ECOREA

Environmental Review 2015, Korea

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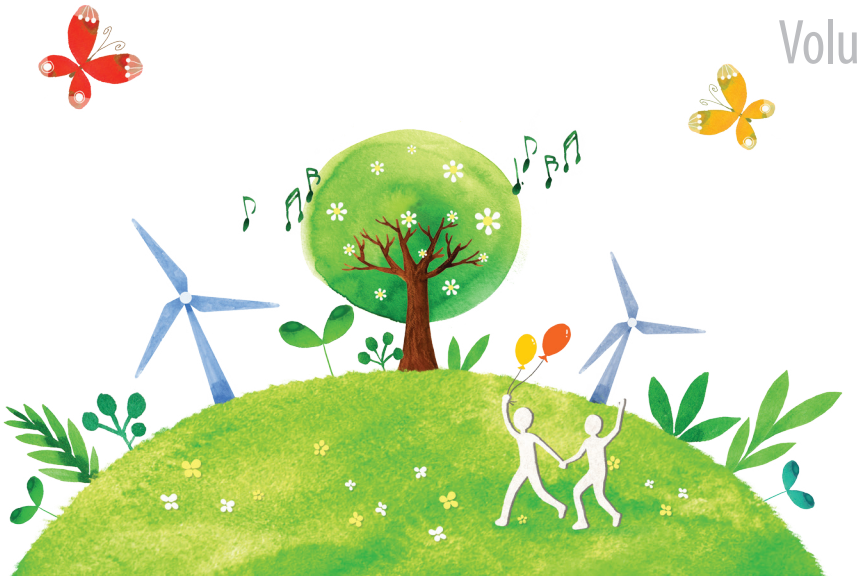


Minister's Message

Korea is known with its beautiful nature and landscapes, but has many difficulties in maintaining the blessed environment. Approximately 64% of Korea's 100 thousand km^2 territory is mountainous areas and the remaining 36% of land accommodates over 50 million people. Consequently, Korea's population density is the third highest in the world except city-states, causing a serious disadvantage in managing the environment as well as a strong possibility of ecosystem fragmentation. Besides, Korea has a monsoon climate where more than 60% of annual precipitation is concentrated on a rainy season from mid-June to July. This not only places the country at a high risk of water stress, but also leads to difficulties in managing air quality and keeping rich biodiversity.

For the past four decades, Korea has made all-out efforts with a variety of policy measures to overcome the inherent disadvantages in national environment management and succeeded in dramatically improving environmental quality across the country.

Black smoke rising up from factory stacks has disappeared to make way for clear blue sky. As an indicator, SO_2 concentration in the air in Seoul has dramatically reduced from 0.068ppm in 1988 to 0.006ppm in 2013. The Han River, the largest river in Korea crossing the center of the Seoul Metropolitan Area, now shows an average BOD of 1mg/L remarkably improved from 5mg/L in 1970s, so you can see wild fishes freely swimming in the clean river. Only 43% of the Korean people were provided with water supply service in 1970, but now the nationwide water supply rate stands at 98.5%.

As a result of successful implementation of policies such as the Volume-based Waste Fee system and recycling promotions, wastes which were dumped indiscriminately in the past have been greatly reduced in volume with a spectacular growth in material recycling and being converted into renewable energy sources.

Going beyond the accomplishments in improving environmental quality, the Park Geun-hye Administration has pushed for further advanced environmental management and environmental welfare policies to usher in a sustainable future.

For instance, the Ministry of Environment introduced Off-site Consequence Analysis to evaluate the potential risk of chemical facilities to outside the boundaries. On the other hand, the Act on the Registration and Evaluation of Chemical Substances has been enacted to establish an advanced chemical management system that would meet the standards of the most developed countries.

The Ministry has introduced the Liability, Compensation and Relief System to promptly compensate the damages caused by short-term and long-term pollutions and offer various insurance options that enable enterprises to operate their business plans in the long run. In order to accelerate circulation of resources and energy, the government is working on the construction of Environment-friendly Energy Towns where clean technology-based energy will be produced from incineration plants and landfills, while pursuing the enactment of the Act on the Promotion of Resource Cycle Society.

This year, the Greenhouse Gas Emissions Trading Scheme has begun for the purpose of actively responding to the global challenge of climate change.

Also, the Ministry is working on shifting the existing media-based emission permit systems into an integrated system similar to the EU's Integrated Pollution Prevention and Control. The new system is designed to protect receptors from pollutions with the use of best available techniques.

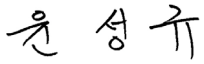
The Ministry of Environment will continue to endeavor to listen to the voices of not only the present generation but also our future generations as well as the soundless demands of plants and animals, so that we can ensure happy and prosperous life for all of them.

First published back in 1999, ECOREA is a part of our efforts to share Korea's experiences regarding environmental policies with our neighbors on the globe. I hope ECOREA will be widely read by many interested readers to make a useful reference, and go further to contribute to the efforts of countries to address commonly faced environmental challenges.

The Ministry of Environment of Korea always keeps our doors wide open to the opportunities for environmental cooperation with other countries around the world.

April 2015

Yoon, Seongkyu, Minister of Environment



Environmental Conditions and Environmental Quality Trends in Korea

Key Facts

Area: 100,033km^2
Population: 50,220,000
Density: 501/km^2
Average Temperature: 12.5°C
Annual Precipitation: 1307.7mm

Note: Population and density (2013),
Average temperature and annual precipitation
(1981-2010 average)

Korea has over 50 million people in about 100 thousand km^2 territory, resulting in a high population density. Mountains account for approximately 64% of the national territory, leaving only a limited proportion of the land for human residence. The country has the monsoon climate and 1,307.7mm annual average precipitation. However, 50-60% of the rainfall is concentrated during summer season placing the country at a high risk of water stress. Ecological axes across the country were disconnected or damaged during the rapid economic growth since 1960s. Population growth, urbanization and industrialization have accompanied air and water pollution, increasing wastes, destruction of ecosystems. However, Korea has come up with a wide variety of policy measures to overcome the inherent disadvantages and improve environmental quality across the country and made remarkable accomplishments in many areas.

Air Quality

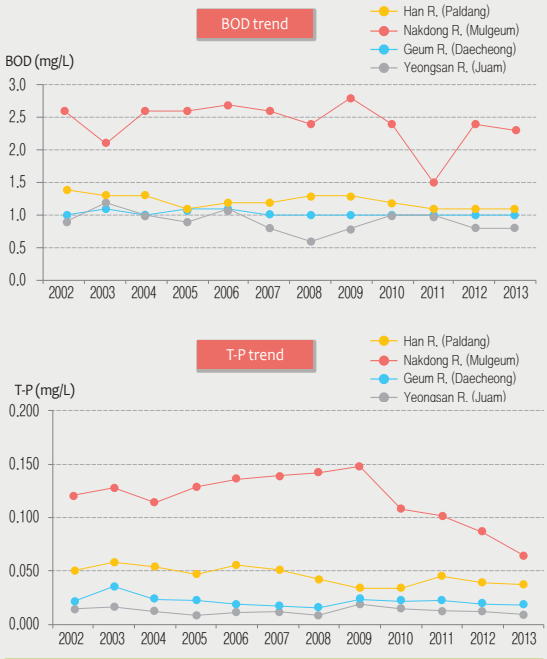
SO_2 and CO concentration in the air have significantly decreased since late 1990s with a slight reduction of PM_{10}. NO_2 and O_3 have been maintained below the standards, although without notable improvement in the figures.

	1998	2000	2005	2010	2013
SO_2 (ppm)	0.009	0.008	0.006	0.005	0.006
NO_2 (ppm)	0.020	0.024	0.022	0.025	0.024
O_3 (ppm)	0.020	0.020	0.022	0.023	0.026
CO (ppm)	1.0	0.9	0.6	0.5	0.5
PM_{10} ($\mu g/m^3$)	55	53	57	51	49

Trend in Air Pollution Levels

Water Quality, Water Supply and Sewerage

Water quality, including those in the four major rivers has shown steady improvement thanks to continued policy efforts, especially in BOD and T-P level. Water supply and sewerage service have greatly expanded standing at 98.5% and 92.1% respectively. The government is now focusing on further expanding the service to cover rural villages.



Water Pollution Trend in Four Major Rivers

	1980	1990	2000	2010	2013
Water Supply Rate (%)	55.0	78.4	87.1	97.7	98.5
Sewerage Distribution Rate (%)	8.3	32.9	70.5	90.1	92.1

Trends in Waterworks and Sewerage Distribution

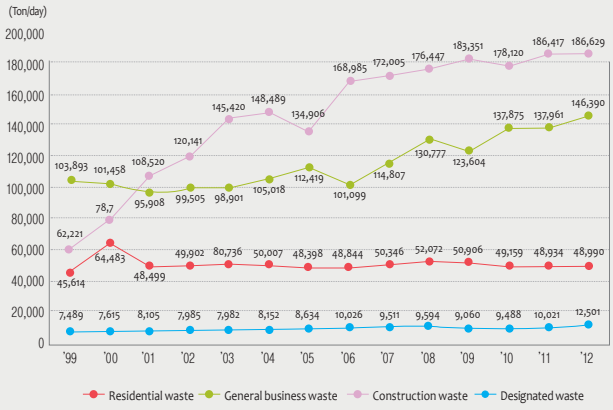
Waste

Generation of domestic wastes has been substantially decreased since the enforcement of volume-based garbage bag system and separate disposal of recyclables and food wastes, staying at a level around 0.95kg/day/person (as of 2012) down from 1.3kg/day/person in 1994. When it comes to waste treatment, recycling rate has been greatly increased with a remarkable decrease in landfilling, while seeing a slight increase in incineration.

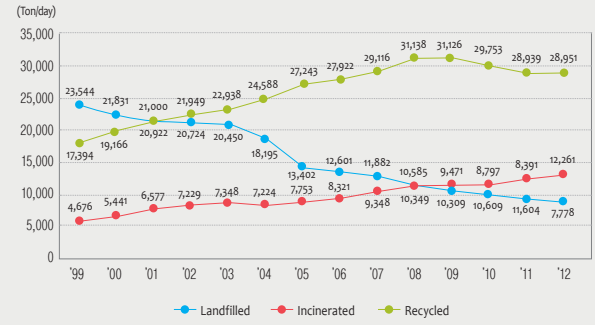
Nature

A total of 42,756 indigenous plant and animal species inhabit Korea, and 2,422 of them are endemic species. [1)]

For the purpose to conserve natural ecosystems, the government has designated 246 plants and animals as endangered wild species while managing legal protected zones including 84 Natural Parks, 32 Landscape/ Ecosystem Protected Areas, and 219 Protected Island Areas.



