Knowledge Sharing Program

2014 Modularization of Korea's Development Experience:

Experiences and Lessons of Green Growth

2014

MINISTRY OF STRATEGY AND FINANCE

KOREA UNIVERSITY

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Preface

The study of Korea's economic and social transformation offers a unique window of opportunity to better understand the factors that drive development. Within about one generation, Korea transformed itself from an aid-recipient basket-case to a donor country with fast-paced, sustained economic growth. What makes Korea's experience even more remarkable is that the fruits of Korea's rapid growth were relatively widely shared.

In 2004, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) to assist partner countries in the developing world by sharing Korea's development experience. To provide a rigorous foundation for the knowledge exchange engagements, the KDI School has accumulated case studies through the KSP Modularization Program since 2010. During the first four years, the Modularization Program has amassed 119 case studies, carefully documenting noteworthy innovations in policy and implementation in a wide range of areas including economic policy, admistration·ICT, agricultural policy, health and medicine, industrial development, human resources, land development, and environment.Individually, the case studies convey practical knowhow and insights in an easily accessible format; collectively, they illustrate how Korea was able to kick-start and sustain economic growth for shared prosperity.

Building on the success during the past four years, we are pleased to present an additional installment of 19 new case studies completed through the 2014 Modularization Program. As an economy develops, new challenges arise. Technological innovations create a wealth of new opportunities and risks. Environmental degradation and climate change pose serious threats to the global economy, especially to the citizens of the countries most vulnerable to the impacts of climate change. The new case studies continue the tradition in the Modularization Program by illustrating how different agents in the Korean society including the government, the corporations, and the civil society organizations, worked together to find creative solutions to challenges to shared prosperity. The efforts delineated include overcoming barriers between government agencies; taking advantage of new opportunities opened up through ICT; government investment in infrastructure; creative collaboration between the government and civil society; and painstaking efforts to optimize

management of public programs and their operation. A notable innovation this year is the development of two "teaching cases", optimized for interactive classroom use: Localizing E-Government in Korea and Korea's Volume-based Waste Fee System.

I would like to express my gratitude to all those involved in the project this year. First and foremost, I would like to thank the Ministry of Strategy and Finance for the continued support for the Modularization Program. Heartfelt appreciation is due to the contributing researchers and their institutions for their dedication in research, to the former public officials and senior practitioners for their keen insight and wisdom they so graciously shared as advisors and reviewers, and also to the KSP Executive Committee for their expert oversight over the program. Last but not least, I am thankful to each and every member of the Development Research Team for the sincere efforts to bring the research to successful fruition, and to Professor Taejong Kim for his stewardship.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessarily represent those of the KDI School of Public Policy and Management.

December 2014

Joon-Kyung Kim

President

KDI School of Public Policy and Management

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Summary

Korea is a leader in green growth, having implemented a new paradigm for national economic growth. Korea recognized that the process of rapid economic growth since the 1960s did not take environment considerations into account, leading to environmental deterioration. The new growth paradigm pursued a virtuous relationship between the environment and economy. Korea's green growth policy seeks to create harmony between the environment and economy, and has served as public policy for significant yet sustainable development. The successful implementation of the green growth policies was attributable to the fact that green growth was not an abruptly or newly created idea. Rather, the advancement of past policy efforts, combined with the green growth paradigm, led to comprehensive economic growth policy.

In 2009, the Five-Year Plan for Green Growth was established, and Korea's green growth policies were actively promoted. The Five-Year Plan established three sectors and ten policy directions to respond to climate change, foster new growth engines, improve the quality of life and boost Korea's national status. This movement established its legal foundation when the Framework Act Low Carbon, Green Growth was enacted in 2010, becoming national policy with support from the Presidential Committee on Green Growth and regional committees on green growth in each local government and related institutions. The legislation mandated various efforts to establish, implement, and update policies.

As a policy to reduce GHG emissions, the Greenhouse Gas and Energy Target Management System began in 2010 with the establishment of the Greenhouse Gas Inventory & Research Center. In 2011, the Greenhouse Gas Management System was created, and in 2012, the Renewable Portfolio Standard was introduced. In 2015, the emission trading system will

begin. Of course, in addition to policies for GHG emissions reduction, various policies are being implemented to reduce the use of fossil fuels, strengthen energy independence, implement green changes to the manufacturing industry, build green land and promote the green lifestyle.

Although Korea's green growth policies resulted in many achievements, many lessons to address shortcomings were revealed as well. First, green growth policies are a strategy to achieve sustainable development and the government needs to take into account the economy, environment and social development—the three pillars of sustainable development—in a balanced manner. Second, green growth is an environment-friendly growth strategy that involves development projects but the environmental effects should be sufficiently taken into account to minimize environmental degradation. Third, legal and institutional foundations must be established to promote green growth policies. Fourth, in order to support developing nations to promote green growth policies, Korea needs to highlight green growth, using existing knowledge sharing programs.

Facing international crises such as climate change and global warming, developing nations should also participate in strategic discussions for common prosperity in the international community. As a leading nation for green growth, Korea can assist developing nations participate in green growth by sharing the results and lessons of its own experience of green growth. This can be achieved through various means of cooperation, while Korea seeks to improve the quality of its own green growth policies.

Chapter 1

Introduction

Introduction

Korea achieved very high growth to the extent that no comparable example can be found in the history of economic development over the past half century. This high growth was achieved despite conditions following Japanese colonial rule and the Korea War (1950~1953). As such, Korea's growth has been called the East Asian Miracle by the World Bank (World Bank, 1993). According to World Bank data, ordinary GDP per capita increased by approximately 167 times over approximately 50 years, from 156 US dollars in 1961 to approximately 26,000 US dollars in 2013 (World Bank, online database).[1] Based on this outcome, Korea transitioned from a recipient country (relying on foreign aid) in the early 1960s to a foreign aid donor country in an unprecedentedly short period of time, joining the OECD DAC in 2010.

For this high growth, the successful transitions in industrial structure—from the primary industry in the 1960s to the heavy and chemical industry in the 1970s~1980s and then to digitization in the 1990s—have played important roles. However, the high growth also entailed heavy costs. The strategies based on the fossil-fuel energy-intensive heavy and chemical industry led to increases in energy consumption and hence greenhouse gas (GHG) emissions. In addition, as it will be discussed in detail later, Korea is ranked about sixth to seventh in terms of its share in global GHG gas emissions or per-capita GHG emissions, and cannot be exempted from the responsibility for the global problem of global warming.

Korea's economic growth strategy was not unique, but was built on economic growth strategy pursued by other major developed countries in the past. Since the Industrial Revolution, these nations had achieved significant economic growth that greatly improved

1. World Bank Open Data (http://data.worldbank.org/, Accessed: 2014.9.25.).

the material quality of life through an economic development strategy based on fossil fuels. Yet, the negative effect of the use of non-renewable fossil fuels has accumulated gradually. Due to the increase in greenhouse gas emissions with the rapid increase in fossil fuel consumption, problems such as global warming, fossil fuel depletion and pollution have recently received global attention. To that end, leading natiosn and international organizations, such as the Organization for Economic Co-operation and Development (OECD), the Economic and Social Commission for Asia and the Pacific (UNESCAP), and the United Nations Environment Program (UNEP), have raised questions regarding whether the fossil fuel-based economic development strategy can achieve sustainable growth of the economy.

Transitioning from conventional development strategies, the international society began to discuss green growth or the green economy as new development strategies. Korea was not an exception in this discussion about the problems of climate change and pollution. In 2008, green growth policies were established as a new paradigm for economic growth, and Korea became an active participant in the international movement. International organization and nations have different definitions of green growth. Yet in general, it is perceived as the growth strategy that enables economic growth to form a virtuous cycle with the environment.

Green growth emerged as a policy paradigm due to the negative effect of massive greenhouse gas emissions that accelerate global warming and result in climate change and frequent natural disasters such as floods, droughts and earthquakes. This problem poses a common threat to developing nations as well as developed nations. Hence developing nations need to care about, and participate in, the international movement. Yet for developing nations, the desire for economic growth is relatively stronger than that for green technology development and the transition to economic and industrial structures that do not damage the environment. Therefore, the international community needs to encourage developing nations to adopt and implement green growth as their policy paradigms.

Korea has not been completely indifferent to the environment while it has been implementing high growth strategies. Even in the process of economic growth, efforts to prevent forest devastation have been steadily made through reforestation, etc. In addition, efforts to restore the environment have continued, such as changing rivers that were contaminated in the process of economic growth into environment-friendly ecological rivers. However, green growth strategies can be said to be part of a bigger effort to transition from development strategies that have deteriorated the environment in the past, by implementing environment-friendly development strategies instead of conventional

development strategies. To this end, Korea has been playing a leading role in green growth policies that can propel economic growth and promote the environment since implementing green growth as a national paradigm since 2008.

As a country that has achieved high economic growth in a short period of time, Korea has the economic development experience, which can serve as a role model to many developing nations. For instance, it implemented green growth as a national paradigm in 2008 and has become a leader in green growth policies. Its experience of economic growth, and the establishment and implementation of green growth policies, will become an example to developing nations that need to establish economic policies that take the environment into account. Korea has achieved many results during the process of establishing green growth policies. Yet, at the same time, problems were exposed that need to be resolved. These problems will provide lessons to developing nations that plan to establish and implement green growth policies in the future. Hence this paper will explain the background, progress and major policy results of Korea's green growth policies so that policymakers in developing nations can use it as a guideline, which provide lessons from this experience.

The structure of this paper is as follows. Chapter 2 will summarize the background and progress of green growth policies. Chapter 3 discusses the policies for environmental maintenance and restoration that were implemented prior to green growth policies of 2008. Chapter 4 discusses the current status and tasks of green growth policies, with a focus on legal and institutional foundations, voluntary GHG emissions reduction and major policies. Chapter 5 provides the lessons of green growth policies. Finally, Chapter 6 included concluding thoughts and provides suggestions for developing nations.

Chapter 2

Background and Progress of Green Growth Policies

1. Economic Growth Experience and Environment
2. Background and Concept of Green Growth Policies
3. Institutional Change
4. Major Environmental Restoration Policies

Background and Progress of Green Growth Policies

1. Economic Growth Experience and Environment

Korea has developed around energy-intensive industries for its economic growth. It achieved a successful transition in industrial structure from the light industry in 1960s, the initial phase of its economic growth, to the heavy chemical industry through the 1970s and recently towards digitization. This section aims to discuss the major results and characteristics of Korea's growth based on the major indicators for economic growth.

1.1. Economy and Energy

In 1960, Korea was one of the least-developed countries with its per-capita GDP at $156. In order to restore the infrastructure destroyed by the Korean War and to eradicate poverty, the Korean government chose the development model of a market economic system centered on the private sector with strong support from the government. The President and the Economic Planning Board (EPB) promoted policies for economic growth and trade expansion. In particular, export promotion policy aimed to achieve economic growth through export expansion was chosen over an import substitution policy. This approach was continuously maintained from the 1960s to the present. Moreover, during this period, the policies to foster the heavy chemical industry were actively implemented, and as a result Korea's industrial structure transitioned toward the heavy chemical industry. The companies that were fostered during this period, such as Samsung and Hyundai, have grown to become conglomerates that currently represent Korea.

Since the 1980s, problems from overinvestment in the heavy chemical industry had emerged. With the oil crisis, Korea faced a difficult economic environment as well.

Nonetheless, Korea aimed to transition from an input-driven economic growth strategy towards an industrial structure based on technological innovation and technology-driven strategy. During the 1980s, the manufacturing and processing industries, such as household appliances and automobiles, expanded, and the IT industry grew in the 1990s. However, until the 2000s, the heavy chemical industry was still the driving force behind Korea's economic growth. Since the 2000s, the Korean economy experienced a foreign exchange crisis, which triggered the transition to the global open economic system, and exposed the limitations of the traditional economic growth model. Korea made various efforts for transitioning the economic growth paradigm, thus continuously implementing privatization and liberalization policies. In 2008, green growth policies emerged as a new economic growth paradigm.

<Table 2-1> shows the changes in the major economic indicators for Korea since the 1960s. The per-capita GDP, total savings, total fixed capital formulation, exports, imports and trade have all increased and expanded rapidly since the 1960s. The current price per-capita GDP increased from $156 in 1960 to $1,778 in 1980, which is 11.4 times the 1960 level, and Korea has currently become a high-income country with its per-capita GDP exceeding $20,000. Also, as a result of the export promotion policy, the share of trade in GDP greatly increased from 15.76% in 1960 to 67.81% in 1980.

Table 2-1 | Major Economic Indicators

National Accounts	1960	1970	1980	1990	2000	2010	2011	2012	2013
GDP per Capita (Constant 2005 USD)	1,107	1,968	3,926	8,829	15,162	22,236	22,884	23,303	23,893
GDP per Capita (Current USD)	156	292	1,778	6,642	11,948	22,151	24,156	24,454	25,977
Total Savings (% of GDP)	1.87	14.34	22.51	33.75	35.01	35.21	34.45	33.8	34.05
Total Fixed Capital Formation (% of GDP)	11.44	24.18	30.33	34.35	31.62	30.5	30.24	29.57	29.66
Exports (Current billion USD)	0.12	1.21	20.47	73.74	196.6	540.9	670.3	688.9	703.5
Imports (Current billion USD)	0.49	2.12	25.51	76.57	185	506	652.4	654.8	637.4
Trade (% of GDP)	15.76	35.41	67.81	52.78	67.95	95.65	110	109.9	102.8

Source: World Development Indicators (http://databank.worldbank.org, Accessed: 2014.8.6.).

Like other developed nations, Korea achieved industrialization based on a development paradigm dependent on fossil fuels. Hence the imports of energy such as coal and oil, which served as inputs during rapid growth, increased as well. <Table 2-2> shows the amounts of Korean energy imports by year. In the early 1980s, the oil imports temporarily decreased due to the oil shock, reducing the share of energy imports from all imports. Since 1985, the share of energy imports in total imports has increased continuously. Also, from both the supply and demand sides, the energy consumption in Korea has continuously increased every year. In 1990, the per-capita electricity consumption was 2,202 kWh, but it had gradually increased to 9,331 kWh by 2012. The per-capita oil consumption greatly increased from 8.31 barrels in 1990 to 16.55 barrels in 2012. The above-mentioned indicators show that Korea achieved rapid growth in a short period of time based on fossil fuels, thereby increasing energy dependence in both the supply and demand sides during this period.

First, the share of energy imports in total imports was 29.7% in 1981. This figure temporarily decreased to 15.6% in 1990, increased again to 23.6% in 2000 and to 35.6% in 2012, exceeding the ratio recorded during 1981. As the size of the economy increased based on economic growth, the dependence on overseas energy sources continuously increased (Korea has a very few number of natural energy resources). Korea's energy dependence continuously increased from 87.9% in 1990 to 97.2% in 2000. The rate then decreased to 96.0% by 2012, which is still significantly higher than those recorded during the 1980s.

Table 2-2 | Amounts of Energy Imports

Category	1981	1985	1990	1995	2000	2005	2010	2012
National Total Imports (A) (million USD)	26,131	31,136	69,844	135,119	160,481	261,238	425,212	519,584
Energy Imports (B) (million USD)	7,762	7,322	10,908	19,053	37,888	66,697	121,654	184,800
Share of Energy Imports in Total Imports (B/A, %)	29.7	23.5	15.6	14.1	23.6	25.5	28.6	35.6
Energy Overseas Dependence (%)	-	-	87.9	96.8	97.2	96.6	96.5	96.0

Source: Korea Energy Economics Institute Energy Supply and Demand Statistics (http://kosis.kr/statHtml/statHtml.do?orgId=339&tblId=DT_F_Y160&conn_path=I3, Accessed: 2014.8.6.); Korea Energy Economics Institute (2013), pp.14~15.

Energy consumption in Korea has increased continuously each year, signifying inefficient energy usage (see <Table 2-3>). For electricity and oil consumption, not only the absolute levels but also per-capita consumption increased continuously during the process of economic growth. First, electricity consumption increased from 35,424 GWh in 1981 to 94,384 GWh in 1990, reaching 466,593 GWh in 2012. This increase in consumption is due to the increase in the size of the economy. Also, the per-capita electricity consumption shows that Korea has used electricity in an inefficient and excessive manner. The per-capita electricity consumption continuously increased from 915 kWh in 1980 to 2,202 kWh in 1990, and to 9,331 kWh in 2012.

