with the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) and the Korea International Cooperation Agency (KOICA) to lead air quality improvement in the Asian region. This network shares satellite observation data and ground remote observation networks, providing real-time satellite observation information on air pollution and short-lived climate forcers. Since 2022, annual workshops have been held to provide air quality-related training on environmental satellites and Pandora equipment to policy makers and ground remote observation equipment operators in beneficiary countries. By 2024, installation of ground remote observation networks at 20 locations in 7 countries, Thailand, Vietnam, Indonesia, Mongolia, Cambodia, the Philippines, and Laos, will be completed, and cooperation projects for Asian air quality improvement will be promoted through this network.

Ⅱ. Education, Training and Public Awareness

1. Education and Training

The ROK enacted the Carbon Neutrality Act in September 2021 to establish various measures enabling citizens to minimize GHG emissions in their daily lives through energy and resource conservation and increased consumption of green products. Additionally, the Act mandated the implementation of a nationwide green lifestyle movement that strengthens education, training, and public relations through cooperation with local governments, businesses, and civil organizations.

Subsequently, in April 2023, the Carbon Neutrality Framework Plan was established, presenting the strategy of achieving carbon neutrality together through understanding and cooperation of all members of society. To this end, efforts are being made to create a culture of climate change response practice among all citizens by promoting: ⅰ) activation of carbon neutrality education and training for all citizens, ⅱ) support for human resource development and workforce training in preparation for new demands arising from industrial structure transformation, and ⅲ) expansion of collaborative campaigns between public, corporate, and civil society.

To respond to climate change and transition to a carbon-neutral society, the ROK provides quality education and training programs to nurture future environmental citizens and enable all citizens to actively participate in and practice environmental issues. This includes school environmental education conducted in kindergartens and elementary, middle, and high schools, social environmental training for the general public, and training for nurturing carbon neutrality professionals.

1.1 Environmental Education

1.1.1 School Environmental Education

1) Legal and Institutional Framework

As the importance of education for human-environment coexistence, ecological education for a sustainable society, and climate change response has been emphasized. Legal frameworks supporting school and social environmental education have been established and further supported through the revision of the *Framework Act on Education* (enacted in December 1997, revised in 2021), the *Act on the Promotion and Support for Environmental Education* (enacted in March 2008, revised in 2022), and the enactment of the Carbon Neutrality Act. In particular, under the *Act on the Promotion and Support for Environmental Education*, environmental education has been mandated for elementary and middle schools starting in 2023. This ensures the right to environmental learning, enabling students, as stakeholders in climate change, to acquire the literacy and competencies needed for carbon neutrality and climate change response at an early age.

Additionally, various initiatives have been launched to promote environmental education across all educational stages, from early childhood education institutions to universities. Metropolitan and provincial offices of education have enacted the *School Environmental Education Promotion Ordinance*, establishing policies to foster environmental education and reinforce its institutional foundation in schools.

2) Educational Practices and Developments

Customized education is being provided for young children to help future generations recognize and cope with the climate crisis. Through three designated early childhood environmental education centers nationwide, educational programs focused on play and experience are operated for children aged 3-5 to enhance climate sensitivity. The Korea Meteorological Administration develops and provides various contents such as children's storybooks and animations through its climate information portal to support future generations in acquiring knowledge about climate change science.

For elementary, middle, and high schools, environment, climate, and carbon neutrality-related content has been included extensively in the national curriculum. These

topics are integrated into achievement standards for major subjects such as social studies and science. Moreover, the new curriculum to be applied from 2025 will strengthen education to recognize the severity of climate change and the importance of carbon neutrality by establishing climate and environment-related subjects. Furthermore, practice-centered educational activities linked to schools, local communities, and homes are being promoted through creative experiential activities within the national curriculum for elementary, middle, and high school students. The Ministry of Environment, Ministry of Education, Ministry of Agriculture, Food and Rural Affairs, Ministry of Oceans and Fisheries, Korea Forest Service, and Korea Meteorological Administration are cooperating to designate 774 carbon neutrality focus schools and pilot schools nationwide, discovering and spreading excellent models of school environmental education that link ministerial expertise. From 2024, zero-emission hydrogen buses have been introduced and offered environmental education opportunities across the country.

Universities are also offering environmental education, including climate change response, as general education courses to enhance students' basic environmental literacy. Designated universities are operating green leadership development programs to support the development of eco-friendly talent and the spread of eco-friendly university culture. Environmental education for pre-service teachers has also been strengthened with environmental education courses being established and operated through teacher training colleges. Furthermore, through the National Environmental Education Center, diverse carbon neutrality and climate change education contents tailored to all educational stages are continuously being developed and distributed to enhance teachers' and students' access to environmental education.

1.1.2 Social Environmental Education

In addition to school education, various social environmental education initiatives are being promoted to raise public awareness of the climate crisis and encourage practical action. Multiple entities, including public institutions and civil organizations, are actively engaged in activities to spread understanding of environmental issues among citizens. Recently, carbon neutrality, green growth, and environmental education have been significantly expanded for civil servants, teachers, and public institution employees, and industry-specific and hierarchical education programs have been strengthened for corporate employees. According to the 2021 Environmental Education Survey results, climate change and carbon neutrality accounted for the largest proportion among social environmental education topics.

To enhance the quality and reliability of environmental education, the Ministry of Environment operates Environmental Education Specialists as a national professional qualification for those who can plan and implement environmental education programs. Since 2022, climate change-related courses have been established within the Environmental Education Specialist training curriculum to cultivate experts who understand climate crisis issues and can lead carbon neutrality practices. This aims to promote the dissemination of more professional climate education. Additionally, the Ministry of Environment and the Korea Adaptation Center for Climate Change have been operating the Climate Adaptation Academy since 2023 to provide basic education on the climate crisis and adaptation to the general public, thereby increasing interest in the climate crisis and improving public awareness of adaptation policies. Furthermore, since 2022, the Korea Meteorological Administration has been training climate change science instructors to deliver educational programs on climate change science to multicultural family support centers and senior welfare centers.

1.2 Training

The ROK is developing personnel who will lead the transition to a low-carbon green industry based on expertise in low-carbon technology as well as an understanding of policy, economy, and society. To this end, a framework for human resource development has been established based on the Fifth Environmental Technology, Environmental Industry, and Environmental Technology Human Resources Development Plan (February 2023) and the Carbon Neutrality Framework Plan. Through universities and various educational programs, professionals who will lead low-carbon and green fields are being produced.

1.2.1 Human Resource Development in the Graduate School

To nurture advanced human resources who will lead a sustainable future society, the ROK operates 15 specialized graduate schools in four fields, including climate change, carbon neutrality, and waste-to-energy, as of 2023. Additionally, the Pilot Project for Climate Technology Human Resource Development, implemented since 2022 based on the *Act on Promotion of Technology Development for Coping with Climate Change* enacted in April 2021, supports the development of global capabilities for domestic graduate students. Officials from four Southeast Asian countries (Indonesia, Malaysia, Philippines, and Vietnam) were invited to identify the current status of climate technology development and required technologies, and seminars for climate technology dissemination and joint research were held. Field training visits were also conducted to participate in universities, research institutes, plant sites, workshops, and technology exhibitions related to renewable energy-linked low-carbon desalination technology in Qatar and the UAE.

1.2.2 Professional Training

Various work-related practical and incumbent worker education programs have been established to support the carbon neutrality transition, and professional personnel are being trained through 16 specialized human resource development courses. In 2023, professional training programs related to corporate ESG were newly established. Subsequently, in 2024, systematic training programs are being further strengthened by introducing advanced courses on high-priority topics such as climate disclosure, supply chain due diligence, and life cycle carbon emission calculation. The Korea Environment Corporation provides theoretical and practical education on climate change understanding and GHG emission estimation for job seekers, linking education to employment support to develop GHG management experts.

Professional human resource development is also being pursued in the energy sector. The Ministry of Trade, Industry and Energy operates specialized education programs that reflect the latest trends in the energy industry, such as new energy industries and convergence education, to achieve carbon neutrality. It is producing specialists who will lead the energy paradigm shift by establishing various educational courses designed to enhance knowledge on major energy policy trends and related background knowledge.

Education is also continuously being provided to protect workers potentially marginalized in the process of industrial structure transition and to develop eco-friendly human resources. The Ministry of Employment and Labor is proactively developing measures to support the human resource development and job transition of incumbent workers in response to industrial structure transitions such as low-carbon transformation. Through diagnosis of transition progress stages and job analysis for SMEs, training roadmaps are established, and since 2022, industrial transition joint training centers have been opened to provide customized job transition training for SMEs employees. Furthermore, Korea Polytechnic University, a public vocational education and training institution, has established departments in promising eco-friendly and low-carbon fields such as low-power semiconductor design and electric vehicles, combining theoretical education with project-based training to develop professional personnel at various levels.