Trends in Waste Generation



Residential Waste Treatment

1) Number of indigenous species (2014), endemic species (2014)

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Climate Change

E C O R E A

is a compound of the prefix "ECO", which suggests an ecologically sound and comfortable environment, and the name the of the nation, "KOREA"

Main Policy Framework

(1) Greenhouse Gas Reduction Goals and Statistics

(2) Greenhouse Gas Target Management System

(3) Systematic Approach to Climate Change Adaptation

Current Policy Focus

(1) Greenhouse Gas Reduction Road Map

(2) Greenhouse Gas Emissions Trading Scheme

(3) Implementation of the Climate Change Adaptation Plan

Key Facts and Trends

(1) Greenhouse Gas Emissions

(2) Climate Change Outlook

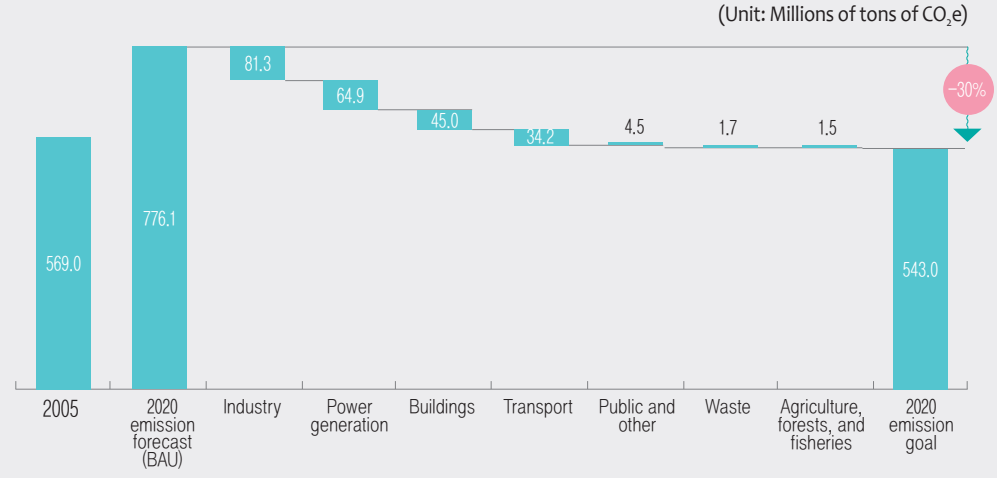
Main Policy Framework

(1) Greenhouse Gas Reduction Goals and Statistics

National Greenhouse Gas Reduction Goals

In November 2009, Korea set and announced a voluntary mid-term goal of reducing greenhouse gas emissions by 30% of the business-as-usual (BAU) level by 2020 as part of the Nationally Appropriate Mitigation Action (NAMA), the Convention track of the Bali Road Map. This goal is equivalent to the highest reduction level recommended by the IPCC for developing countries (15-30%) and was met by international attention and anticipation, as it is a reduction activity carried out independently without assistance from developed countries. This reduction goal was based on the results of a joint analysis of reduction potential by policy research institutes. It was officially announced at the Climate Change Conference (COP15) held in Copenhagen in November 2009 and submitted in writing to the United Nations Framework Convention on Climate Change (UNFCCC) in January of the following year.

Fig. 1-1 Greenhouse Gas Reduction Goal by Sector



In July 2011, this mid-term reduction goal was further divided into specific reduction goals for each sector (seven sectors), industries (25 industries), and year. Total emissions forecast for 2020 (without additional reduction efforts, BAU) are 7.76 million tons of CO_2, and from this figure, the nationwide reduction goal of 30% will be reached by reductions of 18.2% in the industry sector, 26.7% in power generation, 34.4% in transport, 26.9% in buildings, 5.2% in agriculture, forests, and fisheries, 12.3% in waste, and 25% in public and other sectors.

If these reduction goals are successfully achieved, national greenhouse gas emissions will peak in 2014 followed by a gradual decrease, which is expected to result in the decoupling of economic growth and greenhouse gas emissions. Although mainly low-cost reduction measures will be applied in the early stages of reduction to account for factors such as cost minimization and time taken for technology investments, high-cost reduction measures will be progressively increased from 2015, and greenhouse gas emissions will decrease significantly.

Providing economic entities with clear signals by setting reduction goals is expected to facilitate the conversion of the national economic and industrial structure to a high-efficiency, low-carbon system, promote development of green technologies and industries, and secure new growth engines for Korea.

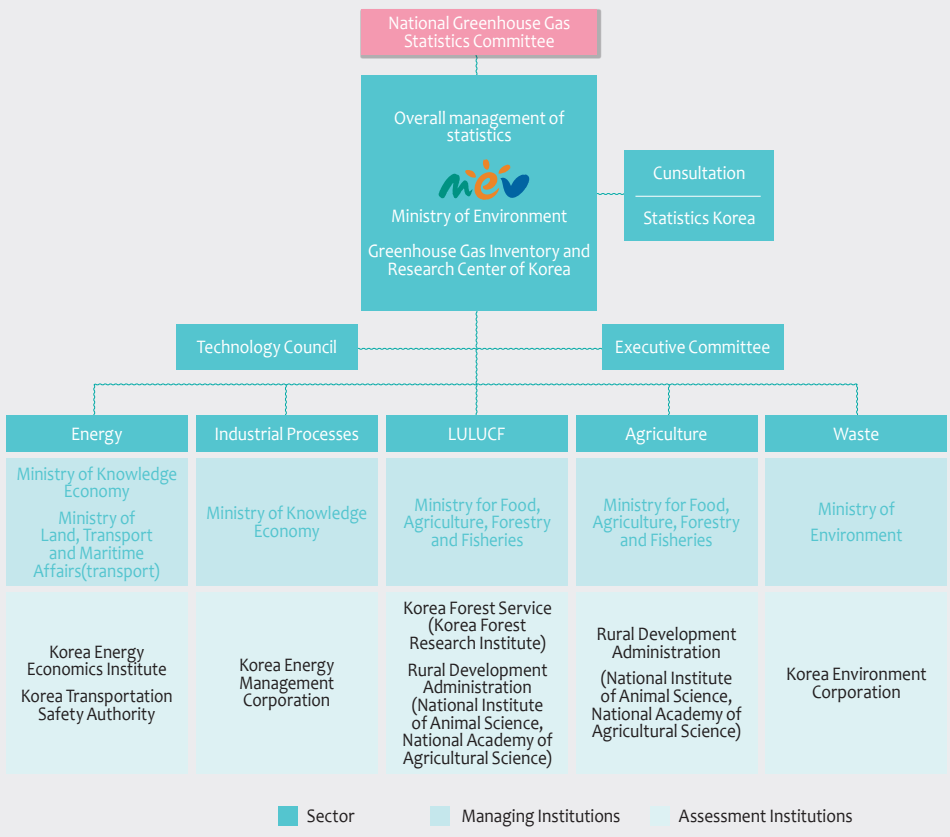
National Greenhouse Gas Inventory

In June 2010, the Greenhouse Gas Inventory and Research Center of Korea (GIR) was established under the Ministry of Environment to manage greenhouse gas emission information in a comprehensive and systematic manner. It is in charge of setting greenhouse gas reduction goals for each sector and industry and managing statistical data.

"Guidelines on the Calculation, Reporting, and Verification of National Greenhouse Gas Statistics" and other guidelines necessary for greenhouse gas statistics, as well as national greenhouse gas emissions and emission factors, are finalized via expert verification by a statistical techniques council, a review by the National Greenhouse Gas Executive Committee, and approval by the National Greenhouse Gas Statistics Committee. After national emissions are finalized, the Center uses this information to prepare and announce a National Inventory Report (NIR).

In operation since 2011, the "National GHG Management System" (NGMS) is an electronic system that manages statistical data on greenhouse gases. It is used in relation to the greenhouse gas and energy target management system by businesses subject to the target management system, the managing institution of each industry (competent ministry), and the Ministry of Environment as the supervising authority to report on and finalize greenhouse gas emissions, energy consumption, and other relevant information. The emissions register and offsets register of the emissions trading scheme to be enforced in 2015 will also be managed through NGMS.

Fig. 1-2 National Greenhouse Gas Statistics Preparation System



(2) Greenhouse Gas Target Management System

The greenhouse gas and energy target management system is a key measure currently being used to achieve greenhouse gas reduction goals. It targets establishments and businesses that emit large quantities of greenhouse gases or consume large amounts of energy ("controlled businesses") but are not included in the emissions trading scheme. Each controlled business is assigned to a greenhouse gas reduction and energy savings goal, and its fulfillment is managed by the government.

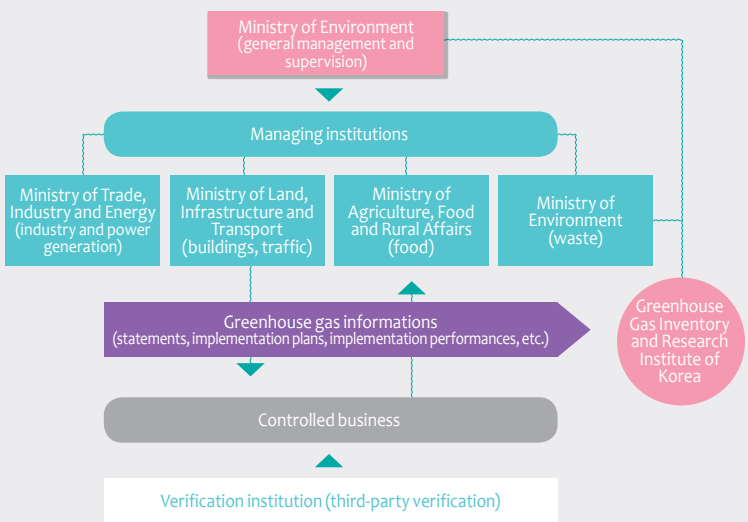
The target management system has been applied to an increasing scope of targets since it commenced in 2010. From 2014, it will be applicable to businesses with greenhouse gas emissions of 50,000 ton CO_2 or more, or an energy consumption of 200TJ or more, and to establishments with greenhouse gas emissions of 15,000 ton CO_2 or more, or an energy consumption of 80TJ or more.

When a controlled business reports its previous emissions to the managing institution of each sector, the managing institution sets greenhouse gas emission goals for each industry, which then submit an implementation plan to achieve the goals. In the following year, the controlled business submits a statement specifying its emissions and energy consumption together with an implementation performance report after third-party verification. The statement and implementation performance are confirmed by the managing institution of each sector, then submitted to GIR. Correction notices and other such measures are used to address any business that fails to reach its goals or does not meet measurement, reporting, and verification (MRV) requirements.

As the managing institutions of each sector, the Ministry of Agriculture, Food and Rural Affairs (agriculture, forestry, and livestock), Ministry of Trade, Industry and Energy (industry and power generation), Ministry of Environment (waste), and Ministry of Land, Infrastructure and Transport (buildings and traffic) designate controlled businesses, set goals for each business, and directly manage implementation by each business by checking implementation performance and statements. The Ministry of Environment, as the supervising authority, examines and evaluates

the affairs of the managing institution of each sector and prepares comprehensive standards, procedures, and guidelines necessary for system operation. As of 2015, it has designated 24 verification institutions and trained 181 examiners to build a third-party system to verify reduction implementation by each business.

Fig. 1-3 Operation of the Greenhouse Gas Target Management System

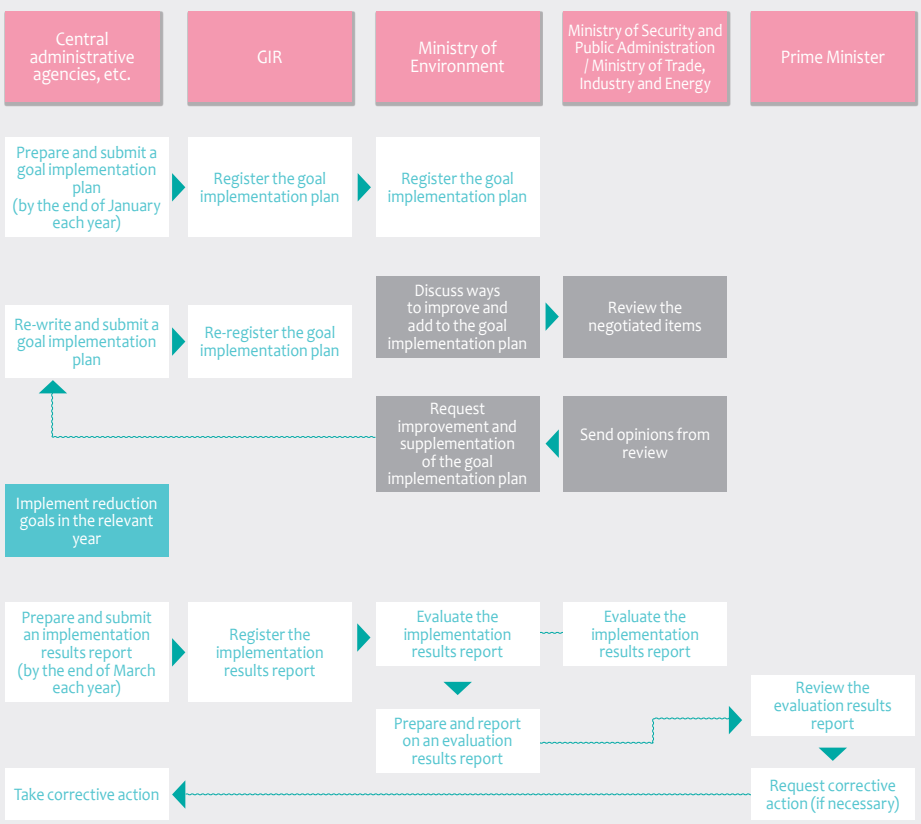


Greenhouse Gas Target Management System in the Public Sector

Central administrative agencies, local governments, public institutions, and other parts of the public sector are also subject to the greenhouse gas target management system in addition to industrial sectors. The aim is to encourage private sector participation to reach national greenhouse gas reduction goals based on public sector participation and leadership. The public sector is aiming for a reduction of at least 20% of the baseline emission level (annual average emissions for 2007 to 2009) by 2015. Reduction goals for 2016 onwards will be adjusted appropriately after reviewing the BAU and reduction goals for each sector.