Although it has not increased as much as electricity consumption, oil dependence has also increased in size and become inefficient. Oil consumption increased from about 130 million barrels in 1981 to about 320 million barrels in 1990, and to about 800 million barrels in 2012, increasing by eight-fold since 1981. Per-capita oil consumption was 3.39 barrels in 1981, increasing to 7.56 barrels in 1990, and to 15.93 barrels in 2012. The above-mentioned indicators show that Korea achieved rapid growth in a short period of time based on fossil fuels. It has also increased its energy dependence, for both the supply and demand sides.

Table 2-3 | Final Energy Consumption

Category	1981	1985	1990	1995	2000	2005	2010	2012
Coal (Thousand Ton)	26,970	33,615	35,699	27,702	30,370	34,616	43,516	48,419
Petroleum (Thousand Barrels)	131,230	159,929	323,981	601,515	698,709	729,891	767,386	796,495
Natural gas (Thousand TOE)	-	-	-	-	-	-	430	550
City gas (Million m^3)	21	77	963	5,327	11,963	16,963	19,982	23,776
Electricity (GWh)	35,424	50,733	94,384	163,270	239,535	332,413	434,160	466,593
Thermal Energy (Thousand TOE)	0	0	75	641	1,119	1,530	1,718	1,751
Electricity Consumption per Capita (kWh/person)	915	1,243	2,202	3,621	5,096	6,905	8,787	9,331
Petroleum Consumption per Capita (Barrels/person)	3.39	3.92	7.56	13.34	14.86	15.16	15.53	15.93

Source: Korea Energy Economics Institute, Statistics for Energy Supply and Demand (http://kosis.kr/statHtml/statHtml.do?orgId=339&tblId=DT_F_Y170&conn_path=I3, Accessed: 2014.8.6.), Statistics Korea Population Estimates by Age (City and Province) (http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parentId=A#SubCont, Accessed: 2014.8.6.).

1.2. Economic Development and Environmental Change

Korea accomplished industrialization based on fossil fuels, thereby achieving rapid growth in a short period of time. However, the import and consumption of fossil fuels increased proportionally. The increase in the use of fossil fuels led to an increase in greenhouse gas emissions.

<Table 2-4> shows the trend in greenhouse gas emissions by the top 15 emitting countries. In 2010, China had the most emissions with about 10.7 billion tons CO2eq, which was 34.6% of the global emissions. Since 1990, China has increased its carbon emissions by 181% over a 10-year period, the highest increase rate during this time period. The U.S. had the second most emissions with 6.6 billion tons CO2eq in 2010, which was 21.4% of the global emissions.This figure had increased by 13.8%, when compared to 1990 data. Hence, the emissions from the U.S. and China are 56% of the global emissions, and their policies for greenhouse gas emissions reduction are crucial for the reduction in global greenhouse gas emissions. In 2010, Korea was ranked 11th with 625 million tons CO2eq, which is 2.0% of the global emissions. Nonetheless, Korea had increased its output by 112% since 1990. As such, Korea needs measures for greenhouse gas emissions reduction.

<Table 2-5> shows the per-capita greenhouse gas emissions of the major countries. In 2010, the per-capita greenhouse gas emissions of Korea was 12.7 tons CO2eq, and Korea was ranked 27th in the world. Except for Australia (25.2 tons CO2eq) and Canada (19.6 tons CO2eq), most of the major emitting countries are oil producers. Korea is still one of the countries who consume large amounts of fossil fuels for economic growth.

Table 2-4 | Greenhouse Gas Emissions of Countries (Top 15 Countries as of 2010)

(Unit: million tons CO2eq, %)

Rank	Country	1990	2000	2010	90~10 Rate of Increase (%)
1	China	3,808 (18.0)	4,898 (21.0)	10,700 (34.6)	181.0
2	United States of America	5,807 (27.4)	6,767 (29.0)	6,610 (21.4)	13.8
3	India	1,373 (6.5)	1,961 (8.4)	2,885 (9.3)	110.1
4	Russia	3,363 (15.9)	2,168 (9.3)	2,395 (7.7)	-28.8
5	Japan	1,226 (5.8)	1,349 (5.8)	1,308 (4.2)	6.6
6	Brazil	693 (3.3)	844 (3.6)	1,081 (3.5)	56.1
7	Germany	1,248 (5.9)	977 (4.2)	871 (2.8)	-30.2

Rank	Country	1990	2000	2010	90~10 Rate of Increase (%)
8	Indonesia	392 (1.9)	523 (2.2)	745 (2.4)	90.0
9	Iran	289 (1.4)	478 (2.0)	714 (2.3)	146.9
10	Canada	582 (2.7)	694 (3.0)	666 (2.2)	14.6
11	South Korea	294 (1.4)	511 (2.2)	625 (2.0)	112.5
12	Mexico	456 (2.2)	532 (2.3)	612 (2.0)	34.2
13	England	749 (3.5)	672 (2.9)	596 (1.9)	-20.5
14	Australia	470 (2.2)	537 (2.3)	556 (1.8)	18.2
15	Republic of South Africa	410 (1.9)	453 (1.9)	551 (1.8)	34.3
World			21,162	23,365	30,916

Note: This table shows the total national emissions data of top 15 countries that is from calculated the total emissions of the six greenhouse gases based on the greenhouse gas emissions (CO2, CH4, N2O, HFCs, PFCs, SF6) of countries provided by the World Bank. In some countries, only part of the greenhouse gas emissions information of the six global emissions is provided, thus it may be different from those of the actual data. We use UNFCCC data for the 1990 greenhouse gas emissions in Russia and Germany.

Source: Word Bank (http://databank.worldbank.org/ Accessed: 2014.9.25.); UNFCCC (https://unfccc.int/files/ghg_emissions_data/application/pdf/deu_ghg_profile.pdf, https://unfccc.int/files/ghg_emissions_data/application/pdf/rus_ghg_profile.pdf Accessed: 2014.9.25.).

Table 2-5 | Global Per Capita Greenhouse Gas Emissions (Top 15 countries as of 2010)

(Unit: tCO2eq, %)

Rank	Country	1990	2000	2010	90~10 Rate of Increase (%)
1	Qatar	34.2	81.1	63.5	86.0
2	Trinidad and Tobago	16.5	23.9	49.3	197.9
3	Kuwait	26.3	34.8	36.2	37.6
4	Brunei	41.2	32.8	35.9	-12.9
5	Oman	9.9	14.9	26.8	171.7
6	Australia	27.6	28.0	25.2	-8.4
7	Luxembourg	29.8	22.3	25.0	-16.1
8	United Arab Emirates	37.1	44.4	23.3	-37.0
9	Aruba	29.6	24.6	22.8	-22.9
10	Bahrain	32.8	31.9	22.3	-31.9
11	United States of America	23.3	24.0	21.4	-8.1

Rank	Country	1990	2000	2010	90~10 Rate of Increase (%)
12	Kazakhstan	6.3	12.3	20.5	225.9
13	Canada	20.9	22.6	19.6	-6.4
14	Saudi Arabia	15.8	17.2	19.6	24.2
15	Russia	22.7	14.8	16.8	-26.0
27	South Korea	6.9	10.9	12.7	84.3
37	Japan	9.9	10.6	10.3	3.4
55	China	3.4	3.9	8.0	139.1
126	India	1.6	1.9	2.4	51.4

Note: This table shows the calculation of greenhouse gas emissions per capita based on countries' greenhouse gas emissions data (CO2, CH4, N2O, HFCs, PFCs, SK6) and population data provided by World Bank, and it provides top 15 countries' data. In some countries, the state provides only a portion of the six greenhouse gas emissions, thus total greenhouse gas emissions are not reflected in the calculation of greenhouse gas emissions per capita.

Source: Word Bank (http://databank.worldbank.org/, Accessed: 2014.9.25.).

Advanced countries have taken the lead in discussing the need to seek a new economic growth paradigm that takes the environment into consideration. They have had a strong will to curb catastrophes such as global warming caused by greenhouse gas emissions from burning fossil fuel during the process of development. Just as greenhouse gas emissions are a global issue, air and water pollution, mainly caused by wastewater and contaminants produced from factories and homes during the initial stages of industrialization, is critical to all nations.

In Korea, large amounts of air pollutants had been released until the 2000s (refer to <Table 2-6>). The Korean government's environmental policies, carried out at the national level, have contributed to a significant drop of particles, sulphur dioxide and carbon monoxide emissions since 2000. Nitrogen dioxide has been decreasing since 2005 as well. Some of the government's efforts to tackle environmental pollution include the enactment of the Framework Act on Environmental Policy and the Clean Air Conservation Act in 1990, and the Special Act on Seoul Metropolitan Air Quality Improvement in 2003. With these acts in place, the government started implementing various policies to regulate air pollutants released from factories and during transport. With the implementation of Green Growth Policy, greenhouse gas emissions reduction and energy policies contributed to a reduction in air pollutants.

<Table 2-7> illustrates the annual status of water pollution in the Han River (Noryangjin) and the Nakdong River (Gupo) water systems. The quality of water is measured at various river points with a focus on the Han and Nakdong rivers. Among others, the BOD (Biological Oxygen Demand) and the SS (Suspended Solids) are used as water pollution indicators. While the BOD decreased in both rivers, the SS shows a clear drop in the Han River only. Relatively speaking, the government paid less attention to air pollution reduction. For air pollution, laws and policies had been introduced since the 1990s, but the Total Pollution Load Management System, a flagship scheme, began in 2004 (Ministry of Environment, National Institute of Environmental Research, 2004. p.16). However, it has been quite difficult to manage water pollution caused by industrial waste water that businesses with smaller factories produce (Ministry of Environment, 2007, p.32). Against this backdrop, the government needs to pay more attention and focus its policy efforts to stop water degradation, resulting from industrialization and urbanization.

Table 2-6 | Korea's Air Pollutant Emissions by Year (1988~2011)

(Unit: ton)

Year	Sulfuric Acid Gas (SO2)	Nitrogen Dioxide (NO2)	Debris (TSP)	Carbon Monoxide (CO)	Total
1988	1,417,282	978,741	388,657	1,534,347	4,321,015
1990	1,610,960	926,065	420,318	1,991,065	4,950,398
1995	1,532,320	1,152,765	405,526	1,109,097	4,201,703
2000	531,060	1,003,958	89,424	825,198	2,451,640
2005	408,462	1,306,724	88,909	788,917	2,595,017
2010	401,741	1,061,210	177,601	766,269	2,408,831
2011	434,113	1,049,435	236,081	980,626	2,702,266

Note: The Environmental Statistics Portal, which provides statistical data, have used the terms Sulfur Oxides (SOx) and Nitrogen Oxide (NOx) for Sulfuric Acid Gas and Nitrogen Dioxide, respectively in their reports since 2000.

Source: Ministry of Environment, Environmental Statistics Portal (http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_03_0100005&inq_gubun=1&lang=kor&list_id=106H_01_002002&l_interval=2#stat_btm, Accessed: 2014.10.25.).

Table 2-7 | The Current Status of Korea's Water Pollution by Year

(Unit: mg/L)

Year	Hanriver Basin System: Noryangjin		Nakdongriver Basin System: Gupo	
	BOD	SS	BOD	SS
1981	5.2	25.0	4.3	18.8
1985	4.7	22.6	4.2	9.2
1990	3.4	11.3	3.3	10.9
1995	5.5	12.6	8.9	12.6
2000	2.7	9.0	2.9	14.2
2005	3.1	8.8	3.0	17.8
2010	3.2	10.5	2.4	23.3
2012	2.6	12.3	2.4	13.7

Note: The data for Nakdongriver basin system (Gupo) is available from 1982, so the 1981 data in <Table 2-7> is the data collected in 1982, which is the first year of investigation.

Source: Ministry of Environment, Environmental Statistics Portal (http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_03_0100005&inq_gubun=1&lang=kor&list_id=106H_01_002002&l_interval=2#stat_btm, Accessed: 2014.10.25.), (http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_ZZZ_003313&inq_gubun=1&lang=kor&list_id=106H_01_007002002&l_interval=2, Accessed: 2014.10.25.), (http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_ZZZ_003297&inq_gubun=1&lang=kor&list_id=106H_01_007002002&l_interval=2, Accessed: 2014.10.25.).

2. Background and Concept of Green Growth Policies

2.1. Background

In order to share Korea's experience of promoting green growth policies with developing nations, we need to make developing nations understand the economic and environmental circumstances in which Korea decided to promote green growth policies. Hence this section will summarize in detail the domestic and international backgrounds, with which the discussion on green growth began, and in particular, the necessity of an environment-friendly economic growth paradigm that has emerged due to climate change and fossil fuel exhaustion.

Sustainable economic growth has become impossible to achieve with the traditional growth paradigm based on fossil fuels. Along with population growth, energy demand has been increasing rapidly, yet natural resources are finite. Global warming and climate change caused by the increase in greenhouse gas emissions require a transition to a new growth paradigm. Due to the global crisis, which is not a natural phenomenon but has been caused by mankind's desire for development, the necessity of policies for environment-friendly policies has emerged. Accordingly, the Korean government recognized the need to make green the energy-intensive industry, and to create a new industry (new and renewable energy, etc.) through green growth policies. Korea proclaimed the pursuit of green growth policies as a new economic growth paradigm in 2008.

President Lee Myung-bak's commemorative address for the 60th anniversary of Korea started the discussion for green growth in Korea (see <Table 2-8>). In his address, he asserted that Korea needed to take the current situation, in which the Korean economy faced difficulties with the energy crisis, as an opportunity to change the economic structure and create a new growth engine. Also, he proclaimed "Low Carbon, Green Growth" as the axis of a new vision that will achieve sustainable growth while reducing greenhouse gas emissions and pollution (Lee, 2008).

In 2009, the Presidential Committee on Green Growth (PCGG) was organized, and a 'Five-Year Plan for Green Growth,' an action plan for green growth policies, was established. The Five-Year Plan for Green Growth summarizes internal and external conditions as the background for establishing the plan. First, as internal economic conditions, the plan proposed the advent of high industrialization and a knowledge-based economy, the sustenance of growth structure, and a decrease in the relevance of growth engines. As internal social conditions, it listed the improvement in standards of living, and the polarization and pollution caused by development and growth. Then as external conditions, it suggested global warming, energy crises and competition to develop growth engines. Based on these internal and external conditions, the plan proposed future tasks for the economy, society, environment, climate change and energy, and these tasks provided the basis for establishing the Five-Year Plan for Green Growth (PCGG, 2009b, pp.17~25).

2.2. Concept of Green Growth

Although the international community, including Korea, is actively carrying on discussions about responses to climate change and new economic growth paradigms, different countries or international organizations are using different terms. Whereas Korea uses the term green growth, some other countries or organizations use the terms green economy and new climate economy. The term green growth in Korea is meaningful in that it did not suddenly appear as a means by which to carry on discussions in 2008, but was declared as a comprehensive economic development plan. The definitions and characteristics of terms similar to green growth are briefly introduced below.

The concept of green growth has been actively discussed in the Presidential Council for Future and Vision (2009), the Framework Act on Low Carbon, Green Growth (2011), and international organizations such as UNESCAP and OECD (2011). First, the definitions of the concept in Korea are introduced as follows (refer to <Table 2-8>). The Presidential Council for Future and Vision (2009) defined green growth as "growth in harmony between economy and environment by preventing climate change and reducing environmental damage with conservation of energy and resources and efficient use of them, securing new growth engines through research and development of clean energy and green technology and creating new jobs." The「Framework Act on Low Carbon, Green Growth」(2011) defined green growth as "growth achieved by saving and using energy and resources efficiently to reduce climate change and damage to the environment, securing new growth engines through research and development of green technology, creating new job opportunities, and achieving harmony between the economy and environment."

UNESCAP, an organization that has been carrying on research and discussions on green growth, defined the concept as "a policy for the Asia and Pacific region that emphasizes environmentally sustainable economic progress to foster low-carbon, socially inclusive development."[2] The OECD (2011) defined green growth as "fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services, on which our well-being relies."