2. Public Awareness and Participation

2.1 Public Awareness

The ROK transparently discloses information about climate change response and adaptation policies to its citizens, enabling active participation in climate change mitigation and adaptation activities in daily life.

2.1.1 Climate Information Portal

The Climate Information Portal is an internet-based system that comprehensively provides scientific information on global warming and climate change. It delivers integrated climate change monitoring data on atmospheric, terrestrial, and oceanic changes, future climate projections based on national standard climate scenarios, and visualized climate change situation maps. Additionally, it offers climate change impact information detailing the current status of global warming and its future effects on various sectors such as meteorology, agriculture, forestry, and ecosystems. Since its initial development in 2000, the portal has undergone continuous updates, systematically building a database essential for climate change monitoring and research.

The National Adaptation Information Portal for Climate Crisis provides diverse information related to climate crisis adaptation. This portal includes policy trends, research materials, educational content, and basic data categorized by administrative district. To promote information sharing and collaboration among ministries, it facilitates the formation of an industry-academia-research human network and supports governance through tools for vulnerability and risk assessment. It serves as a comprehensive platform for two-way communication on adaptation strategies.

2.1.2 Transitioning to Carbon-Neutral Lifestyle

In 2021, the Carbon Neutrality Life Practice Guide was published to promote the transition to a carbon-neutral society by presenting practical methods for reducing GHG emissions in daily life. This guide outlines 81 actionable rules and facility improvement measures across five key areas - energy, consumption, transportation, resource circulation, and carbon sinks - within three sectors: households, schools, and businesses. It was developed incorporating feedback from youth supporters, civil organizations, local governments, educational offices, and relevant ministries to reflect diverse practical scenarios.

The 2050 Carbon Neutrality Policy Portal and 2050 Carbon Neutrality Practice Portal act as communication channels between the government and citizens, providing policy information and practical guides for carbon neutrality. The Policy Portal offers updates on climate change response policies and GHG emissions statistics, while the Practice Portal introduces daily carbon neutrality practices and promotes various public campaigns.

2.2 Public Participation

2.2.1 Public Campaigns on Climate Action

The ROK provides various information and programs to empower citizens to practice carbon neutrality independently and encourages participation through diverse campaigns integrated into daily life.

First, program that provides incentives for participating in eco-friendly activities for carbon neutrality in daily life is being maintained. Participants can receive incentives of up to KRW 100,000 annually when they reduce electricity, water, and city gas usage in homes or commercial facilities, or reduce vehicle mileage. Since 2022, the Carbon Neutrality Point System has been introduced, providing benefits of up to KRW 70 thousand annually for ten activities including using tumblers, returning disposable cups, using refill stations, and purchasing eco-friendly products.

Since 2009, Climate Change Week has been observed annually for 1–2 weeks around Earth Day (22 April). During this period, various climate-friendly events such as lights-off initiatives are organized nationwide to promote the necessity of carbon neutrality and green growth while encouraging public participation. The Rural Development Administration also utilizes this period to conduct diverse campaigns, including carbon neutrality practices in the agricultural sector.

The government operates the ‘Plenty of Resources’ platform, linking discarded office furniture and equipment with institutions for reuse, thereby promoting resource circulation culture. From 2022 onward, 13 companies have participated in this initiative, supplying a total of 3,244 items, of which 2,845 items have been reused by 55 institutions. To enhance corporate participation, the government quantifies performance outcomes and actively promotes best practices. Additionally, the ‘Bye Bye Plastic’ campaign calls for reduced plastic use and has seen active participation from public institutions, businesses, and citizens.

Since 2021, public participation governance has been expanded, focusing on youth through initiatives such as the formation of Carbon Neutral Supporters. These supporters plan climate change response and carbon neutrality campaigns and create online content about government policies and practical carbon reduction methods to spread a culture of carbon neutrality.

Efforts to enhance scientific understanding of climate change are ongoing. The Korea Meteorological Administration developed the 'Dalcom Climate' brand to improve awareness of climate change science, hosting contests and busking events to foster public engagement and communication.

To promote public transportation, a cost-support program has been implemented. Since 2020, the Thrifty Transportation Card project has offered mileage rewards based on public transportation travel distances, with additional benefits for young and low-income groups. This initiative has led to an average increase of seven public transportation uses per month. Recognized for promoting eco-friendly transportation, the Thrifty Transportation Card received a special award from the International Association of Public Transport (UITP) in 2021.

2.2.2 Community Activities

The ROK widely collects opinions from various sectors of society in the process of establishing carbon neutrality and green growth policies. The Presidential Commission on Carbon Neutrality and Green Growth has conducted opinion-gathering sessions and public hearings with stakeholders, including major emission industry representatives and academics. It has also reflected diverse perspectives through discussions with youth, civil society, industry, and labor. Additionally, public forums are regularly held to introduce climate finance, climate technology, regional carbon neutrality progress, and international carbon neutrality trends.

Furthermore, the Public Assessment Group of Climate Change Adaptation Policy is being operated in accordance with the *Third National Climate Change Adaptation Plan* (December 2020). The assessment group, consisting of 50 general citizens, received education on climate change adaptation policies and measures and participated in evaluating 49 tasks. This initiative enhances public understanding of policies and strengthens transparency and accountability in the decision-making process.

As carbon neutrality is presented as a national future strategy for climate change response, voluntary participation is expanding across various sectors, including industry, education, religion, and civil society. In the industrial entity, 36 companies have voluntarily declared their participation in RE100 and are actively utilizing renewable energy. Major GHG emitting industries, such as steel, petrochemicals, and automobiles, have launched a Hydrogen Economy Council to express their commitment to reduction.

The religious community is also showing active movements toward carbon neutrality. Beginning with the Christian community's carbon neutrality declaration in May 2021, the Catholic Diocese of Suwon announced its carbon neutrality plan for 2040, and Buddhist Climate Action urged the achievement of carbon neutrality by 2040. Participation in climate change response is spreading throughout society, as evidenced by metropolitan and provincial offices of education announcing a Joint Declaration on the Environment in 2021.

Annex II

National Inventory Report

Refer to the Common Reporting Tables (CRT) and the National Inventory Document (NID) expected to be listed on the United Nations Framework Convention on Climate Change (UNFCCC) website.

Annex III

Common Tabular Formats to Track Progress in Implementing and Achieving NDC

< Enhanced 2030 National Greenhouse Gas Reduction Target (NDC) (October 2021) >

	Information
Target and description, as applicable	The Republic of Korea's updated NDC target is to reduce 40% from the total national GHG emissions in 2018, which is 727.6 $MtCO_2eq$, by 2030. The Republic of Korea plans to use voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure to its domestic mitigation efforts including LULUCF to achieve its target
Target Type, as applicable	Single-year reduction target
Target Year, as applicable	2030
Reference point, level, baseline, base year or starting point, as applicable	2018, 727.6 $MtCO_2$-eq (excluding LULUCF)
Time frame and/or periods for implementation, as applicable	2021.01.01. - 2030.12.31
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	Power generation, Industry, Building, Transportation, Agriculture/Livestock Farming/Fisheries, Waste, Carbon Sinks (LULUCF)
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Any updates or clarifications of previously reported information, as applicable	Plan to utilize voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure
NDC Update	Enhancing the reduction target from 26.3% to 40% compared to 2018 total emissions (excluding LULUCF)

1. Structured summary: Description of selected indicators

Indicator selected to track progress	Description
Annual national total GHG emissions (excluding LULUCF)	
Information for the reference point, level, baseline, base year or starting point, as appropriate	In 2018, 732.9 $MtCO_2$-eq (excluding LULUCF)
Updates in accordance with any recalculation of the GHG inventory, as appropriate	Based on the latest inventory calculated in December 2024, the 2018 emissions were recalculated from 727.6 $MtCO_2$-eq to 732.9 $MtCO_2$-eq
Relation to NDC	Indicators to track progress toward NDC target achievement

2. Structured summary: Definitions needed to understand NDC

Definition needed to understand each indicator	
Annual total greenhouse gas emissions	Total annual emissions by sector including energy and IPPU, excluding LULUCF sector
Any sector or category defined differently than in the national inventory report:	
Sectors	Power Generation, Industry, Building, Transportation, Agriculture/Livestock Farming/Fisheries, Waste, Carbon Sinks
Definition needed to understand mitigation co-benefits of adaptation actions and/or economic diversification plans:	
Mitigation Co-benefits	NA ※ Applicable to countries that present co-benefits of mitigation from adaptation actions as NDC targets

3. Structured summary: Methodologies and accounting approaches – consistency with Article 4, paragraphs 13 and 14, of the Paris Agreement and with decision 4/CMA.1