The target management system applies to 778 institutions as of 2013, including central administrative agencies, local governments, public institutions, regional public corporations, national and public universities, national university hospitals, and dental clinics. These institutions are required to carry out target management regarding the buildings and vehicles that they own or use. Some public institutions such as military camps, police and fire vehicles, elementary and middle schools, welfare facilities for the elderly, children, and disabled persons, and small buildings with a floor area of less than 100m^2 were exempt for such purposes as national defense, public order, and protection of the right to learn.

Fig. 1-4 Operation of the Greenhouse Gas and Energy Target Management System in the Public Sector



The Ministry of Environment subsidizes the Green Rooftop Project to support greenhouse gas reduction activities by local governments. It also offers on-site reduction technology diagnosis and customized consultation to suit the circumstances of each institution by operating a "Public Greenhouse Gas Reduction Technical Support Team" (since 2012) to manage reduction and provide greater support for vulnerable institutions. It is making a variety of efforts to encourage reduction activities in public institutions by organizing the "Public Sector Greenhouse Gas Target Management Performance Report Presentation" to award institutions that have been exceptionally successful in reduction activities, recognize exemplary cases, and gather suggestions.

(3) Systematic Approach to Climate Change Adaptation

Climate change is a progressive phenomenon that affects all areas of society. Accordingly, Korea has been seeking climate change adaptation measures based on an integrated, systematic approach that covers all parts of society. With a growing awareness of the necessity and urgency of such measures, specific political efforts are being made, such as by formulating national plans and establishing support organizations.

Korea formulated four versions of the "Comprehensive Plan on Climate Change Adaptation" starting in 1999. The first (1999-2001) and second (2002-2005) comprehensive plans only covered climate change mitigation, but the third (2005-2007) comprehensive plan began to include climate change adaptation.

In December 2008, the "National Comprehensive Plan on Climate Change Adaptation (2009-2030)" was formulated through joint efforts by 13 government ministries, resulting in an integrated climate change adaptation plan for the whole country. The "National Strategy for Green Growth and Five-year Plan," through which the Presidential Committee on Green Growth was announced in July 2009, included "reinforced climate change adaptation capacity" as one of the 10 major national policy tasks, and the Korean Adaptation Center for Climate Change (KACCC) was founded in the same month (July 2009) for the purpose of carrying out strategic

research and providing policy support regarding national climate change adaptation. The KACCC helps to formulate government adaptation responses to reinforce national adaptation capacity. It analyzes impacts of extreme meteorological phenomena, performs vulnerability assessments, and analyzes the extent of damages to provide policy decision makers with the necessary climate change information. It makes efforts to establish partnerships among the various sectors and ministries associated with climate change adaptation. In terms of international cooperation, it held an international symposium to help countries share outstanding adaptation policies and tools and provided climate change adaptation training for developing ASEAN countries.

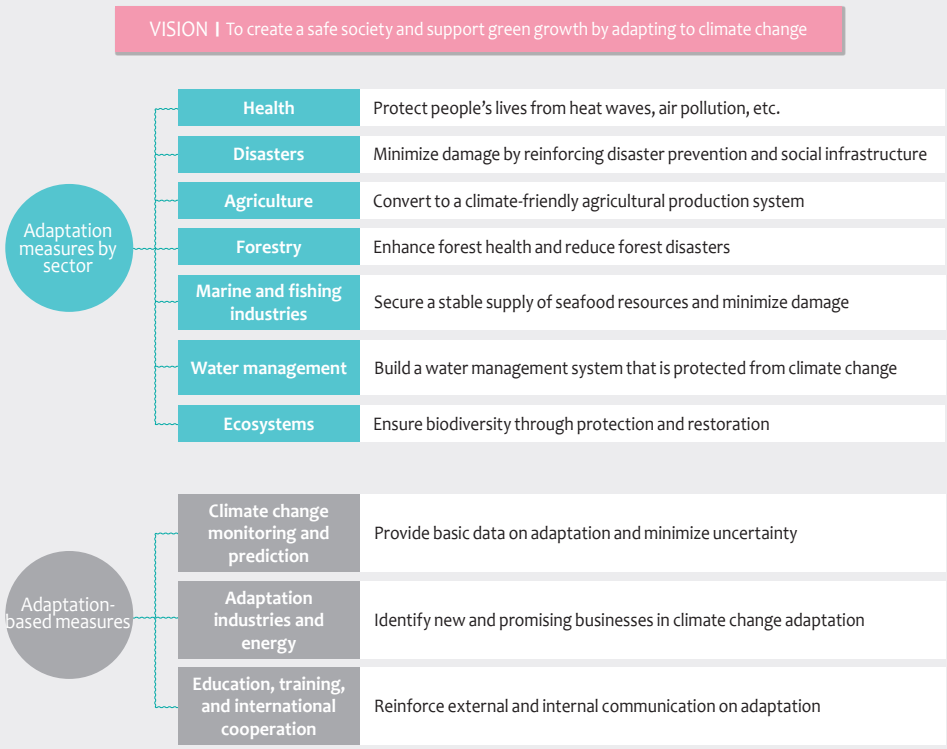
Formulation of the National Climate Change Adaptation Plan (2011-2015)

Enforced in April 2010, the "Framework Act on Low Carbon, Green Growth" prescribed government responsibilities to formulate a national adaptation plan, and accordingly, the National Climate Change Adaptation Plan (2011-2015) was established as Korea's first legally prescribed adaptation policy in October 2010 through joint efforts by 13 associated government ministries under the supervision of the Ministry of Environment.

This plan takes on the characteristics of a master plan; a detailed implementation plan will be formulated for each government ministry based on this plan and wide-area local governments will formulate their own detailed implementation plans that account for regional characteristics. The plan will also be formulated in a five-year rolling plan format in order to ensure flexible response to variations in climate change phenomena and to reflect advancements in climate change monitoring and prediction technologies.

The plan contains 87 tasks across the 10 sectors of health, disasters, agriculture, forestry, marine and fishing industries, water management, ecosystems, climate change monitoring and prediction, adaptation industries and energy, education and promotion, and international cooperation. It involves monitoring the climate environment on a yearly basis, carrying out implementation evaluations, and reflecting the results in the plan for the following year.

Fig. 1-5 National Climate Change Adaptation Plan (2011-2015): Vision and Measures by Sector



The Intergovernmental Panel on Climate Change (IPCC) 2011 adopted "representative concentration pathways" (RCP) as a new climate change scenario to be used for the Fifth Climate Change Assessment Report. The new scenario predicted climate change to occur at a faster rate than previously expected and anticipated that temperature and precipitation variation in Korea will be above the international average. Compared to the previous scenario, the increase in average temperature forecast for the Korean Peninsula in 2050 was 1.4°C higher at 3.2°C, and the increase in average precipitation was also 4.1% higher at 15.6%. The National Climate Change Adaptation Plan was revised according to this new scenario and announced in December 2012.

The basic direction of this adaptation plan is to carry out impact analyses and vulnerability assessments in each sector according to the new scenario, formulate measures to give priority to

vulnerable populations and regions that will be most directly damaged by climate change, and focus on identifying cooperative projects among sectors instead of measures for each sector.

First, customized measures for vulnerable populations were formulated to prevent health hazards in vulnerable classes such as the elderly, people with disabilities, and chronically ill patients who are most directly affected by climate change. An integrated information system on climate change adaptation is being built to formulate integrated policies and help private businesses to make use of climate change information. Accordingly, government ministries and institutions will mutually leverage each other's expertise, and there are plans to carry out long-term climate-change adaptation R&D to help formulate highly effective adaptation measures. In addition to enhancing the adaptive capacity of the public sector, measures will also be implemented to do the same for industries and other parts of the private sector such as by developing a climate change risk assessment system and preparing methods to introduce a public institution (public enterprise) adaptive capacity reporting system.

The Ministry of Environment is developing a geostationary environment monitoring satellite to be launched in 2018 to reinforce climate change monitoring and prediction. This satellite will constantly monitor climate change in East Asia and the emission and monitoring of air pollutants (nitrates, sulfates, ozone, aldehydes, aerosols, etc.). To develop the satellite, the Geostationary Environment Monitoring Satellite Team has been in operation in the National Institute of Environmental Research since June 2009, and the feasibility of the project was confirmed through a preliminary feasibility study in 2010.

In consideration of the fact that climate change adaptation requires extensive consensus and participation, the Ministry of Environment has formulated and is implementing strategies to promote climate change adaptation that experts, NGOs, university students, and various other groups can identify with. It is also building a "climate change adaptation information delivery hub" to provide experts and the public with information in an efficient manner. In order to achieve this, metadata is being created on climate change adaptation information dispersed throughout Korean government ministries, research institutions, international organizations (UNDP, OECD, UNEP, etc.), and other countries, and an information provision system is being constructed for the public and expert groups.

The Ministry of Environment will continue to maximize the effectiveness of climate change adaptation policies by extending them from the central government to regional and private organizations and giving priority to looking after regions and populations that are vulnerable to climate change.

Climate Change Adaptation Policies of Local Governments

Each local government is required to formulate and enforce a detailed implementation plan on climate change adaptation measures based on the National Climate Change Adaptation Plan, and the Minister of Environment reviews the performance each year. The Ministry of Environment and Korea Adaptation Center for Climate Change (KACCC) helps local governments to enhance their adaptive capacity to ensure they become the actual main entities of climate change adaptation.

In 2010, the Ministry of Environment and KACCC selected Seoul and Incheon as targets of a pilot project to formulate detailed implementation plans on local government adaptation measures. They predicted climate change in these regions, carried out climate change impact assessments in the pilot fields (health and disasters in Seoul, marine ecosystems and marine disasters in Incheon), and formulated detailed implementation plans based on this information. They went further to complete detailed implementation plans on adaptation measures for all wide-area local governments by 2012. From 2012 to 2013, they provided 35 selected basic local governments with assistance regarding the pilot project, as basic local governments will also be required to formulate detailed implementation plans on climate change adaptation starting in 2015.

Detailed implementation plans on local government adaptation measures assess current and future impacts of climate change, analyze the adaptive ability of each region to identify key vulnerabilities, and thereby establish annual implementation strategies to reduce damage caused by climate change. Adaptation measures require extensive experience and many professionals, as they must predict the impact of climate change on health, agriculture, ecosystems, and various other areas and prepare appropriate measures. Korea's local governments often have low levels of

financial independence, which limits active pursuits for climate change adaptation measures.

In this light, the Ministry of Environment distributes adaptation policy formulation manuals, operates an expert consultation team, has an adaptation policy inventory, creates regional vulnerability maps, develops vulnerability analysis tools, and offers a variety of other support programs in order to help local governments to formulate adaptation policies. Since 2008, it has also been selecting themed and joint projects for each local government to develop climate change response models that suit regional characteristics and to spread and promote outstanding examples, providing technical, financial, and administrative support.