2. UNESCAP (http://www.greengrowth.org/?q=static-page/sat-10012011-1104/about-green-growth, Accessed: 2014.8.6.).

Table 2-8 | Comparison of Green Growth Definitions

Institution/Organization	Definition
The Fifth Ministerial Conference on Environment and Development in Asia and Pacific (2005)	Environmentally sustainable growth
President Lee Myung-Bak's Commemorative Speech for the 60th Anniversary of the Founding of the Republic of Korea (2008)	Green growth refers to sustainable growth that mitigates greenhouse gas emissions and prevents environmental degradation. It is also a new national development paradigm that creates new growth engines and jobs through green technology and clean energy
Presidential Council for Future and Vision (2009)	Green growth means growth in harmony between economy and environment by preventing climate change and reducing environmental damage with conservation of energy and resources, and the efficient use of them, securing new growth engines through research and development of clean energy and green technology and creating new jobs
Framework Act on Low Carbon, Green Growth (2011)	Growth achieved by saving and using energy and resources efficiently to reduce climate change and damage to the environment, securing new growth engines through research and development of green technology, creating new job opportunities, and achieving harmony between the economy and environment
UNESCAP	Green growth is a policy for the Asia and Pacific region that emphasizes environmentally sustainable economic progress to foster low-carbon, socially inclusive development
OECD (2011)	Green growth means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services, on which our well-being relies

Source: Jung and Kang (2012), p.29.

In addition to the term green growth, similar terms exist regarding environment-friendly economic growth strategies to create a virtuous cycle between economic growth and the environment (refer to <Table 2-9>). The World Business Council for Sustainable Development (WBCSD, 1992, p.9) used the term eco-efficiency, which means "creating more goods and services while using less resources and reducing generations of waste and

contamination." The UN Environment Programme (UNEP, 2011, p.16) used the term green economy, which was defined as pursuing "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities."

The World Bank (2012, p.2) uses the term inclusive green growth and says that this is necessary to increase the social welfare for all, in addition to the focus on the environment and economic growth, in order to achieve sustainable development. The World Bank has introduced broad strategies, including social welfare, rather than just green growth. Recently, Global Commission on the Economy and Climate was organized to conduct and publish a study about the New Climate Economy. New Climate Economy can be understood as an economy that "reduces risks due to climate change, while achieving the goals of economic growth and development", and the report suggests various policy options (New Climate Economy, 2014, p.12).

Table 2-9 | Similar Concepts of Green Growth

Terms	Institutions and Organizations	Definitions
Eco-efficiency	WBCSD (1992)	Eco-efficiency means creating more goods and services while using less resources and reducing the generation of wastes and contamination
Green Economy	UNEP (2011)	Green economy is pursuing improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities
Inclusive Green Growth	World Bank (2011)	Inclusive green growth is choosing inclusive green growth policies to increase the social welfare for all, in addition to the focus on the environment and economic growth, in order to achieve sustainable development
New Climate Economy	Global Commission on the Economy and Climate	New Climate Economy reduces risks due to climate change while achieving the goals of economic growth and development

Source: WBCSD (1992), p.9; UNEP (2011), p.16; World Bank (2012), p.2; New Climate Economy (2014), p.12.

The term green growth that appeared as a new economic development paradigm, and similar terms such as green economy and new climate economy, are very similar concepts in that all of them pursue sustainable economic growth along with responses to climate change. In relation to this, Jung and Kang (2012, p.31) argued that "when seen from the dimension of pursuing increases in employment, economic growth, and poverty alleviation by switching to environment-friendly economic growth strategies…identifying differences between green growth and green economy can be regarded not easy and using the two terms interchangeably is desirable". In this paper, the two terms are regarded as not much different in that they pursue mutual win-win relations of economic development and environment development to achieve the ultimate goal of sustainable development.

3. Institutional Change

After declaring the pursuit of green growth policies as the new economic development paradigm in 2008 by President Lee Myung-Bak, the Korean government has established and implemented economic development policies considering the environment in diverse areas such as green economy, green technologies, green industries, and green consumption. In addition, for efficient implementation of these green growth policies, diverse legal and institutional frameworks were prepared. In this section, institutional changes related to green growth policies will be reviewed in terms of government organizations, laws, and policies.

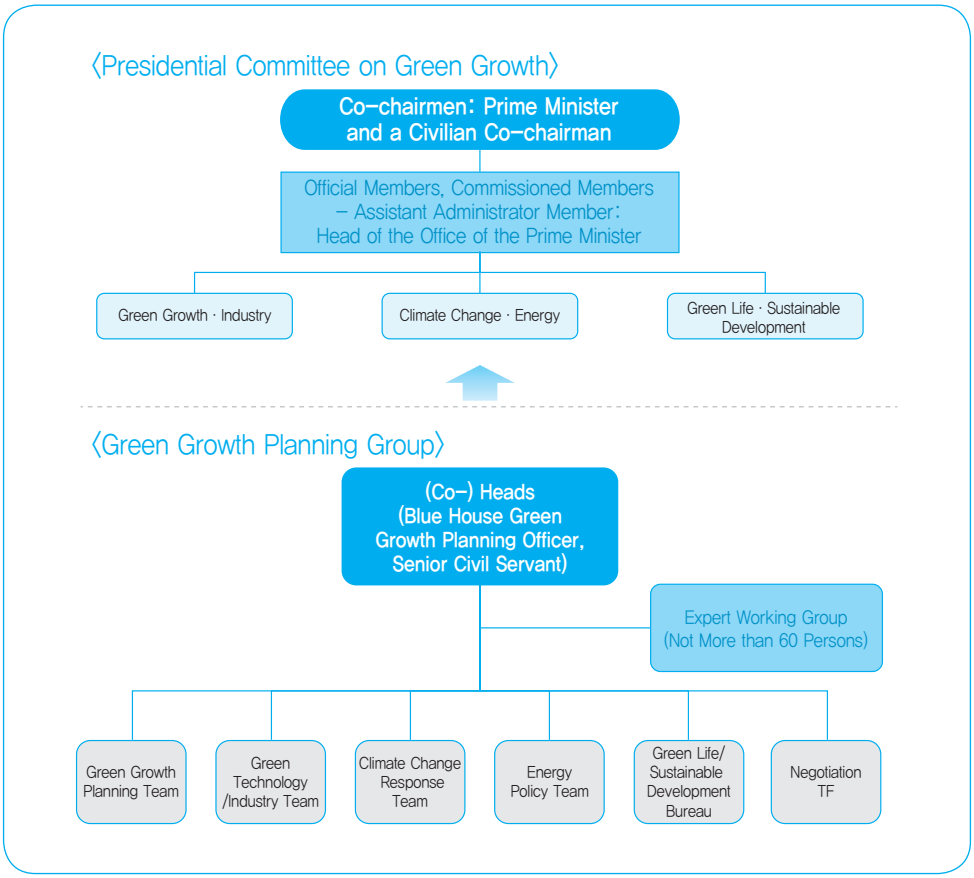
3.1. Presidential Committee on Green Growth

To promote a green growth policy announced in August 2008, the Presidential Committee on Green Growth (PCGG) was launched as a key mechanism in February 2009.[3] The 「Regulations regarding the Establishment and Operation of the Presidential Committee on Green Growth」 was established by presidential instructions in January 2009, and the 「Framework Act on Low Carbon, Green Growth」 was established in 2010 so that the legal basis for PCGG could be established. According to Article 15 of the 「Framework Act on Low Carbon, Green Growth」, PCGG should be in charge of overall matters related to the basic direction of green growth policies, the establishment, change, and implementation of national green growth strategies, responses to climate change, basic energy plans, basic sustainable development plans, green growth of the central government and local governments, green growth related legal systems, finances for green growth, and international cooperation. To put these together, PCGG can be said to be an organization for deliberation regarding major green growth related policies.

[Figure 2-1] shows the structure of PCGG when it was established. PCGG was co-chaired by the Prime Minister and a civilian co-chairman, and consisted of ministers from related departments in the government, the heads of national research institutes as official members, and civilian experts in related areas as commissioned members. Three subcommittees—green growth and industry, climate change and energy, and green life and sustainable development—were installed under the umbrella of the committee and separate expert working groups were organized to pursue communication and cooperation among the government, the private sector, and experts. In addition, to support the committee's work, green growth planning groups were organized and operated with staff members dispatched from various departments and institutions (Blue House, 2009).

3. Although green growth policy agendas exist across many sectors such as climate change, energy policies, and sustainable development, before the establishment of the Presidential Committee on Green Growth, related individual agendas had been distributed to the Committee on Climate Change (belonging to the Office of the Prime Minister), the National Energy Committee (belonging to the Ministry of Knowledge Economy), and the Sustainable Development Committee (belonging to the Ministry of Environment) and addressed separately (Green Book Compilation Committee, 2013, p.533). In order to centralize national green growth capability on the Presidential Committee on Green Growth, green growth related agendas of the Committee on Climate Change, the National Energy Committee, and the Sustainable Development Committee were absorbed and functionally integrated (Blue House, 2009).

Figure 2-1 | Initial Structure of PCGG



Note 1: The above structure of the Presidential Committee on Green Growth reflects when the committee was first established (Year 2009). The above structure of the green growth planning group corresponds to the third period Presidential Committee on Green Growth (2011). Currently, the green growth planning group consists of the green planning cooperation division, the climate change response division, and the green future industry division. The office of the group head is held by the head of the Office for Government Policy Coordination as a concurrent office.

2: While President Lee Myung-bak was in power (2008~2012), the Presidential Committee on Green Growth acted as a core organization for the implementation of green growth policies. Thereafter, when President Park Geun-hye was inaugurated, the Presidential Committee on Green Growth was reestablished as an organization under the umbrella of the Office of the Prime Minister instead of a presidential organization. In this process, the green growth planning group that had supported the activities of the committee in practice was reorganized to have three teams (the green planning cooperation division, the climate change response division, and the green future industry division) instead of the previous six teams.

Source: prepared firsthand by the author referring to the contents of Korean Government (2013), pp.76~78 and the homepage of the Presidential Committee on Green Growth (www.greengrowth.go.kr, Accessed: 2014.8.5.).

The subcommittees of PCGG were reorganized by period. Whereas PCGG consisted of three subcommittees when it was established, it was operated with four subcommittees from the second period (launched in 2010) and the third period (launched in 2011). In the second period, it was operated with four subcommittees: climate change; energy, green technologies; industry, green economy; finance; legislation; and green life, culture & arts. In the third period, it was operated with four subcommittees: climate change; energy, green technologies; industry, green economy and finance; and green life/education/public relations. In the current fourth period (launched in 2013), it has four subcommittees: green growth strategies, climate change responses, energy and green technologies/industry.[4]

PCGG was a presidential organization, in which not only the persons in charge in related departments in the government but also civilian experts participated. To boost public-private partnerships, civil green growth councils were established in individual teams under the umbrella of the PCGG. The civil green growth councils were staffed by important figures from the industrial/financial world, the scientific/research world, consumers, civic organizations, and local governments (Government of Korea, 2013, pp.78~79). The role of the PCGG secretariat was played by the green growth planning group, which was established together with PCGG. The Blue House future vision secretarial official took position as a co-head of the group (called the green growth planning official thereafter) and a green growth planning team, a green technology/industry team, a climate change response team, an energy policy team, a green life sustainable development team, and a negotiation TF team were installed under the umbrella of the group (refer to [Figure 2-1]) (Government of Korea, 2013, p.78).

In addition, to enable green growth to be implemented throughout the country, a provision to allow the organization of Regional Committees on Green Growth under mayors and provincial governors (article 20) was included in the 「Framework Act on Low Carbon, Green Growth」. Accordingly, individual cities and provinces organized Regional Committees on Green Growth, with similar structures to that of the PCGG (Government of Korea, 2013, p.78). After the organization of Regional Committees on Green Growth, green growth related policies and plans were deliberated at the local government level. Therefore, green growth policy discussions and implementation could occur simultaneously at the national and the regional levels.

4. The second period Presidential Committee on Green Growth: Presidential Archives at National Archives of Korea (http://17cwd.pa.go.kr/kr/president/news/news_view.php?uno=1113&board_no=P01, Accessed: 2014.8.4.); the third period Presidential Committee on Green Growth: Blue House press release (31 Oct, 2011); the fourth period Presidential Committee on Green Growth: Presidential Committee on Green Growth (http://www.greengrowth.go.kr/?page_id=196, Accessed: 2014.8.4.).

PCGG led the establishment of the Five-Year Plan for Green Growth and contributed to the establishment of the 「Framework Act on Low Carbon, Green Growth」 in 2011 and the 「Enforcement Decree for the Framework Act on Low Carbon, Green Growth」 in 2012. In addition, PCGG held regular reporting sessions and implementation results reporting sessions in order to share the outcomes of the implementation of green growth policies, check progress, share opinions on future tasks, and promote discussion. By September 2012, 21 PCGG reporting sessions and 11 implementation results reporting sessions were held (Kang, 2012, p.167).

3.2. Establishment of the Five-Year Plan for Green Growth

Korea was able to achieve high growth in short periods of time during its economic development because long-term plans, such as the 'Five-Year Economic Development Plans,' were successfully implemented. Based on that experience, the Lee Myung-Bak government established the 'National Strategy for Green Growth (2009~2050)' in July 2009 as a comprehensive plan for green growth and the 'Five-Year Plan for Green Growth (2009~2013)' as a mid-term strategic plan.

The PCGG, the green growth planning group, the Office of the Prime Minister, the Ministry of Strategy and Finance and related departments, national research institutes, and civilian specialized institutes all participated in creating the five-year plan (PCGG, 2009b, p.12). In particular, to avoid overlapping with various national plans and projects that had been already implemented, existing plans were re-reviewed, integrated and adjusted so that the five year plan could become an inclusive and comprehensive mid-term plan based on the National Strategy for Green Growth (PCGG, 2009b, p.10).

The Five-Year Plan for Green Growth sought to become one of the seven greatest green countries by 2020, and become one of the five greatest green countries in the world by 2050. As action plans, this plan set three strategies: mitigation of climate change and energy independence, creating new engines for economic growth and improvement in quality of life, and enhanced international standing. It presented ten policy directions and 50 practical tasks for achieving the goals established under this plan (refer to <Table 2-10>).

Three national strategies of green growth consisted of mitigation of climate change and energy independence, creating new engines for economic growth and improvement in quality of life and enhanced international standing. Unlike other developed countries, Korea included policies to maintain sustainable economic growth rather than simple measures to climate change. This point is a major feature of the green growth policy. More importantly,

they also stressed the creation of a new industry, but to emphasize the environmentally-friendly economic growth through the greening for the heavy manufacturing industry, which was a major source of economic growth in Korea, for the second strategy. This emphasized the strategy to achieve the greening of manufacturing to continue the production, while reducing greenhouse gas emissions on a relative basis. This strategy also sought to maintain existing industries, and not abandon the conventional growth engine industries.

Table 2-10 | Three Strategies and Ten Policy Directions

Three Strategies	Ten Policy Directions
Mitigation of Climate Change and Energy Independence	1. Effective mitigation of greenhouse gas emissions 2. Reduction of the use of fossil fuels and the enhancement of energy independence 3. Strengthening the capacity to adapt to climate change
Creating New Engines for Economic Growth	4. Development of green technologies 5. The 'greening' of existing industries and promotion of green industries 6. Advancement of industrial structure 7. Engineering a structural basis for the green economy
Improvement of the quality of life and strengthening of the national stature	8. Formation of green national lands and transportation 9. Green revolution of living 10. Implementation of a world level exemplary green growth country

Source: PCGG (2009b), p.31.

Before the five year plan was announced, the 'Comprehensive Measures for Green Technology Research & Development' and 'Visions and Development Strategy for New Growth Engines' were announced in January 2009. The 'Core Green Technology Development and Commercialization Strategy' and 'National Green IT Strategy' were announced in May of the same year (PCGG, 2009b, p.134). Among the strategies announced earlier, the five year plan included a strategy to make intensive investments on core green technologies.

There were five technology areas in which intensive investments would be made: energy source technologies, energy efficiency enhancing technologies, industry/space greenification, environment protection technologies, pollution-free economic activity technologies. For these areas, investment directions by technology were presented, considering nature by technology-investment scales, technology levels, and time points of commercialization-based on four types of investments: short-term intensive investments,

mid-term intensive investments, long-term intensive investment, and long-term gradually increasing investments (refer to <Table 2-11>) (PCGG, 2009b, p.31). In addition, a plan to implement a comprehensive research & development program for 27 core technology areas selected from the 'Comprehensive Measures for Green Technology Research & Development (2009)' was announced. <Table 2-11> sets forth the 27 core technology areas.[5] The Five-Year Plan for Green Growth was intended to lead the development of these green technologies to commercialization to contribute to the creation of new growth engines.

Table 2-11 | Technologies for Intensive Investment and Types of Investment in the Five-Year Plan for Green Growth

Investment Type	Characteristics of Technologies and Relevant Technology Types
Short-term Intensive Investment	- Characteristics: technologies that must be proved and diffused in short periods of time and should enter the market on time - Types: silicon solar battery, Advanced Light Water Reactor, LED for lighting, etc.
Mid-term Intensive Investment	- Characteristics: technologies for which market dominance should be preoccupied through mid-term securing of competitiveness - Types: high efficiency low pollution vehicles, green processes, secondary battery, Non-CO2 treatment, water system water quality management, alternative water resources securing, waste reduction, virtual reality, etc.

