Korea's Green Growth

based on OECD Green Growth Indicators

STATISTICS KOREA

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Preface

The necessity for environmentally-friendly economic growth is emerging due to a deepening global environmental crisis and depletion of natural resources. The IPCC (Intergovernmental Panel on Climate Change) reports that the global average temperature has increased by 0.6℃ over the last century. Accordingly, this climate change arises as the biggest environmental problem that human beings have encountered. Climate change triggers a variety of meteorological disasters and results in ecosystem disturbance. And in doing so, threatens the survival of humankind. As a result, green growth as an alternative solution has become a newly emerging solution to help curb greenhouse gases and environmental pollution in the world.

The OECD (Organization for Economic Cooperation and Development) and its ministerial council meeting adopted a Green Growth Strategy in 2009. The organization announced a set of green growth indicators to statistically support the strategy in 2011. It also, proposed each member country prepare their own indicators to adapt to their situation by applying the OECD indicators relevant to their own country.

Statistics Korea selected and analyzed twenty-three green growth indicators applicable to Korea among the OECD-proposed indicators. This report includes the results.

It is expected that green growth indicators listed in this report will be applied to objectively and specifically evaluate the implementation of Korea's green growth policies. Also, this report will provide an opportunity to introduce the level of Korea's green growth both at home and abroad.

Hopefully, green growth indicators are further developed for environmentally-friendly and sustainable economic growth in the midst of attention and participation of the government, businesses, and citizens.

On behalf of Statistics Korea, I would like to extend my heart-felt thanks to the Presidential Committee on Green Growth and related authorities, which participated in this report documentation and review.

March 2012

Woo, Ki-Jong
Commissioner
Statistics Korea

Summary

As part of preparing the 2009 OECD Green Growth Strategy Synthesis Report, indicators were developed for the measurement and analysis of progress towards green growth. Green growth indicators were announced during the OECD 2011 Forum.

Statistics Korea selected and analyzed 23 green growth indicators applicable to Korea among the OECD-proposed green growth indicators. Through the result, it has intended to show the level of implementation of Korea's green growth since 2000.

Green growth indicators listed in this report have been applied as OECD proposed indicators. The details are based on the following four groups; Environmental and Resource Productivity, Natural Asset Base, Environmental Quality of Life, and Economic Opportunities & Policy Responses.

The level of Korea's green growth based on the above green growth indicators is summarized as follows.

First, the group of indicators on the environmental and resource productivity includes (i) CO2 emissions productivity, (ii) energy productivity, (iii) domestic material consumption intensity, etc. Most of them have been improved on a long-term perspective since 2000. It shows that the decoupling of environmental pressure from economic growth is under way. However, in recent years it leaves a little more to be desired.

Second, among the indicators from the natural asset base, water resources show an insufficient state as the area of forest and wooded land consistently decreases. Despite these decreases, timber stock and biological resources have steadily increased.

Third, the group of indicators on the environmental quality of life includes (i) the share of population connected to sewage treatment and with access to safe drinking water, (ii) urban green space, (iii) population exposure to urban air pollution, etc. Most of them have been showing improving trends since 2000.

Finally, the group of indicators on the economic opportunities and policy responses includes (i) R&D expenditure related to green growth, (ii) the share of green ODA, etc. They are rapidly improving with Korea's green growth policies started on full-scale in 2009.

In general, the OECD green growth indicators show that Korea is changing its direction towards a greener economy.

Contents

1

Concept of green growth and its measurement

OECD

1. Concept of green growth and its measurement

1.1 What is green growth?

1.2.1 Background

It is safe to say that the concept of green growth starts with the introduction of sustainable development. The 1972 book 『The Limits to Growth』 published by the Club of Rome reports that the world would face the limits to growth within a century. As a result, awareness of environmental pollution and attention towards sustainable development as a counter-measure began to spread across the world. (Young-geun Jung, 2001)

The concept of environmentally sound and sustainable development was first introduced in the 1980 International Union for Conservation of Nature. The 1987 Brundtland Report defined that sustainable development would mean development, which would meet the needs of the present without compromising the ability of future generations to meet their own needs.(http://www.un-documents.net/ocf-02.htm)

Also, the Rio Declaration was announced in the 1992 UN Environment and Development Conference. It specified that environmental protection and economic growth should not be separated in the process of sustainable development.

The world summit on sustainable development, so-called Rio+10, held in Johannesburg, South Africa, 2002, evaluated achievements of Agenda 21 and discussed future goals and specific action plans. The concept of sustainable development, which has been discussed for a long time, consisted of the three interconnected systems: environmental sustainability, social sustainability, and economic sustainability.

However, there are some criticisms that the concept of sustainable development would be too simple and abstract. (Peter Bartelmus, 1999) For that reason, the new concept of green growth, which would be more specific and applicable to both developing and developed countries, was newly introduced.

1.2.2 Concept of green growth

The term 'Green Growth' was first stated in the 2000 Economist. After that, it began to be seriously discussed in the international community beginning in the fifth Ministerial Conference on Environment and Development in Asia and the Pacific, 2005, sponsored by the UN ESCAP. Green growth, defined by UN ESCAP, focused more on environmentally friendly growth instead of sustainable development. Also, the OECD defined green growth as environmentally friendly sustainable economic growth. (OECD, 2011)

Korea's Presidential Committee on Green Growth explains green growth as follows.

> "Green growth is designed to reduce greenhouse gases and environmental pollution. At the same time it is designed to maintain environmental preservation and economic growth. Industrial development and economic growth, which have been under way so far, caused side-effects such as energy depletion and environmental damages. However, green growth protects environment and makes new industries and jobs with clean energies such as solar, wind, tide/wave/ocean, hydro power and green technologies instead of fossil fuels like oil and coal. It becomes a new locomotive of national economic growth. The key to green growth pursues economic growth by minimizing the use of natural resources and environmental pollution so that it makes a virtuous cycle."
> (http://www.greengrowth.go.kr)

In conclusion, green growth supplements abstractness and extensiveness of sustainable development in terms of implementation of effective policies. Therefore, it is safe to understand that economic growth moves towards more environmentally -friendly patterns.

1.2 OECD green growth indicators

1.2.1 Background

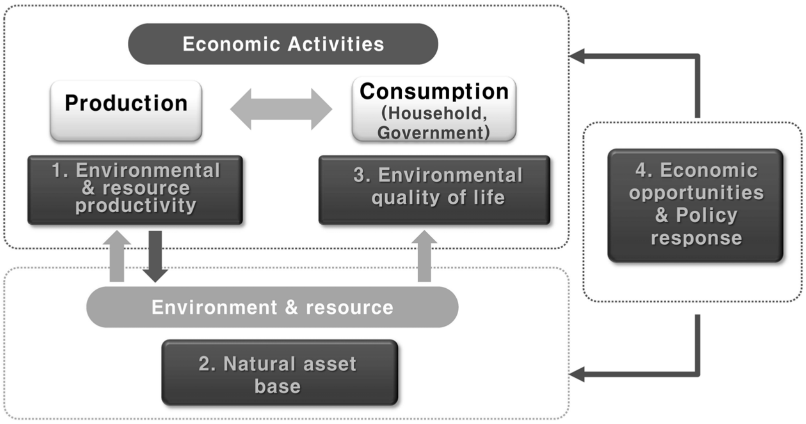
The Green Growth Strategy Synthesis Report was prepared in the OECD

Ministerial Council Meeting, 2009. The OECD Environment Directorate and Statistics Directorate developed internationally comparable indicators to measure the implementation of green growth. They proposed OECD green growth indicators along with the Green Growth Strategy Synthesis Report in the OECD 2011 Forum (OECD, 2011)

1.2.2 Set of indicators

The set of OECD green growth indicators consists of the following four groups in consideration of interaction between green growth components such as economy, environment and systems.

[Figure 1.2.2] OECD green growth indicators



A first group of indicators is Environmental and Resource Productivity, representing Production/Consumption-based Emissions Productivity, Energy Productivity, Material Productivity, Water Productivity, Multi-factor Productivity Reflecting-Environmental Services.

A second group of indicators is Natural Asset Base, representing Water Resources, Forest Resources, Fish Resources, Mineral Resources, Land Resources, Soil Resources, Wildlife Resources, etc.

A third group of indicators is Environmental Quality of Life, representing Environmentally Induced Health Problems and Related Costs, Population Living in Areas exposed to Natural Risks or Industrial Risks, Assess to Sewage Treatment and Sanitation.

A fourth group of indicators is Economic Opportunities and Policy Responses, representing Green R&D, Patents of Importance to Green Growth, Environment-related Innovation in all Sectors, Production of Environmental Goods and Services, Financial Flows of Importance to Green Growth, Environmentally Related Taxes, Energy Taxes and End-Use Prices, Environmental Expenditures and Training and Skill Development.

1.3 Selection of indicators and analyzing methods

1.3.1 Selection of indicators

Finally, 23 indicators were selected among the OECD-proposed green growth indicators, in consideration of Korea's characteristics and data availability. Those indicators were developed with appropriate statistical data, which fit into definition and purpose as the OECD proposed.

1.3.2 Analyzing methods

Most statistical data for each indicator were generated from statistics officially announced by Statistics Korea and the Ministry of Environment, etc. However, some of the statistical data were developed with unofficial statistics or administrative information provided by policy authorities and research institutes.

The period to analyse indicators was from 2000 to 2010; however some of the data were developed in a relatively short period of time due to limits of data availability.

Analyzing methods including time series analysis, defining indicators, positive trend direction, policy implication, or future forecast, were separately applied on a required basis.

1.4 Overview of Korea's green growth

Policy response indicators, including Government R&D expenditure of importance to green growth, the share of green ODA, share of GDP dedicated to environmental protection expenditures, etc., are rapidly improving with Korea's green growth policies started on full-scale in 2009.

Indicators of environmental and resource productivity, such as CO_2 emissions productivity, energy productivity and domestic material consumption intensity have been improved on a long-term perspective. It shows that the decoupling of environmental pressure from economic growth is under way. However, in recent years they leave a little more to be desired.