Current Policy Focus

(1) Greenhouse Gas Reduction Road Map

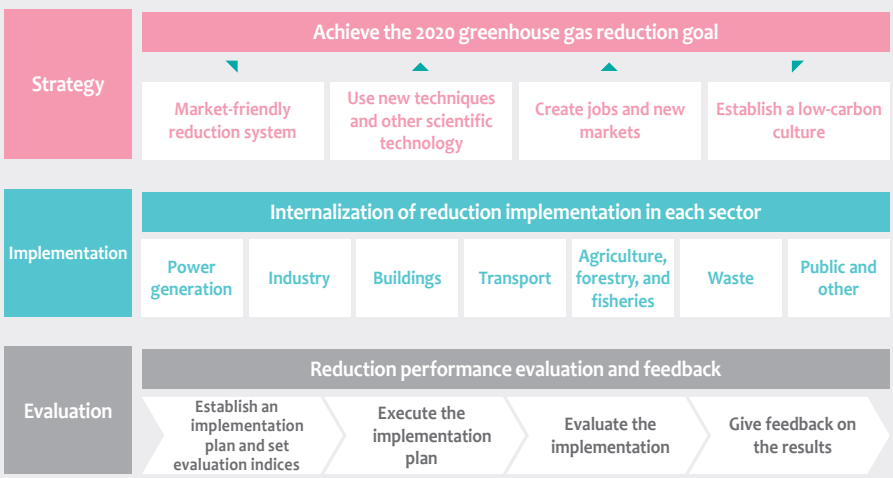
The "Road Map to Achieve National Greenhouse Gas Reduction Goals," which contains detailed implementation plans to achieve the national greenhouse gas reduction goals set in 2009, was announced in January 2014. This road map was jointly created by associated government ministries including the Ministry of Environment, Ministry of Trade, Industry and Energy, Ministry of Land, Infrastructure and Transport, Ministry of Science, ICT and Future Planning, Ministry of Agriculture, Food and Rural Affairs, and Ministry of Oceans and Fisheries. It contains implementation plans for each sector, implementation measures, and assessment methods from 2014 to 2020, the reduction goal year.

The final road map retained the BAU and reduction goals for each sector announced in July 2011. The BAU of greenhouse gas in the goal year of 2020 is 776 million tons of CO_2e, which will be reduced to 543 million CO_2e if the reduction goal of 30% is reached.

Reduction rates for the seven major sectors, in decreasing order, are 34.3% in transportation,

26.9% in buildings, 26.7% in power generation, 25.0% in public, 18.5% in industry, 12.3% in waste, and 5.2% in agriculture and fisheries. Although reduction rates in the non-industry sectors of transport and buildings may appear to be relatively high, industry and power generation make up more than 50% in terms of the reduction proportion (proportion of the reduction quantity of each sector relative to the total reduction quantity). Reduction goals for each sector are specified by year, and detailed implementation measures for each are also provided.

Fig. 1-6 National Greenhouse Gas Reduction Implementation Strategy and System



Greenhouse Gas Reduction Implementation Strategies

Four major implementation strategies were formulated to ensure reduction goals are achieved in an effective manner. The first strategy is to minimize the industrial burden by operating a market-friendly reduction system. Reduction costs will be reduced as much as possible through the emissions trading scheme and energy demand management, and free allocation of emission allowances will be continuously maintained for the petrochemical, cement manufacturing, and other sensitive industries that are highly export-dependent and have relatively high production

costs, thereby reducing industrial burden. Technical and financial support will also be provided to small and medium businesses to enhance their reduction capacity.

The second strategy is to use scientific technology and otherwise pursue reduction based on the creative economy. A R&D strategy road map will be created to boost climate change responsiveness in the field of Korean science and technology, and systematic technological development will be pursued accordingly. Furthermore, core technologies will be developed and demonstrated in the fields of CCS and non-CO_2 reduction technology, which has high development potential and investment efficiency, and technologies for reduction and energy efficiency in heavily-emitting businesses will be developed and distributed.

The third strategy is to create new jobs and new markets through reduction. This includes training greenhouse gas verifiers and other professional talent for managing greenhouse gases to ensure reliability of emission calculations and reports, and increasing the distribution of new renewable energy facilities, greenhouse gas reduction facilities, and high-efficiency equipment to nurture associated industries.

The fourth strategy is to carry out a daily reduction campaign with the public. This involves everyday campaigns to save cooling and heating energy, use eco-friendly transportation, and reduce standby power, and promoting the "Green Card" and "Carbon Points System" to provide economic incentives for low carbon consumption.

Implementation Plan by Sector

In the industry sector, an increase in heavily power-consuming facilities in the steel, oil refining, petrochemical, and other heavily energy-consuming industries has resulted in a rapidly increasing demand for power. The plan is to achieve a reduction of 81.3 million tons (18.5%) from the 2020 BAU of 439 million tons. Key reduction methods are to replace heavy oil in the oil refining, steel, and petrochemical industries with LNG, breaking down N_2O in petrochemicals and recovering SF_6 from electronic industries to reduce process emissions, and increasing cogeneration and waste heat recovery facilities.

The transport sector is characterized by a low number of fuel efficiency regulations for motor vehicles, high mileages, and inadequate distribution of biofuels. The plan is to achieve a reduction of 34.18 million tons (34.3%) from the 2020 BAU of 99.58 million tons. Key reduction methods are to reorganize the traffic system with a focus on public transportation, green (eco-friendly) cars, bicycles, walking, and other green traffic, green traffic policies such as increased public transportation, improved fuel efficiency, distribution of green cars, and other green technologies.

The buildings sector has shown a steady increase in greenhouse gas emissions due to people seeking a pleasant atmosphere and convenience in buildings. The plan is to achieve a reduction of 45.01 million tons (26.9%) from the 2020 BAU of 167.63 million tons. Key reduction measures are to enhance energy reduction performance and improve the efficiency of heating and cooling facilities.

Measures such as the public sector greenhouse gas target management system are in force in the public sector, but there appears to be room for additional reduction efforts. The plan is to achieve a reduction of 4.46 million tons (25.0%) from the 2020 BAU of 78.86 million tons. The key reduction measure is to improve the efficiency of heating and cooling facilities, lighting equipment, and office appliances.

The agriculture, forestry, and fisheries sector will manage sowing and livestock emission sources and improve the efficiency of energy use; the waste sector will reduce wastes, recycle, and convert waste into energy; and the power generation sector will improve the power supply mix and increase the distribution of new renewable energy as their key reduction measures.

An evaluation system has also been prepared for the reduction implementation plans of each sector. The implementing institution (government ministry concerned) of each sector will evaluate its own performance, followed by a final inspection by the Office for Government Policy Coordination, the supervising institution, with help from GIR. The results are used to provide feedback for improving the implementation plan.

(2) Greenhouse Gas Emissions Trading Scheme

Korea will implement the greenhouse gas emissions trading scheme starting in 2015. The "Act on the Allocation and Trading of Greenhouse Gas Emission Permits" was enacted in 2012 and basic research necessary for formulating a national emission permit allocation plan and detailed guideline was carried out in 2013. In January 2014, the Korea Exchange was designated as an emission permits exchange, and an exchange system has since been in construction. A mock exchange will be held among target businesses in October. The "National Emission Permit Allocation Plan" will be formulated in 2014; it will include a comprehensive operation plan for the first phase (2015 to 2017), covering such aspects as allocations by sector and allocation standards for each business. The Ministry of Environment was designated as the single competent authority to ensure efficient and consistent scheme operation.

The emissions trading scheme is a system in which the government allocates emission permits to greenhouse gas-emitting businesses, requiring them to keep their emissions within the allocated emission limit and allowing them to trade any post-reduction surplus or shortage of emission permits with other businesses. Firms with a high reduction capacity (low marginal abatement costs) can achieve greater reductions and sell surplus emission permits on the emission permits market, and those with a low reduction capacity (high marginal abatement costs) can cut costs by purchasing emission permits to address shortages instead of directly reducing emissions.

Businesses subject to allocation of emission permits are those with total annual greenhouse gas emissions of 125,000 tons of CO_2e or higher, and corresponding businesses of establishments of 25,000 tons of CO_2e or higher.

The total emissions allowance set for each country is allocated to each sector and emission permits are then allocated to individual establishments. Emission permits are allocated for free or by auction. Allocation will be 100% free during the first phase of the plan from 2015 to 2017. The proportion of auctioned allocation will be gradually increased to 3% in 2018 and at least 10% in 2021 to reduce the industrial burden in the early stages of implementation and facilitate the soft landing of the scheme. To account for international industrial competitiveness, however, 100%

free allocation will be available to industries with a high share of experts and energy-focused industries even after 2018.

An establishment that has been allocated with emission permits is required to carry out emission and reduction activities during the period concerned, measure its emissions, and report it to the government after verification by an external agency. The government evaluates the appropriateness and certifies the emission. Emission permits can be submitted as allocated or, in the event of a surplus or shortage, purchased from another establishment. They can also be borrowed from the following year. Offset emission permits (greenhouse gas reduction certified through an external project by a third party outside the establishment) can also be submitted. However, emission permits that are submitted in any way other than allocation are subject to size limits. Borrowing is restricted to 10% of the total emission permit, and offset emission permits are also limited to 10%. Overseas offsets are restricted to 50% of the submission of all offset emission permits. Surplus emission permits can be carried forward to and used in the following year.

A transaction account must be created in the registry in order to trade emission permits. They can be traded bilaterally, but the emission permits exchange provides a safe method. The government has prepared measures to stabilize the emission permits exchange market. It can supply the market with a reserve of emission permits in the event of a sudden price increase or other urgent circumstances and can also set minimum and maximum holding limits, borrowing limits, offset emission permit submission limits, and maximum and minimum prices for emission permits.

(3) Implementation of the Climate Change Adaptation Plan

Formulated in October 2010, the "National Climate Change Adaptation Plan" was revised and supplemented in December 2012 by applying climate change scenarios. At the end of 2013, detailed implementation plans reflecting the changed provisions were jointly formulated by associated ministries. A total of 65 tasks were planned across nine sectors for the period from 2013 to 2015 based on performance from 2011 to 2012.

<Table 1-1> Climate Change Adaptation Performance (2011-2012) and Plans (2013-2015) by Sector

(Unit: Hundreds of millions of won)

Sector	2011-12 Performance		2013-15 Plan	
	No. of tasks	Budget	No. of tasks	Budget
Health	5	370	5	1,901
Agriculture and fisheries	17	52,804	17	103,219
Water management	8	57,865	7	90,067
Disasters	6	22,207	5	45,878
Forests and ecosystems	14	14,105	14	27,664
National land and coasts	5	2,570	5	7,472
Industries	3	2,896	3	10,549
Infrastructure and international cooperation	2	148	2	448
Monitoring and prediction	7	513	7	3,310
Total	67	153,478	65	290,508

An evaluation method and a feedback system were established in January 2014 to evaluate the implementation performance of the National Climate Change Adaptation Plan. Effective fulfillment of climate change adaptation measures requires effective fulfillment of specific measures implemented by each government ministry and greater accountability, and this highlighted the need for an organized evaluation and feedback system that assesses implementation performance and accordingly addresses any issues and makes improvements to future plans. Although the Framework Act on Low Carbon, Green Growth had been providing the legal grounds requiring the Ministry of Environment, as the authority in charge of the National Climate Change Adaptation Plan, to review the performance of the adaptation plan of each government ministry, a specific and systematic method and procedure was now established.

The method involves evaluating the entire process, from formulation of the adaptation plan, implementation, performance achievement, and feedback efforts, and particularly focuses on faithful implementation and progress. Based on self-evaluations by each government ministry,

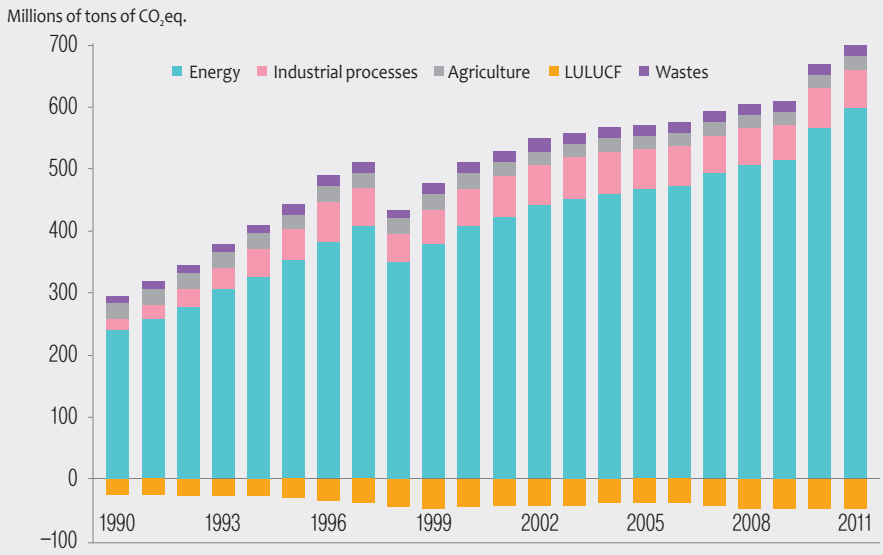
a comprehensive evaluation by professional agencies and an independent evaluation committee ensure reliability of the evaluation. Final results are publicly disclosed and communicated to government ministries in order to encourage them to actively apply the improvement measures identified in the evaluation results when formulating future plans.