5. (1) Climate change prediction and modeling development technologies, (2) Climate change prediction, impact evaluation, and adaptation technologies, (3) Silicon solar battery efficiency enhancing and price reducing technologies, (4) Non-silicon solar battery mass production and core source technologies, (5) Bio-energy production element technologies and system technologies, (6) Advanced light water reactor design and construction technologies, (7) Environment-friendly non-nuclear diffusion fast reactor and cycling nuclear period system development technologies, (8) Fusion reactor design and construction technologies, (9) High efficiency hydrogen manufacturing and hydrogen storage technologies, (10) Next generation high efficiency fuel cell system technologies, (11) Environment-friendly plant growth promotion technologies, (12) Coal gasification complex development technologies, (13) High efficiency low pollution vehicle technologies (14) Intelligent transportation and logistics technologies, (15) Ecological space formation and urban restoration technologies, (16) Environment-friendly low energy building technologies, (17) Green Process technologies considering environmental load and energy consumption prediction, (18)LED for lighting green IT technologies, (19) Electric power IT and electric equipment efficiency enhancing technologies, (20) High efficiency secondary battery technologies, (21) CO2 capture, storage, and treatment technologies, (22) Non-CO2 (greenhouse gas except for CO2) treatment technologies, (23) Water system water quality evaluation and management technologies, (24) Alternative water resources securing technologies, (25) Waste reduction, recycling, and energy recovery technologies, (26) Harmful material monitoring and environment purification technologies, (27) Virtual reality technologies (Source: Ministry of Strategy and Finance, et al. (2009), "Comprehensive plan for green technology research & development (proposal)", p.iii).

Investment Type	Characteristics of Technologies and Relevant Technology Types
Long-term Intensive Investment	- Characteristics: technologies that should be fostered into global leading technologies through long-term investments - Types: climate change prediction, climate change prediction, fast reactor, fusion reactor, hydrogen energy, fuel cell, environment-friendly plant growth, IGCC, urban regeneration, environment-friendly buildings, smart grid, CCS, harmful materials, etc.
Long-term Gradually Increasing Investment	- Characteristics: technologies for which basic sources should be secured through continuous investments - Types: non-silicon solar battery, bio-energy, intelligent transportation and logistics, etc.

Source: PCGG (2009b), p.31.

Unlike past economic development plans, the Five-Year Plan for Green Growth is a comprehensive national development strategy considering the economy, the environment, society, and even living conditions, in order to overcome the current crisis while achieving sustainable development. Technical development and the strengthening of industrial competitiveness for economic growth were established, taking into consideration the environment, and environment-friendly policies such as climate change response and low energy consumption/high efficiency policies, and green national land, transportation, living policies were included in the strategies to pursue improvement in the quality of life. After the five year plan was established, detailed follow-up plans were prepared, mainly by those government departments and local governments that were involved in the plan. Relevant plans and policies are continuously implemented by the current government.[6]

The Five-Year Plan for Green Growth needed large-scale fiscal investment to promote various and detailed policies across several sectors (refer to <Table 2-12>). During the planning period, the government estimated that the support for green growth would cost a

6. The Five Year Plan for Green Growth (2009~2013), which was established in 2009, ended in 2013, and the Second Five Year Plan for Green Growth (2014~2018) was established in 2014, according to the Framework Act on Low Carbon Green Growth. The first plan had limitations in producing real outcomes, included government-led policies based on supply, and lacked considerations for communication among the stakeholders and the concept of social equity. Consequently, the following three policy goals were established. The first policy goal was the establishment of low carbon economic and social structure. The second was the realization of a creative economy with green technology and ICT convergence. The third was the establishment of a safe and sound lifestyle in response to climate change. Five policy directions were established for this purpose. The first direction was effective curbing of greenhouse gas emissions, and the second is the establishment of a sustainable energy system. The third was the construction of ecology for the green creative industry. The fourth was the realization of sustainable green society, and the fifth was the reinforcement of global green cooperation (Joint Work of Relevant Agencies, 2014, p.6, 14).

total of 107.4 trillion KRW between 2009 and 2013. In 2009, the first year of the project, it would cost 17.5 trillion KRW, and it would be necessary to increase the investment amount every year by 10.2% on annual average. The investment is equivalent to about 2% of Korea's annual average GDP, and this investment was reflected in the '2009~2013 National Fiscal Management Plan' (PCGG, 2009b, p.373).[7] The National Fiscal Management Plan (2009~2013), which was established in 2009, considered focusing investment in green growth, new growth engines and the advancement of the service industry as key elements of financial management. In this way, the government established plans to gradually expand its investment on green technologies in R&D part from 1.9 trillion KRW in 2009, to 2.2 trillion KRW in 2010, and to 2.8 trillion KRW in 2013 (Ministry of Strategy and Finance, 2009, p.35 and p.55).

Table 2-12 | Fiscal Investment Plan in Five-Year Plan for Green Growth (2009~2013)

Category	2009	2010~2011	2012~2013	Total
Total (trillion KRW)	17.5	48.3	41.5	107.4
Mitigation of Climate Change and Energy Independence	8.6	29.2	19.2	56.9
Creating New Engines for Economic Growth	4.8	10.7	13.1	28.6
Improvement in Quality of Life and Enhanced International Standing	5.2	10.5	12.2	27.9

Source: PCGG (2009b), p.373.

3.3. Establishment of Legal Foundation

After PCGG was established, experts in the government and private sectors gathered in the committee, and a variety of laws was enacted for the successful implementation of green growth policies. The 「Framework Act on Low Carbon, Green Growth」 and the 「Enforcement Decree for Framework Act on Low Carbon, Green Growth」 were established in 2010. The 「Act on the Allocation and Trading of Greenhouse Gas Emission Permits」 was established in 2012, and the 「Enforcement Decree for the Act on the Allocation and Trading

7. It must be noted that this investment is not new, but funds that were transferred from the existing non-green sector to the green sector. Thus, when evaluating the policy effects, the decrease in the employment and value-add in the sectors without investment must be considered.

of Greenhouse Gas Emission Permits」was established in 2014. In addition, other laws that support sub-projects of green growth include the「Act on the Creation and Facilitation of Use of Smart Grids」, the「Act on the Support for Construction of Green Buildings」, and the「Development Act for Sustainable Transportation and Logistics (Green Book Compilation Committee, 2013, p.13)」. Although various acts have been established in relation to green growth, this chapter will summarize the status of the establishment of legal foundations, centering on the「Framework Act on Low Carbon, Green Growth」and the「Act on Allocation and Trading of Greenhouse Gas Emission」that can be said to be the legal foundations, upon which green growth has been pursued.

3.3.1 Framework Act on Low Carbon, Green Growth

To secure driving force and grounds for green growth policies in Korea, the「Framework Act on Low Carbon, Green Growth」and「Enforcement Decree for Framework Act on Low Carbon, Green Growth」were established in 2010. This Act consists of seven chapters, including national low carbon green growth strategies, organization of PCGG, promotion of low carbon green growth, implementation of low carbon society and realization of green life and sustainable development. <Table 2-13> summarizes it.

Table 2-13 | Structure and Main Content of the Framework Act on Low Carbon, Green Growth

Structure	Main Content
Chapter 2: National Low Carbon Green Growth Strategies	• Matters that must be included in national low carbon green growth strategies • Matters related to the establishment and implementation of plans by central administrative institutions and local governments
Chapter 3: Presidential Committee on Green Growth, etc.	• Composition and operation of PCGG and the functions of the committee • Matters regarding the composition and operation of individual subcommittees, the green growth planning group, and Regional Committees on Green Growth
Chapter 4: Promotion of Low Carbon Green Growth	• Matters regarding the fostering and support for green economy · green industry, resource cycling, promotion of enterprises' green management, green technology research & development and commercialization, dissemination and utilization of information communication technologies, support for small and medium enterprises, and formation of green technology · green industry clusters and complexes

Structure	Main Content
Chapter 5: Implementation of Low Carbon Society	• Matters regarding basic principles and basic plans for responses to climate change • Matters regarding basic principles of and basic plans for energy policies • Matters regarding responses to climate change and management of energy goals • Matters regarding the construction of comprehensive greenhouse gas information management systems • Matters regarding the introduction of cap and trade emission trading system • Matters regarding greenhouse gas management in the transportation sector
Chapter 6: Realization of Green Life and Sustainable Development	• Matters regarding basic principles of green life and sustainable development • Matters regarding the establishment and implementation of basic plans for sustainable development • Matters regarding green national land management, water management to respond to climate change, low carbon transportation systems, green buildings, and the expansion of carbon absorption sources • Matters regarding the promotion of green life movements and education · public relations

Note 1: This is a summary of content addressed in chapter 2 through 6 excluding chapter 1 (general rules) and chapter 7 (supplementary rules).

2: This act was established in 2010 as law no. 9331 and became effective in the same year. This act was amended one time thereafter and has been maintained until now.

Source: 「Framework Act on Low Carbon, Green Growth」(Law no. 11965, other laws were amended on 2013.7.30, became effective on 2013.10.31).

3.3.2. Act on the Allocation and Trading of Greenhouse Gas Emission Permits

To introduce the ETS pursuant to article 46 of the 「Framework Act on Low Carbon, Green Growth」, the 「Act on the Allocation and Trading of Greenhouse Gas Emission Permits」 and the 「Enforcement Decree of the Act on the Allocation and Trading of Greenhouse Gas Emission Permits」 were established in 2012. In spite of the fact that Korea is not a country with obligation to reduce greenhouse gas emissions according to the Kyoto Protocol, the Korean government in 2009 set a national reduction goal to reduce greenhouse gas emissions by 30% of the 2020 BAU level. The establishment and the enforcement decree of this act is meaningful in that it shows Korea's voluntary will to reduce greenhouse gas emissions. When the content presented in this act is seen comprehensively, the emission trading system

can be regarded as a system to select companies that emit large amounts of greenhouse gases to allocate allowable amounts of emissions every year, and allow them to transact excessive emissions or remaining allowances pursuant to market principles. Through the establishment and enforcement of this act, criteria were prepared for the designation of companies, to which amounts of emissions are to be allocated, allocation of emission rights, and transactions of emission rights. The emission trading system will become effective in 2015. <Table 2-14> summarizes the main content of the Act on the Allocation and Trading of Greenhouse Gas Emission Permits.

Table 2-14 | Act on the Allocation and Trading of Greenhouse Gas Emission Permits

Structure	Main Content
Chapter 2: Establishment of a Basic Plan for the Emission Trading System	• Matters regarding mid/long-term policy goals and basic direction of the emission trading system • Matters regarding the establishment of national emission rights allocation plans and the emission committee
Chapter 3: Designation of Companies for Allocation and Allocation of Emission Rights	• Matters regarding the designation of companies for allocation, management, and operation of the emission right register • Matters regarding the allocation, application, notice, and cancellation of emission rights
Chapter 4: Emission Trading	• Matters regarding the registration of emission rights trading accounts, trade reporting, the carbon emission right exchange, and the stabilization of the exchange market
Chapter 5: Reporting, Verification, and Certification of Emissions	• Matters regarding the reporting, verification, and certification of emissions and the establishment of the certification committee
Chapter 6: Submission, Carry Over, Borrowing, Offset, and Extinction of Emission Rights	• Matters regarding the submission, carry over, borrowing, offset, and extinction of emission rights and the management of emission rights and offset register • Matters regarding the collection of fines and delinquency dispositions
Chapter 7: Supplementary Rules	• Matters regarding financial and tax system based support, linkage with international carbon markets, real state surveys, formal objections, fees, and delegation or commissioning of rights
Chapter 8: Penalties and Fines	• Matters regarding violating acts and resultant penalties, penal provisions, and fines

Note: This act was established in 2012 as law no. 11419 and amended once thereafter until now.

Source: 「Act on the Allocation and Trading of Greenhouse Gas Emission Permits」(Law no. 11690, established on 2010.1.13, other laws were amended on 2013.3.23, became effective on 2013.3.23).

3.3.3. Other Laws

With the Five-Year Plan for Green Growth, national and industry level plans—not only for responses to climate change but also for responses in the sectors of national lands and living—were established, and legal grounds for the implementation of the relevant plans were prepared. After the establishment of the five year plan, some existing laws were amended. In particular, new laws were established to promote green national lands, green transportation, and smart grids. In this direction, the 「Development Act for Sustainable Transportation and Logistics」 was established in 2009, the 「Act on the Creation and Facilitation of Use of Smart Grids」 was established in 2011, and the 「Act on the Support for Construction of Green Buildings」 was established in 2012 (refer to <Table 2-15>).

The 「Development Act for Sustainable Transportation and Logistics」 was established to promote reductions in greenhouse gas emissions and energy saving in the area of transportation and logistics that were major greenhouse gas and environmental pollution emission sources in order to form a base of sustainable development of transportation and logistics. In particular, this act includes contents regarding the promotion of switching to sustainable transportation and logistics systems and the activation of carbon free means of transportation.

The 「Act on the Creation and Facilitation of Use of Smart Grids」 was established to foster related industries, actively respond to climate change, form a base of low carbon green growth type future industries, innovate the environment for energy use, and promote development of the national economy through the construction and facilitation of smart grids. This act stipulates content regarding the management of business operators to form a base of smart grids, and facilitate the use of the grids to support investment costs, certification and standardization, designation of stronghold districts, and the designation of industrial development support organizations, as well as the management of related information.

The 「Act on the Support for Construction of Green Buildings」 aims to contribute to the realization of low carbon green growth and the enhancement of national welfare through reductions in buildings' greenhouse gas emissions. It also aims to increase green buildings by stipulating matters necessary for theit formation. This act includes matters regarding the establishment of basic plans for green buildings, green building formation projects, building energy and greenhouse gas management plans, and the implementation of the green building grade system.

These acts were established as ground acts to ensure that the Five-Year Plan for Green Growth established by the government can be implemented without any legal problems. In addition, these acts not only stipulated matters regarding the establishment of basic plans,

but also stipulated matters regarding those projects and support that are necessary to support transportation and logistics, smart grids, and green buildings. This was done so that the driving force of sub-projects could be secured.

Table 2-15 | Act on Allocation and Trading of Greenhouse Gas Emission

Laws	Main Content
Development Act for Sustainable Transportation and Logistics Established on 2009.6.9. (law no. 9777) Became Effective on 2013.5.22. (law no. 11801)	• Purpose: To form a base of sustainable development of transportation and logistics, and contribute to the development of the national economy and the enhancement of national welfare, in response to changes in transportation and logistics conditions such climate change, energy crises, and demands for environmental protection • Matters regarding basic plans for the sustainable development of national transportation and logistics • Matters regarding the promotion of switching to sustainable transportation and logistics systems • greenhouse gas emission reducing actions, socioeconomic cast calculation and management, total vehicle traffic volume setting, transport share structure setting and management, large and heavy cargo transport measures, transfer transportation support, fostering and promotion of use of public transportation, environment friendly transportation and logistics facility development, support for environment friendly transportation technology development, support for expansion of operation of environment friendly transportation means • Matters regarding the activation of non-motorized, carbon-free transportation means - Support for development, support for securing connected transportation facilities, diffusion of non-motorized, carbon-free transportation culture, ambulatory transportation improvement plans, etc.
Act on the Creation and Facilitation of Use of Smart Grids Established on 2011.5.24. (law no. 10714) Became Effective on 2014.1.1. (law no. 12154)	• Purpose: To construct smart grids and facilitate the use of smart grids in order to foster related industries, to actively respond to climate change, to form low carbon green growth type bases of future industries, to innovate the environment for energy use, and to pursue national economic development • Matters regarding the establishment of basic smart grid plans • Matters regarding the establishment of a base of smart grids and the facilitation of use of smart grids • management of smart grid business operators, support with investment costs, certification and standardization, stronghold district designation, designation of industrial development support organizations • Matters regarding the collection, utilization, and protection of smart grid information - Collection/management of information, provision/utilization of information, and information protection actions

Laws	Main Content
Act on the Support for Construction of Green Buildings Established on 2012.2.22. (law no. 11365) Became Effective on 2013.3.23. (law no.11690)	• Purpose: to stipulate matters necessary for the formation of green buildings and to realize low carbon green growth, and contribute to the enhancement of national welfare through reductions in buildings' greenhouse gas emissions and increases in green buildings • Matters regarding the establishment of basic green building plans and green building formation projects • Building energy·greenhouse gas management plan - Construction of building energy/greenhouse gas information systems, management of total building energy consumption by region, restriction of total energy consumption of individual buildings, criteria for improvement of existing buildings' energy performance, disclosure of public buildings' energy consumption, submission of energy saving plans, installation of awnings, etc. for reductions in buildings' energy consumption • Matters regarding the enforcement of the green building grade system - Efficient building energy management, activation of green building construction, green building maintenance/management, green building certification, buildings' energy efficiency grade certification, buildings' energy consumption certificates, etc. • Realization of and support for green building formation - Fostering of, and support for, experts in green buildings, green building formation technology research & development, green architecture center designation, implementation of pilot projects for green building formation, support/special treatment for green building formation projects, financial support and activation • Supplementary rules - Support for green remodeling, support for international cooperation and overseas expansion, formation of green remodeling funds, establishment of green remodeling creation centers, building energy evaluator qualifying examinations, etc.