Among indicators on the natural asset base, water resources show insufficient state and the area of forest and wooded land consistently decreases. However, timber stock and biological resources have steadily increased.

Most of indicators on the environmental quality of life, including the share of population connected to sewage treatment and with access to safe drinking water, urban green space per capita and population exposure to urban air pollution have been showing improving trends.

〈Table 1.4〉 Green growth indicators

1. Environmental & Resource Productivity

Subject	Indicators	Trend
Emission	GDP/GHG emission	Improving, but stagnant in 2009
Energy	GDP/Primary energy consumption	Improving, but stagnant in 2009-2010
	Share of Renewable energy	Improving, but short of target rate
Material	DMC/GDP	Improving
	Municipal waste per capita	Insufficient but improved in 2009
	Chemical fertilizer/arable land	Improving; improved greatly post-2008
Water	Municipal water per capita	Improving but stagnant in 2010

2. Natural asset base

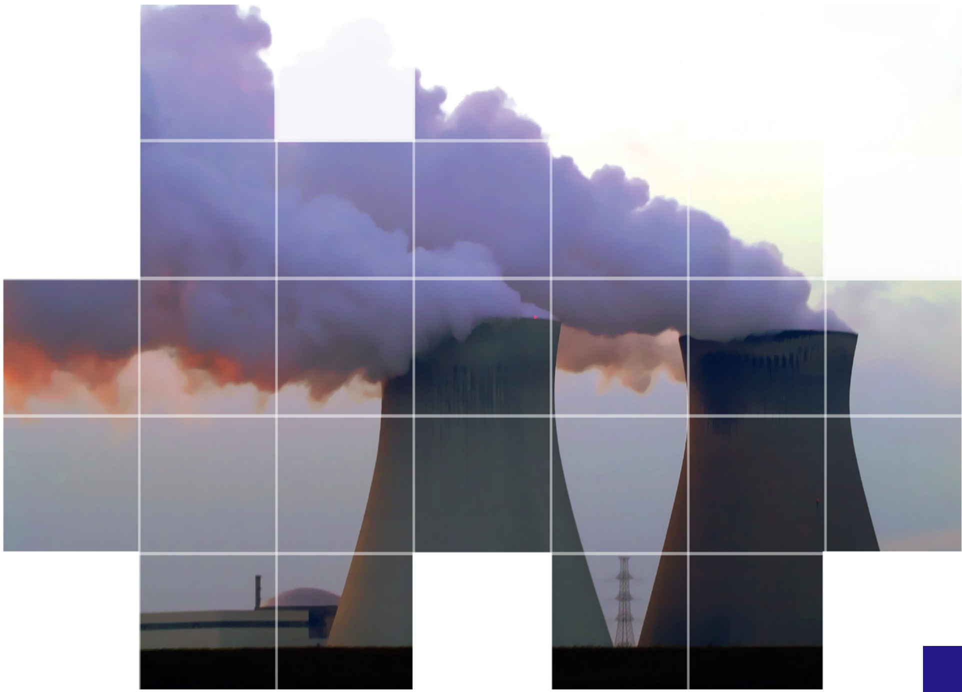
Subject	Indicators	Trend
Water	Rainfall per capita	Stagnant
Forest	Area of forest	Decreasing
	Timber stock	Increasing
Biodiversity	Share of threatened wildlife	Improving
Fish	Share of aquaculture	Increasing

3. Environmental quality of life

Subject	Indicators	Trend
Environmentally induced health problem	Population exposure to urban air pollution	Improving; improved greatly post-2008
	Urban green space per capita	Improving
Access to sewage treatment & drinking water	Population connected to sewage treatment	Improving
	Population with access to safe drinking water	Improving

4. Policy response & Economic opportunities

Subject	Indicators	Trend
Green R&D	Government green R&D expenditure	Increasing; increased greatly post-2008
Green technology	International patent applications	Increasing
Environment al industry	Environmental sector employment	Was decreasing, but began increasing since 2008
Green finance	Share of Green ODA	Increasing
Environmentally related tax & recovery cost	Share of environmentally related tax	Was decreasing, but increased in 2010
	Environmental protection expenditure	Increasing



2

Indicators of environmental and resource productivity

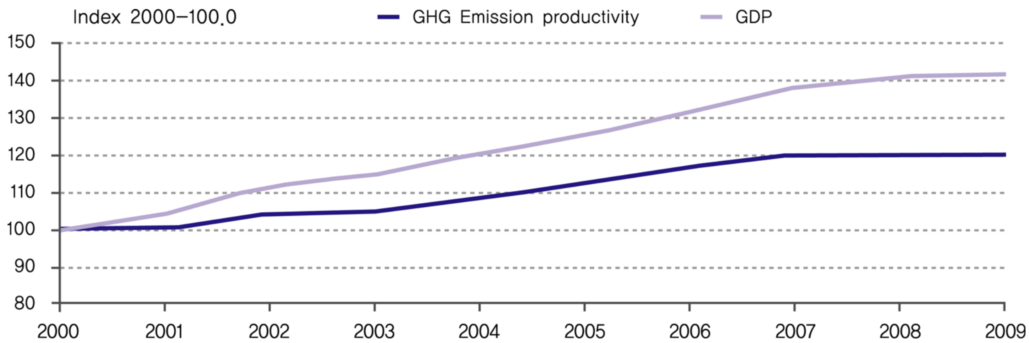
OECD

2. Indicators of environmental and resource productivity

2.1 Greenhouse gas emissions productivity

Korea's greenhouse gas emissions productivity was 1,352,000KRW/kgCO_2 in 2000 and 1,616,000KRW/kgCO_2. in 2009. The GHG emissions productivity increased by 19.5% from 2000 to 2009. At the same time, GHG emissions productivity of 2009 was reduced slightly compared to that of 2008. It was assumed that energy-intensive business sectors increased and air-conditioning demands escalated due to a series of cold and heat waves.

[Figure2.1] GHG emissions productivity



Source : Greenhouse Gas Inventory & Research Center of Korea, Third National Communication under UNFCCC

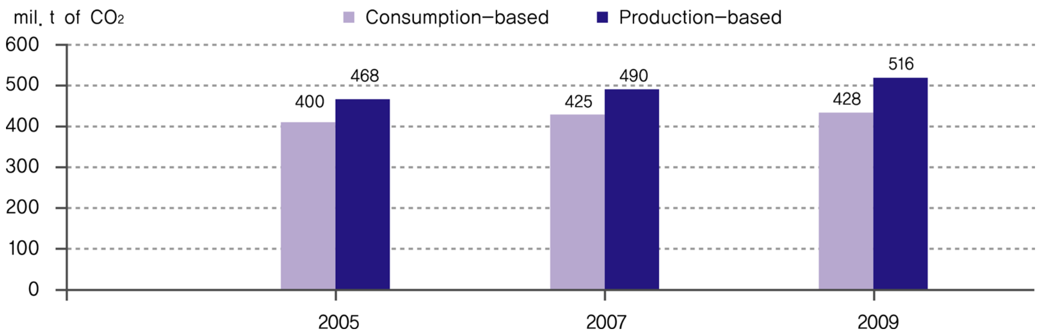
GHG emissions productivity is calculated by dividing real GDP with annual GHG emissions. GHG emissions productivity is a key indicator to manage efficiency of GHG emissions and to attain limitation targets for GHG emission. As GHG emissions productivity increases, decoupling of environmental pollution from economic growth expands. Therefore, it can be translated as a positive sign.

It is expected that when national policies to reduce GHG such as GHG Target Management Scheme and Emissions Trading Scheme, etc. are earnestly applied in Korea, GHG emissions compared to BAU (Business As Usual) will be reduced by 30% in 2020. Also, it is expected that GHG emissions productivity will increase consistently by doing so.

2.1.1 Consumption-based CO2 emissions productivity

Korea's consumption-based CO_2 emissions productivity increased by 8.0% from 2.468USDppp/kgCO_2 in 2005 to 2.665USDppp/kgCO_2 in 2009. At the same time, Korea's production-based CO_2 emissions productivity increased by 2.9% from 2.152 USDppp/kgCO_2 in 2005 to 2.213USDppp/kgCO_2 in 2009.

[Figure 2.1.1] Consumption-based and production-based CO_2 emissions



Source : International Energy Agency (IEA), CO_2 emissions from fuel combustion - 2011 Highlights
Note : Estimates Based on Source Data

Consumption-based CO_2 emissions productivity is calculated by dividing real GDP with annual CO_2 emissions from a total of domestic energy combustion. Consumption-based CO_2 emissions include CO_2 emissions caused by domestically -consumed products and embodied in imported products as well. CO_2 emissions embodied in imported products are calculated based on coefficients of CO_2 emissions of the same or similar kind of domestic products. Production -based CO_2 emissions productivity is calculated in consideration of CO_2 emissions caused by domestically-consumed products and embodied in exported products from Korea.

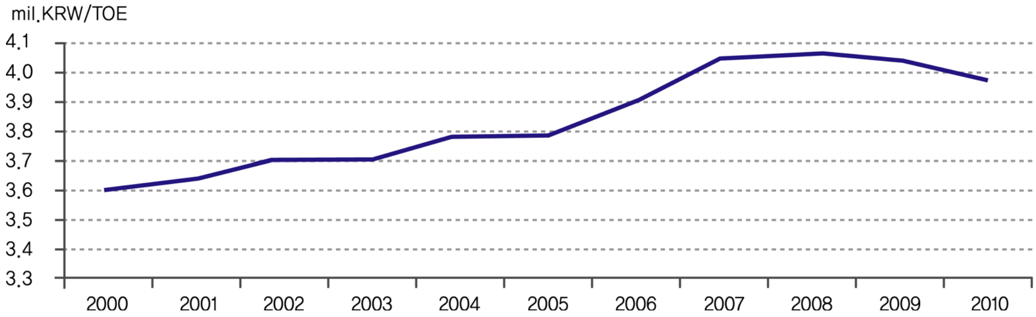
Consumption-based CO_2 emission productivity is an important indicator to manage CO_2 emission productivity in terms of consumption. If the indicator shows an increasing pattern, it can be translated as a positive sign.