Key Facts and Trends

(1) Greenhouse Gas Emissions

Korea's greenhouse gas emissions in 2011 totaled to 697.7 million tCO_2. This is a 4.5% increase from the previous year and can be explained by steel production and thermal power generation as the key factors. Emissions from the steel industry and thermal power generation increased by 14.1 million tons and 7.3 million tons, respectively, compared to the previous year, which is equivalent to 47.0% and 24.2% of the total increase in greenhouse gas emissions, respectively. Total greenhouse gas emissions have been continuously increasing since 1990, excluding a considerable decrease during the economic recession of 1998. Current emissions are a 136% increase compared to the emissions of 295.7 million tCO_2 in 1990.

Fig. 1-7 Greenhouse Gas Emission Trend (1990-2011)



Greenhouse gas emissions for 2011 consist of 89.4% CO_2, 4.2% CH_4, 2.7% SF_6, 2.1% N_2O, 1.2% HFCs, and 0.4% PFCs. The proportion of carbon dioxide emissions has increased from 85.7% in 1990 to 89.4% in 2011. There was a significant decrease in methane, from 10.1% in 1990 to 4.2% in 2011, due to a decrease in agricultural land and implementation of waste reduction measures.

Emissions by sector consist of 85.7% from energy, 9.1% from industrial processes, 3.2% from agriculture, and 2.1% from wastes. Emissions from fuel combustions make up 98.7% of the energy sector, which is equivalent to 86% of total national emissions, and has increased by 5.1% compared to the previous year. The fuel combustion sector consists of 44.7% from energy industries, 31.1% from manufacturing and construction, 14.4% from transport, and 9.9% from other areas. In terms of the increase in emissions by sector, the energy sector, industrial processes, and wastes showed an increase of 5.1%, 1.1%, and 2.5%, respectively, and the agricultural sector showed a decrease of 0.7%.

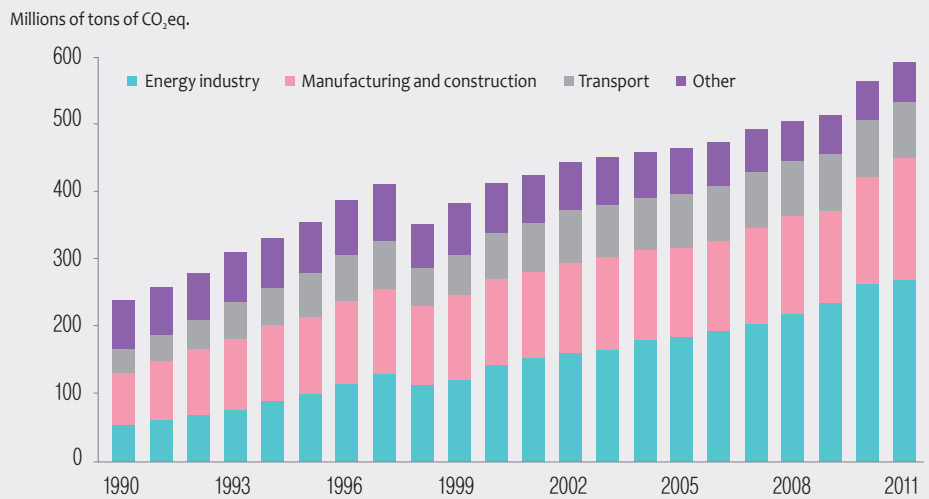
<Table 1-2> Emission Composition by Sector and Greenhouse Gas (1990-2011)

(Unit: Millions of tCO_2)

Year		'90	'95	'00	'05	'07	'08	'09	'10	'11
Total emissions		295.7	442.8	511.3	569.5	591.4	605.4	609.2	667.8	697.7
Increase (%)		-	8.3%	7.2%	0.6%	2.8%	2.4%	0.6%	9.6%	4.5%
Sector	Energy	241.0	353.5	410.8	467.5	494.4	508.8	515.1	568.9	597.9
	Industrial processes	20.2	49.4	58.5	64.5	60.8	60.6	57.8	62.6	63.4
	Agriculture	24.6	25.3	24.4	22.0	21.8	21.8	22.1	22.1	22.0
	Wastes	9.9	14.6	17.6	15.4	14.4	14.3	14.1	14.0	14.4
Greenhouse gas	CO_2	252.4	387.0	441.1	493.5	522.8	536.7	541.3	594.5	624.0
	CH_4	31.7	29.2	28.7	28.1	27.9	27.9	27.6	28.8	29.1
	N_2O	10.7	15.4	19.3	23.1	13.3	13.7	13.6	14.2	14.7
	HFCs	1.0	5.2	8.4	6.7	7.4	6.9	5.9	8.2	8.0
	PFCs	-	1.7	2.2	2.8	3.1	2.9	2.3	2.7	2.7
	SF_6	-	6.4	11.3	15.3	16.9	17.4	18.6	19.4	19.1

Note : Total emissions: Without accounting for absorption by LULUCF (Land-Use, Land Use Change and Forestry)

Fig. 1-8 Greenhouse Gas Emission Trend and Composition: the Fuel Combustion Sector (1990-2011)



(2) Climate Change Outlook

The world has experienced a temperature increase of 0.8°C over the past one hundred years due to increased greenhouse gases since the industrial revolution. Korea's temperature has increased by 1.8°C over the past one hundred years, which is two times the average global temperature rise, and the increase in water levels and ocean temperature is also three times the global average. The increasing trend has recently intensified; the average temperature of the Korean Peninsula increased by 1.2°C during the past 30 years (1981-2010, 0.41°C every 10 years) and this trend was observed during all seasons. The Korea Meteorological Administration published the "Korean Peninsula Climate Change Outlook Report" in December 2012. It applies representative concentration pathways (RCP), a new climate change scenario adopted by the IPCC (Intergovernmental Panel on Climate Change) in 2011. According to the report, future climate change on the Korean Peninsula will involve the warming trend from the past 30 years continuing steadily until 2100. If greenhouse gases are emitted at current levels (RCP 8.5 scenario), a temperature rise of 0.63°C/10 years is forecast until 2100, which is 1.6 times faster than the past 30 years. If greenhouse gas reduction policies are substantially fulfilled (RCP 4.5 scenario), the temperature is expected to rise at a rate of 0.33°C/10 years, which is somewhat lower than the trend on the Korean Peninsula from the past 30 years.

Both the RCP 4.5 and RCP 8.5 scenarios predicted that the average annual precipitation of the Korean Peninsula will exceed natural variation and show a clear increase after the mid-21st century. The RCP 4.5 scenario predicted increases of +6.2% in the early period of the 21st century, +10.5% in the middle period, and +16.0% in the late period compared to the current annual average precipitation. The increase in precipitation on the Korean Peninsula in the late 21st century is a large increase of about 3.9 times the global average. A substantial increase in precipitation is forecast even under the RCP 4.5 scenario, which is the case in which greenhouse gas reduction policies are substantially fulfilled, making it very necessary to prepare climate change adaptation measures.

Water levels around the Korean Peninsula were predicted to increase along all coasts on the east, west, and south. The RCP 4.5 scenario predicted that water levels will increase by 53cm on the south and west coasts and 74cm on the east coast in the late 21st century (2071-2100), which is comparable to the global water level increase of 70.6cm for the same period. According to the RCP 8.5 scenario, water levels will increase by 65cm on the south and west coasts and 99cm on the east coast in the late 21st century. The increase on the east coast is 10% higher than the global water level increase of 88.5cm for the same period.

The subtropical climate currently limited to the south coast of the Korean Peninsula is expected to gradually move north in the 21st century. The RCP 8.5 scenario predicts that most of South Korea, excluding Gangwon-do and northwest Gyeonggi-do, will be defined as subtropical regions.

Extreme weather such as heat waves and tropical nights was also expected to increase rapidly. Annual heat wave duration was predicted to increase from the current 7.3 days to 13.1 days in the late 21st century under RCP 4.5 and to 30.2 days in the late 21st century under RCP 8.5, resulting from an increase of 2.5 days every 10 years. The number of tropical nights was also expected to increase significantly from the current annual average on the Korean Peninsula of 2.8 days to 13.6 days in the late 21st century under RCP 4.5 and to 37.2 days under RCP 8.5. The number of days of torrential rain was expected to increase significantly under both RCP 4.5 and RCP 8.5 from the current 2.0 days to 2.8 days in the late 21st century, an increase of more than 30%.

If the entire world actively reduces greenhouse gases, the rate of temperature rise on the Korean Peninsula can be expected to decrease by half. Alleviation of climate change due to greenhouse gas reduction is predicted to be greater in terms of heat waves, tropical nights, and other extreme weather rather than temperature and precipitation.

<Table 1-3> Korean Peninsula Climate Change Outlook

Type	Current climate (1981-2010)	Early 21st century (2011-2040)		Mid-21st century (2041-2070)		Late 21st century (2071-2100)		Tendency (every 10 years)	
		RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Average temperature	11.0	12.4	12.5	13.4	14.4	14.0	16.7	0.33	0.63
Daily maximum temperature	16.6	17.9	18.1	18.9	19.9	19.4	22.2	0.31	0.62
Daily minimum temperature	6.2	7.7	7.7	8.6	9.7	9.3	12.0	0.34	0.64
Precipitation	1,162	1,234	1,201	1,284	1,342	1,348	1,366	20.66	22.74
Days of heat waves	7.3	8.8	10.2	11.1	15.2	13.1	30.2	0.64	2.54
Days of tropical nights	2.8	4.1	5.7	9.0	16.6	13.6	37.2	1.20	3.82
Days of torrential rain	2.0	2.3	2.1	2.6	2.8	2.7	2.8	0.08	0.09

02

Air

E C O R E A

is a compound of the prefix "ECO", which suggests an ecologically sound and comfortable environment, and the name the of the nation, "KOREA"

Main Policy Framework

(1) Management of Air Pollutant-emitting Facilities

(2) Fuel Regulations

(3) Automobile Exhaust Gas Management

(4) Urban Air Quality Management

Current Policy Focus

(1) Risk-oriented Air Quality Management

(2) Management of Pollution Sources in Everyday Surroundings

(3) Distribution of Eco-friendly Motor Vehicles

Key Facts and Trends

(1) Air Quality Standards and Air Pollution Level

(2) Number of Registered Motor Vehicles and Emission Quantity

Main Policy Framework

(1) Management of Air Pollutant-emitting Facilities

Emission Facility Management System

The "Clean Air Conservation Act," enacted in 1990, designates gaseous or granular materials that cause air pollution as "air pollutants" and requires them to be managed through monitoring and emission controls. There are 61 designated air pollutants, including carbon monoxide, ammonia, nitrates, and sulfates. Among these, substances that may be directly or indirectly harmful to human health or animal and plant growth and development in the event of long-term consumption or exposure, even at low concentrations, are designated and managed as "specified air pollutants." There are 35 types of specified air pollutants, including dioxins, benzene, chromium, and cadmium.

As of 2013, Korea has at least 48,000 air pollutant-emitting facilities, which are managed by the following key measures.

The first is a permit and reporting system regarding the installation and modification of emission facilities. Any facility that emits specified air pollutants or is installed in an air conservation special countermeasure area must obtain a permit, and other facilities must be reported.

The second is the progressive tightening of, and an advance notice system on, permissible emission levels. Permissible emission levels have been specified for 26 substances; they are being progressively tightened after accounting for the development rate of industrial technologies and reduction ability and advance notices are given to allow establishments to prepare ahead of time. The advance notice system began with an announcement in 1991 regarding tightened permissible emission levels applicable from 1995. Since then permissible emission levels have been progressively tightened in 1999, 2005, and 2010. The tightened permissible emission levels applicable from January 1, 2015 were announced on December 31, 2012.