Source: 「Development Act for Sustainable Transportation and Logistics (law no.11801)」, 「Act on the Creation and Facilitation of Use of Smart Grids (law no. 12154)」, 「Act on the Support for Construction of Green Buildings (law no. 11690)」.

3.4. Establishment of Institutional Foundation

To achieve the goals set by the Five-Year Plan for Green Growth and effectively reduce greenhouse gas emissions, effective and efficient policy means were necessary. However, the government's policy could not be delivered to the market, armed only with past regulations. Therefore, the government used policy means that reflected efficient market principles instead of conventional regulations, induced investments and technical development, and established systems to internalize the external economy. The Greenhouse Gas and Energy Target Management System, the Renewable Portfolio Standard (RPS), and the Greenhouse Gas Emissions Trading Scheme (ETS) that are mentioned most frequently in relation to the foregoing will be introduced.

3.4.1. Greenhouse Gas and Energy Target Management System (2010)

To overcome the energy crisis, and in order to prepare a stable base of economic growth and achieve the national mid-term greenhouse gas reduction goal, national greenhouse gas reduction and energy demand management were necessary. In addition, the introduction of the 'Greenhouse Gas and Energy Target Management System' by sector was promoted by resolving the 'Energy Demand Management Plan' in the emergency economic measure meeting in June 2009 (Government of Korea, 2013, p.92). An institutional base for the implementation of the Greenhouse Gas and Energy Target Management System was constructed as the 「Framework Act on Low Carbon, Green Growth」, and was established in 2010, and the 「Enforcement Decree for Framework Act on Low Carbon, Green Growth」 was established in April 2010. The 「Guidelines for the Operation of the Greenhouse Gas and Energy Target Management System」 were fixed and notified in March 2011, and the system began implementation in 2012. The details of promotion of the Greenhouse Gas and Energy Target Management System as mentioned above were set forth in <Table 2-16>.

Table 2-16 | Details of Promotion of the Greenhouse Gas and Energy Target Management System

Date	Main Content
2009.06	While resolving the 「Energy Demand Management Plan」 in the emergency economic measure meeting, the government decided to introduce the target management system that strengthened means of forcing the performance in order to effectively respond to high oil prices and climate change
2009.11	In the 6th meeting of PCGG, the introduction of the energy target management system and the implementation of a pilot project for national greenhouse gas emission reduction
2010.01	The introduction of the Greenhouse Gas and Energy Target Management System was specified under the 「Framework Act on Low Carbon, Green Growth」 (article 42)
2010.04	The Greenhouse Gas and Energy Target Management System was implemented pursuant to the enforcement decree (articles 26~32) for the 「Framework Act on Low Carbon, Green Growth」
2011.03	The Guidelines for the Operation of the Greenhouse Gas and Energy Target Management System were fixed and notified
2014.05	The Guidelines for the Operation of the Greenhouse Gas and Energy Target Management System were amended and notified

Source: Greenhouse Gas and Energy Target Management System in Industrial and Electricity Generation Sectors (http://www.greencompany.or.kr/introduce/info.aspx, Accessed: 2014.8.5.).

The Greenhouse Gas and Energy Target Management System is a system that "designates companies that use large amounts of greenhouse gases as companies subject to management, sets reduction goals by company subject to management, and firsthand manages the performance (refer to <Table 2-17>)." This system was evaluated as a concrete greenhouse gas reduction policy because companies subject to management in this system accounted for approximately 2/3 of the entire national greenhouse gas emissions (Ministry of Environment press release, October 11, 2011, p.2). The target companies were those with greenhouse gas emissions that are more than 125 thousand ton CO2eq and business place's greenhouse gas emissions that are more than 25 thousand ton CO2eq. Executive authority lies with the Ministry of Environment and managing organizations by sector shall manage companies: Ministry of Commerce, Industry and Energy (industry, development), Ministry for Food, Agriculture, Forestry and Fisheries (agriculture, forestry, livestock production), Ministry of Land, Transport and Maritime Affairs (building·transportation), and Ministry of Environment (wastes).

Table 2-17 | Overview of the Greenhouse Gas and Energy Target Management System

Division	Main Content
Applicable Act	Article 42 of the「Framework Act on Low Carbon, Green Growth」
System Concept	A system that designates companies that use large amounts of greenhouse gases as companies subject to management, sets reduction goals every year, and manages the performance
Subject Companies, Business Places	① Companies with 125,000 ton CO2eq or more of greenhouse gas emissions from all business places of them ② Business places with greenhouse gas emissions exceeding 25,000ton CO2eq
Implementation System	• The Ministry of Environment shall generally manage and managing organizations by sector shall manage companies • Generally managing organization: establish and amend goal management guidelines, and conduct comprehensive inspections/ evaluation • Managing organizations: designate companies subject to management, set goals, manage performance results - Ministry of Commerce, Industry and Energy (industry · development), Ministry for Food, Agriculture, Forestry and Fisheries (agriculture, forestry, livestock production), Ministry of Land, Transport and Maritime Affairs (building · transportation), Ministry of Environment (wastes)
Significance	① Management of emission statistics of major emission sources ② Directory regulatory means for greenhouse gas reductions in the industry sector ③ Prerequisite learning effect before the implementation of the emission trading system

Source: Ministry of Environment press release (January 23, 2014b).

In 2014, the performance results of companies subject to management in 2012 (434 companies in total) were evaluated. According to the results, 21.3 million tons CO2eq, which is 3.78% of the emissions expected for 2012 (563.61 million tons CO2eq), was reduced. This was an achievement that exceeded the 2012 reduction goal 'reduction rate 1.41%, approximately 8 million tons CO2eq.' Among these companies, 90.3% or 392 companies achieved their goals, and among them, 372 companies were acknowledged to have achieved an amount of excessive reductions of 30.05 million tons CO2eq that can be used as emission rights when they participate in emission rights trading. If converted into the Euro, the price of EU emission trading permits would be 130 million EUR based

on 2013 (4.49EUR/ton) and 320 million EUR on the basis of average price of last five years (10.61EUR/ton). According to the press release, the extra reduction was achieved by sector: industrial sector (28.15 million tons CO2eq), food and wood sector (450 thousand tons CO2eq), building and transportation sector (700 thousand tons CO2eq) and waste sector (720 thousand CO2eq). Year 2012 was the first year that activities were performed to reduce greenhouse gas emissions by the Greenhouse Gas and Energy Target Management System. The Ministry of Environment evaluated that performance as greater than expected, as greenhouse gas emissions growth (1.13%) was for the first time lower than GDP growth (2.00%) since the emissions reported by the company started in 2007 (Ministry of Environment press release, January 23, 2014b, pp.1~5).

3.4.2. Renewable Portfolio Standard (RPS) System (2012)

The Renewable Portfolio Standard (RPS) is a "system that made power generation business operators (obligatory supplier) having power generation facilities larger than a certain scale (500MW) compulsorily supply at least a certain ratio of their total power generation quantity using new and renewable energy," which has been implemented since 2012 (homepage of the Korea Energy Management Corporation)[8]. Before the RPS was implemented in Korea, this system had been already introduced and operated in advanced countries such as the USA, the UK, Italy, Sweden, and Japan. Referring to cases of countries in which the system had been already implemented, Korea introduced the system in order to drastically increase new and renewable energy supply, while enhancing the efficiency of supply through competition between business operators and energy sources (PCGG, 2009b, p.79; Ministry of Knowledge Economy press release, 2010, p.1).

The Ministry of Knowledge Economy submitted a revised bill of the act for the introduction of the RPS to the National Assembly at the end of 2008. The revised bill underwent deliberation and a public hearing at the National Assembly thereafter. As a result, the 「Act on the Promotion of the Development and Use of New and Renewable Sources of Energy (law no. 10253)」, its enforcement decree, and its enforcement rules were amended and the guidelines for the management and operation of the Renewable Portfolio Standard system (Ministry of Knowledge Economy notification no. 2010-244) were established in 2010. The rules regarding the supply certificate issue and exchange market operation (center announcement no. 2011-9) were established in 2011, and the RPS was implemented in 2012. Currently, as a department in charge of new and renewable energy

8. Korea New and Renewable Energy Center at Korea Energy Management Corporation (http://www.energy.or.kr/knrec/12/KNREC120700_02.asp, Accessed: 2014.09.08.).

policies, the Ministry of Commerce, Industry and Energy plays the role of deliberating on related policies and establishing plans. The Korea Energy Management Corporation's new and renewable energy center implements practical works for RPS operation.

Business operators that should be obliged to supply new and renewable energy are a total of 14 power generation business operators having facilities exceeding 500MW in scale, including Korea Hydro & Nuclear Power Co., Ltd., Korea South-East Power Co.Ltd., Korea Midland Power Co., Ltd., Korea Western Power Co., Ltd., Korea Southern Power Co.Ltd., and Korea East·West Power Co., Ltd. (as of 2014). They should generate power using new and renewable energy sources in the quantity obtained, by multiplying their total power generation quantity less the power generation quantity using new and renewable energy by their compulsory supply quantity ratio. The compulsory supply quantity ratio was 2.0% in 2012 and has increased thereafter. The ratio is to be raised gradually by 0.5% until 2016, and from 2016, it will be increased gradually by 1% to reach 10% in 2022. By compensating the costs for expanding the supply of new and renewable energy and performing the obligation through the introduction of the RPS, the government wishes to obtain industrial competitiveness and job creating effects through reductions in government budgets, early industrialization, and market expansion (Ministry of Knowledge Economy and Korea New and Renewable Energy Center at Korea Energy Management Corporation, 2012, p.2, Ministry of Knowledge Economy press release reference, 2010, p.3). Main content related to the RPS system is set forth in <Table 2-18>.

Korea Energy Management Corporation announced the outcome of RPS system in the first half of 2014. According to the press release, in 2014, the third year of introducing RPS system, the capacity of renewable energy facilities increased rapidly. The number of installed renewable energy power plants in 2013 was 1,945, and it increased by 115.8% to 2,252 in the first half of 2014. This is the same as 380 renewable energy power plants corresponding to a total of 150MW class installed on a monthly average. In addition, compared to the installation of 2,090 renewable energy power plants of a total of 1,031MW under the Feed in Tariff (FIT) scheme that was introduced in 2002, 5,363 plants of total 2,644MW were expanded during RPS enforcement for two and a half years. In the solar sector, new solar power of 376MW was installed in the first half of 2014 (the cumulative installed capacity of 948MW until the first half of 2014), and it is expected to exceed 2014 additional obligation of 480MW. In the non-solar sector, plants of total 524MW (the cumulative installed capacity of 1,696MW until the first half of 2014) have been installed, and it is also expected to surpass the 2014 non-solar cumulative of 2,000MW (Korea Energy Management Corporation Press Release, August 7, 2014, pp.1~6).

Table 2-18 | Overview of the Renewable Portfolio Standard (RPS) System

<table>
<tr><th>Division</th><th>Main Content</th></tr>
<tr><td>Department in Charge</td><td>Ministry of Commerce, Industry and Energy</td></tr>
<tr><td>Operating Organization</td><td>Korea Energy Management Corporation, New and Renewable Energy Center</td></tr>
<tr><td>Related Regulations</td><td>• 「Act on the Promotion of the Development and Use of New and Renewable Sources of Energy」 (law no. 12296)
• Guidelines for the management and operation of the Renewable Portfolio Standard system (Ministry of Commerce, Industry and Energy notification no. 2014-30)
• Rules regarding supply certificate issue and exchange market operation (new and renewable energy center announcement no. 2014-8)</td></tr>
<tr><td>Obligatory Suppliers</td><td>• Power generation business operators having facilities exceeding 500MW in scale
• A total of 14 companies: Korea Hydro & Nuclear Power Co., Ltd., Korea South-East Power Co.Ltd., Korea Midland Power Co., Ltd., Korea Western Power Co., Ltd., Korea Southern Power Co.Ltd., and Korea East·West Power Co., Ltd., Korea District Heating Corporation, Korea Water Resources Corporation, SK E&S, GS EPS, GS Power, POSCO Energy, MPC Yulchon Generation Co., Ltd, Pyeongtaek Energy Service Co., Ltd. (2014)</td></tr>
<tr><td>Obligatory Supply Quantities by Year</td><td>• Each obligatory supply shall generate power using new and renewable energy sources in the quantity calculated by "total power generation quantity (excluding the quantity generated using new and renewable energy) × compulsory supply quantity ratio"
<table>
<tr><th></th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2020</th><th>Post-2022</th></tr>
<tr><td>Required Supply Ratio (%)</td><td>2.0</td><td>2.5</td><td>3.0</td><td>3.5</td><td>8.0</td><td>10.0</td></tr>
<tr><td>Solar Required Supply (GWh)</td><td>276</td><td>723</td><td>1,353</td><td>1,971</td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td>Penalty</td><td>• Fines are imposed on the difference between the quantity actually supplied using new and renewable energy and the compulsory supply quantity
- Fines are imposed considering the reason for non-performance and the number of times of non-performance within 150% of the average market price of the supply certificate
- The performance of the difference between the quantity actually supplied using new and renewable energy and the compulsory supply quantity can be postponed</td></tr>
</table>

Division	Main Content
Penalty	- Up to 20% of the compulsory supply quantity can be postponed for less than three years. - Provided that, by 2014, up to 30% of the compulsory supply quantity can be postponed.
Effect of the Implementation	Supply expansion: Supply effects are increased because power generation companies are directly compelled to supply new and renewable energy supply Financial burdens are relieved: Government budgets will be saved because performance costs can be compensated through power markets Fostering of the industry: The industrial competitiveness will be strengthened and jobs will be created through early industrialization and market expansion

Source: Ministry of Knowledge Economy and Korea New and Renewable Energy Center at Korea Energy Management Corporation (2012), p.2, Ministry of Knowledge Economy press release reference data (2010), p.3.

3.4.3. Greenhouse Gas Emissions Trading Scheme (ETS) (2015)

After the adoption of the Kyoto Protocol in 1997, as means of assisting greenhouse gas reductions, 'Kyoto Mechanisms' using market principles such as the clean development mechanism (CDM), joint implementation (JI), emission trading (ET) were introduced (Ministry of Strategy and Finance, 2014, p.8). Accordingly, advanced countries such as the EU (implemented in 2005), New Zealand (implemented in 2008), Australia (implemented in 2011), and the USA (implemented in 2009) have introduced and operated the ETS to minimize the effects brought about by increases in greenhouse gas emissions using market mechanisms (Ministry of Strategy and Finance, 2014, p.13). The Korean government included the fostering of carbon markets, centering on the emission trading system in the detailed practical tasks presented for 'the formation of a base of green economy' that was set as the seventh policy direction in the Five-Year Plan for Green Growth. Thereafter, through many discussions and consultation, the ETS was introduced in 2015.

The process through which the emission trading system was introduced will be described now. First, legal grounds for the introduction of the emission trading system were prepared in 2010 by establishing the「Framework Act on Low Carbon, Green Growth」. Article 46 of this act stipulated that the government "may operate a Greenhouse Gas Emissions Trading Scheme to efficiently achieve national greenhouse gas reduction goals using market functions." Thereafter, in 2011, as a preparation stage for the emission trading scheme, the

'Greenhouse Gas and Energy Target Management System' was implemented. In 2012, the 「Act on the Allocation and Trading of Greenhouse Gas Emission Permits (law no.11419)」 and the enforcement decree (presidential decree no. 24180) were established to prepare legal grounds for ETS.