It is expected that Korea's consumption-based CO_2 emissions productivity will positively progress with nationwide efforts aligning with results it has recently shown. Because the Korean government has been trying to expand FTA with major trading partners, it appears that Korea's increased trade volume will affect consumption /production-based CO_2 emissions productivity trends.

2.2 Energy efficiency

Korea's energy efficiency increased by 10.2% between 2000 and 2010. It was assumed that the energy efficiency of 2009 and 2010 was reduced slightly compared to that of the previous years due to increased energy-intensive business and abnormal climate.

[Figure 2.2] Energy efficiency



Source : Korea Energy Economics Institute, Yearbook of Energy Statistics

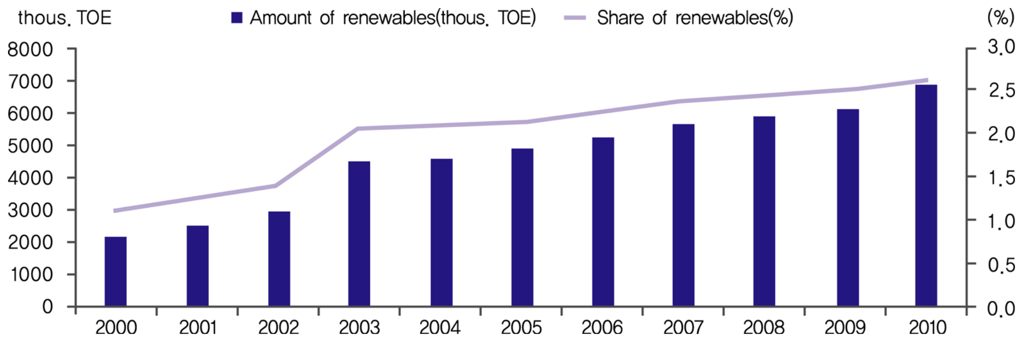
Energy efficiency is calculated by dividing real GDP with an annual of primary energy consumption. Energy productivity is an important indicator to evaluate energy efficiency inputted in national economic activities. If the indicator shows an increasing pattern, it can be translated as a positive sign.

In terms of supply and demand of energy, the Korean government faces many obstacles such as neo-resource nationalism toward fossil fuels, soaring international oil prices, global energy market changes, international cooperation to cope with climate change, enhanced international environmental regulations including climate change conventions, etc. The government diversifies its efforts to gain alternative energy resources and to enhance energy efficiency with the development and implementation of basic plans for energy-use rationalization and new and renewable energy, and promotional strategies for the green energy industry, etc.

2.3 Share of new and renewable energy

Korea's share of new and renewable energy has been consistently increasing. It was 2.61% of 2010 increased by 1.51% compared to 1.10% of 2000.

[Figure2.3] Share of renewable energy



Source : Korea Energy Management Corporation, New and renewable energy statistics

The share of new and renewable energy is calculated by dividing an annual of new and renewable energy supply with a total of energy supply in the same year. New and renewable energy consists of renewable energies such as solar heat, solar light, biomass, wind, hydro, geothermal, ocean, and waste-to-energy and new energies such as fuel cell, coal gasification, and hydrogen.

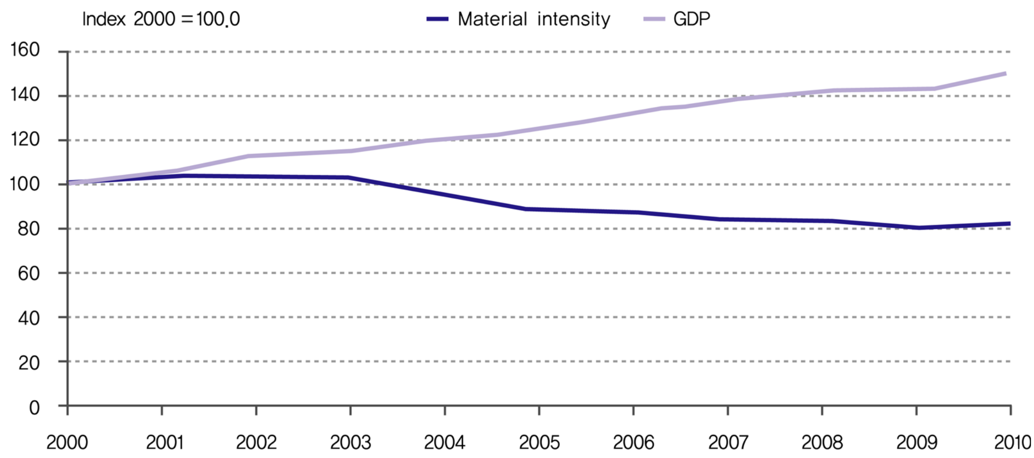
The share of new and renewable energy is a direct target indicator for the post-petroleum paradigm. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The share of new and renewable energy has been recently increasing. It is expected that the share will consistently increase with the continuous investment of government and businesses. In 2010, the share was 2.61% which was slightly below the 2.98% government target. This was attributed to location restrictions related to new and renewable energy industries as well as the financial limitations of the government.

2.4 Domestic material consumption intensity

Korea's domestic material consumption intensity decreased from 0.790kg /1,000KRW in 2000 to 0.647kg/1,000KRW in 2010. Therefore, domestic material consumption intensity decreased by 18.2% over the last ten years.

[Figure2.4] Domestic material consumption intensity



Source : Korea Environment Institute, Environment Accounts (data for 2008-2010 are estimates)

Domestic material consumption intensity is calculated by dividing an annual of domestic material consumption with real GDP. Domestic material consumption includes domestic abstractions and a total of consumed weights of materials composed of fossil fuel, industrial minerals, construction minerals and biomass as a result of net trading.

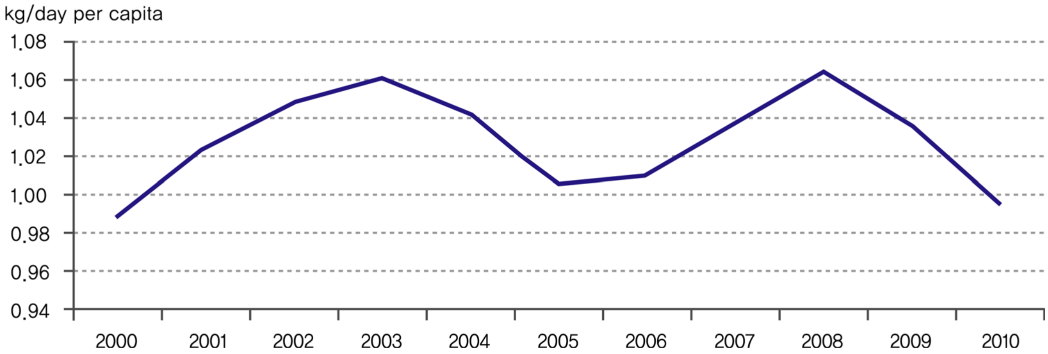
Domestic material consumption intensity is an important indicator to measure and manage efficiency of the use of natural resources. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

Effective material consumption with the use of new and renewable energy has a very significant meaning in the process of changing into green growth. Therefore, the Korean government makes its efforts to enhance the efficiency of material consumption by carrying out the basic plans for energy-use rationalization, etc. For that reason, it is expected that domestic material consumption intensity will decrease.

2.5 Municipal waste generation per capita

Korea's municipal waste generation per capita was 0.99kg/day/capita in 2000. After that, the number repeatedly moved up and down. It increased 1.06kg/day/capita in 2008. It began to decrease from 2009. It declined to 0.99kg/day/capita in 2010, which was almost equivalent level with 2000.

[Figure2.5] Municipal waste generation per capita



Source : Ministry of Environment, Nationwide Waste Generation and Treatment

Municipal waste generation per capita is calculated by dividing a daily average of waste generated in household and business with the total population. Municipal waste generation per capita is an indicator to estimate future waste generation and to establish waste control policies. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

Korea's municipal waste generation per capita has repeatedly moved up and down since 2000. The number is relatively lower than that of the OECD member countries. It is deemed that the volume-rate garbage disposal system started in 1995 has been implemented successfully. Also, in the event that the volume-rate food waste disposal system is expanded nationwide by 2012, it is expected that the food waste accounting for a large portion of municipal waste generation will decrease. Therefore, it is expected that municipal waste generation per capita will also decrease on a mid- and long-term basis.

2.6 Consumption of chemical fertilizers

Korea's consumption of chemical fertilizers was 382kg/ha in 2000. It decreased to 232kg/ha in 2010 a decrease of 39.3% compared to that of 2000.

[Figure2.6] Consumption of chemical fertilizers

Source : Korea Fertilizer Industry Association

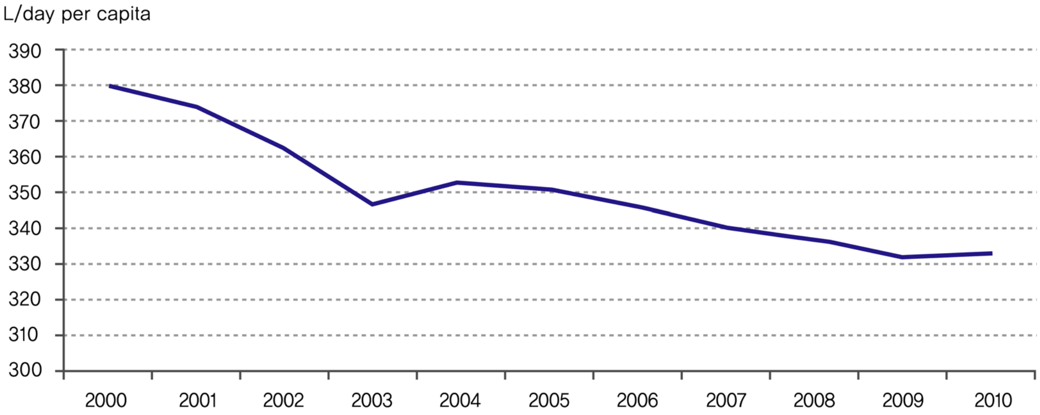
Consumption of chemical fertilizers is calculated by dividing the annual consumption of chemical fertilizers with the area of arable land. Consumption of chemical fertilizers is an important indicator to control consumption of chemical fertilizers causing soil and water pollution. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

Recently, consumption of chemical fertilizers has drastically decreased since the termination of chemical fertilizer subsidy and the expansion of organic fertilizer subsidy created in 2005. Also, customized-fertilizer support project based on soil testing has been under way since 2010. Therefore, it is expected that consumption of chemical fertilizers will consistently decrease.