Third, emission facilities are particularly strictly managed in heavily polluted regions. Even stricter permissible emission levels can be applied to industrial complexes and other areas of severe air pollution that have been designated as "air conservation special countermeasure areas." Such strict permissible emission levels are currently applicable to the Ulsan-Onsan Industrial Complex and Yeosu Industrial Complex. Moreover, permissible emission levels may be tightened by a municipal ordinance in designated "air quality control areas" and other regions where it is difficult to meet national or regional air quality standards.

Fourth, emission facilities are provided with continuous guidance and inspections to ensure the appropriate operation of emission facilities and prevention facilities. Failure to operate prevention facilities without legitimate circumstances or installation of bypass ducts to discharge pollutants without passing through a prevention facility is subject to prosecution and administrative disposition, such as suspension of operation.

Fifth, emission of pollutants in excess of permissible emission levels is addressed by an improvement mandate and emission charges. There are two types of emission charges: the "basic charge" is imposed according to the quantity and concentration of pollutants emitted within permissible emission levels, and the "excess charge" is imposed on emissions in excess of permissible emission levels. The basic charge is currently imposed on sulfur oxides and dust, and the excess charge is imposed on nine types of pollutants, including sulfur oxides, ammonia, and dusts. Nitrogen oxides are not subject to the basic charge, but its inclusion is under review.

Management of Major Industrial Emitters by SmokeStack TMS

The SmokeStack Tele-Monitoring System (TMS) constantly measures air pollutants emitted by major industrial emitters through remote automatic sensing equipment. Automatic sensors installed in smokestacks continuously measure seven types of air pollutants (dust, SO_2, NO_x, NH_3, HCl, HF, and CO) to produce data every 5 minutes and 30 minutes. The SmokeStack TMS was first installed in the special countermeasure area of the Ulsan-Onsan Industrial Complex, and as of the end of July 2014, it has been installed in 1,477 smokestacks of 569 major industrial emitters (Classes 1 to 3) nationwide. Construction of control centers to collect measurements began in

1998, and a total of four control centers have been completed in each region. The transmitted data is also used as administrative materials for emission charges and administrative dispositions.

Based on its stable operation over the years, the SmokeStack TMS has been the foundation of the Seoul Metropolitan Air Pollutant Emission-cap Management System from 2007. It is also expected to play a fundamental role in the emissions trading scheme to be introduced in the future.

Management of Fugitive Dust-producing Establishments

Article 43 of the Clean Air Conservation Act requires establishments that produce fugitive dusts, or dust emitted directly into the air without a specific outlet, to be reported to the local government. As of the end of 2013, a total of 37,131 fugitive dust-producing establishments have been reported, and 82.4% of these were construction businesses. Compared to other air pollutants, fugitive dusts are more noticeable by the public and give rise to many civil complaints. Accordingly, efforts are being made to reduce fugitive dusts in an effective manner through continuous guidance, inspections, and education.

Fugitive dust-producing establishments are required to install dust control facilities or take the necessary action to inhibit fugitive dust production, and any violation is subject to implementation mandates, fines, prosecution, and other administrative dispositions. Special inspections are carried out on fugitive dust-producing establishments throughout the country each year in spring when fugitive dusts become common due to active construction work and dry weather. In 2013, local governments carried out special inspections on a total of 12,589 establishments, identified 868 violating businesses, and took administrative action, including prosecution, fines, and improvement mandates. Any construction business that is fined due to failure to address fugitive dusts is penalized in bidding eligibility evaluations for government-funded construction projects to ensure strict fugitive dust management.

Management of Volatile Organic Compounds

Volatile organic compounds (VOCs) generally refer to hydrocarbons emitted in gas form into the air at ordinary temperatures and pressure, but there is yet to be an internationally agreed-upon definition or scope of target substances. Since 2009, Korea has designated 37 VOCs, including acetaldehyde, benzene, and gasoline, and facilities that emit these substances are managed under regulations. In addition to managing emission facilities, regarding VOC content limits in paint, "organic compounds (excluding carbonic acid and carbonates, etc.) having a minimum boiling point below 250°C at 1 atm" are subject to controls.

VOCs are emitted by a variety of sources, but the largest proportion comes from the use of organic solvents at 63.7% of total emissions, followed by production processes at 15.8%. VOC content limits have been established for paint to reduce emissions from the use of organic solvents. The limits applied only to the Seoul Metropolitan region during the early stages of introduction but they were extended to the rest of the country in 2013.

Gas stations emit VOCs such as gasoline vapors, and they were in high need of management as they are often located close to residential areas. To address this matter, prevention facilities were installed in gas stations situated in air conservation special countermeasure areas and air quality control areas. Installation was completed for Stage I (from manufacturing facilities to gas station storage facilities) by 2004 and for Stage II (from gas station storage facilities to filling vehicle fuel tanks) from 2007 to 2012.

(2) Fuel Regulations

Mandatory Use of Low Sulfur Fuel

This is a system to reduce sulfur dioxide concentrations in Seoul, Seoul Metropolitan area, and major cities by ensuring only fuel oil with low sulfur content can be supplied and used. Different sulfur content standards apply depending on the region or type of facility. The system began in

1981 by supplying diesel fuel and heavy fuel with a sulfur content of 0.4% or less and 1.6% or less, respectively. Since then content standards have been tightened and applicable regions have been increased.

Since 2012, only diesel fuel with a sulfur content of 0.1% or less must be supplied and used throughout the country. Heavy fuel must have a sulfur content of 0.3% or less in a total of 58 local governments, including Seoul and the six other special and metropolitan cities and Jejudo; 0.5% or less in the 104 *si* and *gun* areas, and 1.0% or less in other parts of the country.

Prohibition on the Use of Solid Fuels

Air pollution in the major cities became severe when coal use was recommended after the oil shock of the 1970s. Consequently, since 1985, this prohibition has banned the use of coal, coke, firewood, charcoal, and other solid fuel in regions that exceed or may exceed environmental standards. It is being applied to an increasing number of regions, and since 1999, the use of solid fuels has been banned in a total of 20 regions, which includes Seoul and the six metropolitan cities and 13 *si* areas of Gyeonggi-do.

Mandatory Use of Clean Fuels

This is a system to mandate the use of clean fuels (LNG, LPG, etc.) that emit almost no pollutants depending on the region in order to further reduce air pollution in large cities after the introduction of the systems to supply low sulfur fuel and prohibit the use of solid fuels. It began with compulsory replacement of fuels used in commercial boilers in Seoul Metropolitan City and by the Incheon Thermal Power Plant. It has been applied to an increasing number of regions and facilities, and since 2000, the use of clean fuels has become compulsory for commercial boilers above a certain size, multi-unit dwellings, regional heating and cooling facilities, and power generation facilities in a total of 37 regions, including the seven special and metropolitan cities.

(3) Automobile Exhaust Gas Management

The following policy measures are used to manage automobile exhaust gases.

Permissible Emission Levels for Manufactured Motor Vehicles

This system mandates the manufacture of vehicles with low pollutant emissions from the production stage to reduce environmental pollution caused by automobiles at the source. Permissible emission levels for manufactured motor vehicles have been tightened several times over the years, and current standards are equivalent to those of the United States and Europe. Ultra-low emission vehicle (ULEV) standards were applied to gasoline vehicles by adopting U.S. standards in 2006, and the fleet average system (FAS) of California was introduced and has been applied since 2009. Permissible emission levels equivalent to Euro-5 standards were applied to diesel vehicles from 2009 by adopting European standards, and Euro-6 will be applicable from 2014.

Project to Reduce Exhaust Gases from Vehicles in Operation

It has been pointed out that in order to improve Seoul Metropolitan air quality, it is essential to reduce the particulate matter emitted by diesel vehicles in operation. Accordingly, diesel vehicles registered in the Seoul Metropolitan region whose emissions warranty has expired are tested under stricter conditions than previous permissible emission levels for vehicles in operation. A vehicle that fails to satisfy the requirements must be equipped with a DPF, p-DPF, DOC, or other exhaust reducing device, remodeled with a low-pollution engine, or scrapped early.

After a pilot project in 2004 targeting vehicles owned by public institutions, a total of 770,000 decrepit diesel vehicles have been addressed to ensure low pollution, with 1.876 trillion won injected from the National Treasury from 2005 to 2013. In 2013, a total of 54,000 vehicles were addressed by investing 65.9 billion won.

(4) Urban Air Quality Management

1st Seoul Metropolitan Air Quality Improvement Plan (2005-2014)

With populations and industries in close proximity, Seoul Metropolitan regions are affected by severe air pollution, and there was high need for improvement. In this light, the Seoul Metropolitan Air Quality Improvement Planning Team was launched in 2002; the "Special Act on the Improvement of Air Quality in Seoul Metropolitan Area" was enacted in 2003 (enforced in 2005); the "1st Seoul Metropolitan Air Quality Control Master Plan (2005-2014)" was formulated in 2005; and implementation plans were established for each local government in 2006 to carry out the master plan. Various special measures regarding the Seoul Metropolitan area were implemented based on these plans. In 2013, the second master plan was formulated for 2015 to 2024.

The special act is also meaningful in that it was enacted through opinion gathering from various groups, debates, and social agreement. More than 190 debates took place through various committees, public hearings, seminars, and conferences, and issues were resolved by a joint task force consisting of associated government ministries, industrial groups, and civil organizations.

The Seoul Metropolitan Air Quality Control Master Plan aims to improve PM_{10} and nitrogen dioxide concentrations to the levels of Tokyo, Paris, and other major cities by reducing Seoul Metropolitan air pollutant emissions by half of 2001 figures by 2014.

<Table 2-1> Seoul Metropolitan Air Quality Improvement Goals (in Seoul)

Pollutant	2003	2007	2009	2011	2014
PM_{10} ($\mu g/m^3$)	69	60	55	50	40 (same as Tokyo)
Nitrogen dioxide (ppb)	38	35	32	28	22 (same as Paris)

Control measures to achieve these goals consist of automobile management, including the project to reduce exhaust gases from vehicles in operation, management of emission facilities,

including the total load management system for large establishments, and management of eco-friendly energy and cities. Projects to simultaneously reduce air pollutants and greenhouse gases will be carried out to improve air quality and make a positive contribution to climate change. Examples include distribution of low NO_x burners, equipping vehicles with idle stop and go systems, and expanding green spaces in urban regions.

The Seoul Metropolitan air pollutant load management has been enforced since January 2008. It allocates yearly emission allowances for nitrogen oxides and sulfur oxides to Class 1 and Class 2 large establishments, requiring them to keep their emissions within the allowances and allowing them to trade any surplus allocations.

Intensely Polluted Areas Outside Seoul Metropolitan Regions

▶ Designation of Special Countermeasure Areas

In accordance with Article 38 of the Framework Act on Environmental Policy, the Minister of Environment may designate any area affected or likely to be affected by considerable environmental pollution as a special contermeasure area and restrict land use and facility installation within this area. There are two designated air conservation special countermeasure areas, which are the National Industrial Complexes in Ulsan and Yeosu, densely packed with large emission facilities. Particularly strict permissible emission levels can be applied to these emission facilities.

▶ Designation of Air Quality Control Areas

Earlier, industry-focused regulations have had limitations in addressing air pollution in large cities. This is due to the increase in emissions from area sources and mobile sources caused by urbanization, an increase in vehicles, and use of chemical substances in addition to point sources such as industries. Secondary pollutants such as ozone are heavily influenced by weather and

geographical conditions. This necessitates comprehensive improvement measures that account for the environmental capacity of each region affected by air pollution and includes traffic and energy demand management.

Accordingly, the "Clean Air Conservation Act" was amended in December 1995 so that regions that have exceeded or may exceed environmental limits and are deemed to require urgent improvement of air quality can be designated as "air quality control areas." The Seoul Metropolitan area, Busan area, Daegu area, and Gwangyangman area were consequently designated as air quality control areas.[1] The *si* or *do* governors of the areas concerned are required to formulate a relevant execution plan, implement the plan after obtaining approval from the Minister of Environment, and report on implementation performance each year. Key control measures for air quality control areas are compulsory installation of VOC inhibition and prevention facilities, close inspection of exhaust gases from vehicles in operation, and introduction of low-pollution vehicles.