The ETS is a "system to allocate greenhouse gas emission rights to companies, allow emitting acts within the limit of allocated quantity, allow transactions with other companies for remaining or short emission rights." Therefore, "individual companies can autonomously determine where to reduce greenhouse gas emissions or buy emission rights based on their ability to reduce greenhouse gas emissions to meet their allowed emission quantities" (Ministry of Strategy and Finance, 2014, p.4). For this system, the Ministry of Strategy and Finance plays the role of a general management organization and performs functions such as the establishment of basic plans, taking the office of the chairman of the emission right allocation committee, determination of the direction of operation of the emission trading system, and deliberation on and adjustment of allocation plans. As a competent administrative agency, the Ministry of Environment establishes allocation plans and actually operates the emission trading system (refer to <Table 2-19>) (Ministry of Strategy and Finance, 2014, p.32).

Companies or business places subject to the emission trading system are "companies with the annual average greenhouse gas emissions over the last three years exceeding 125,000 CO2 tons or business places with the annual average greenhouse gas emissions over the last three years exceeding 25,000 CO2 tons" and include "companies that voluntarily applied for participation regardless of emission standards." The government wishes to achieve national greenhouse gas reduction goals effectively by including those companies and business places that emit large quantities of greenhouse gases (Ministry of Strategy and Finance, 2014, p.39). Main content related to the ETS is set forth in <Table 2-19>.

Table 2-19 | Overview of the ETS

Division	Main Content
Implementation System	• The Ministry of Strategy and Finance establishes basic plans and the Ministry of Environment plays the role of a competent administrative agency • The Ministry of Strategy and Finance - Establishes basic plans, takes the office of the chairman of the emission right allocation committee, determine the direction of operation of the emission trading system, and deliberate on/adjust of allocation plans • Ministry of Environment (competent administrative agency) - Establishes allocation plans and actually operates the emission trading system
Related Regulations	• 「Framework Act on Low Carbon, Green Growth」 (law no. 11965) - 「Act on the Allocation and Trading of Greenhouse Gas Emission Permits」 (law no. 11690)
Concept of the Emission Trading System	• Allocate greenhouse gas emission rights to companies, allow emitting acts within the limit of allocated quantity, and allow transactions with other companies for remaining or short emission rights • Individual companies can autonomically determine where to reduce greenhouse gas emissions or buy emission rights based on their ability to reduce greenhouse gas emissions to meet their allowed emission quantities
Establishment of Basic Plans	• Basic plans (in the nature of emission trading system related mid/long-term comprehensive plans) are established every five years or ten years • Procedure: make a draft of a basic plan → discussions among related organs · a public hearing is held →deliberation by the committee on green growth · a cabinet council
Goal	• Effective achievement of national greenhouse gas reduction goals
Five Major Principles	1. Observe international conventions 2. Consider economic effects 3. Activate market functions 4. Fair trading 5. Compliance with international standards
Scope of Application of the ETS	• Companies with the annual average greenhouse gas emissions over the last three years exceeding 125,000 CO2 tons or business places with the annual average greenhouse gas emissions over the last three years exceeding 25,000 CO2 tons are the subjects and companies that voluntarily applied for participation regardless of emission standards are included

Source: Ministry of Strategy and Finance (2014), pp.1~39.

4. Major Environmental Restoration Policies

If green growth policies are limited to the level of agendas of certain government policies, their sustainability cannot be guaranteed, and the ultimate goal of sustainable development cannot be achieved. In Korea, green growth policies have been implemented in earnest after President Lee Myung-Bak proclaimed green growth as a new economic development paradigm in 2008. Green growth policies are not new fully developed policies, but contain policies conducted by the previous government with a similar policy orientation. However, since considerations about growth were treated more heavily than considerations about the environment at that time, damage to the environment could not be avoided in the process. However, the awareness of the environment has been strengthened gradually in the process of economic development, and growth policy with environmental considerations have come to be considered in recent years.

Representative examples include afforestation, Saemaul Movement, Shihwaho Lake restoration, the Ulsan Taehwagang (river) restoration into an ecological river, and the Cheonggyecheon (Stream) Restoration Project. In particular, forest greenification and Saemaul Movement are important policies that are extensions of green growth. Shihwaho Lake restoration, Ulsan Taehwagang (river) restoration into an ecological river, and Cheonggyecheon (Stream) Restoration Project are cases of ecology and environment protection projects. These policies were intended to maintain environmental conditions without damaging the motive power for industrial development during economic growth in Korea.

Therefore, before describing major outcomes of green growth policies in Korea in this section, the process of implementation, outcomes, and relationships with green growth policies of afforestation projects, the Saemaul Movement, the Ulsan Taehwagang (river) restoration, and the Shihwaho Lake restoration are representative cases of policies with similar orientations to those of green growth policies.

4.1. Afforestation Project

The afforestation project shares a common purpose with green growth policies and was implemented with the cooperation of the government and the private sector to stop the forest degradation. It is one of the projects, in which developing nations show a keen interest. Due to the procurement of war materials by the Japanese government and population growth following independence, Korea faced severe forest degradation. After Korea's independence from Japan in 1945, the Korean government, created in 1948, established the Bureau of

Forest under the Department of Agriculture and Forestry and devised the 'Ten-Year Plan for Erosion Control (1948~1957).' However, the Korean War began in 1950, and the policies and projects for forests were suspended. During the war, in September 1951, 'Temporary Measures for Forest Protection' was enacted in Busan, and Korea's policies and projects for forests resumed. Despite the national crisis caused by the war, the government enacted related laws, granted authority to the forest police for protection, and deployed about 1,000 people for protection of private forests because the level of forest degradation was very severe in Korea. The government provided all of the necessary funds.[9]

The forest projects implemented by Korea can be largely categorized as afforestation, erosion control, readjustment of slash-and-burn fields, forest fire prevention, forest disease, pest control, etc. After the war, as aid from United Nations Korean Reconstruction Agency (UNKRA) and International Cooperation Agency (ICA) helped the restoration projects make an impact, forest policies had been actively implemented. For the implementation of forest policies, the Forest Law (1961), Work against Land Erosion or Collapse Act (1962) and Temporary Measures Act to Promote Afforestation (1963) were enacted, and the Seven-Year Plan for Erosion Control and Greening (1965~1971) was established. Since the initial phase of economic growth, the interest in afforestation continued (Korea Saemaulundong Center, 2013, p.242). Also, during this period, the project to develop forests for fuels was implemented along with erosion control, in order to stop indiscriminate gathering of forest fuels and promote smooth supply of forest fuels. To this end, the project for afforestation of private forests and the Ten-Year Plan about Erosion Control were established in 1955. Also, the policies for reduction of forest fuels were drastically promoted, encouraging the supply of anthracite and implementing the project for development of forests for fuels separately in 1957 (National Archives of Korea Homepage).[10]

As a result of the concerted afforestation efforts of the Korean government, the denuded land greatly decreased from about 680,000 ha in 1952, to 370,000 ha in 1962 and to 80,000 ha in 1964. Since then, the Korean government continuously made efforts for afforestation through the Erosion Control and Greening Project from the 1970s to the 1990s. Based on the above-mentioned afforestation project, the growing stock greatly increased from 69 million m in 1970 to 800 million m in 2010 (refer to <Table 2-20>).[11] One successful

9. National Archives of Korea (http://theme.archives.go.kr/next/forest/policy/startBefore.do, Accessed: 2014.8.7).

10. National Archives of Korea (http://theme.archives.go.kr/next/forest/scene/successfulCase.do, Accessed: 2014.9.29).

11. National Archives of Korea (http://theme.archives.go.kr/next/forest/outline/greenKept.do, Accessed: 2014.9.29).

case of erosion control projects is the anti-flood afforestation project in Youngil region (refer to [Figure 2-2]). Over the period of five years, it prevented soil erosion and forest degradation in the industrial region in Pohang, contributing to watershed conservation (National Archives of Korea Homepage).[12]

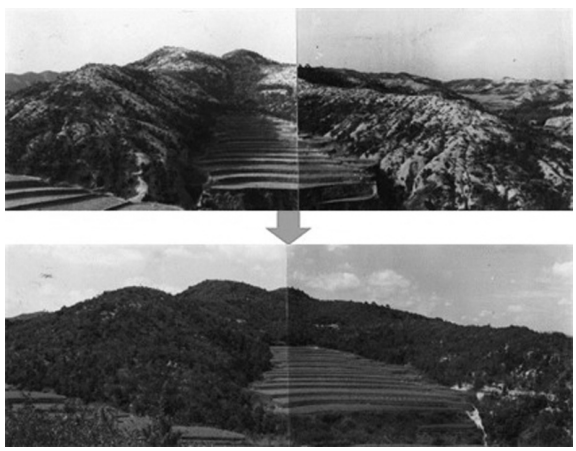
Table 2-20 | Annual Growing Stock

(Unit: million m)

Category	1970	1975	1980	1985	1990	1995	2000	2005	2010
Growing Stock	69	105	146	179	248	309	408	506	800

Source: Korea Forest Service, Forest Basic Statistics (http://www.index.go.kr/potal/stts/idxMain/selectPoSttsIdxSearch.do?idx_cd=1300&clas_div=&idx_sys_cd=628&idx_clas_cd=1, Accessed: 2014.9.29).

Figure 2-2 | Result of Erosion Control Project (Youngil-gun) (1972~1975)



Source: National Archives of Korea (http://theme.archives.go.kr/next/forest/scene/successfulCase.do, Accessed: 2014.8.7.).

12. National Archives of Korea (http://theme.archives.go.kr/next/forest/scene/successfulCase.do, Accessed: 2014.9.29.).

4.2. Saemaul Movement

Saemaul Movement was a national movement and rural policy, implemented in all parts of the country during the 1970s. In the industrial process, rural alienation problem emerged, so it was introduced by the need for balanced regional and rural modernization. It was conducted among 3,400 rural villages, and a primary goal was to improve farm income. Farm income in 1971 was 360,000 KRW, but was significantly increased by 1.16 million KRW in 1976 and 4.47 million KRW in 1982 (National Council of Saemaul Undong Movement, 2012, p.15). The primary success factor of Saemaul Movement was the role of the government, which contributed to foster and nurture rural Saemaul leaders. The government trained the Saemaul leaders through Saemaul Training Institute for the successful implementation of the movement. It elected one male leader and one female leader in all rural areas, and trained them to become the driving force of the movement through technical training and mental training (National Council of Korea Saemaulundong Center, 2012, p.9).

Saemaul Movement was a major factor to improve forest greening projects and raise farm income in Korea. The Movement was launched in April 1970, and tree planting has become a part of the Movement since 1971. Before the Movement, desolated areas were significantly reduced by erosion control projects. Also, afforestation area was greatly enlarged in accordance with the strong afforestation projects and erosion control business from the movement.

<Table 2-21> contains the main components of the tree planting project from 1972 to 1975. Afforestation projects implemented in the early stage of Saemaul Movement contain afforestation of mountains behind villages, afforestation in villages, tree planting from workplace, schools and families, creating flower gardens, and others.

Table 2-21 | Tree Planting Policy in the Early Stage of Saemaul Movement

Project Name	Content	
Period	4-Year Plan (1972~1975)	
Basic Policy	Separate from the afforestation plan of Korea Forest Service	
Afforestation of Mountain Behind a Village	Project entity	Village forestry association (ri and dong)
	Afforestation unit	Village unit
	location	Composition of fruit trees near the village and fuel forest at the top of that
	Species	Fruit trees (chestnut, persimmon, walnut, cypress, ginkgo), Gangwon-do (apricot), Jollanam-do (citron), Chuncheongnambuk (jujube), fuel forest (black locust tree, hirsute)
Afforestation in a Village	Species	Road side (Italian poplar, populous tomentiglandulosa, ginkgo), fence (forsythia, hibiscus, oriental arborvitae, trifoliate orange)
Tree Planting as a Unit of Work, School Family	One person plant one tree on the day of birth, admission, marriage, sixtieth birthday, anniversary	
Creating a Flower Garden	Creating a flowerbed	

Source: Korea Saemaulundong Center (2013), p.262 (original source: 1972 Saemaul handbook, the Ministry of Home Affairs's farming community leader's training institute.

<Table 2-22> shows the percentage composition of the afforestation area as part of the Saemaul Movement against the national afforestation area by the first plan for Erosion Control and Greening (1971~1978). During the three years from 1977 to 1979, the afforestation by the Saemaul Movement occupied over 50% of total afforestation area, so the Movement contributed considerably to the national afforestation.

In the name of 'Building Greener Mountains', 3,453 villages participated as the part of the Saemaul Movement and planted trees in 5,884 ha with expenses of 186 million KRW. Tree planting enlarged its scale in 1972 as the 'Saemaul Tree Planting' project. This project took over 1.24 million man-days, and 29.2 million trees were planted in 23,091 ha. In 1973, in which the Erosion Control and Greening Project began, a reforestation program was promoted on 11% of the total afforestation area (1.12 million ha) that was 12,000 ha. It was then extended to 60.5% of total afforestation area (2.25 million ha). During the

Second Erosion Control and Greening Project, reforestation work completed on 38% area of afforestation (966 thousand ha), and many people had been involved in the project (1.24 million people in 1972/6.7 million people in 1977). The areas, in which fruit trees and rapid growth trees were planted, were 105,422 ha in 1979, which was similar to the areas afforested during the first ten-year plan. Since the 1980s, the afforestation area had been reduced, so total afforestation area in 1987, the last year of the second ten-year plan, was 17,241 ha (Korea Saemaulundong Center, 2013, p.243, 262, 282, 288~289).

Table 2-22 | Comparison between Saemaul Afforestation Area and National Afforestation Area during the First Erosion Control and Greening 10-year Project (1971~1978)

Year	National Afforestation Area (ha) (A)	Saemaul Afforestation Area (ha) (B)	Ratio of Saemaul Afforestation to National Afforestation Area (B/A) (%)
1972	88,934	23,091	26.0
1973	112,316	11,976	10.7
1974	134,862	39,855	29.6
1975	173,650	78,881	45.4
1976	203,900	83,000	40.7
1977	225,837	136,700	60.5
1978	229,208	123,400	53.8
1979	189,394	105,422	55.7
1980	165,583	73,000	44.1
1981	153,261	30,000	19.6
1982	135,979	66,414	48.8
1983	94,138	32,800	34.8
1984	71,605	31,689	44.3
1985	52,327	13,015	24.9
1986	52,792	14,469	27.4
1987	50,792	17,241	33.9

Source: Korea Saemaulundong Center (2013), pp.284~285.

The Saemaul Movement in Korea was a successful nationwide movement that improved farm income, as well as increase the capacity of rural area by training local leaders. Also, it had contributed to raise the awareness of the public, including farmers, and to afforestation of the country. One can see that the Saemaul Movement is similar to green growth policies promoted by Korea in this regard. Many developing countries have a significant interest in the Saemaul Movement in Korea, and want to share its experience.

4.3. Volume Based Waste Fee System[13] [14]

In Korea, consumption increased during economic growth, and waste discharges rapidly increased as well. <Table 2-23> shows total and per capita figures for domestic waste treated from 1987 to 2011. In 1987, 67,031 tons of domestic waste were generated per day on average, and were treated by landfill, incineration, or recycling. Thereafter, the quantity of domestic wastes treated steadily increased until 1991 when 92,246 tons of domestic wastes were treated per day on average. Since 1992, waste has been decreasing, with 48,934 tons per day being processed in 2011. The quantity of waste treated per person steadily increased from 1987 to 1991 when the highest value 2.13kg/day was recorded. Since then, the quantity has been declining and 0.98 tons per capita were treated in 2011.

Waste disposal has decreased as people have started to recognize environmental problems caused by increasing the amount of waste. The government also became interested in solving waste problems with other environmental policies. As a result, in 1995, a volume-based waste fee system was launched to reduce waste, by making the person who disposes of waste pay a processing cost in proportion to the amount of waste being thrown away.

13. A report with detailed information regarding the Standard Plastic Garbage Bag System in the process of economic development of Korea is documented by the Korea Environment Institute (2012). The research jointly conducted by the Ministry of Strategy and Finance and KDI School of Public Policy and Management is titled "Creating a Module based on Our Economic Development Experience, 2011."