2.7 Municipal water use per capita

Korea's municipal water use per capita was 380 l /day/capita in 2000. It was decreased to 333 l /day/capita in 2010. Therefore, it was decreased by 12.4% over the last ten years.

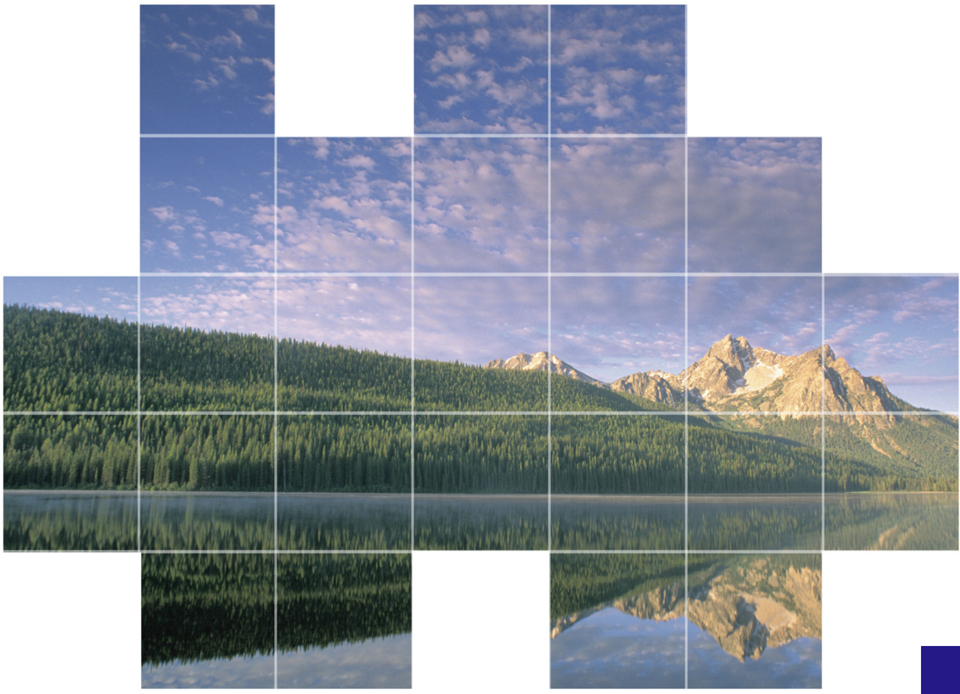
[Figure2.7] Municipal water use per capita



Source : Ministry of Environment, Drinking Water Supply Statistics

Municipal water use per capita is calculated by dividing the daily average of the annual water use in households and businesses with the total population with access to safe drinking water. Municipal water use per capita is an indicator to establish the scope of drinking water production, to secure financial resources for waterworks supplies, and to estimate the size of drinking water production facilities. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

Municipal water use per capita was 333 l /day/capita in 2010. It was similar to 332 l /day/capita in 2009. The trends in municipal water use per capita showed overall decrease. It was analyzed that water use and water leakage decreased by installing water saver devices and reusing waste water through water revenue raising projects.



3

Indicators of the natural asset base

3. Indicators of the natural asset base

3.1 Annual rainfall per capita

Annual rainfall per capita was 2,810㎥/capita in 2000. It repeatedly moved up and down without distinct trends. It was 3,069㎥/capita in 2010. Korea's annual rainfall per capita shows only 1/6 of the world average due to its high density of population. (Water Vision 2020)

[Figure 3.1] Annual rainfall per capita

Source : Korea Meteorological Administration, Surface Meteorological Statistics

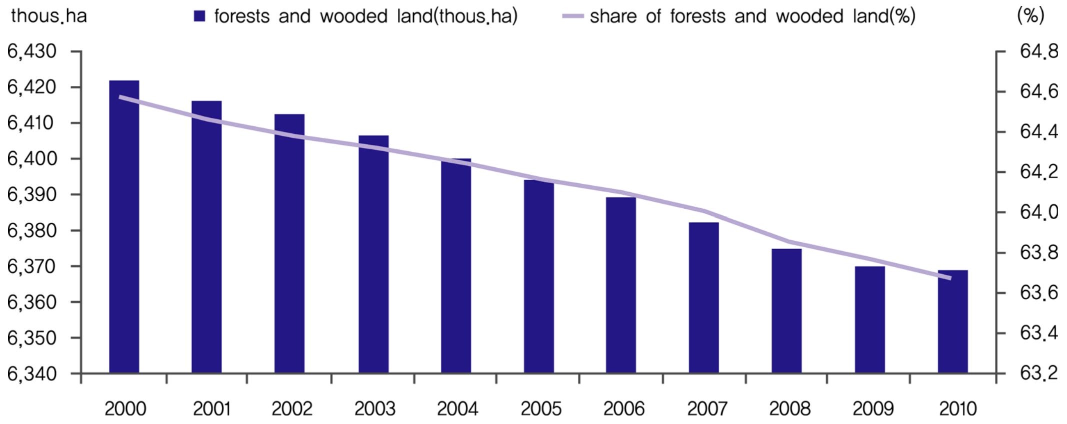
Annual rainfall per capita is calculated by dividing the total annual-rainfall with the total population where the total annual rainfall was calculated by multiplying the total national territory and the annual rainfall average. Annual rainfall per capita is an important indicator to develop water resources and to plan the use of water resources. If the indicator shows an increasing pattern, it can be translated as a positive sign.

Korea's annual rainfall per capita is much smaller than that of the world's annual rainfall per capita. The annual variation fluctuates extremely and rainfall is concentrated during summer season from June to September. It is very uncertain to forecast the annual rainfall for the future. To address this issue, the Korean government endeavours to gain a stable supply of water resources by carrying out the projects such as the four major rivers restoration, environmentally-friendly small- and mid-sized dam construction, and public groundwater development in preparation for uncertain situations.

3.2 Area of forests and wooded land

Korea's area of forests and wooded land was 64.6% in 2000. However, it has been declining by an annual average of 0.1% since 2000. Therefore, the area of forests and wooded land was 63.7% of 2010, which was decreased by 0.9% compared to that of 2000.

[Figure3.2] Area of forests and wooded land of Korean territory



Source : Korea Forestry Service, Statistical Yearbook of Forestry

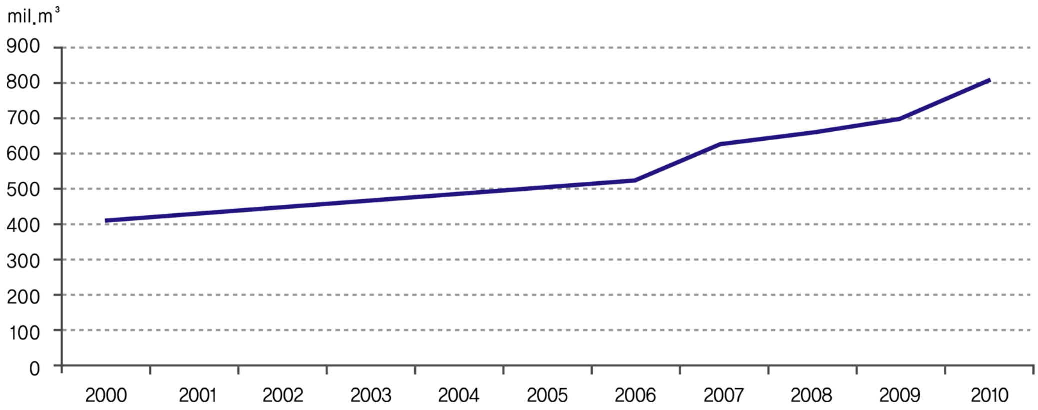
The area of forests and wooded land rate is calculated by dividing the area of forests and wooded land with the entire national territory. The area of forests and wooded land rate is an important indicator to manage forest resources and to effectively utilize the national territory. If the indicator shows an increasing pattern, it can be translated as a positive sign.

Korea's area of forests and wooded land rate was 63.7% in 2010. The rate was much higher level compared to that of OECD member countries. It is expected that the decrease of social and industrial infrastructure construction will gradually mitigate the reduction rate of the forest area and wood lands. The Korean government intends to rationally manage forests through reconciliation between development and conservation in accordance with the basic plans for forest management. Therefore, it is expected that the appropriate level of the area of forests and wooded land will remain stable by doing so.

3.3 Timber stocks

Korea's timber stocks continuously increased from 408 million ㎥ in 2000 to 800 million ㎥ in 2010. The number almost doubled over the last ten years.