Reporting Requirements	Description or reference to the relevant section of the BTR
For the first NDC under Article 4	
Accounting approach, including how it is consistent with Article 4, paragraphs 13～14, of the Paris Agreement (para. 71 of the MPGs)	・The following methodologies are applied to ensure transparency, accuracy, completeness, comparability, consistency, and environmental integrity while preventing double counting when calculating GHG emissions and removals [Methodologies] - Calculated based on Decision 24/CP.19 and the 1996 IPCC GL - Partial application of IPCC GPG 2000, IPCC GPG-LULUCF 2003, and 2006 IPCC GL [Common Metrics] IPCC Second Assessment Report (SAR) Global Warming Potentials (GWP)
For the second and subsequent NDC under Article 4, and optionally for the first NDC under Article 4	
Information on the accounting approach used is consistent with paragraphs 13-17 and annex II of decision 4/CMA.1 (para. 72 of the MPGs)	NA
Explain how the accounting for anthropogenic emissions and removals is in accordance with methodologies and common metrics assessed by the IPCC and in accordance with decision 18/CMA.1 (para. 1(a) of annex II to decision 4/CMA.1)	NA
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1)	NA

Reporting Requirements	Description or reference to the relevant section of the BTR
Explain how overestimation or underestimation has been avoided for any projected emissions and removals used for accounting (para. 2(c) of annex II to decision 4/CMA.1)	NA
For each NDC under Article 4	
Accounting for anthropogenic emissions and removals in accordance with methodologies and common metric assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement	
Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable (para. 74(a) of the MPGs)	Assessment of reduction target implementation and achievement through comparison between total emissions (excluding LULUCF) in the base year 2018 and net emissions (including LULUCF) in the target year 2030
Each methodology and/or accounting approach used for the construction of any baseline, to the extent possible (para. 74(b) of the MPGs)	NA
If the methodology or accounting approach used for the indicator(s) in table 1 differ from those used to assess the implementation and achievement the target, describe each methodology or accounting approach used to generate the information generated for each indicator in table 4 (para. 74(c) of the MPGs)	NA
Any conditions and assumptions relevant to the achievement of the NDC under Article 4, as applicable and available (para. 75(i) of the MPGs)	NA
Key parameters, assumptions, definitions, data sources and models used, as applicable and available (para. 75(a) of the MPGs)	NA

Reporting Requirements	Description or reference to the relevant section of the BTR
IPCC Guidelines used, as applicable and available (para. 75(b) of the MPGs)	Application of 1996 IPCC GL with partial utilization of IPCC GPG 2000, IPCC GPG-LULUCF 2003, and 2006 IPCC GL
Report the metrics used, as applicable and available (para. 75(c) of the MPGs)	IPCC Second Assessment Report (AR2) Global Warming Potentials (GWP)
For Parties whose NDC cannot be accounted for using methodologies covered by IPCC guidelines, provide information on their own methodology used, including for NDCs, pursuant to Article 4, paragraph 6, of the Paris Agreement, if applicable (para. 1(b) of annex II to decision 4/CMA.1)	NA
Provide information on methodologies used to track progress arising from the implementation of policies and measures, as appropriate (para. 1(d) of annex II to decision 4/CMA.1)	NA
Where applicable to its NDC, any sector-, category- or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, taking into account any relevant decision under the Convention, as applicable (para. 75(d) of the MPGs)	Application of 1996 IPCC GL with partial utilization of IPCC GPG 2000, IPCC GPG-LULUCF 2003, and 2006 IPCC GL Preparing to apply 2006 IPCC GL, 2013 KP Supplement, and 2013 Wetlands Supplement
For Parties that address emissions and subsequent removals from natural disturbances on managed lands, provide detailed information on the approach used and how it is consistent with relevant IPCC guidance, as appropriate, or indicate the relevant section of the national GHG inventory report containing that information (para. 1(e) of annex II to decision 4/CMA.1, para. 75(d)(i) of the MPGs)	Planning to calculate and report emissions and subsequent removals from natural disturbances on managed lands in accordance with the 2013 KP Supplement

Reporting Requirements	Description or reference to the relevant section of the BTR
For Parties that account for emissions and removals from harvested wood products, provide detailed information on which IPCC approach has been used to estimate emissions and removals (para. 1(f) of annex II to decision 4/CMA.1, para. 75(d)(ii) of the MPGs)	Planning to calculate and report emissions and removals from harvested wood products using the 2006 IPCC GL and 2013 KP Supplement
For Parties that address the effects of age-class structure in forests, provide detailed information on the approach used and how this is consistent with relevant IPCC guidance, as appropriate (para. 1(g) of annex II to decision 4/CMA.1, para. 75(d)(iii) of the MPGs)	Continuously managing forests to secure stable removals by improving the age-class structure of forests concentrated in specific age groups
How the Party has drawn on existing methods and guidance established under the Convention and its related legal instruments, as appropriate, if applicable (para. 1(c) of annex II to decision 4/CMA.1)	Preparing to apply 2006 IPCC GL, 2013 KP Supplement, and 2013 Wetlands Supplement
Any methodologies used to account for mitigation co-benefits of adaptation actions and/or economic diversification plans (para. 75(e) of the MPGs)	NA ※ Applicable to countries that present co-benefits of mitigation from adaptation actions as NDC targets
Describe how double counting of net GHG emission reductions has been avoided, including in accordance with guidance developed related to Article 6 if relevant (para. 76(d) of the MPGs)	As international mitigation projects are in their initial stages, plans for ITMO use in NDC and measures to prevent double counting will be reported from subsequent BTRs

Reporting Requirements	Description or reference to the relevant section of the BTR
Any other methodologies related to the NDC under Article 4 (para. 75(h) of the MPGs)	NA
Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs (para. 12(b) of the decision 4/CMA.1)	
Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs (para. 2(a) of annex II to decision 4/CMA.1)	No changes in sectors, definitions, data sources, metrics, assumptions, or calculation methodologies since the submission of the 2030 NDC (2021)
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable (para. 76(c) of the MPGs)	The 2030 NDC (2021) utilizes the 1996 IPCC GL and (GWP) from the IPCC AR2. However, the latest NIR in Chapter 1 applies the 2006 IPCC GL and (GWP) from the IPCC AR5 for the six GHGs* and nitrogen trifluoride (NF_3). Consequently, there are differences in targeted GHG, calculation methodologies, and common metrics between them * Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)
For Parties that apply technical changes to update reference points, reference levels or projections, the changes should reflect either of the following (para. 2(d) of annex II to decision 4/CMA.1)	
Technical Changes Related to the NIR	The NIR calculation methodology in Chapter 1 differs from the NDC reference point methodology (1996 IPCC GL) as it applies the 2006 IPCC GL and IPCC Fifth Assessment Report (AR5) Global Warming Potentials (GWP) for the six GHGs* and nitrogen trifluoride (NF_3) * Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)

Reporting Requirements	Description or reference to the relevant section of the BTR
Technical changes related to improvements in accuracy that maintain methodological consistency (para. 2(d)(ii) of annex II to decision 4/CMA.1)	NA
Explain how any methodological changes and technical updates made during the implementation of their NDC were transparently reported (para. 2(e) of annex II to decision 4/CMA.1)	NA
Striving to include all categories of anthropogenic emissions or removals in the NDC and, once a source, sink or activity is included, continuing to include it (para. 3 of annex II to decision 4/CMA.1)	
Explain how all categories of anthropogenic emissions and removals corresponding to their NDC were accounted for (para. 3(a) of annex II to decision 4/CMA.1)	[Calculation Methodology] - Calculated through 1996 IPCC GL - Partial application of IPCC GPG 2000, IPCC GPG-LULUCF 2003, and the 2006 IPCC GL [Common Metrics] IPCC Second Assessment Report (AR2) Global Warming Potentials (GWP) [Measurement Tiers] - Primarily uses Tier 1 for inventory calculations - Applies Tier 2 for specific sectors > Energy sector: (1) CO_2 from fuel combustion, (2) CH_4 and N_2O from public electricity and heat generation > IPPU sector: (3) PFCs, HFCs, SF_6 from semiconductor and LCD manufacturing > Agriculture sector: (4) CH_4 from rice cultivation, (5) N_2O from agricultural soils > LULUCF sector: (6) CO_2 from forestland > Waste sector: (7) CH_4 from landfill, (8) CH_4 from wastewater treatment, (9) N_2O from waste incineration
Explain how Party is striving to include all categories of anthropogenic emissions and removals in its NDC, and, once a source, sink or activity is included, continue to include it (para. 3(b) of annex II to decision 4/CMA.1)	NA

Reporting Requirements	Description or reference to the relevant section of the BTR
Provide an explanation of why any categories of anthropogenic emissions or removals are excluded (para. 4 of annex II to decision 4/CMA.1)	NA
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of its NDC	
Provide information on any methodologies associated with any cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 (para. 75(f) of the MPGs)	As international mitigation projects are currently in their initial stages, plans for ITMO use in NDC and measures to prevent double counting will be reported in subsequent BTRs.
Provide information on how each cooperative approach promotes sustainable development, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	Same as above
Provide information on how each cooperative approach ensures transparency, including in governance, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	Same as above
Provide information on how each cooperative approach applies robust accounting to ensure, inter alia, the avoidance of double counting, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	Same as above
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs)	Same as above

4. Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress
			2021	2022			
Indicators and Related Information for Tracking Progress in NDC Implementation and Achievement							
Annual Total Greenhouse Gas Emissions	$MtCO_2$-eq	732.9	690.8	671.2	40%	2030	As of 2022, approx. 8.4% reduction compared to 2018
Where applicable, total GHG emissions and removals consistent with the coverage of the NDC (para. 77(b) of the MPGs)	$MtCO_2$-eq	732.9	690.8	671.2	-	-	-
Contribution from the LULUCF sector for each year of the target period or target year, if not included in the inventory time series of total net GHG emissions and removals, as applicable (para. 77(c) of the MPGs)	-	-	-	-	-	-	-
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 of the Paris Agreement, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of the NDC, shall provide (para. 77(d) of the MPGs)	As international mitigation projects are at the initial stage, the ROK plans to report on NDC utilization of ITMOs and double counting prevention in its subsequent BTRs.						
If applicable, an indicative multi-year emissions trajectory, trajectories or budget for its NDC implementation period (para. 7(a)(i), annex to decision 2/CMA.3)	-	-	-	-	-	-	-

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress
			2021	2022			
If applicable, multi-year emissions trajectory, trajectories or budget for its NDC implementation period that is consistent with the NDC (para. 7(b), annex to decision 2/CMA.3)	-	-	-	-	-	-	-
Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the emission or sink categories as identified by the host Party pursuant to paragraph 10 of annex to decision 2/CMA.3 (para. 23(a), annex to decision 2/CMA.3) (as part of para. 77 (d)(i) of the MPGs)	-	-	-	-	-	-	-
Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the portion of its NDC in accordance with paragraph 10, annex to decision 2/CMA.3 (para. 23(b), annex to decision 2/CMA.3)	-	-	-	-	-	-	-
If applicable, annual level of the relevant non-GHG indicator that is being used by the Party to track progress towards the implementation and achievement of its NDC and was selected pursuant to paragraph 65, annex to decision 18/CMA.1 (para. 23(i), annex, decision 2/CMA.3)	-	-	-	-	-	-	-
Annual quantity of ITMOs first transferred (para. 23(c), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	-	-	-	-	-	-	-

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress
			2021	2022			
Annual quantity of mitigation outcomes authorized for use for other international mitigation purposes and entities authorized to use such mitigation outcomes, as appropriate (para. 23(d), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	-	-	-	-	-	-	-
Annual quantity of ITMOs used towards achievement of the NDC (para. 23(e), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	-	-	-	-	-	-	-
Net annual quantity of ITMOs resulting from paras. 23(c)-(e), annex to decision 2/CMA.3 (para. 23(f), annex to decision 2/CMA.3)	-	-	-	-	-	-	-
If applicable, the cumulative amount of ITMOs, divided by the number of elapsed years in the NDC implementation period (para. 7(a)(ii), annex to decision 2/CMA.3)	-	-	-	-	-	-	-
Total quantitative corresponding adjustments used to calculate the emissions balance referred to in para. 23(k)(i), annex to decision 2/CMA.3, in accordance with the Party's method for applying corresponding adjustments consistent with section III.B, annex to decision 2/CMA.3 (Application of corresponding adjustments) (para. 23(g), annex to decision 2/CMA.3)	-	-	-	-	-	-	-
The cumulative information in respect of the annual information in para. 23(f), annex to decision 2/CMA.3, as applicable (para. 23(h), annex to decision 2/CMA.3)	-	-	-	-	-	-	-

	Unit	Reference Point[1] (2018)	NDC Implementation Period		Target Level[2]	Target Year	NDC Progress
			2021	2022			
For metrics in tonnes of CO_2 eq. or non-GHG, an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment), annex, decision 2/CMA.3 (para. 23(k)(i), annex to decision 2/CMA.3) (as part of para. 77 (d)(ii) of the MPGs)	-	-	-	-	-	-	-
For metrics in non-GHG, for each non-GHG metric determined by participating Parties, annual adjustments resulting in an annual adjusted indicator, consistent with para. 9 of chapter III.B (Corresponding adjustments), annex to decision 2/CMA.3, and future guidance to be adopted by the CMA (para. 23(k)(ii), annex to decision 2/CMA.3	-	-	-	-	-	-	-
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs	-	-	-	-	-	-	-
NDC Achievement Status	As the ROKs NDC sets a single-year target for 2030, achievement status cannot be verified in the first BTR.						

1) Updated figures due to recalculation (727.6 → 732.9)
2) The ROK plans to use voluntary cooperation under Article 6 of the Paris Agreement as a complementary measure to its domestic mitigation efforts including LULUCF to achieve its target.

5. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Cross-Sector	Emissions Trading System	Allocates emission allowances to carbon-intensive entities, permitting greenhouse gas (GHG) emissions within allocated limits, with provisions for trading surplus or deficit allowance with other entities	The government sets and allocates total GHG emission allowances to carbon-intensive entities and promotes GHG mitigation by enabling trading between entities with surplus and deficit allowances	Economic Measure	In Progress	Energy, IPPU	CO_2 CH_4 N_2O HFCs PFCs SF_6	2015	Ministry of Environment, Ministry of Land, Infrastructure, and Transport, Ministry of Agriculture, Food, and Rural Affairs, Ministry of Economy and Finance, Ministry of Trade, Industry and Energy, Ministry of Oceans and Fisheries	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Cross-Sector	Target Management System	Sets annual mitigation targets for facilities with high GHG emissions and imposes penalties for non-achievement.	Designates entities that emit GHGs above certain levels as controlled emitters and establishes and manages GHG mitigation targets, although these entities are not subject to the emissions trading system	Other	In Progress	Energy, IPPU	CO_2 CH_4 N_2O HFCs PFCs SF_6	2010	Ministry of Environment	-	-	-
Power Generation	Phasing Down Aging Coal Power Plants	Accelerating the phasing-down of aging coal power plants and transitioning to lower-emission facilities such as LNG power plants	Contributes to GHG mitigation by decommissioning high-emitting aging coal power plants and replacing them with lower-emitting LNG facilities.	Other	In Progress	Energy	CO_2 CH_4 N_2O	2020	Ministry of Trade, Industry and Energy	570	11,458	-
Power Generation	Continued Operation of Nuclear Power Plants	Developing plans and licensing procedures to extend operations of nuclear power plants beyond their design life to expand zero-carbon energy sources.	Achieving a low-carbon power mix and reducing GHG emissions by continuing the operation of nuclear power plants beyond their design life.	Other	In Progress	Energy	CO_2 CH_4 N_2O	2022	Ministry of Trade, Industry and Energy	-	-	-
Power Generation	Financial Support for Renewable Energy Facilities	Providing long-term, low-interest loans to support the installation of renewable energy facilities	Aims to reduce GHG emissions in the power generation sector through expansion of renewable energy generation	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	2006	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Power Generation	Support for Residential Renewable Energy Deployment Based on the Electric Power Industry Fund	Providing financial support for the installation of renewable energy facilities in single-family and multi-family homes.	Aims to reduce GHG emissions in the power generation sector through expansion of renewable energy generation	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	1993	Ministry of Trade, Industry and Energy	-	-	-
Power Generation	Support for Building Renewable Energy Deployment Based on the Electric Power Industry Fund	Providing financial support for the installation of renewable energy facilities in non-residential buildings.	Aims to reduce GHG emissions in the power generation through expansion of renewable energy generation	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	1993	Ministry of Trade, Industry and Energy	-	-	-
Power Generation	Support for Integrated Renewable Energy Deployment Based on the Electric Power Industry Fund	Supports projects that integrate two or more renewable energy sources or community-level initiatives	Aims to reduce GHG emissions in the power generation through expansion of renewable energy generation	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	2013	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Power Generation	Renewable Portfolio Standard (RPS)	Power generation companies must secure Renewable Energy Certificates (RECs) through installation or purchase to meet mandatory renewable energy supply targets. Renewable energy generators receive and sell RECs as part of the system.	Companies with power generation facilities of 500MW or more are required to generate a certain percentage of their total electricity from renewable sources, contributing to the expansion of renewable energy generation.	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	2012	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Power Generation	Support for the Renewable Energy Usage Certification System (K-RE100)	Improves systems to enable general electricity consumers to purchase RECs, allowing private companies to procure renewable electricity by paying additional fees to transmission and distribution operators, and establishing implementation measures such as power purchase agreements (PPAs) between renewable energy power producers and electricity consumers.	Supporting voluntary renewable energy use (RE100) adoption in the private sector to expand renewable energy deployment and reduce GHG emissions.	Other	In Progress	Energy	CO_2 CH_4 N_2O	2021	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Power Generation	Establishment of Future Power Grid System	Formulating and implementing optimized power grid plans to accommodate increasing electricity demand and evolving power mix, while establishing a foundation for smart and flexible grid operations to ensure power supply stability.	Building a power grid system incorporating High Voltage Direct Current, ESS, and other advanced technologies to meet future electricity demand growth and support the expansion of renewable energy deployment.	Other	In Progress	Energy	CO_2 CH_4 N_2O SF_6	-	Ministry of Trade, Industry and Energy	-	-	-
Power Generation	Promotion of Distributed Energy Systems	Enacts the *Special Act on Activation of Distributed Energy* to mandate distributed energy installation, introduce power grid impact assessment systems, and implement incentive measures.	Enhancing grid stability and efficiency by facilitating power generation near high-demand areas, alleviating grid congestion, and optimizing electricity distribution.	Other	In Progress	Energy	CO_2 CH_4 N_2O	2023	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Industry	Research and Development Technologies for Achieving Carbon Neutrality	Develops core carbon neutrality technologies to reduce carbon emissions in manufacturing processes of four major carbon-emitting industries (steel, petrochemical, cement, semiconductor/display)	Driving essential process and facility innovations in industrial sites to accelerate the transition to a low-carbon industrial structure.	Other	In Progress	IPPU	CO_2 HFCs PFCs	2023	Ministry of Trade, Industry and Energy	-	-	-
Industry	Support for Technology Investment in the Private Sector	Enacts the *Special Act on Distributed Energy Activation* to mandate installations, establish grid impact assessment systems, and implement incentives.	Developing a comprehensive support system to foster technology innovation and commercialization, ensuring the successful development of core technologies needed to achieve carbon neutrality.	Economic Measure	In Progress	Energy, Transport, IPPU, Waste	CO_2 CH_4 N_2O HFCs PFCs SF_6	2022	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Industry	Building Infrastructure for Energy Management Systems	Helping businesses optimize energy use by offering energy efficiency consulting, implementing real-time monitoring and measurement systems, and supporting practical energy-saving initiatives through established energy management infrastructure.	Supporting businesses in establishing energy management system infrastructure to enhance corporate energy efficiency.	Economic Measure	In Progress	Energy	CO_2	2014	Ministry of Trade, Industry and Energy	-	-	-
Industry	Voluntary Energy Efficiency Target System	Setting energy intensity improvement targets in collaboration with energy-intensive businesses (annual energy consumption of 2,000 toe or more) and providing incentives for achieving these targets.	Encouraging voluntary energy efficiency improvements among high-energy-consuming businesses through goal setting and incentive mechanisms.	Other	In Progress	Energy	CO_2	2020	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Industry	Support for Energy-Saving Facility Investments	Assisting companies facing financial constraints by enabling ESCO companies to invest on their behalf or providing low-interest loans and interest subsidies for energy-saving facility investments.	Facilitating corporate energy efficiency by supporting energy-saving facility investments that might otherwise be delayed or abandoned due to financial difficulties.	Economic Measure	In Progress	Energy	CO_2	1980	Ministry of Trade, Industry and Energy	-	-	-
Industry	Support for Carbon-Neutral Leading Plants	Providing financial assistance for the construction of carbon-neutral leading plants that incorporate optimal technologies to reduce GHG emissions in high-emission industries.	Accelerating GHG reduction by promoting the adoption of carbon-neutral leading plants utilizing advanced low-carbon technologies in carbon-intensive industries.	Economic Measure	In Progress	Energy, IPPU	CO_2	2022	Ministry of Trade, Industry and Energy	-	-	-
Industry	Consultation for Energy Use Plan	A regulatory framework requiring consultations on energy supply, demand, and efficiency improvement plans before initiating large-scale projects.	Enhancing energy efficiency and promoting renewable energy adoption in businesses by requiring mandatory consultations on energy use plans.	Regulation	In Progress	Energy	CO_2	1991	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Industry	Energy Supporters to Small and Medium-sized Enterprises	Deploying energy experts to SMEs that lack specialized energy management personnel, providing on-site support to improve energy efficiency.	Helping SMEs reduce energy consumption through site visits, technical guidance, and expert consultations.	Others	In Progress	Energy	CO_2	2010	Ministry of Trade, Industry and Energy	-	-	-
Industry	Mandatory Energy Audits	Requiring energy-intensive businesses to conduct periodic energy audits to assess energy usage and identify potential inefficiencies.	Enhancing energy efficiency by identifying energy-saving opportunities and optimizing energy use through audits.	Regulation	In Progress	Energy	CO_2	2007	Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Industry	Government-Industry Partnership for Carbon Neutrality	Launches the Carbon Neutral Industrial Transition Promotion Committee as a government-industry communication channel for achieving carbon neutrality	Encourages voluntary private sector GHG mitigation practives and removes legal and institutional barriers through the committee.	Others	In Progress	Energy, Transport, IPPU	CO_2 CH_4 N_2O HFCs PFCs SF_6	2021	Ministry of Trade, Industry and Energy, Office for Government Policy Coordination, Ministry of Land, Infrastructure, and Transport, Ministry of Economy and Finance, Ministry of Agriculture, Food, and Rural Affairs, Ministry of SMEs and Startups, Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Building	Promotion of Zero Energy Building	Implementing zero-energy standards for new buildings to enhance renewable energy self-sufficiency and reduce fossil fuel consumption	Minimizing building energy consumption by promoting zero energy buildings with enhanced energy performance	Regulation	In Progress	Energy, Other (Building)	CO_2 CH_4 N_2O	2017	Ministry of Land, Infrastructure, and Transport, Ministry of Trade, Industry and Energy	101	114	354
Building	Promotion of Building Energy Management Systems	Mandating the installation of energy management systems in new buildings to reduce energy consumption	Enhancing energy efficiency in new buildings through implementation of energy management systems	Regulation	In Progress	Energy, Other (Building)	CO_2 CH_4 N_2O	2017	Ministry of Land, Infrastructure, and Transport, Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Building	Green Remodeling for Existing Buildings	Supporting energy efficiency improvements in aging buildings through remodeling projects with enhanced insulation	Reducing building energy consumption by enhancing energy efficiency in aging buildings	Economic Measure	In Progress	Energy, Other (Building)	CO_2 CH_4 N_2O	2013	Ministry of Land, Infrastructure, and Transport	37	22	-
Building	Improving the Efficiency of Household Appliances	Enhancing gas equipment efficiency in buildings by establishing energy efficiency targets and conducting performance evaluations for large buildings	Reducing fossil fuel consumption and GHG emissions by improving the efficiency of gas-powered building equipment	Others	In Progress	Energy	CO_2 CH_4 N_2O	2001	Ministry of Trade, Industry and Energy	-	-	-
Building	Development of Energy Efficiency Indicators by Building Type	Developing energy efficiency indicators and evaluation systems for building performance assessment	Creating a framework for building owners to voluntarily reduce GHG emissions by implementing energy efficiency evaluations and management systems	Others	In Progress	Energy, Other (Building)	CO_2 CH_4 N_2O	2019	Ministry of Trade, Industry and Energy, Ministry of Land, Infrastructure, and Transport, Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Building	Advanced Metering Infrastructure	Expanding the adoption of AMI to enable real-time monitoring and management of building energy consumption through wired and wireless communication.	Enhancing energy efficiency in buildings by promoting energy consumption reduction through smart metering systems.	Others	In Progress	Energy	CO_2 CH_4 N_2O	2010	Ministry of Trade, Industry and Energy	-	-	-
Building	Deploying New and Renewable Energy in Buildings	Facilitating fuel transition by promoting the adoption of renewable energy technologies in buildings, including BIPV, solar thermal, and geothermal systems.	Reducing fossil fuel consumption and GHG emissions by increasing renewable energy deployment in the building sector.	Economic Measure	In Progress	Energy	CO_2	2022	Ministry of Trade, Industry and Energy, Ministry of Land, Infrastructure, and Transport	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Transportation	Support for Eco-friendly Vehicle Purchases	Encouraging the deployment of electric and hydrogen vehicles by providing purchase incentives, developing zero-emission vehicle charging infrastructure, and mandating public institutions to purchase or lease low-emission vehicles.	Reducing GHG emissions in the road transport sector by increasing the adoption of low-emission vehicles, including electric and hydrogen vehicles.	Economic Measure	In Progress	Transport	CO_2 CH_4 N_2O	2011	Ministry of Environment, Ministry of Land, Infrastructure, and Transport, Ministry of Economy and Finance, Ministry of Trade, Industry and Energy	274	413	-
Transportation	Reduction of Private Vehicle Kilometers Traveled (VKT)	Providing incentives to encourage individuals to reduce their private vehicle kilometers traveled, promoting less car dependency.	Lowering fossil fuel consumption and reducing GHG emissions by decreasing private vehicle kilometers traveled.	Others	In Progress	Transport	CO_2 CH_4 N_2O	2018	Ministry of Land, Infrastructure, and Transport, Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Transportation	Intelligent Transport System (ITS) Infrastructure	Applying advanced technologies to roads and traffic systems to improve user safety and convenience, while automating and optimizing management systems to enhance transportation efficiency.	Improving overall fuel efficiency and reducing fossil fuel consumption by developing an Intelligent Transportation System (ITS) and optimizing traffic flow on ITS-equipped roads.	Others	In Progress	Transport	CO_2 CH_4 N_2O	2020	Ministry of Land, Infrastructure, and Transport	-	-	-
Transportation	Modal Shift for Freight Transportation (Road→Railroad)	Promotes modal shift from road transportation to eco-friendly railroad transportation	Reduces GHG emissions through activation of relatively low-emission railroad transport	Others	In Progress	Transport	CO_2 CH_4 N_2O	2010	Ministry of Land, Infrastructure, and Transport	-	-	-
Transportation	Modal Shift for Freight Transportation (Road→Maritime)	Promotes modal shift from road transportation to eco-friendly maritime transportation	Reduces GHG emissions through activation of relatively low-emission maritime transport	Economic Measure	In Progress	Energy	CO_2 CH_4 N_2O	2010	Ministry of Oceans and Fisheries	454	439	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Transportation	Vehicle GHG Emission and Fuel Efficiency Standards	Establishes standards for average fuel efficiency and GHG emissions for passenger and cargo vehicles with 15 or fewer seats and total weight under 3.5 tonnes	Reducing fossil fuel consumption and GHG emissions by tightening vehicle GHG and fuel efficiency standards.	Others	In Progress	Transport	CO_2 CH_4 N_2O	2012	Ministry of Environment, Ministry of Land, Infrastructure, and Transport, Ministry of Trade, Industry and Energy	-	-	-
Transportation	Early Scrapping and Operation Restrictions of Old Diesel Vehicles	Implementing operational restrictions by designating target vehicles, enforcement periods, and time frames to promote energy conservation and ease traffic congestion.	Reducing GHG emissions by limiting the operation of old diesel vehicles with poor fuel efficiency.	Others	In Progress	Transport	CO_2 CH_4 N_2O	2005	Ministry of Environment, Ministry of Land, Infrastructure, and Transport	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Transportation	Increasing Mandatory Biodiesel Blend Ratio	Mandates petroleum refiners and importers to blend a certain annual percentage of renewable energy fuel into transportation fuel	Reduces GHG emissions through mandatory blending of biodiesel with lower GHG emissions into transportation fuel	Others	In Progress	Transport	CO_2	2018	Ministry of Trade, Industry and Energy, Ministry of Land, Infrastructure and Transport	1,942	1,880	-
Transportation	Railroad Network Extension	Promotes railroad use activation by extending low-carbon transportation railroad networks	Reduces GHG emissions by encouraging expanded railroad use for transportation through network extension	Others	In Progress	Transport	CO_2 CH_4 N_2O	2018	Ministry of Land, Infrastructure, and Transport	-	-	-
Transportation	Improvement of Aircraft Operation Efficiency	Promotes improvement of aircraft operation efficiency for domestic national carriers through aircraft engine cleaning, weight and operation management	Reduces fuel consumption and GHG emissions for the same distance operation through improved aircraft efficiency	Others	In Progress	Transport	CO_2	2018	Ministry of Land, Infrastructure, and Transport, Ministry of Trade, Industry and Energy	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Transportation	Eco-friendly Ships	Contributes to private sector distribution expansion by certifying ships using eco-friendly energy sources such as liquefied natural gas as power sources	Reduces GHG emissions by promoting conversion to eco-friendly ships with lower emissions	Economic Measures	In Progress	Transport	CO_2	2021	Ministry of Oceans and Fisheries	-	-	-
Transportation	Eco-friendly Alternative Maritime Power (AMP) Supply	Supplies power to ships through shore power supply facilities instead of fossil fuels.	Reducing GHG emissions by utilizing shore power instead of fuel-based generation while ships are berthed.	Others	In Progress	Transport	CO_2 CH_4 N_2O	2019	Ministry of Oceans and Fisheries	-	-	-
Agriculture, Livestock Farming, and Fisheries	Water Management Technology	Expands mid-term water drainage, which maintains dry paddy fields by cutting off water supply for 2 weeks or more and opening drainage channels, in the rice cultivation area	Reduces methane emissions during rice cultivation by expanding mid-term water drainage	Others	In Progress	Agriculture	CH_4	2022	Ministry of Agriculture, Food, and Rural Affairs	-	-	-
Agriculture, Livestock Farming, and Fisheries	Fertilizer Prescription Based on Soil Testing	Provides appropriate fertilizer amounts for each field based on scientific soil analysis to induce proper fertilization of agricultural land	Reducing nitrous oxide emissions caused by over-fertilization by applying appropriate amounts of fertilizer to agricultural soils.	Others	In Progress	Agriculture	N_2O	2023	Ministry of Agriculture, Food, and Rural Affairs	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Agriculture, Livestock Farming, and Fisheries	Biochar	Develops and distributes biochar that enhances the carbon storage function of soil	Strengthens the N_2O storage capacity of soil by enhancing its carbon storage ability	Otherrs	Planned	Agriculture	N_2O	2026	Ministry of Agriculture, Food, and Rural Affairs	-	-	-
Agriculture, Livestock Farming, and Fisheries	Energy-Saving and Renewable Energy Facilities in the Agriculture Sector	Promotes carbon mitigation by introducing energy-saving facilities and expanding the distribution of renewable energy such as solar power	Induces energy efficiency improvement and GHG mitigation in the agricultural sector	Others	In Progress	Agriculture	CO_2	2023	Ministry of Agriculture, Food, and Rural Affairs	-	-	-
Agriculture, Livestock Farming, and Fisheries	Low-Methane and Low-Nitrogen Feed	Feeds livestock with feed containing methane-reducing agents that have been confirmed to have a methane mitigation effect of 10% or more compared to conventional feed, and low-protein feed with a lower crude protein content than the current standard	Reduces enteric fermentation methane emissions and nitrous oxide from livestock excreta treatment by expanding the supply of low-methane and low-nitrogen feed	Regulation	Planned	Agriculture	CH_4 N_2O	2024	Ministry of Agriculture, Food, and Rural Affairs	-	-	751