14. In an effort to tackle the issue of waste disposal, power plants using landfill gas started to commercially operate on landfill sites in the Seoul metropolitan area since 2007. Wastes from Seoul, Incheon, and Kyounggi Province are buried in the landfill sites in Seo-gu, Incheon. All landfill gases (i.e. CH4 and CO2) emitted in the process of burying wastes are captured and converted into energy through landfill gas-to-electricity facilities. These plants produce the fuel of 523m³ for power generation every day, and the energy generated using the fuel is used to power boilers in the leachate treatment facilities and office. (http://www.slc.or.kr/design/contents.asp?code=101212&lang=kor&left=15&sleft=17, Data Search Date: 10.25. 2014). Using landfill gases as a resource may not seem to be directly related to the issue of the Standard Plastic Garbage Bag System. However, we can view this as a resource recovery policy. Whilst the Standard Plastic Garbage Bag System is to cut down on the waste volume in the first place, converting landfill gas as into a resource is to better manage wastes that are generated already. Such project has been discussed even before the Green Growth Policy. There have been discussions between the government and related agencies since 1999, and the actual operation of the landfill gas-to-electricity plant started in 2001 (http://dream-ics.slc.or.kr/cp/gs/gs0030/cpgs0030/viewPage.do, Data Search Date: 10.25. 2014).

Table 2-23 | Trend in the Quantity of Domestic Waste Treated

Year	Total Quantity Treated (tons/day)	Quantity Treated Per Person (kg/day)
1987	67,031	1.61
1988	72,897	1.73
1989	78,021	1.84
1990	83,962	1.96
1991	92,246	2.13
1992	75,096	1.72
1993	63,940	1.45
1994	58,118	1.3
1995	47,774	1.06
2000	46,438	0.99
2005	48,398	1.01
2010	49,159	0.99
2011	48,934	0.98

Note: The quantity of domestic wastes treated per person was calculated by this author based on the 'estimated populations by age (city/do)' in the national statistics portal.

Source: Ministry of Environment (2011), p.25, national statistics portal, estimated populations by age (city/do) (http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=MT_ZTITLE&parmTabId=M_01_01#SubCont, Accessed: 2014.09.29).

<Table 2-24> summarizes the preparation process and discussions on the introduction of the volume-based waste fee system from 1992 to 1995. From 1992, the feasibility of introducing the waste fee system was reviewed, opinions were collected, and opinions of related organizations were inquired. Based on the results of discussions and studies conducted at that time, the volume based waste fee system was implemented in 1~3 cities, guns, or gus each selected from 15 cities or provinces in Korea, from April to December of 1994 on a trial basis. According to the results of the trial implementation, the volume-based waste fee system had effects, such as reductions in waste discharges, increases in the discharges of recyclable materials, enhancement of waste finance self-reliance, and budget saving. Therefore, national public relations were conducted to implement the volume-based waste fee system throughout the country (Korea Environment Institute, 2012, pp.33~34).

Table 2-24 | Preparation for Introduction of the Volume Based Waste Fee System

Stage	Time	Content
Feasibility of Introduction of the Volume Based Waste Fee System	1992.9~1993.1	The feasibility of introduction of the volume-based waste fee system was verified through surveys and research
	1993.2~1993.8	Opinions on the necessity of introducing the volume-based waste fee system were collected from a variety of citizens Public hearings and meetings participated in by related specialized private organizations and cleaning companies were held (1993.2~1993.7) Meetings were held with consumer organizations, housewife organizations, and garbage bag manufacturers (1993.7) Opinions were collected from city/do cleaning section chief meetings and waste sub-committees (1993.7~8)
	1993.9	Opinions of related organizations such as the Ministry of Government Administration and the Ministry of Justice on the manufacturing of standard garbage bags
Implementation on a Trial Basis	1993.11	The policy to implement the volume-based waste fee system was confirmed and trial guidelines were notified
	1994.4~1994.12	The volume-based waste fee system was implemented on a trial basis
Preparation for Expanded Implementation Throughout the Country	1994.6~8	Interim evaluation of the volume-based waste fee system by the civil evaluation group (August), volume based waste fee system related public officials' workshop (June)
	1994.9~1995.12	Supplementary implementation guidelines were prepared, city/do related organization meetings were held and interim evaluation of the situation of implementation by local governments was conducted (1994.11) Measures to relieve problems appeared in the interim checks were instructed (1995.12)

Source: written based on the Korea Environment Institute (2012), pp.32~35.

The volume-based waste fee system was implemented across the country from January 1, 1995. The volume based waste fee system was implemented under the Polluter Pays Principle and the discharge-based system as basic principles to have polluters pay pollution costs, thereby making them suppress their polluting acts and to impose fees based on actual discharges in order to secure equity.[15] The volume-based waste fee system applies to domestic waste but not to designated or industrial waste. People had to buy garbage bags made by city/gun/gu from designated selling places such as supermarkets, pharmacies, and apartment management offices, instead of paying garbage collection fees as they had in the past, and the garbage bags could be used only in the regions set forth on their outside surface. Garbage bag prices were determined by local assemblies as ordinances comprehensively considering the cost to dispose of wastes generated in relevant regions, the levels of finances of relevant local governments, and residents' living standards (Korea Environment Institute, 2012, pp.45~48).

[Figure 2-3] shows garbage bags under the volume-based waste free system. In 1995 when the volume-based waste fee system was introduced, prices for a 20 liter size volume based waste fee system bag were determined in a range of 200~300 KRW and final selling prices of garbage bags were stipulated to be applied differently according to local governments' conditions based on "disposal cost per liter bag volume residents' burden ratio (targeted value)+garbage bag manufacturing cost+selling fee." The volumes of standard bags being sold were 2, 3, 5, 10, 20, 30, 50, 75, and 100 liters as of 2013. The volumes of standard bags have become more diverse over time (Korea Environment Institute, 2012, pp.35~36, 44~48).

After the introduction of the volume-based waste fee system, the method of disposing general wastes and that of recyclable materials were stipulated differently. General wastes were required to be put into the bags up to the dotted lines on the bags and discharged in front of houses and recyclable materials were required to be discharged after being separated into paper, bottles, cans, and plastics. Large wastes such as wardrobes were disposed by reporting the address, waste types, and sizes to the administrative agency by phone in advance so that public officials could visit, collect the wastes, and charge the cast. Other wastes excluded from the subjects of the volume based waste fee system were disposed of in methods determined according to city/gun/gu ordinances (refer to <Table 2-25>) (Korea Environment Institute, 2012, pp.35~36, 44~46).

15. Seoul resource recovery facility (http://rrf.seoul.go.kr/waste/manage/cwaa0201.jsp?m_topMenuVal=1&m_leftMenuVal=0&m_submenu=2, Accessed: 2014.9.28).

Figure 2-3 | Garbage Bags under the Volume Based Waste Fee System

Source: Seoul Resource Recovery Facility (http://rrf.seoul.go.kr/waste/manage/cwaa0202.jsp?m_topMenuVal=1&m_leftMenuVal=0&m_submenu=2, Accessed: 2014.09.29.).

Table 2-25 | Forms of Waste Discharges by Discharge Source

Division	Discharge Sources	Forms of Discharge
Subjects of Use of Volume Based Waste Fee System Bags	Home discharge sources	Volume-based waste fee system bags for home
	Business place	Volume-based waste fee system bags for business places
	Road and green area wastes	Volume-based waste fee system bags for the public
Subjects Excluded from the Application of the Volume Based Waste Fee System Bag	All regions	Recyclable materials, coal briquette ash, separate discharges of large wastes
	Some business places that discharge large volumes of wastes	Entrusted to collection companies
	Construction work site	Separate discharge of construction wastes (Sewage dredged soil)
	Regions in the vicinity of incineration plants	Separate discharge of combustible wastes
	Regions in the vicinity of landfills	Separate discharge of incombustible wastes

Source: Korea Environment Institute (2012), p.45.

The quantity of domestic waste per capita, an indicator of performance, has greatly decreased after implementing the volume-based waste fee system. As already described in <Table 2-23>, the amount of processed domestic waste has decreased since volume-based waste fee system was discussed in 1992, and it has fallen dramatically since implementation in 1995. In particular, the volume of domestic wastes discharged per person that recorded the maximum value in 1991 at 2.13kg/day, has decreased to below a half of the level in 1991 to 0.98kg/day by 2011.

In addition to the reduction of emissions, processing costs decreased due to reduced emissions. <Table 2-26> represents cost savings in the process of waste disposal after the volume-based waste fee system, and it can be easily seen that the total savings have been increasing continuously since 1995. In 1995, total savings were 380 billion KRW, but 800 billion KRW was reduced in 2004 as cost savings have doubled compared to those in 1995. This phenomenon usually occurs due to the total waste emissions reduction and transportation costs savings, so it was caused by the reduction of total waste.

Table 2-26 | Yearly Cost Savings related to the Disposal of Wastes (Landfill and Incineration)

(Unit: million KRW)

Year	Total Aounts Saved	Collection and Transportation Costs	Landfill Cost	Incineration Cost
Total	5,746,005	5,321,278	1,602,612	-1,177,885
1995	383,256	305,214	74,932	3,111
1996	312,981	264,239	70,829	-22,087
1997	402,502	350,417	97,903	-45,817
1998	599,413	520,676	145,045	-66,308
1999	651,189	581,746	167,922	-98,480
2000	673,112	617,264	183,819	-127,971
2001	638,441	617,739	195,098	-174,396
2001	641,492	640,325	208,653	-207,486
2003	647,525	651,550	213,960	-217,985
2004	796,092	772,108	244,450	-220,465

Note: The minus (-) values among the amounts saved from incineration costs indicate cost increments.
Source: Korea Institute for Industrial Research (2005), p.82.

In addition, as general wastes have been discharged in garbage bags and recyclable materials have been discharged separately from general wastes following the implementation of the volume-based waste fee system, positive results were brought about in terms of hygiene and landscapes because various vermin-rodents, cockroaches, etc. decreased, bad smells decreased, and urban views were improved. Thereafter, the volume-based waste fee system was expanded further and the volume-based food waste fee system was implemented in 2012. In addition, various policies and campaigns for reductions of discharges or treatment of wastes by type were implemented, leading to active reductions in wastes (Korea Environment Institute, 2012, pp.38~40).

The implementation of the volume-based waste fee system could achieve its goals, reductions in wastes and increases in recyclable materials and form the basis of green consumption and production. The national consciousness about waste discharges that was missing before the implementation was formed through public relations implemented together with the implementation of the volume-based waste fee system, so that people's perception about environmental pollution could be enhanced. Although there have been many positive outcomes, great difficulties were experienced in implementing the system because of hurried establishment of ordinances, short preparation periods, and the lack of perceptions of the beginning of the year and long holidays (Korea Environmental Institute, 2012, p.36). However, the system has become stable through continued supplementations and improvement. Even though the government and people underwent trial and error in the early stage of policy implementation, the volume-based waste fee system can be evaluated to be quite meaningful and positive in terms of the environment, economy, and national consciousness.

4.4. Restoration of Lake Shihwa

Lake Shihwa is an artificial lake surrounded by Siheung City, Ansan City and Hwaseong City, and its construction began, based on the Banwol Special Regional Development Plan of 1970. The construction for Shihwa seawall began in April 1987 and was completed in January 1994. The total construction cost was 493 billion KRW, and the total length of Shihwa seawall was 12.7 km. The area of the lake was 56.8 km , and the area of the basin was 476.5 km . The total water storage capacity was 332 million tons, and the size of the reclaimed land from the construction of the seawall was 133.7 km (Korea Institute of Ocean Science and Technology, 2012, p. 5).

Lake Shihwa was originally planned as a freshwater lake to provide agricultural areas that utilize the reclaimed land around the lake, and to supply industrial complexes with water. Since the completion of the seawall in 1994, however, the inflow of industrial wastewater

and domestic sewage from the surrounding areas deteriorated the water quality rapidly. The lake had suffered from environmental deterioration and water pollution that it became nicknamed the 'Lake of Death.' The effort to restore Lake Shihwa began in 1996. <Table 2-27> summarizes the process from the development of Lake Shihwa, to the deterioration of its water quality, and to its restoration.

The Department of Environment presented the 'Measures to Improve Water Quality' that would use about 450 billion KRW through 2005. Since December 1996, the initiative has opened the sluice gate of Shihwa's seawall to allow seawater inflows. The government hoped to improve the water quality with seawater inflows, yet the impact was limited at best. In December 2000, the government gave up the desalination of Lake Shihwa and confirmed that the water source had come under salinization (Korea Institute of Ocean Science and Technology, 2012, p.9)[16]. After the government gave up the desalination of Lake Shihwa, it decided to manage it as a seawater lake in December 2000. Since then, the 'First-Stage Lake Comprehensive Management Plan for Lake Shihwa (2002~2006)' in 2001, the 'Second-Stage Lake Comprehensive Management Plan for Lake Shihwa (2007~2011)' in 2007 and the 'Third-Stage Lake Comprehensive Management Plan for Lake Shihwa (2012~2016)' have been implemented.

Table 2-27 | Timeline for Lake Shihwa

Date	Content
1977.04	Notify appointment of Banweol special region to develop Ansan New Town
1985.10	Established and launched Shihwa district development feasibility studies and basic plan
1986.09	Economic Planning Board confirmed Shihwa district development plan
1987.06	Undertaken Shihwa embankment construction project
1988.09	Han River Basin Environmental Office consulted Environmental Impact Assessment
1994.01	Completed the final embankment body (12.7km)
1996.06	Discharge of wastewater in Lake Shihwa
1996.07	Ministry of Environment announced water quality improvement measures (up to 450 billion KRW until 2005)
1996.08	Hundreds of thousands of fish were found dead in Lake Shihwa
1996.12	Water flew by opening the Shihwa sea dyke sluice

16. Shihwa Lake (http://www.shihwaho.kr/location.php, Accessed: 2014.8.7.).

Date	Content
1997.10	Ministry of Agriculture announced plans to develop 49.5 km² reclaimed land as farmland until 2006
1998.02	Full enforcement of seawater circulation
1998.12	Ministry of Agriculture abandoned the agricultural use of Lake Shihwa
2000.02	Ministry of Oceans and Fisheries designated Lake Shihwa and Incheon coast as a special management area
2000.12	The government officially announced the abandonment of desalination of Lake Shihwa and decided to manage it as a seawater lake
2001.08	Ministry of Oceans and Fisheries confirmed the Lake Shihwa comprehensive management plan (put 745.1 billion KRW until 2006)
2007.06	Lake Shihwa management committee confirmed Step 2 Lake Shihwa comprehensive management plan
2010.07	Decided to introduce the Lake Shihwa total coastal pollution management (8th Lake Shihwa management committee)
2012.10	Confirmed Step 3 Lake Shihwa comprehensive management plan
2013.07	Implemented Lake Shihwa total coastal pollution management

Source: Shihwa Lake website (http://www.shihwaho.kr/history.php, Accessed: 2014.8.7.).

As shown in <Table 2-28>, the water quality of Lake Shihwa has greatly improved since the water started flowing in 1997, a part of the water quality improvement efforts. The Chemical Oxygen Demand (COD) was 17.4 mg/L in 1997, but it continued to decline in 2000 and 2012, reaching 4.5 mg/L and 3.0 mg/L respectively. Total Phosphorus (TP), known as the main cause of water pollution and eutrophication, was reduced from 0.064 mgP/ml in 2001 to 0.059 mgP/ml in 2012.

Table 2-28 | Water Quality of Lake Shihwa

Category	1997	1998	1999	2000	2001	2005	2010	2011	2012
COD	17.4	7.9	4.3	4.5	4.5	4.2	3.3	4.2	3.0
T-P	-	-	-	-	0.064	0.075	0.037	0.053	0.059

Note 1: COD is short for Chemical Oxygen Demand, and its unit is mg/L. T-P is Total Phosphorus, and its unit is mgP/ml.

2: The data from 1997 to 2000 is from Lake Shihwa Management Committee (2007), and the data from 2011 to 2012 is 'water quality status report' from Ministry of Oceans and Fisheries.

Source: Lake Shihwa Management Committee (2007), p.3; 'Water Quality Status Report' from Ministry of Oceans and Fisheries (http://kosis.kr/statHtml/statHtml.do?orgId=116&tblId=DT_MLTM_1740&vw_cd=&list_id=&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=I2, Accessed: 2014.8.7.).

Also, as the tidal power plant was constructed, Lake Shihwa began to contribute to the production of new and renewable energy using its seawall. The Lake Shihwa Tidal Power Plant, the construction of which began in 2004 and was completed in 2011, is the world's largest tidal power plant with a facility capacity of 254 MW. Using the large difference between the rise and fall of tide on the Yellow Sea, it generates electricity with the water turbine that utilizes the waterfall of the seawater inflows during the flood tide and drains water during the ebb tide. In February 2012, its electricity generation reached 100 million kWh. Its electricity supply reached 5 million kWh in December 2012, and after about a year, it reached 1 billion kWh in December 2013.[17]

Lake Shihwa is an example of development projects that were implemented without environmental considerations during Korea's economic development. It clearly shows what harm a development project may cause if its environmental effects are not taken into account sufficiently. Yet, the process of overcoming environmental harm, introducing a methodical management system and producing new and renewable energy with a seawall-based tidal power plant has become highly regarded.