[Figure3.3] Timber stocks



Source : Korea Forestry Service, Statistical Yearbook of Forestry

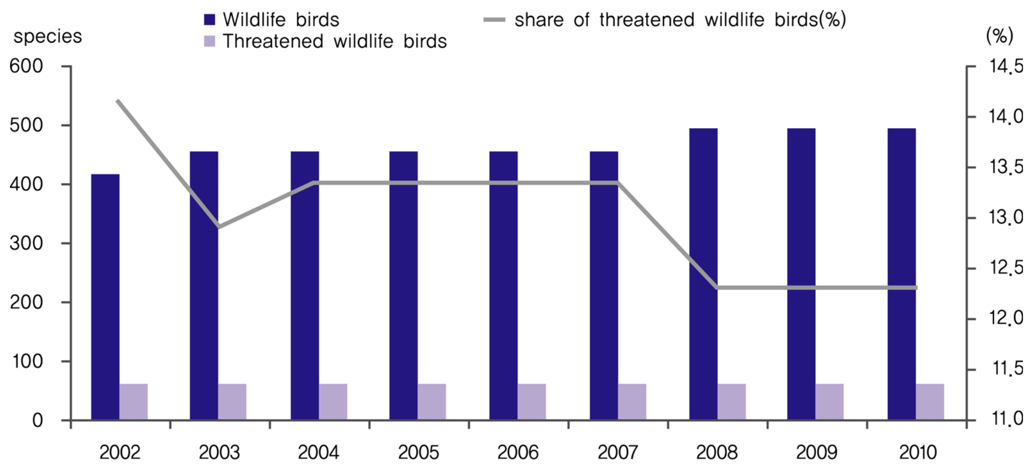
Timber stocks mean a total volume of woods in the forests and wooded land. Timber stocks are an important indicator to control carbon sink and eco-resources. If the timber stocks show an increasing pattern, it means the forest value appreciates socio-economically and environmentally.

The increase in timber stocks brings out carbon sink expansion, biodiversity, economic enhancement of timber and forest resources, relaxation, and improvements of quality of life through forest experiences. The Korean government consistently carries out forest tending projects to foster forest resources. Therefore, it is expected that the increase in timber stocks will continue in the future.

3.4 Share of threatened wildlife resources (birds)

Korea's share of threatened wildlife resources (birds) was 12.3% of 2010 decreased by 1.8% compared to 14.1% of 2000. The decrease in threatened wildlife resources (birds) was attributable to the increase of the total number of bird species. This increase resulted from the discovery of some migratory bird species in Korea. On the other hand, the number of threatened species (wildlife birds) in Korea was 61. It remained constant between 2005-2010.

[Figure3.4] Share of threatened wildlife resources (birds)



Source : Ministry of Environment, Statistical Yearbook of Environment

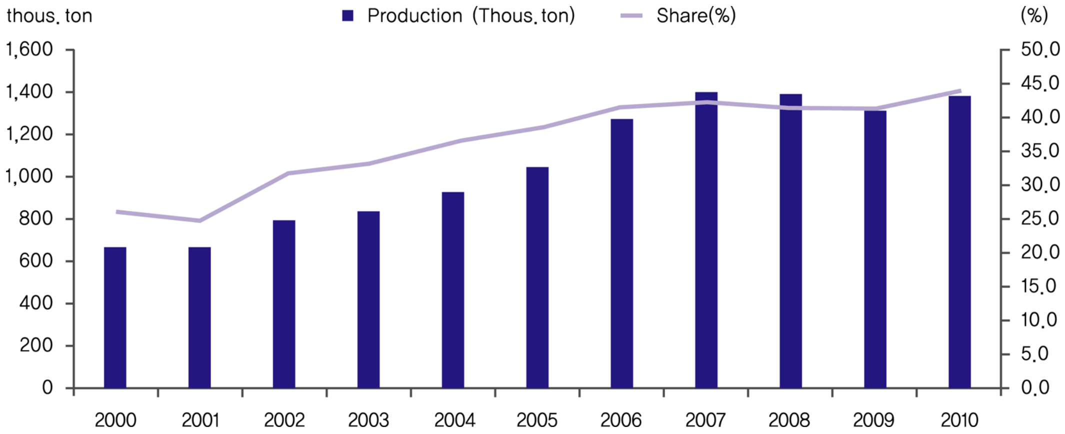
The share of threatened wildlife resources (birds) is calculated by dividing the number of threatened wildlife bird species with the total number of Korea's wildlife bird species. The share of threatened wildlife resources (birds) is an important indicator to preserve and manage biodiversity. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

The Korean government established a comprehensive plan for the restoration of threatened wild fauna and flora species in 2006. It plans to proactively implement projects for proliferation by stage and restoration of threatened wild fauna and flora species such as storks. It has ascertained the nationwide status of habitats and geographical distribution of threatened wildlife fauna and flora species to take protective measures for control-required areas each year since 2001. Korea plans to promote policies for the protection and management of threatened species and to recover and maintain the diversity and health of Korean peninsula's ecosystems.

3.5 Contribution of aquaculture to fish production

Korea's contribution of aquaculture to fish production was 43.8% of 2010 increased by 17.38% compared to 26.0% of 2000.

[Figure3.5] Contribution of aquaculture to fish production



Source : Statistics Korea, Survey on the Status of Fish Culture

The contribution of aquaculture to fish production is calculated by diving annual aquaculture production with the total fish production in the same year. The contribution of aquaculture to fish production is an important indicator to monitor fish resources for their use and preservation. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The Korean government proactively implements policies to grow the aquaculture industry such as support for strategic items for aquaculture, release of restrictions on the development of new aquaculture farms, and modernization of aquaculture facilities, etc. Therefore, it is expected that the contribution of aquaculture production to the total fish production will increase steadily. However, it is concerned that future growth of aquaculture will be impeded due to a decline in the number of fishing households, and rapid aging population in fishing villages.

4

Indicators of environmental quality of life

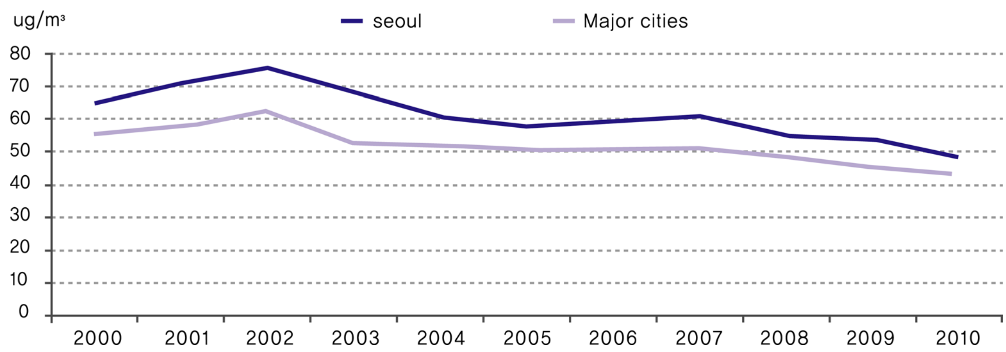
OECD

4. Indicators of environmental quality of life

4.1 Population exposure to urban air pollution (PM-10)

Population exposure to urban air pollution steadily decreased from 65㎍/㎥ in 2000 to 49㎍/㎥ in 2010. It is improved by 24.6% compared to that of 2000. Also, a weighted average value of air pollution in Korea's seven cities divided by population of each city decreased from 55㎍/㎥ in 2000 to 43㎍/㎥ in 2010. It was decreased by 21.8% over the last ten years.

[Figure4.1] Population exposure to urban air pollution (fine dust)



Source : Ministry of Environment, Atmosphere Environment Yearbook

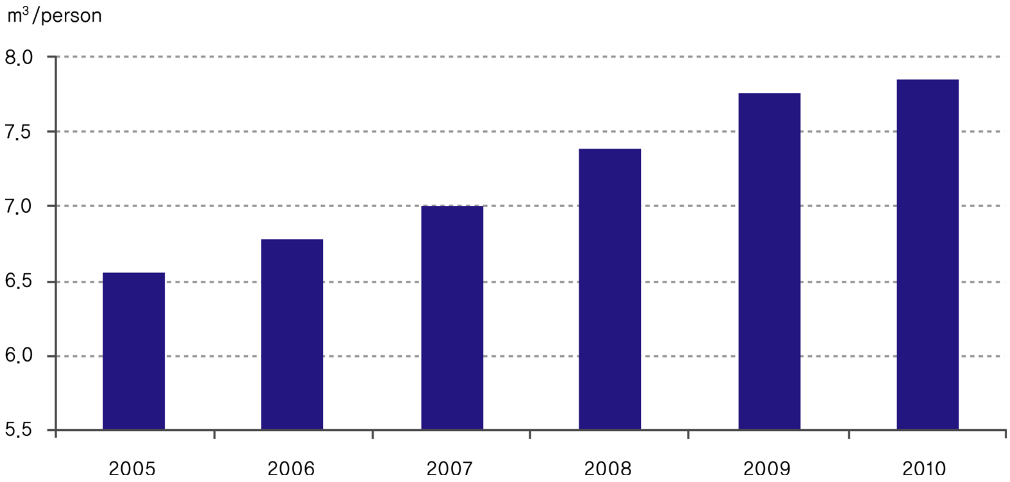
Population exposure to urban air pollution (fine dust, PM) is measured by the annual average concentration of fine dust in 7 major cities of Korea. Population exposure to urban air pollution is an important indicator to monitor the air environmental quality of life. If the indicator shows a decreasing pattern, it can be translated as a positive sign.

The level of air pollution in Seoul, the capital of Korea, has been steadily reducing as a result of expanding the share of LNG buses (17% in 2004 → 95% in 2010), mandatorily installing diesel particulate filters in diesel-powered vehicles, started from 2006, removing street dust and tightly controlling fugitive dust at construction sites. Unfortunately, the level of fine dust in Seoul showed 49㎍/㎥ in 2010, which was almost double that of major advanced nations. The Korean government plans to consistently implement the related policies in an effort to reduce air pollution.

4.2 Urban green space per capita

Korea's urban green space per capita showed 6.56㎡/capita in 2005, and consistently increased to 7.84㎡/capita by 19.5% up compared to that of 2005.