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Agriculture, Livestock Farming, and Fisheries	Energy Recovery and Purification Treatment in Livestock Excreta Management Facilities	Expanding treatment options for livestock excreta beyond composting by implementing energy recovery and water purification systems	Reducing both fossil fuel consumption and nitrous oxide emissions through advanced livestock excreta treatment processes	Regulation	In Progress	Agriculture	CH_4 N_2O	2022	Ministry of Agriculture, Food, and Rural Affairs	-	792	2,058
Agriculture, Livestock Farming, and Fisheries	Replacement of Aging Fishing Vessels	Subsidies for replacing aging engines of coastal and offshore fishing vessels (30% national treasury, 30% local funds, 40% own expense), and interest subsidy for replacement construction of aging fishing vessels	Reduces GHG emissions in the fishing vessel sector of the fisheries industry	Economic Measure	In Progress	Transport	CO_2	2021	Ministry of Oceans and Fisheries	1	1	1
Agriculture, Livestock Farming, and Fisheries	Energy-Saving Facilities and Equipment in Aquaculture Farms	Supply inverters and heat pumps, which are energy-saving facilities, to aquaculture farms and fishery processing workplaces	Improves energy efficiency and induce GHG mitigation by distributing energy-saving facilities to fisheries workplaces	Others	Planned	Energy	CO_2	2020	Ministry of Oceans and Fisheries	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Waste	Imposition of Waste Incineration and Landfill Charges	Imposes and collects waste disposal charges on those who incinerate or landfill recyclable waste	Induces waste recycling and reduce GHGs by imposing and collecting waste disposal charges	Regulation	In Progree	Waste	CO_2 CH_4 N_2O	2021	Ministry of Environment	-	-	-
Waste	Improvement of Unsanitary Landfills	Excavate, sort, and transfer waste from previously installed unsanitary landfills	Prevent methane generation from the decomposition of organic waste through sorting and transfer of waste from unsanitary landfills	Others	In Progress	Waste	CH_4	1995	Ministry of Environment	-	-	-
Waste	Expansion of Landfill Methane Capture	Captures and utilizes methane gas generated from biological treatment facilities as an energy source	Reduces fossil fuel use and GHG emissions through landfill methane collection	Others	In Progress	Waste	CH_4	2009	Ministry of Environment	1,758	1,720	-
Waste	Extended Producer Responsibility (EPR) System	Assigns responsibility to companies to collect and recycle waste generated from packaging materials and products manufactured or imported by them	Induces waste reduction and GHG mitigation by assigning responsibility for waste recycling to companies at the source	Regulation	In Progress	Waste	CO_2 CH_4 N_2O	2003	Ministry of Environment	1,036	1,086	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Waste	Installation of Community Recycling Centers	Providing permanent collection facilities in areas with limited recycling infrastructure to enable easy sorting of recyclable materials.	Enhancing recycling and reducing GHG emissions by improving access to separate waste disposal in underserved areas.	Others	In Progress	Waste	CO_2 CH_4 N_2O	2015	Ministry of Environment	4	6	16
Waste	Modernization of Public Sorting Facilities	Replaces aging public sorting facilities with newly constructed and modernized sorting facilities	Strengthen recycling and reduce GHGs by improving the sorting rate of public recycling facilities	Others	In Progress	Waste	CO_2 CH_4 N_2O	2000	Ministry of Environment	47	103	-
Waste	Public Procurement of Recycled Products	Mandating public institutions to purchase recycled products, creating leading demand and fostering market expansion for sustainable goods.	Encouraging recycling and reducing GHG emissions by expanding public sector procurement of recycled products.	Others	In Progress	Waste	CO_2 CH_4 N_2O	2005	Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Waste	Electric Vehicle Battery Recycling	Expanding institutional support for waste battery recycling by increasing storage facilities and designating remanufactured and reused batteries as recyclable resources.	Promoting a circular economy and reducing GHG emissions through waste battery recycling.	Others	In Progress	Waste	CO_2 CH_4 N_2O	2022	Ministry of Environment, Ministry of Land, Infrastructure, and Transport, Ministry of Trade, Industry and Energy	-	0.1	2.8
Waste	Construction Waste Recycling	Introduces a selective dismantling system to remove combustible waste first so that waste that can be recycled into recycled aggregate and waste that cannot be mixed during demolition work, and expand institutional support for construction waste recycling	Promoting a circular economy and reducing GHG emissions by expanding construction waste recycling.	Others	In Progress	Waste	CO_2 CH_4 N_2O	2019	Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Waste	Organic Waste Biogas Facilities	Installs organic waste biogas facilities that produce biogas using organic waste resources such as food waste and livestock excreta	Prevents methane generation from organic waste resources and reduce GHGs by utilizing methane as alternative fuel through biogas production	Economic Measure	In Progress	Energy, Waste	CO_2 CH_4	2022	Ministry of Environment	-	-	115
Carbon Sinks, Carbon Capture, and Hydrogen	Reforestation	Promotes afforestation projects to enhance forest carbon sink functions as part of sustainable forest management	Maintains and enhances carbon storage functions through afforestation	Regulation	In Progress	LULUCF	CO_2	2021	Korea Forest Service	117	228	1,202
Carbon Sinks, Carbon Capture, and Hydrogen	Forest Tending	Implements forest tending by dividing the work into afforestation site management, young tree management, and large tree management according to the growth stage of trees	Strengthens the carbon sink function of forests and reduce GHGs through forest tending	Regulation	In Progress	LULUCF	CO_2	2021	Korea Forest Service	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	High Value-Added Timber Utilization	Promoting the use of wood in building and infrastructure construction to enhance carbon storage capacity.	Enhances the carbon storage capacity of wood and reduce GHGs by encouraging wood use	Regulation	In Progress	LULUCF	CO_2	2021	Korea Forest Service	2,106	1,744	1,871