Current Policy Focus

(1) Risk-oriented Air Quality Management

The environmental policy paradigm has recently shifted to a focus on prevention, and there is growing demand for receptor-oriented environmental management policies that comprehensively account for the impact of harmful substances on public health and ecosystems. Accordingly, air quality management policies are also shifting towards a risk orientation and giving priority to protecting public health.

1) Among these, the Seoul metropolitan area is managed under the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area as of its enactment in 2003.

Improvement of the Air Pollutant Classification System

The Clean Air Conservation Act has classified pollutants into air pollutants and specific hazardous air pollutants, and it has been pointed out that classification standards are ambiguous and lack consistency. There were also substances that were omitted even though they must be managed as air pollutants due to their high emission volumes and large risks. Consequently, it became necessary to review the air pollutant classification system and reorganize it with a focus on risks.

Accordingly, the Clean Air Conservation Act was amended in 2012 to reclassify air pollutants into monitored hazardous air pollutants and specific hazardous air pollutants and to specify such classification standards as substance toxicity, impact on ecosystems, atmospheric emission volume, and pollution level. These classifications are required to be designated via an air pollutant evaluation committee.

A "monitored hazardous air pollutant" is an air pollutant that may be harmful to human health or animal and plant growth and development, and is deemed by committee evaluation to require continuous measurement, monitoring, or observation. A "specific hazardous air pollutant" is a monitored hazardous air pollutant that may be directly or indirectly harmful to human health or animal and plant growth and development in the event of long-term consumption or exposure, even at low concentrations, and is deemed by committee evaluation to require atmospheric emission control.

Indices for air pollutant evaluation were prepared in 2014. Committee evaluations will begin in 2014 and the results will be applied to law amendments starting from 2015.

<Table 2-2> Improvement of the Air Pollutant Classification System

	Current	Improved(Draft)
Criteria	N/A	◦ Judged and evaluated through **risk-oriented air pollutant evaluation standards** - **Evaluation indices have been prepared for the four areas** of air movement, toxicity and risks to the human body, atmospheric emission volume and pollution level, and domestic and international regulations
Procedure	N/A	◦ Evaluated by an air pollutant **evaluation committee** (National Institute of Environmental Research) → Enforcement rule amended (Ministry of Environment)
Pollutant classification (tentative)	◦ Air pollutants (61 types) ◦ Specific air pollutants (35 types)	◦ **Air pollutants (161 types)** ◦ Monitored hazardous air pollutants (97 types) ◦ Specific hazardous air pollutants (38 types)

<Table 2-3> Air Pollutant Evaluation Indices

	Air pollutant evaluation criteria			
	Air movement	Toxicity and risks to the human body	Atmospheric emission volume and pollution level	Level of domestic and international regulations
Evaluation details	◦ Atmospheric half-life ◦ Henry's constant ◦ Vapor pressure ◦ Atmospheric reactivity	◦ Inhalation carcinogenicity ◦ Inhalation unit risk ◦ Toxic hazard quotient ◦ Risk variation	◦ Atmospheric emission volume ◦ Air pollution level, etc. * Reviewed in conjunction with PRTR information	◦ Compare with domestic cases and advanced countries

2nd Seoul Metropolitan Air Quality Improvement Plan (2015-2024)

The first Seoul Metropolitan Air Quality Master Plan ends in 2014, and a second master plan (2015-2024) was formulated in December 2013 with a focus on reinforcing human health risks until 2024.

The second Seoul Metropolitan Air Quality Control Master Plan promotes air quality improvement with a focus on managing human health risks by adding ultrafine particles ($PM_{2.5}$) and ozone (O_3), which pose major risks to human health, to the list of managed substances. It aims to reduce the emission of each pollutant by 34 to 56% of BAU.

<Table 2-4> Pollutants Managed by the Seoul Metropolitan Air Quality Improvement Plan

1st plan	2nd plan
PM_{10}, NO_x, SO_x, VOCs	PM_{10}, $PM_{2.5}$, SO_x, NO_x, VOCs, O_3

The second master plan continues to implement key reduction measures from the first master plan, including distribution of eco-friendly vehicles, management of exhaust gases from vehicles in operation, and tightened permissible smokestack emission levels for establishments. It also aims to intensively manage high-risk pollutants distributed throughout everyday surroundings by providing support to replace home boilers with low NO_x boilers and prescribing control measures for VOC sources such as laundry shops, gas stations, painting facilities, printing offices, and everyday consumables.

Facility Management Standards on Fugitive Emissions of Hazardous Air Pollutants (HAPs)

Air pollution was previously managed with a focus on permissible emission levels for smokestacks, resulting in a lack of control measures for pollutants (fugitive dust emissions) emitted directly by processes and facilities other than smokestacks. A chemical emissions survey in 2010 found that approximately 61% of the 50,000 tons of annual emissions of 388 hazardous air pollutants (HAPs) were fugitive emissions from non-smokestack facilities and processes.

In order to reduce the fugitive emissions of air pollutants, facility management standards for HAP-emitting facilities were enacted when the Clean Air Conservation Act was amended in 2012, and they will be effective as of January 1, 2015. Permissible emission levels, reduction facility

installation and operation, leakage monitoring, and maintenance standards will be applicable to each industry according to the facility management standards, and it will be compulsory to appoint administrators and to keep and report on operation records.

Facility management standards are being prepared and enacted according to the annual plan for each industry. Establishments are being provided with guidance and training and relevant guidelines are being prepared before the standards come into force in 2015.

VOC Control System

Volatile organic compounds (VOCs) are carcinogenic and otherwise highly toxic precursors of ozone (O_3), which induces atmospheric photochemical smog. Average annual ozone concentrations in major cities have been increasing over the past 10 years. In Seoul, the average annual ozone concentration increased from 14ppb in 2003 to 22ppb in 2013, an increase of approximately 50% over 10 years.

To address such issues, the previous VOC control system is being reviewed from various angles to identify problems and prepare improvement measures. The first problem is that only 37 types of VOC substances and products have been designated as control targets, creating a blind spot in management. Second, although facility management standards are being operated to reduce VOCs, matters such as treatment efficiency have not been suggested, and it is difficult to check whether treatment has actually taken place. Third, there is a lack of control measures for VOCs in everyday surroundings, despite the fact that everyday consumables such as adhesives, insecticides, and cosmetics account for about 15% of VOC emissions and that laundry shops, printing offices, small painting facilities, and other small VOC sources are scattered around residential areas.

Accordingly, control target VOCs will be re-identified based on ozone-producing ability and a reorganization road map will be prepared on facility management standards for VOC-emitting establishments starting in 2014. Controls will also be reinforced by formulating control measures for everyday VOCs based on basic investigations of laundry facilities and other small emitters and everyday consumables and by preparing VOC content limits for everyday consumables.

Recovery measures for gasoline vapor at gas stations will also be strengthened. Ozone concentrations in medium to large cities with a population of 500,000 or more are exceeding environmental standards[2] at a continuously increasing frequency. Gasoline vapor from gas stations is not only one of the causes, but it also acts as an environmental pollution source located in close proximity to the everyday lives of the public. Accordingly, regions that are required to install gasoline vapor recovery facilities are being expanded from atmosphere preservation special countermeasure areas and air quality control areas to urban regions with a population of 500,000 or more.

(2) Management of Pollution Sources in Everyday Surroundings

Malodor Management

Unlike common air pollution, malodors are caused by a variety of substances, demonstrate complex interaction, and tend to occur and disappear locally and momentarily. This restricts methods that manage the entire country in a standardized manner, such as those for air pollution. In accordance with this perspective, the Malodor Prevention Act, newly enacted after being separated from the Clean Air Conservation Act, has been in force since February 2005. Changes were made according to this act such as managing malodors in regional units instead of the previous facility units and introducing more scientific methods of malodor measurement. The Act also allows the heads of local governments to designate malodor control areas and apply strict permissible emission levels to these areas. Consequently, 32 areas, including the Ulsan National Industrial Complex, have been designated and are managed as malodor control areas. In addition, a project has been in implementation since 2003 to create green space to act as a buffer between industrial complexes and residential areas.

2) Based on 8hr.

Despite these efforts, civil complaints against malodors have been continuously increasing at an average annual rate of 15% over the past several years. The main method of malodor control is for the heads of local governments to designate malodor control areas, but they are reluctant to do so due to concerns regarding decreased land value and local economic recession. Consequently, 86% of malodor-related civil complaints arise outside malodor control areas. While malodor complaints are increasing, malodor-emitting facilities exceeded permissible emission levels by only 1.4% during the past three years, highlighting the need to reexamine the efficiency of the management system for malodor-emitting facilities.

Key improvements to the malodor management system being made as of 2014 are as follows.

First, the scope of target emission facilities will be extended to ensure effective malodor management. Currently, only facilities within malodor control areas are required to declare installation, but this will be extended to all emission facilities regardless of region. Current conditions are that any facility against which complaints persist for one year and that exceeds emission limits three times, and this will be tightened to one complaint and one violation of limits.

Second, the classification system for air pollutant-emitting facilities was applied to establish the current definition of malodor-emitting facilities, but independent classification standards will be formulated and used based on factors such as malodor induction and persistence of civil complaints.

Third, malodor monitoring and measurement methods will be redesigned. This involves enhancing reliability by standardizing the malodor monitoring networks being autonomously operated by each local government, modifying standards for the measuring height of complex malodors, and reviewing the feasibility of introducing automatic malodor collectors.

Boiler NO_x Reduction

NO_2 concentrations in the Seoul Metropolitan area are continuously exceeding the environmental limit of 30ppb, and non-industrial sectors such as residential facilities accounted for 29% (as of 2010) of the NO_x generation in Seoul, pointing to a need for measures to reduce NO_x in non-industrial sectors.

Costs to replace medium to large industrial gas boilers with low NO_x burners have been subsidized since 2006. Permissible emission levels will be applicable to new large gas boilers of 2 tons or more starting from 2015, pointing to a need to change boiler NO_x reduction measures.

Installation costs for low NO_x boilers in homes will be subsidized to cover a total of 680,000 units in the Seoul Metropolitan area from 2015 to 2020. New manufacturing standards will be formulated for home boilers and low NO_x boiler installation will become compulsory when building any multi-unit dwelling of 20 households or more. In terms of industrial boilers, eligibility for the low NO_x burner replacement cost subsidy will be extended from 0.3 tons or more to 0.1 tons or more. The subsidy excludes new boilers of 2 tons or more, to which the new permissible emission levels will apply.

(3) Distribution of Eco-friendly Motor Vehicles

Consumer demand is heading towards low-pollution, high-efficiency, eco-friendly motor vehicles due to factors such as the burden of fuel costs and increased environmental awareness caused by recent climate change issues and high oil prices. Governments and industries around the world are making active investments and formulating support policies to dominate the eco-friendly motor vehicle market in advance.

Korea has also recognized the importance of developing and distributing eco-friendly motor vehicle technologies and is working towards increasing the distribution of electric vehicles, plug-in hybrid electric vehicles (PHEV), hybrid electric vehicles (HEV), fuel cell electric vehicles (FCEV), and other eco-friendly motor vehicles that offer outstanding fuel efficiency and satisfy low pollution standards. This matter is covered by the "Green Car Development Strategies and Projects" announced by the Presidential Committee on Green Growth in December 2010. Electric vehicles with no pollutant emissions have been in distribution since 2011 and FCEVs have been in trial distribution since 2013.

Electric Vehicles

The groundwork was established to distribute electric vehicles by setting electric vehicle and charging facility support standards based on the results of an electric vehicle verification project in 2011 and expert advice. First, national agencies, local governments, and public institutions, upon purchasing an electric vehicle, are provided with a subsidy to partially cover the price difference compared to an equivalent standard vehicle, and assistance is being provided to build a charging infrastructure. In addition, 10 cities, including Seoul and Jeju, were selected as leading EV (electric vehicle) cities. A charging infrastructure network will be established around these cities, which will be nurtured as hubs for full-scale electric vehicle distribution.