[Figure4.2] Urban green space per capita



Source : Korea Forestry Service, Forestry Basic Statistics (data for 2006 and 2008 are estimates)

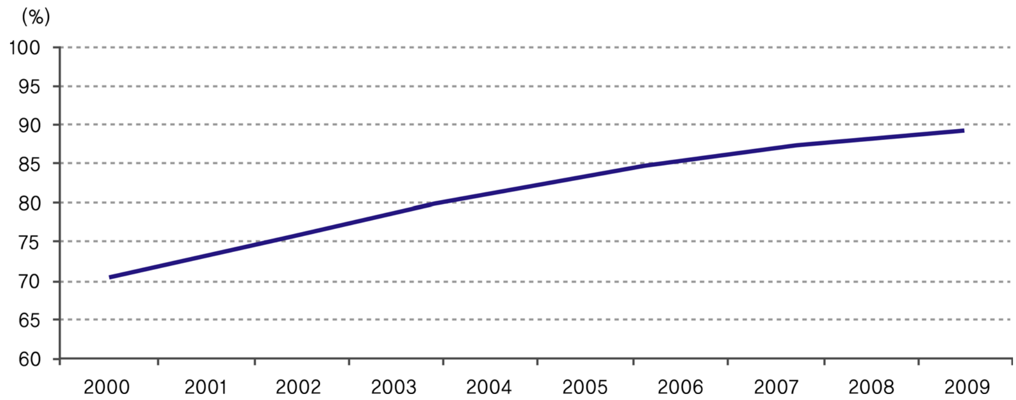
Urban green space per capita is calculated by dividing the area of urban green space, easily accessible to citizens, with the number of citizens. Urban green space per capita is an important indicator for improving quality of life to expand urban green space and carbon sink capacity. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The steady increase in urban green space per capita results from urban forest creation projects of the government. The government plans to increase urban green space per capita to 10.0㎡/capita by 2017. In addition, the budget for urban forest creation projects rose from 10.9 billon KRW in 2005 to 97.7 billion KRW in 2010.

4.3 Share of population connected to sewage treatment

Korea's share of population connected to sewage treatment increased from 70.5% in 2000 to 89.4% in 2009. It went up by 18.9% over the same period.

[Figure4.3] Share of population connected to sewage treatment



Source : Ministry of Environment, Sewage Treatment Statistics

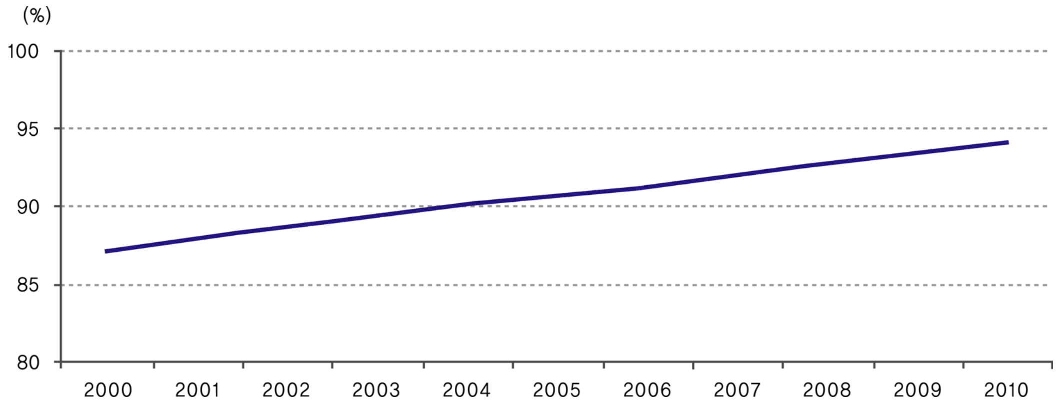
The share of population connected to sewage treatment is calculated by dividing population connected to sewage treatment facilities with the total population of the area. The share of population connected to sewage treatment is an important indicator to measure accessibility to sewage treatment-related sanitary facilities. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The share of population connected to sewage treatment in farming and fishing areas is 40% lower than that of urban areas. Therefore, by supplying farming and fishing areas with sewage treatment facilities, the government plans to increase the share of population connected to sewage treatment to 92% by 2015.

4.4 Share of population with access to safe drinking water

The share of population with access to safe drinking water rose from 87.1% in 2000 to 94.1% in 2010. It went up by 7.0% over the same period.

[Figure4.4] Share of population with access to safe drinking water



Source : Ministry of Environment, Drinking Water Supply Statistics

The share of population with access to safe drinking water is calculated by dividing population with access to safe drinking water with the total population. Areas with village waterworks and small-scale water supply facilities are not included. If those areas are included, the share of population with access to safe drinking water goes up by 3 to 5%.

The share of population with access to safe drinking water is a very important indicator to measure the availability of safe drinking water. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The Korean government focused on drinking water facilities of farming and fishing areas to narrow the gap between urban areas and farming and fishing areas. As a result, the share of population with access to safe drinking water in farming and fishing areas remarkably increased compared to that of urban areas. Also, the government expanded its investment on vulnerable areas to waterworks in a bid to supply safe drinking water. It intends to consistently increase water-supply rate by establishing the 2050 Water Supply Mid- and Long-term Plan.

5

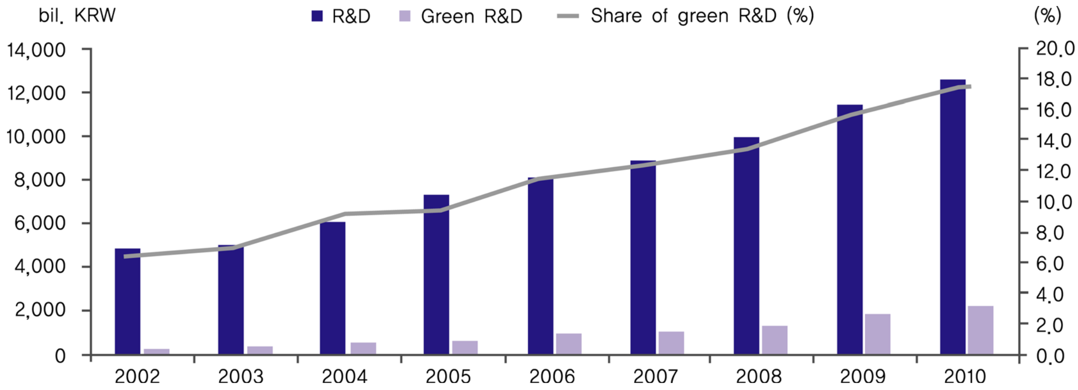
Indicators of economic opportunities and policy responses

5. Indicators of economic opportunities and policy responses

5.1 Government R&D expenditure of importance to green growth

Government R&D expenditure of importance to green growth increased from 6.5% in 2002 to 17.5% in 2010. It went up by 11.0% over the same period. If it is converted into money, R&D expenditure of important to green growth rose from 305 billion KRW in 2002 to 2,187 billion KRW in 2010. It increased about seven times over the same period.

[Figure5.1] Government R&D expenditure of importance to green growth



Source : Korea Institute of S&T Evaluation and Planning, National R&D Survey Analysis Report

Government R&D expenditure of importance to green growth is calculated by Government R&D expenditure of important to green growth with the total Government R&D expenditure. The scope of green R&D includes environmental technologies, clean technologies, energy technologies and marine environmental technologies among six new and emerging technologies selected by the Korean government.

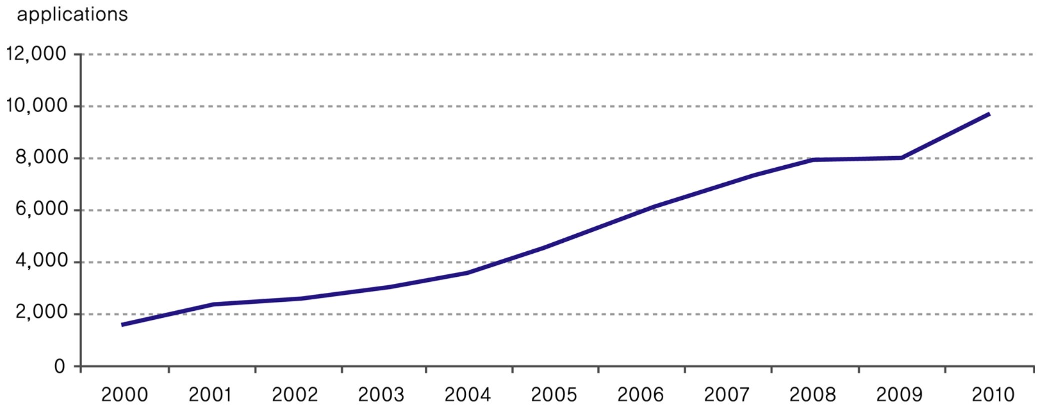
Government R&D expenditure of importance to green growth is an important indicator to control the share of green R&D in the total government R&D to strengthen the competitiveness of basic and original environmental technologies and secure such technologies. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The Korean government plans to increase government R&D budget of 2012 to 1.5 times more than that of 2008. Most of the government R&D budget is for the development of emerging technologies closely related to green R&D, green growth, improvement of quality of life of citizens, support of future-oriented technologies such as space technologies and nuclear fusion. Government R&D expenditures of importance to green growth will consistently increase for the foreseeable future.

5.2 Number of international patent applications

The number of Korea's international patent applications steadily rose from 1,573 in 2000 to 9,639 in 2010. It drastically increased by six times over the same period.

[Figure5.2] Number of international patent applications



Source : Korea Intellectual Property Office, Statistical Yearbook of Intellectual Property

The number of international patent applications relating to green technologies is proposed by the OECD as an indicator. However, the government selected the number of total international patent applications as an alternative indicator due to the absence of long time-series data on the number of green patent applications.