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Carbon Sinks, Carbon Capture, and Hydrogen	Urban Forests for Coping with Climate Crisis	Creates urban forests, which are new carbon sinks, near urban areas	Provides new carbon sinks and reduce GHGs through urban forest creation	Regulation	In Progress	LULUCF	CO_2	2021	Korea Forest Service, Ministry of Land, Infrastructure, and Transport, Ministry of Environment, Ministry of Agriculture, Food, and Rural Affairs	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	Expansion of New Carbon Sinks	Expands new carbon sinks by creating unexecuted urban park green spaces and restoring damaged areas in green belts	Strengthens carbon absorption capacity and reduces GHG emissions by creating and restoring green spaces	Regulation	In Progress	LULUCF	CO_2	-	Korea Forest Service, Ministry of Environment, Ministry of Land, Infrastructure and Transport, Ministry of Environment, Ministry of Agriculture, Food and Rural Affairs	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Carbon Sinks, Carbon Capture, and Hydrogen	Carbon Sinks through Inland Wetlands Conservation	Promotes conservation and systematic management of wetland protected areas by expanding wetland protected areas, purchasing private lands within protected areas, and restoring damaged areas	Enhances the carbon dioxide storage capacity of wetlands and reduce GHGs by expanding wetland areas and conserving ecosystems	Regulation	In Progress	LULUCF	CO_2	2021	Ministry of Environment	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	Prevention of Forest Disasters	Resolves forest fire extinguishing blind spots and prevent forest disasters through ICT forest fire monitoring platforms and advanced extinguishing operations	Strengthens forest carbon absorption functions and reduces GHG emissions by preventing forest disasters and restoring degraded forests	Regulation	In Progress	LULUCF	CO_2	2021	Korea Forest Service	1	2	18
Carbon Sinks, Carbon Capture, and Hydrogen	Restoration and Protection of Coastal Wetlands and Management of Marine Protected Areas	Strengthens marine sink functions by creating tidal flat vegetation and salt marshes and designating and managing marine protected areas	Reduces GHG emissions by strengthening carbon storage in marine carbon sinks	Others	In Progress	LULUCF (Coastal Wetlands)	CO_2 CH_4 N_2O	2022	Ministry of Oceans and Fisheries	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Carbon Sinks, Carbon Capture, and Hydrogen	Marine Forest Creation	Secure new marine carbon sinks by creating sea forests, which are dense areas of seaweed and seagrass in marine ecosystems	Strengthen marine sink carbon storage through ocean forest creation	Others	In Progress	Others	CO_2	2018	Ministry of Oceans and Fisheries	8	9	11
Carbon Sinks, Carbon Capture, and Hydrogen	Establishment of Institutional Framework for Carbon Capture, Utilization, and Storage (CCUS)	Establishes institutional frameworks, including relevant legislation and plans for CCUS Technology Development and Infrastructure Construction	Reduces CO_2 emissions through carbon capture, utilization, and storage	Others	Planned	Others	CO_2	-	Office for Government Policy Coordination, Ministry of Science and ICT, Ministry of Trade, Industry and Energy, Ministry of Oceans and Fisheries	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	Technology Development and Infrastructure Construction for Carbon Capture and Storage (CCS)	Promotes R&D and carbon storage site suitability evaluation for CCS technology development and infrastructure construction	Reduces CO_2 emissions through carbon capture and storage	Others	Planned	Others	CO_2	2026	Ministry of Trade, Industry and Energy, Ministry of Oceans and Fisheries	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Carbon Sinks, Carbon Capture, and Hydrogen	Technology Development and Infrastructure Construction for Carbon Capture and Utilization (CCU)	Promotes R&D and pilot projects for CCU technology development and infrastructure construction	Reduces CO_2 emissions through carbon capture and utilization	Others	Planned	Others	CO_2	2026	Ministry of Science and ICT	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	Hydrogen Technology Development and Infrastructure Construction	Establishes a clean hydrogen ecosystem and reduce GHGs through technology development for achieving a hydrogen economy by revising the Hydrogen Economy Promotion and Hydrogen Safety Management Act and promoting water electrolysis technology demonstration projects	Establishes a clean hydrogen ecosystem and reduces GHG emissions through technology development for achieving a hydrogen economy	Others	In Progress	Others	CO_2	2022	Ministry of Science and ICT, Ministry of Trade, Industry and Energy, Ministry of Oceans and Fisheries, Ministry of Environment	-	-	-

Sector	Name	Description	Objective	Typeg	Status	Affected Sectors	Affected Gases	Implementation Start Year	Implementing Agency	GHG Reduction ($ktCO_2$-eq)		
										Achieved Reduction (2021)	Achieved Reduction (2022)	Expected Reduction (2030)
Carbon Sinks, Carbon Capture, and Hydrogen	Establishment of Stable Hydrogen Supply Base	Promotes the establishment of a stable hydrogen supply base through the construction of water electrolysis hydrogen production bases	Activates the hydrogen economy and reduces GHG emissions through a stable hydrogen supply	Others	In Progress	Others	CO_2	2022	Ministry of Trade, Industry and Energy, Ministry of Science and ICT, Ministry of Oceans and Fisheries, Ministry of Environment	-	-	-
Carbon Sinks, Carbon Capture, and Hydrogen	Expansion of Hydrogen Demand and Utilization	Reduces GHG emissions through hydrogen and ammonia co-firing power generation and hydrogen based ironmaking	Reduces GHGs through the use of hydrogen vehicles and hydrogen based ironmaking	Others	In Progress	Others	CO_2	2022	Ministry of Science and ICT, Ministry of Trade, Industry and Energy, Ministry of Oceans and Fisheries, Ministry of Environment	-	-	-