Fuel Cell Electric Vehicles

FCEVs operate by obtaining electricity by reacting hydrogen and oxygen fuels in a fuel cell inside the vehicle, then using the electricity produced to power the motor. Their only exhaust gases are unreacted oxygen and nitrogen and water vapor, making them truly "pollution free" vehicles.

From 2006 to 2013, Korea invested a total of 69 billion won to carry out a FCEV development and verification project and established a mass production system for FCEVs. To verify the technology and create initial demand, the Ministry of Environment provided the public sector with five FCEVs and one charging station on a trial basis in 2013, and since then, a total of 33 FCEVs have been distributed, including commercial distribution.

Distribution of Natural Gas Vehicles

Previous diesel-powered intra-city buses were regarded as a main cause of air pollution in large cities due to large volumes of pollutant emissions and high operating frequency. Consequently, they were changed to natural gas buses that have no exhaust fumes and whose emissions of other air pollutants are at least 65% lower than previous diesel-powered buses.

Korea completed the development of natural gas buses from 1991 to 1997, and after a trial

operation of a total of four intra-city buses in Incheon and other areas from July 1998, the absence of exhaust fumes and excellent passenger comfort were welcomed by the public. Natural gas buses were distributed in full scale from 2000 based on the results of the trial operation. By the end of 2013 the government had distributed 34,297 buses and 1,174 cleaning vehicles and installed 479 charging stations throughout urban areas of the country.

A mobile charging system was introduced in 2002 to distribute natural gas buses to regions where it is difficult to install natural gas charging stations or where urban gas pipes have not been installed. As of the end of December 2013, this system supplies fuel to about 226 buses.

Korea's natural gas vehicle-related industries achieved significant growth, with exports increasing from $30 million dollars in 2006 to $200 million dollars in 2012. The Ministry of Environment is actively involved in organizing the Global-Korea NGV Policy and Technology Cooperation Forum and other government assistance projects to support and nurture overseas export industries in developing Asian countries.

Eco-friendly Motor Vehicle Mid-term Distribution Strategies and Road Map

The Mid-term Strategies and Road Map for Eco-friendly Motor Vehicle Distribution (2014-2020) was recently formulated. This road map aims to distribute 2.2 million eco-friendly vehicles (10% of registered motor vehicles) by 2020, and specifies the following three strategies.

First, distribution strategies will be customized for each vehicle type, including hybrid vehicles, electric vehicles, hydrogen fuel cell vehicles, and CNG hybrid buses. Second, the market will be expanded by introducing a compulsory zero-emissions vehicle (ZEV) distribution scheme and otherwise improving associated systems. Third, the consumer culture will be improved through early establishment of public infrastructure for electric and hydrogen fuel cell vehicles and promoting the practice of car sharing.

Key Facts and Trends

(1) Air Quality Standards and Air Pollution Level

Korea has set air quality standards for key air pollutants as policy objectives on air quality control and has been making efforts to satisfy these standards. Air quality standards on sulfur dioxide gas (SO_2) were first introduced in February 1978, followed by standards on carbon monoxide, nitrogen dioxide, total suspended particles (TSP), ozone, and hydrocarbons in 1983, standards on lead in 1991, and standards on PM_{10} fine particles in 1995. Standards on benzene were newly introduced in 2010. Additional standards on $PM_{2.5}$ fine particles were enacted in March 2011 and will be applicable from 2015. Environmental standards have been progressively tightened for sulfur dioxide gas in 1995 and 2001, carbon monoxide in 1995, PM_{10} fine particles in 2001 and 2007, and nitrogen dioxide in 2007 to pursue higher air quality goals. The current air quality standards that have been applicable since 2011 are as presented in <Table 2-5>.

<Figure 2-1> shows the trend in national air pollution level over the past 15 years. Concentrations of SO_2, PM_{10}, and Pb are continuously decreasing, and this appears to be the outcome of the government's air quality management policies, including improvement of Seoul Metropolitan air quality (November 2005), increased supply of clean fuels such as low sulfur oil and LNG, supply of lead-free gasoline, and tighter emissions regulations. On the other hand, NO_2 and O_3 concentrations are yet to improve due to rising temperatures caused by climate change and increased number of vehicle registrations.

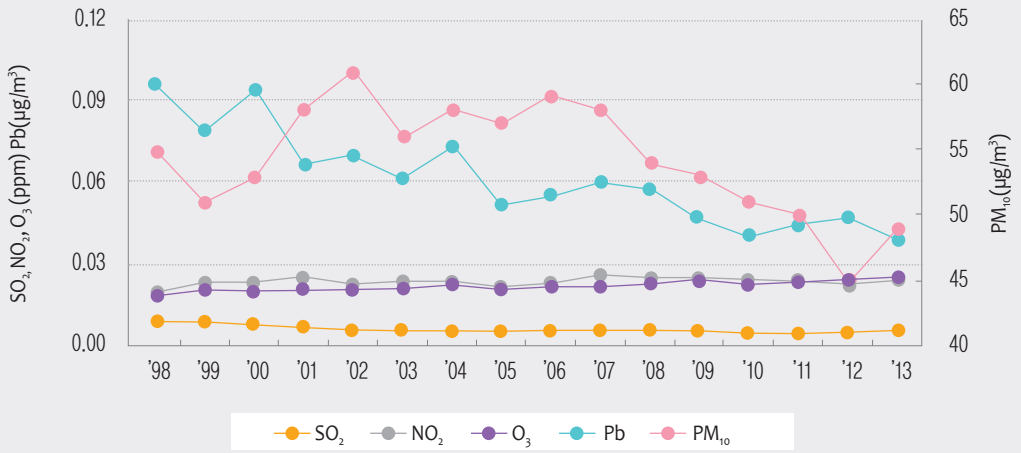
In terms of the national average air pollution level in 2013, the SO_2 concentration is 0.006ppm and has been maintained at less than one-third of the air quality standard of 0.02ppm for more than 10 years. At 0.024ppm, NO_2 has also been kept below the air quality standard of 0.03ppm strengthened in 2007. The atmospheric lead (Pb) concentration is 0.0391μg/m^3 (based on PM_{10})[3], which is only one-tenth of the air quality standard of 0.5μg/m^3. However, PM_{10}, at 49μg/m^3, is only barely below the air quality standard of 50μg/m^3.

3) Based on PM_{10}. Lead concentration was measured based on TSP until 2012, but PM_{10} standards are applied as of 2013.

<Table 2-5> Air Quality Standards

Item		Standard
Sulfur dioxide gas (SO_2)		◦ Annual average of not more than 0.02ppm ◦ 24-hour average of not more than 0.05ppm ◦ Hourly average of not more than 0.15ppm
Carbon monoxide (CO)		◦ 8-hour average of not more than 9ppm ◦ Hourly average of not more than 25ppm
Nitrogen dioxide (NO_2)		◦ Annual average of not more than 0.03ppm ◦ 24-hour average of not more than 0.06ppm ◦ Hourly average of not more than 0.1ppm
Fine particles	PM_{10}	◦ Annual average of not more than 50μg/m^3 ◦ 24-hour average of not more than 100μg/m^3
	$PM_{2.5}$	◦ Annual average of not more than 25μg/m^3 ◦ 24-hour average of not more than 50μg/m^3 (applicable from 2015)
Ozone (O_3)		◦ 8-hour average of not more than 0.06ppm ◦ Hourly average of not more than 0.1ppm
Lead (Pb)		◦ Annual average of not more than 0.5μg/m^3
Benzene		◦ Annual average of not more than 5μg/m^3

Fig. 2-1 National Air Pollution Level Trend

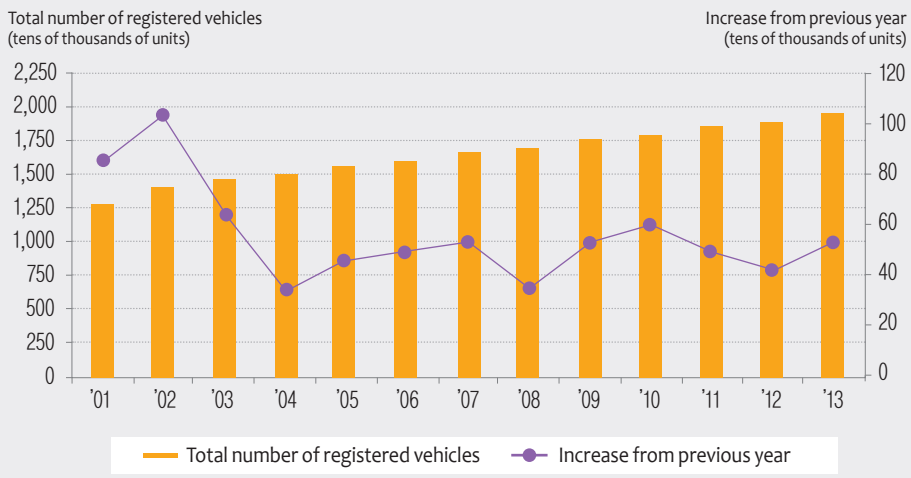


Note : Pb concentration is based on TSP until 2012 and based on PM_{10} from 2013

(2) Number of Registered Motor Vehicles and Emission Quantity

The rate of increase in the number of registered motor vehicles in Korea is regarded to be in the maturity stage, as it has remained in the 3% range for the past 10 years. The number of registered motor vehicles increased by more than 10 million between 1993 and 1996, but there was a major decrease in 1998 when the financial crisis struck. This was followed by a temporary increase, but the rate of increase significantly decreased after 2003 (excluding 2010) and has been maintained below 600,000 annually. There was a temporary but substantial decrease in the number of registered motor vehicles in 2008 due to the global economic recession, but it increased again in 2009 owing to tax benefits for decrepit vehicles and other factors.

Fig. 2-2 Motor Vehicle Registration Trend (2001~2013)



As of 2011, a total of 878,000 tons of air pollutants are emitted by on-road mobile sources, accounting for 24.8% of total air pollutant emissions nationwide. On-road mobile sources are accountable for 64.6% of CO, as well as 31.0% of NO_x, 12.8% of PM_{10}[4)], 7.9% of VOC, and 6.4% of TSP. On-road mobile emissions from the Seoul Metropolitan region amount to 361,000 tons, equivalent to 41.1% of national on-road mobile emissions. In terms of on-road mobile sources classified according to fuel type, diesel vehicles emit 386,000 tons (44.0%) and gasoline vehicles emit 364,000 tons (41.5%) of pollutants.

4) As of 2010.

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Abbreviation

Volume 1

ASEAN	Association of Southeast Asian Nations
BAU	business-as-usual
CCS	carbon capture and storage
CH_4	methane
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COP	Conference of the Parties
DOC	diesel oxidation catalyst
DPF	diesel particulate filter
EV	electric vehicle
FAS	fleet average system
FCEV	fuel cell electric vehicles
GHG	greenhouse gas
GIR	Greenhouse Gas Inventory and Research Center of Korea
HAP	hazardous air pollutant
HCl	hydrochloric acid
HEV	hybrid electric vehicles
HF	hydrogen fluoride
HFC	hydrofluorocarbons
ICT	information and communications technology
IPCC	Intergovernmental Panel on Climate Change
KACCC	Korean Adaptation Center for Climate Change
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MRV	measurement reporting and verification
N_2O	nitrous oxide
NAMA	Nationally Appropriate Mitigation Action
NGMS	National GHG Management System
NGO	non-governmental organization
NGV	natural gas vehicle
NH_3	ammonia
NIR	National Inventory Report
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
OECD	Organization for Economic Co-operation and Development
p-DPF	partial diesel particulate filter
PFC	perfluorocarbons
PHEV	plug-in hybrid electric vehicles
PM_{10}	particulate matter up to 10 micrometers in size
$PM_{2.5}$	particulate matter up to 2.5 micrometers in size
PRTR	Pollutant Release and Transfer Register
R&D	research and development
RCP	representative concentration pathways
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
tCO_2	tonnes of CO_2
TJ	Terajoule
TMS	tele-monitoring system
TSP	total suspended particles
ULEV	ultra-low emission vehicle
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOC	volatile organic compound
ZEV	zero-emissions vehicle