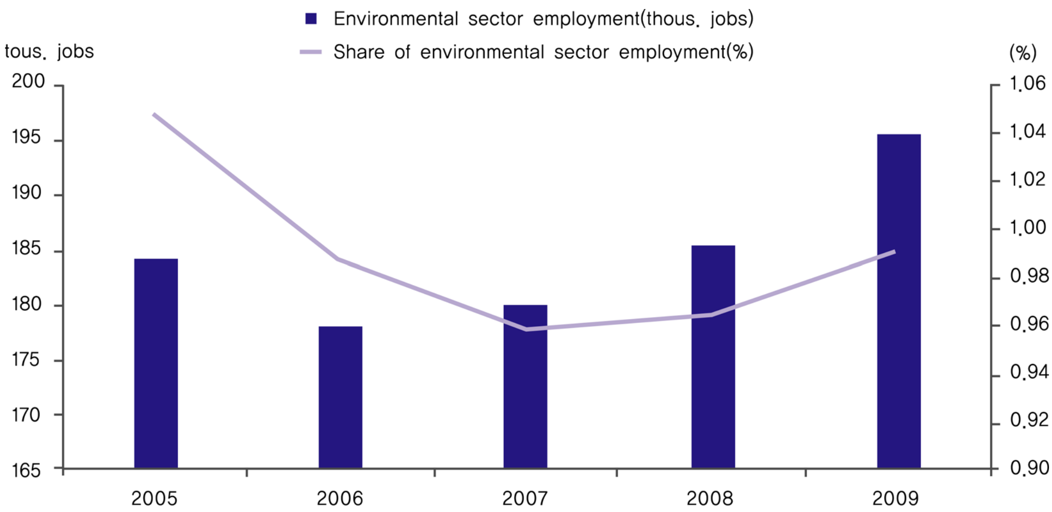
The number of international patent applications is a key and core indicator to measure OECD technology innovation indicators or sustainable development indicators. Therefore, it can show the level of green technologies. The PCT (Patent Cooperation Treaty) is a multilateral treaty administered by the World Intellectual Property Organization to provide a unified and simplified procedure for filing patent applications in each of its member countries. Most of the countries adopting patent systems have joined the PCT. Korea joined in 1984.

The number of international patent applications is a very important indicator to measure the foundation competency of technological innovations supporting Korea's new growth engine industries. If the indicator shows an increasing pattern, it can be translated as a positive sign. The number of Korea's international patent applications significantly increased from 13 in 2002 to 113 in 2008 particularly in terms of new and renewable energy-related patent applications.

5.3 Share of environmental sector employment

Korea's share of environmental sector employment was 0.99% in 2009 a 0.06% decrease compared to 1.05% in 2005, but a 0.03% increase compared to 0.96% in 2008. In addition, the number of environmental sector employees rose slightly from 184,000 in 2005 to 196,000 in 2009.

[Figure5.3] Share of environmental sector employment



Source : Ministry of Environment, Report on the Environment Industry Survey

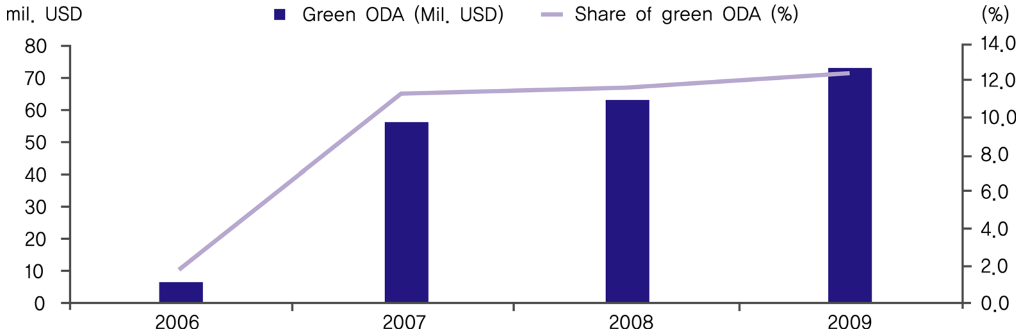
The share of environmental sector employment is calculated by dividing the number of environmental sector employees by the total number of employees. The share of environmental sector employment is an important indicator to ascertain the size of environmental sector employment. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The Statistics Korea is scheduled to announce green industry statistics including the sales of green industries, the number of green industry employees, etc. in 2012. The share of environmental sector employment can be substituted with the share of green industry employment.

5.4 Share of green ODA

Korea's share of green ODA remarkably increased from 1.7% in 2006 to 12.4% in 2009.

[Figure5.4] Share of green ODA



Source : Export-Import Bank of Korea

The share of green ODA is calculated by dividing green ODA which is an environment marker or Rio marker among OECD policy markers by total ODA between Korea and its party country. The share of green ODA is a representing indicator to ascertain the status of a role model nation of green growth. If the indicator shows an increasing pattern, it can be translated as a positive sign.

The Korean government's share of 2009 Green ODA by industry showed 47.7% in the fields of drinking water supply and sanitation, 21.3% in the fields of energy development and supply, 10.4% in the field of environmental protection.

[Table5.4] Green ODA by Industry

Unit : Million US$, %

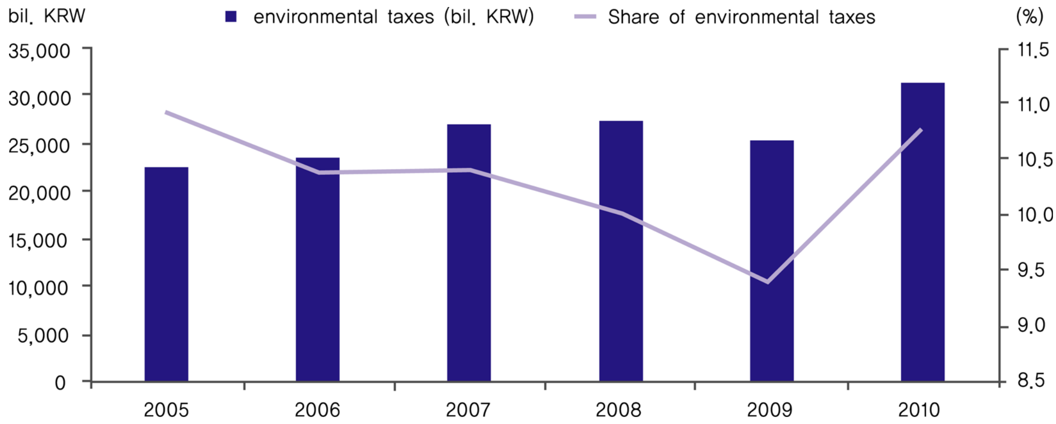
2009	Green ODA	Drinking Water Supply	Energy Development	Environmental Protection	Agriculture and Forestry	Basic Health	Others
US $	72.1	35.8	16.0	7.8	5.0	2.2	8.3
Share	(100.0)	(47.7)	(21.3)	(10.4)	(6.7)	(2.9)	(11.1)

Note : Based on Net Expenditure

5.5 Share of environmental taxes in overall revenues

Korea's share of environmental taxes in overall revenues was 10.9% in 2005 and steadily decreased to 9.4% in 2009, and showed 10.8% in 2010, a 1.4% increase compared to that of 2009. The significant increase in the share of environmental taxes in overall revenues in 2010 resulted from the collection of unpaid environmental taxes in 2009.

[Figure5.5] Share of environmental taxes in overall revenues



Source : National Tax Service, Statistical Yearbook of National Taxes;
Ministry of Public Administration and Security, Annual Local Tax Statistics Report
(data for 2010 is estimates)

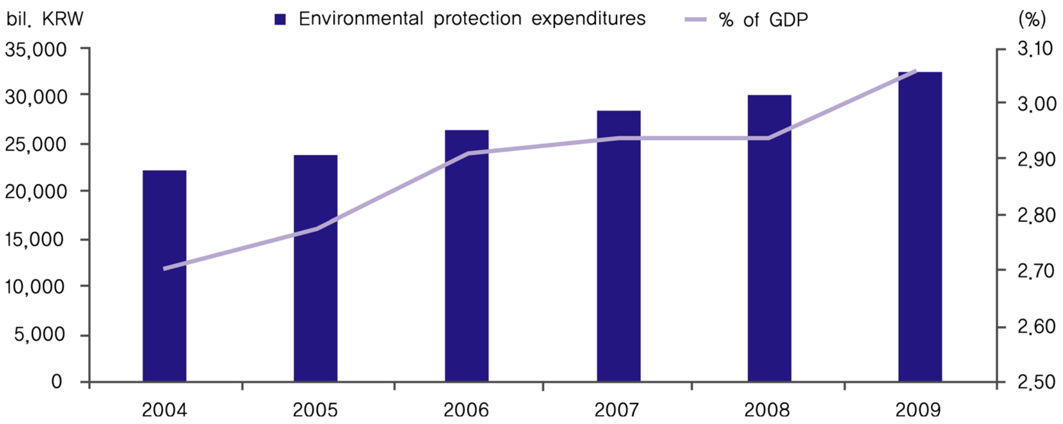
The share of environmental taxes in overall revenues is calculated by dividing environmental tax revenues with the total tax revenues. The environmental taxes include traffic energy tax and consumption tax imposed on passenger cars and oils, which belong to national taxes, vehicle tax, driving tax, and education tax which belong to local taxes.

The share of environmental taxes in overall revenues is an important indicator for institutions and regulations to reduce energy. However, the positive pattern of the indicator depends on economic circumstances and policy objectives.

5.6 Share of GDP dedicated to environmental protection expenditures

Korea's share of GDP dedicated to environmental protection expenditures steadily rose from 2.71% in 2004 to 3.06% in 2009, a 0.35% increase.

[Figure5.6] Share of GDP dedicated to environmental protection expenditures



Source : Ministry of Environment, Environmental Protection Expenditures Account

The share of GDP dedicated to environmental protection expenditures is calculated by dividing the environmental protection expenditures with the real GDP. The environmental protection expenditures mean what the government, businesses, and households paid in a bid to prevent environmental pollution.

The share of GDP dedicated to environmental protection expenditures is an important indicator to diagnose the cost structure of the prevention of environmental pollution and to establish and manage relevant policies. It includes significant implications, but the positive pattern of the indicator depends on economic circumstances and policy objectives.

As the trend has shown, the expenditures of the government, businesses and households have steadily increased to prevent environmental deterioration and to restore a polluted environment. It is expected that with investments in sewage treatment, waste recovery and incineration, reduction of GHG emissions, will steadily rise up. Therefore, the share of GDP dedicated to environmental protection expenditures will also increase.