6. Information on projections of greenhouse gas emissions and removals under a 'with measures' scenario

(Unit: $MtCO_2$-eq)

	Most recent year in the Party's national inventory report	Projections of GHG emissions and removals			
	2021	2025	2030	2035	2040
Sectors					
- Energy	-	-	-	-	-
- Transportation	-	-	-	-	-
- IPPU	-	-	-	-	-
- Agriculture	-	-	-	-	-
- LULUCF	-	-	-	-	-
- Waste	-	-	-	-	-
- Others	-	-	-	-	-
Gas					
- CO_2(Including LULUCF)	594.9	598.5	618.2	628.9	631.4
- CO_2(Excluding LULUCF)	633.1	625.5	638.5	644.2	644.3
- CH_4(Including LULUCF)	36.0	34.0	32.4	31.5	30.5
- CH_4(Excluding LULUCF)	35.6	33.6	32.0	31.1	30.1
- N_2O(Including LULUCF)	10.7	10.73	10.92	11.11	11.22
- N_2O(Excluding LULUCF)	10.7	10.7	10.9	11.1	11.2
- HFCs	30.3	40.7	52.1	65.8	73.6
- PFCs	4.7	8.8	12.3	16.6	22.0
- SF_6	5.2	6.0	7.6	9.6	10.8
- NF_3	1.8	2.8	3.7	4.9	6.1
Net Emissions (Emissions LULUCF)	683.6	701.5	737.2	768.4	785.5
Total Emissions (Excluding LULUCF)	721.4	728.0	757.1	783.3	798.0

7. Projections of key indicators

Key Indicator	Unit, as applicable	Most recent year in the Party's national inventory report	Projections of key indicators			
		2021	2025	2030	2035	2040
Net Emissions (Including LULUCF)	$MtCO_2$-eq	683.6	701.5	737.2	768.4	785.5
Total Emissions (Excluding LULUCF)	$MtCO_2$-eq	721.4	728.0	757.1	783.3	798.0

8. Key underlying assumptions and parameters used for projections

Key underlying assumptions and parameters	Unit, as applicable	Most recent year in the Party's national inventory report	Projections of key underlying assumptions and parameters			
		2020	2025	2030	2035	2040
Population	Million	51.8	51.7	51.3	50.8	50.1
GDP	Trillion KRW	1,839.5	2,077	2,231	2,351	2,447
Crude Oil Price	$/bbl	43.6	92.1	89.4	89.0	88.6

Acronyms and Abbreviations

	Term	Definition
	1996 IPCC GL	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
	2006 IPCC GL	2006 IPCC Guidelines for National Greenhouse Gas Inventories
A	ADB	Asian Development Bank
	AdCom	Adaptation Communication
	AF	Adaptation Fund
	AFoCO	Asian Forest Cooperation Organization
	AFOLU	Agriculture, Forestry and Other Land use
	AMI	Advanced Metering Infrastructure
	AMP	Alternative Maritime Power System
	APEC	Asia-Pacific Economic Cooperation
B	BAU	Business As Usual
	BEMS	Building Energy Management System
	BIPV	Building Integrated Photovoltaic
	BM	Benchmark
	BTR	Biennial Transparency Report
	BUR	Biennial Update Report
C	CBD	Convention on Biological Diversity
	CBDR	Common But Differentiated Responsibilities
	CBIT	Capacity-building Initiative for Transparency
	CCS	Carbon Capture and Storage
	CCU	Carbon Capture and Utilization
	CCUS	Carbon Capture, Utilization, and Storage
	CDM	Clean Development Mechanism
	CH_4	Methane
	CI	Carbon Intensity
	CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
	CO	Carbon Monoxide
	CO_2	Carbon Dioxide
	CO_2-eq	Carbon Dioxide Equivalent
	COP	Conference of the Parties
	CPS	Country Partnership Strategies
	CRT	Common Reporting Tables

	Term	Definition
	CTCN	Climate Technology Centre & Network
	CTF	Common tabular formats
D	DAC	Development Assistance Committee
	DMZ	Demilitarized Zone
E	EDCF	Economic Development Cooperation Fund
	EDPF	Economic Development Promotion Facility
	ETF	Enhanced Transparency Framework
	ETS	Emission Trading System
	ESG	Environmental, Social, and Governance
F	F-gas	Fluorinated Gas
G	GAW	Global Atmosphere Watch
	GCF	Green Climate Fund
	GDP	Gross domestic product
	GEF	Global Environment Facility
	GEMS	Geostationary Environment Monitoring Spectrometer
	GGGI	Global Green Growth Institute
	GHG	Greenhouse Gas
	GIRS	GHG Inventory Reporting System
	GWP	Global Warming Potential
H	HCFC	Hydrogenated Chlorofluorocarbon
	HFCs	Hydrofluorocarbons
	HVDC	High Voltage Direct Current
I	ICAO	International Civil Aviation Organization
	ICT	Information and Communication Technology
	IEA	International Energy Agency
	IMO	International Maritime Organization
	INDC	Intended Nationally Determined Contribution
	IOC	Intergovernmental Oceanographic Commission
	IPCC	Intergovernmental Panel on Climate Change
	IPCC GPG 2000	Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories 2000
	IPCC GPG-LULUCF 2003	Good Practice Guidance for Land Use, Land-use Change and Forestry 2003
	IPPU	Industrial Processes and Product Use
	ITMOs	Internationally Transferred Mitigation Outcomes
	ITS	Intelligent Transport System

	Term	Definition
	i-SMR	innovative Small Modular Reactor
K	KASS	Korea Augmentation Satellite System
	K-BIS	Korea Blue Carbon Information System
	K-IPCC	Korean IPCC Response Council
	K-ESG	K-ESG Guideline
	KGGTF	Korea Green Growth Trust Fund
	KOSIS	Korean Statistical Information Service
	KP	Kyoto Protocol
	KSP	Knowledge Sharing Program
L	LCA	Life Cycle Assessment
	LDCs	Least Developed Countries
	LEDS	Long-Term Low Greenhouse Gas Emission Development Strategy
	LNG	Liquefied Natural Gas
	LPG	Liquefied Petroleum Gas
	LULUCF	Land Use, Land-Use Change and Forestry
M	MDB	Multilateral Development Bank
	MEAs	Multilateral Environmental Agreements
	MOU	Memorandum of Understanding
	MOTIVE	Korean Model Of InTegrated Impact and Vulnerability Evaluation of Climate Change
	MPGs	Modalities, procedures and guidelines for the transparency framework
	MRV	Measurement, Reporting, Verification
N	N_2O	Nitrous Oxide
	NbS	Nature based Solutions
	NC	National Communication
	NDC	Nationally Determined Contribution
	NDE	National Designated Entity
	NID	National Inventory Document
	NIR	National Inventory Report
	NIRS	National Inventory Report System
	NF_3	Nitrogen Trifluoride
	NO_2	Nitrogen Dioxide
	NO_x	Nitrogen Oxide
O	ODA	Official Development Assistance
	ODS	Ozone Depleting Substance
	OECD	Organisation for Economic Co-operation and Development

	Term	Definition
P	P4G	Partnering for Green Growth and the Global Goals 2030
	PaMs	Policies and Measures
	PFCs	Perfluorocarbons
	PPA	Power Purchase Agreement
	PPP	Public-Private Partnership
Q	QA	Quality Assurance
	QC	Quality Control
R	R&D	Research & Development
	RD&D	Research, Development & Demonstration
	REC	Renewable Energy Certification
	REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
	RPS	Renewable Portfolio Standard
S	SAF	Sustainable Aviation Fuel
	SDGs	Sustainable Development Goals
	SF_6	Sulfur Hexafluoride
	SIDs	Small Island Developing States
	SO_x	Sulfur Oxides
	SSP	Shared Socioeconomic Pathways
	SSP1-2.6	Shared Socioeconomic Pathways 1-2.6
	SSP5-8.5	Shared Socioeconomic Pathways 5-8.5
T	TA	Technical Assistance
	TMS	Greenhouse Gas Target Management System
	TOE	Ton of Oil Equivalent
U	UN	United Nations
	UNCCD	United Nations Convention to Combat Desertification
	UNEP	United Nations Environment Program
	UNESCAP	United Nations Economic and social Commission for Asia and the Pacific
	UNFCCC	United Nations Framework Convention on Climate Change
V	VESTAP	Vulnerability Assessment Tool to Build Climate Change Adaptation Plan
W	WB	World Bank
	WAM Scenario	With Additional Measures Scenario
	WM Scenario	With Measures Scenario
	WMO	World Meteorological Organization
Z	ZEB	Zero Energy Building
	ZEV	Zero-Emission Motor Vehicle

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