Appendix: Outline of Korea's green growth indicators

1. Development Background

The Korean government established a Five-year Plan for Green Growth to promote a national green growth strategy in 2009. As a result, preparing green growth statistics to support the strategy was required on a full scale. In particular, the necessity of developing new indicators was raised to assess the current level of green growth and the policy performance of the Five-year Plan for Green Growth. Therefore, Statistics Korea developed green growth indicators.

The Five-year Plan for Green Growth is the supreme national plan implemented in accordance with the Framework Act on Low Carbon Green Growth. It specifically provides basic direction-setting for national green growth policies, yearly goals, investment plans, implementing authorities, and action plans.

2. Progress

Statistics Korea carried out a research project to develop green growth indicators jointly with the Seoul National University R&D Business Foundation in 2010. By doing so, it established plans to prepare and to select indicators in an effort to develop green growth indicators. Based on those research results, Statistics Korea prepared and publicly announced green growth indicators in November, 2011.

3. Set of Indicators

The major purposes for developing green growth indicators are to measure the policy performance and the implementation level of green growth. Therefore, the three strategies and the ten policy direction-setting are applied as a framework to analyze indicators in the Five-year Plan for Green Growth.

〈Appendix Table 1〉 Five-year Plan for Green Growth

3 Strategies	10 Policy Direction-Setting
A. Climate Change Responses and Energy Self-reliance	1. Effective reduction of GHG emissions
	2. Enhancing energy self-reliance for post petroleum paradigm
	3. Enhancing climate change responses
B. Creating New Growth Engine	4. Planning green technology development for growth engine
	5. Greening industries and fostering green industries
	6. Enhancing industrial structures
	7. Forming foundation for green economy
C. Improving Quality of Life and Enhancing National Status	8. Creating green territory & transportation
	9. Green revolution in life
	10. Becoming a role model nation of green growth

Likewise, a set of green growth indicators were developed based on the policy breakdown of the Five-year Plan for Green Growth. It is a strikingly different from the set of OECD green growth indicators. Also, the indicators that OECD green growth indicators do not include but Korea's green growth indicators include are as follows.

A. Climate Change Responses and Energy Self-reliance: GHG absorption by forests, the share of self-development of oil and gas, the self-sufficiency rate of food, accuracy of rainfall forecast, government budget dedicated to disaster prevention,

B. Creating New Growth Engine: Sales of new and renewable energy industries, government-purchased GHG reduction, number of ISO14001-certified businesses, etc.

C. Improving Quality of Life and Enhancing National Status: Share of public passenger transportation between different regions, household energy consumption per capita, GHG reduction certification under CDM (Clean Development Mechanism), etc.

Most indicators related to natural assets among OECD green growth indicators are not included in the Korea's green growth indicators because natural asset indicators decisively governed by natural circumstances cannot ascertain the policy performance and the implementation level of green growth. Natural asset indicators do not comply with the purposes of preparing Korea's green growth indicators. However, almost half of the 30 green growth indicators prepared in Korea are the same or similar to those of the OECD-proposed.

4. Results of Korea's green growth indicators

Results of recent green growth indicators are as follows. Most of the indicators are improving compared to those of 2005. In particular, twenty-four out of thirty indicators are getting better, four are stagnant, and two are getting worse.

It is certain that the indicators related to energy self-reliance and green industries including self-development rate of oil and gas, sales of new and renewable energy, etc. are rapidly improving thanks to green growth policies implemented on a full scale from 2009. GHG emissions and energy consumption per unit of GDP are improving on a long-term base, but were stagnant in 2009. Time-series data have been insufficient since green growth policies have only been under way on a full scale since 2009. Therefore, it was a limit to assess the policy performance of green growth.

〈Appendix Table 2〉 Green Growth Indicators

3 Sectors	10 Policy Direction-Setting	Green Growth Indicators	2005~2009	
			Recent Trend*	Assessment
Climate Change Responses and Energy Self-reliance	Effective reduction of GHG emissions	GHG emissions per unit of GDP	↘ (↗)	☀
		Total GHG emissions	↗	🌧
		GHG absorption by forests	↗	☀
	Enhancing energy self-reliance for post petroleum paradigm	Energy consumption per unit of GDP	↘ (↗)	☀
		Share of self-development of oil and gas	↗	☀
		Share of new and renewable energy	↗	☀
	Enhancing climate change responses	Self-sufficiency rate of food	↘ ↗	☁
		Accuracy of rainfall forecast	↗ (↘)	☀
		Government budget dedicated to disaster prevention	↗	☀
Creating New Growth Engine	Planning green technology development for growth engine	Share of green R&D in government R&D expenditures	↗	☀
		Share of GDP dedicated to total R&D expenditures	↗	☀
		Number of international patent applications	↗	☀
	Greening industries and fostering green industries	Domestic material consumption per unit of GDP	↘	☀
		Share of environmental industry sales	↗	☀
		New and renewable energy industries	↗	☀
	Enhancing industrial structures	Share of service industries VA	↗ ↘	☁
		Share of knowledge intensive industries VA	↗	☀
		Share of Information and Communications industries VA	↗	☀
	Forming foundation for green economy	Government-purchased GHG reduction	↗	☀
		Number of ISO14001-certified businesses	↗	☀
		Share of environmental taxes in overall revenues	↘ ↗	☁
Improving Quality of Life and Enhancing National Status	Creating green territory & transportation	Urban green space per capita	↗	☀
		Share of public passenger transportation	↗ (↘)	☀
		Share of GDP dedicated to environmental protection expenditures	↗	☀
	Green revolution in life	Household energy consumption per capita	↘ (↗)	☀
		Municipal water use per capita	↘	☀
		Municipal waste generation per capita	↗ (↘)	🌧
	Becoming a role model nation of green growth	GHG reduction certification under CDM	↗	☀
		Share of ODA in GNI	↘ ↗	☁
		Share of green ODA in ODA	↗	☀

* Marked as a small arrow in case that a recent indicator is out of existing trend.

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Publisher
Choi, Yeon Ok
Direct of Statistical research institute

Printed by
Narai Publishing Group
Daejeon 302-280, KOREA

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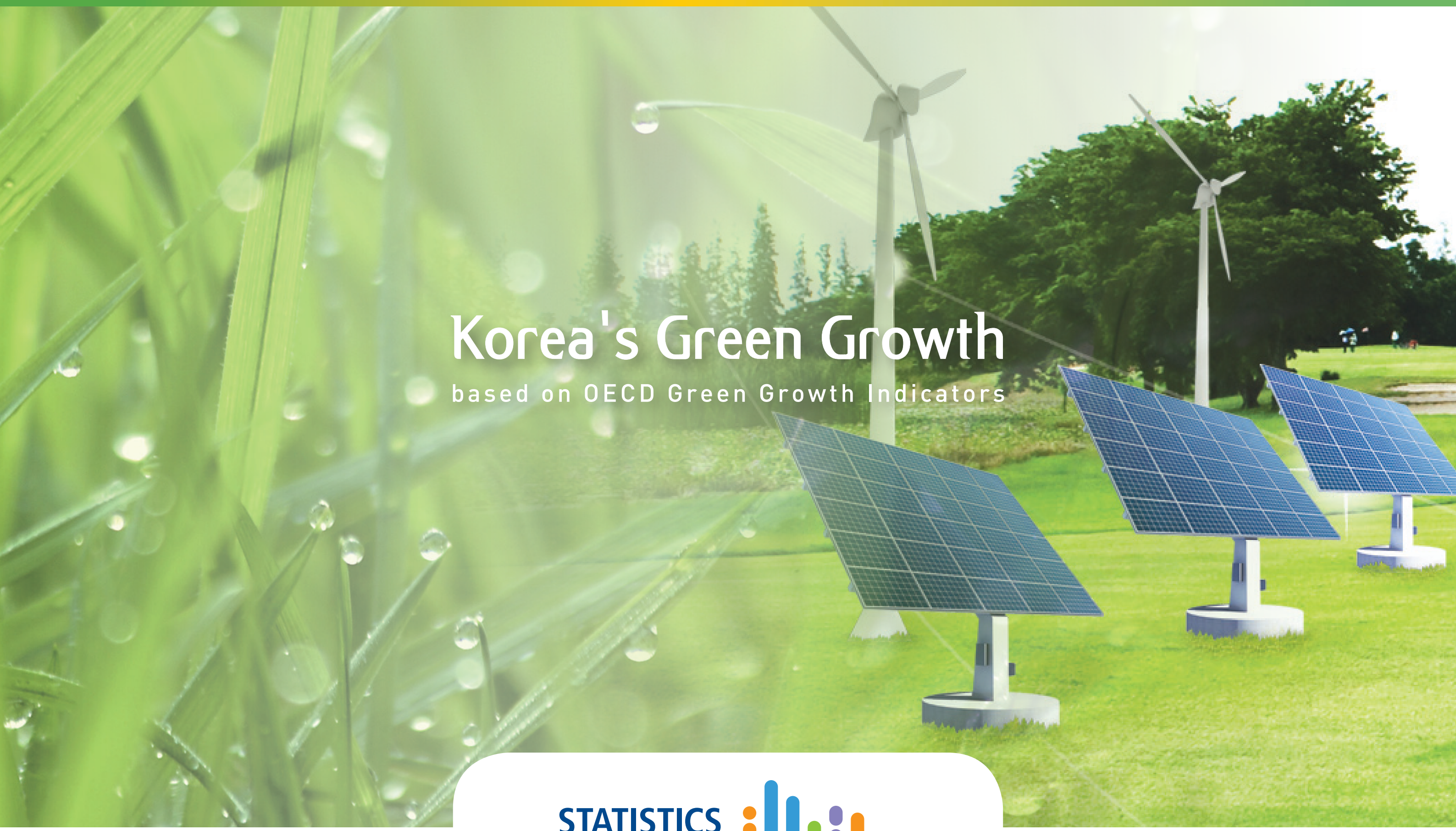

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