4.5. Restoration of Ecological Stream of Taehwa River in Ulsan[18]

Taehwa River had a variety of fish living in high quality water such as salmon, dace, Chinese minnow, slang and others. A bamboo forest formed around the river before the industrialization and urbanization of Ulsan. However, since Ulsan had been designated as the 'Ulsan Industrial District,' the first national industrial complex in 1962, large corporations and factories were introduced, thereby accelerating the expansion of Ulsan. During this period, the Taehwa River was polluted by indiscriminate sewage and wastewater from plants, becoming a river synonymous with death. In 1992, mass deaths of fish occured five times (Ulsan Metropolitan City, 2013, pp.86~88).

17. Lake Shihwa Tidal Power Plant (http://tlight.kwater.or.kr/, Accessed: 2014.9.29.).

18. Taehwa River in the city of Ulsan is a good example of restored stream running within the city. But Korea has also enacted policies for ecosystem conservation of the coastal area. The case in point is Suncheon Wetland Preservation Project. Wetlands (foreshores) with great biodiversity have been formed in the Suncheon Bay Area over a long time. The Ministry of Environment designated the Suncheon Bay Area as a wetland protection area in 2003, and the city of Suncheon also designated the Suncheon Bay Area as Suncheonman Bay Ecological Park in 2004 and has been protecting and managing the ecosystem in the area. The ministry and the city worked hand in hand to restore wetlands in the region, creating a habitat for migratory birds. And the Suncheonman Bay Area was listed on Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) in 2006 for the first time as a wetland in Korea (Ministry of environment, http://www.me.go.kr/gg/web/index.do?menuId=2271, Data Search Date: 10.25.2014; National Wetland Center, http://www.wetland.go.kr/home/wetland/korea/koreawetland_13.jsp, Data Search Date:10.25. 2014).

In order to overcome the negative image of urban pollution, Ulsan declared 'Ecopolis Ulsan Declaration 2004' to create Ulsan as a 'ecological city with coexistence of environment, economy and human beings'. After the declaration, Ulsan made efforts to improve water quality, restore the ecosystem and conservation through 'the First Mid-Term Environmental Protection Plan (1999~2003) and the Second Mid-Term Environmental Protection Plan (2004~2008). Also, as shown in <Table 2-29>, it established the Taehwa River Master Plan in 2005, with the Step 2 Taehwa River Master Plan being implemented now (Ulsan Metropolitan City, 2013, pp.96~103).

Table 2-29 | Taehwa River Master Plan of Ulsan

Step	Category	Contents	
Step 1	Period	2005~2009	
	Basic direction Project	Ecologically healthy Taehwa River	• Wetland ecosystem restoration • Recovery of naturality (concrete revetment maintenance) • Build ecological infrastructure • Create and complement ecological parks
		Safe and clean Taehwa River	• Improve river water quality (pollution control, introduction of river purification system) • Secure river quantity • Environmental improvement of stream
		Familiar and close Taehwa River	• Diversification of riverside facilities • Improve pedestrian access • Renovate bridge • Build bike cycling road network • Build water leisure space • Construct water environment center
		Taehwa River with history and future	• Taehwa river historic restoration (restoration of Taehwaru) • Open a Taehwa river historical trail • Develop Taehwa river festival • Enacted Taehwa special landscape ordinance
	Project	Plans 50 projects in four areas that are safe and clean Taehwa river, healthy ecosystem recovery, the composition of hydrophilic waterfront, and historical restoration and festival	

Step	Category	Contents	
Step 2	Period	2010~2014	
	Basic direction	Breathing with nature and ecology	• Improve water quality and quantity and preserve Taehwa river as a state of nature
		Feeling with green health	• Compose resting place and healthy way to feel healthy and nature
		Flowing with history and culture	• Taehwa river compostion to talk about the history and culture of Taehwa river
	Project	Water quality and quantity	• Secure clean flow road
		Nature and status	• Composition of salmon return road
		Health and leisure	• Create green healthy way
		History and culture	• Composition of hundred-li trail

Source: Ulsan Metropolitan City (2013), pp.103~109.

The Ministry of Environment also established the 'Making the Ecological River 10-Year Plan (2006~2015)' in 2007. This is the basic direction of the river to support 'Water Environment Basic Management Plan)'. This plan was conducted by setting the planning period of 2006~2015 with a vision of "ecological rivers with swimming children and fish" (see <Table 2-30>) (Ministry of Environment, 2007, p.1).

Within the scope of the 'Ecological River 10-Year Plan', the government planned to build ecological river networks to improve the vulnerable shore protection of the Taehwa River, and realize environmental and ecological functions of the river. It also aimed to conserve and restore the river. The total project cost was 5.5 billion KRW and the project was conducted from December 2007 to January 2009. Main content of the project was the composition of natural shore protection and reinforcement debris flow, as well as the installation of waterside observation (1.92km), 5 fish ways and 2 water purifications. In addition, the deposited sludge dredging project (2002~2007) and Securing Taehwa River Maintenance Water project (2007~2010) were conducted (Ministry of Environment, 2011, p.34).

Table 2-30 | Ministry of Environment's Ecological River 10-Year Plan (2006~2015)

Category	Content
Planning Period	2006~2015 (10-Year plan)
Vision	Ecological rivers with swimming children and fish
Target Project	River-related projects
Five Policy Goals	20 implementation challenges
1. Providing Habitat Space of Wild Fauna and Flora	• Limit river maintenance project of natural river • Introduction of rivers rest year system • Installation of a fish way and demolition of concrete bank • Composition of place for aquatic animals' spawn such as a riparian wetland • Demolish stream artificial structures and promote ecological restoration • Composition of the ecological belt around rivers
2. Securing Eco-friendly Resting Place	• Set ecological, cultural, historical theme by rivers • Provide river ecology experience space • Introduction to river restoration techniques considering the natural landscape
3. Preserving the Ecological Health of Stream	• Make rivers meandering to prevent flood and restore floodplain • Secure stream water quantity in drought • Obtain naturally contaminated water purification • Investigate river ecosystem and make ecology map • Set the natural level of rivers
4. Building the Base of Residents Participation	• Promote general public to recognize medium and long-term ecological river • Construct waterway-oriented river council
5. Constructing System and Administration Support	• Construct ecological legal system • Establish coordination of ecological restoration department and guidelines • Launch Eco-STAR • Train enterprises specialized in ecological restoration

Source: Ministry of Environment (2007), pp.1, 8.

The water quality of Taehwa River has improved as a result of aggressive efforts by the Ministry of Environment and Ulsan (see <Table 2-31>). Indeed, the number of returning salmon has increased as well (see <Table 2-32>). First, the Biochemical Oxygen Demand (BOD) has continuously decreased from 1.5 in 1985 to 1.1 in 2000, and to 0.6 in 2009. Also, salmon return in 2003 was 3, but it has rapidly increased to 1,788 in 2013.

Table 2-31 | Water Quality Changes of Taehwa's Downstream by Year

Year	1985	1990	1995	2000	2005	2006	2007	2008	2009
BOD (mg/l)	1.4	1.2	3.3	1.1	0.7	0.7	0.6	0.6	0.6

Note: BOD is the biochemical oxygen demand.

Source: Ministry of Environment Statistical Portal (http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_ZZZ_003337&inq_gubun=1&lang=kor&list_id=&l_interval=2#, Accessed: 2014. 9.18.).

Table 2-32 | Increase of Salmon Return in Taehwa River

Year	2003	2004	2005	2006	2007	2010	2012	2013
Number of Salmon return	5	15	67	80	85	716	592	1,788

Source: Ulsan Metropolitan City (2013), p.270.

The Taehwa River ecological river restoration project has been promoted since 2004, prior to green growth policies. It is therefore important that local government establish its own polices and enforced them actively, without relying on the central government. It is also significant that Ulsan does not stop enforcing the policy in short-term, with follow-ups, thereby maintaining the sustainability of the policy.

4.6. Restoration of Cheonggye Stream

Cheonggye stream is the artificial stream from the early Chosun period, with a length of 13.7km. It raises from Mt. Bukak, Mt. Inwang and Mt. Nam and flows into Han River. In 1934, Japan implemented 'Kyungsung Plan,' to cover the area from Gwanghwamun intersection to Gwangtonggyo at the end of 1940, then the rest area of Cheonggye stream was covered for sanitation, road expansion, maintenance purposes from 1958 to the end of 1978. However, the corrosion concrete at the Chenggye overpass and structural defects at covered construction had raised safety concerns (Seong and Kim, 2005, pp.265~266). In addition, 2 billion KRW were spent annually on maintenance costs for the covered structures. For this reason, Seoul promoted the Cheonggye stream restoration project, which focused on four aspects: urban environmental improvement and addressing noise problems; restoration of historic monuments; urban economic revitalization; and safety concerns of aging covered structures (Ministry of Land, Infrastructure and Transport and KDI School of Public Policy and Management, 2013, pp.58~59).

For planning, Seoul established the Cheonggye Stream Restoration Project Headquarters and launched the Cheonggye Stream Restoration Project Support Group to conduct research on the basis for a successful business and basic research initiative. In addition, it composed the Cheonggye Restoration Citizens Committee to collect the opinions of citizens during the project (Ministry of Land, Infrastructure and Transport and KDI School of Public Policy and Management, 2013, p.59). <Table 2-33> summarizes the key process and details of Cheonggye Stream Restoration Project.

Table 2-33 | The Process and Details of Cheonggye Stream Restoration Project

Category	Content	Details
Planning Phase (Preconstruction phase) 2002.7.1~2003.6.30	Organization	Install the Cheonggye Stream Restoration Project Headquarters (2002.7) Compose the Cheonggye Stream Restoration Project Support Group (2002.7) Compose the Cheonggye Stream Restoration Citizens Committee (2002.9)
	Planning Cheonggye stream restoration	Establish Urban Research Promotion Plan (2002.9~2003.6) Establish the Cheonggye Stream Restoration Plan (2002.9) Develop a comprehensive plan to restore the stream (2003.1~2004.7) Establish transportation comprehensive measures against the stream restoration process (2003.2) Establish river maintenance plan (2003.4)
	Holding seminars/ discussions	Hold professional seminars and discussions for Cheonggye Stream Restoration (2002.8~)
Project Implementation Phase (Construction phase) 2003.7.1~2005.9.30	Design and construction of Cheonggye stream Restoration Project	Groundbreaking ceremony of Cheonggye Stream Restoration Project (2003.7.1) Finalize the basic design of Cheonggye Stream Restoration (2003.7.30) Notice the Stream Maintenance Plan (2003.10) Demolish covered structure and Cheonggye overpass (2003.10), opening up of road linked both banks (2004.4), opening of Dumul bridge et al (2004.5), cleanup the stream road (2004.11~2005.8), comprehensive commission (2005.7) Complete Cheonggye Plaza composition construction and Cheonggye stream restoration project (2005.9.30)
Completion Ceremony 2005.10.1	Ceremony and declared restoration	Cheonggye stream Restoration Memorial Festival (2005.10.1~3)

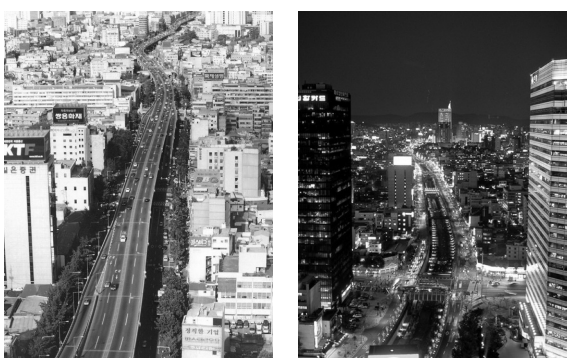
Source: Yang (2008), p.315.

The Cheonggye Stream Restoration Project is a city government-led public project that restored the stream, and demolished covered structures around the 5.84km stream including Chenggye road, Taepyeong road, Dongdaemun, Sindap Railway Bridge (Yang, 2008, p.313). The project, which began on July 1, 2003, was completed on October 1, 2005. A total of 380 billion KRW was spent during the construction period of 27 months (Ministry of Land, Infrastructure and Transport and KDI School of Public Policy and Management, 2013, p.59).

Praise was given to this pioneering model of eco-friendly development, not only in the birth of a restored river, but also the restoration of historic sites and the creation of cultural space. It is significant in that a new tourist attraction in Seoul was born, and historic ruins, such as Gwangneunggyo and Supyogyo, were restored after the completion of the project (Ministry of Land, Infrastructure and Transport and KDI School of Public Policy and Management, 2013, p.62).

Its significance can be found in the economic and environmental aspects as well. Since the restoration project, Cheonggye area has started getting attention as a new residence community. In addition, Cheonggye stream formed wind ways within the city, thus the average wind speed has increased by a minimum of 2.2% to a maximum of 7.1%. The heat island phenomenon in Seoul was mitigated by 2~5%.[19] Also, efforts to increase species that live in the stream was significant in restoring the ecology of the area (Ministry of Land, Infrastructure and Transport and KDI School of Public Policy and Management, 2013, p.62).

Figure 2-4 | Comparison between Before and After the Restoration



Source: Seoul Museum of History (http://blog.naver.com/seoulmuse/30097311621, Accessed: 2014.8.24).

19. Homepage for Cheonggye Stream (http://www.cheonggyecheon.or.kr/, Accessed: 2014.8.24.).

The Cheonggye Stream Restoration Project was not only an effort to restore a city-center stream; it was also a project that had good policy implications from a historical, cultural, environmental and economic perspective. Thus, developed countries, such as the United States and Japan, as well as developing countries, are showing great interest. However, the stream has caused controversy because it is not a natural stream, water brought in from Han River. Although it has the limitation of being an artificial river stream, the project marked the starting point for other river restoration efforts by the Ministry of Environment, such as 'Cheonggye +20 project.'[20]

20. 'Cheonggye Stream+20 Project,' promoted by the Ministry of Environment, aimed to restore the waterway and ecosystem, and improve water quality by demolishing aging facilities such as roads or stores. This purpose of this project is to provide green living space for local residents with a blend of history·culture·ecology by restoring the ecology of local urban river stream due to the city's development in the 70s and 80s (Ministry of Environment press release, May 11, 2010, pp.1~2).

2014 Modularization of Korea's Development Experience
Experiences and Lessons of Green Growth

Chapter 3

Current Status and Prospect of Green Growth Policies

1. Greenhouse Gas Reduction
2. Reduction of the Use of Fossil Fuels and Enhancement of Energy Independence
3. Greening of Manufacturing
4. Green Land and Transportation
5. Green Lifestyle

Current Status and Prospect of Green Growth Policies

1. Greenhouse Gas Reduction

This chapter summarizes the major policies presented since green growth policies were announced in 2008, and we will review backgrounds and results of these policies. It is too early to show concrete results because the policies have been implemented for a short period. Therefore, we will focus on how to establish the status and objective of major policies and how to proceed. While the green growth policy contains a comprehensive economic development plan, this chapter only covers major policies related to greenhouse gas reduction, reduction in the use of fossil fuels, energy independence, greening of manufacturing, green national lands and transportation, and green lifestyle.

1.1. Related Plans and Outcomes

The 'Five-Year Plan for Green Growth' proposed ten policy directions across three strategies. 'Effective Mitigation of Greenhouse Gas Emissions' is included in the first policy direction, and is the most common green growth policy. Korea set a voluntary target to reduce greenhouse gas emissions, even though it was under no obligation to do so. Korea has received a lot of attention from emerging countries taking greenhouse gas reduction efforts as an opportunity to create new value and growth.

The five-year plan sets four practical tasks related with greenhouse gas reduction. First, the 'visible carbon society' task tries to achieve managing the greenhouse gas emissions statistics and efficiency of the reduction targets set by establishing a national comprehensive

system for greenhouse gas. Second, the 'reducing carbon society' task is related with improvement of energy efficiency and energy saving practices. Third, the 'society to absorb carbon' task contains resource recycling and expanding carbon sinks. Lastly, the 'towards a low-carbon green peninsula' task is associated with low-carbon of the entire peninsula, including North Korea and the Demilitarized Zone, to reflect the special circumstances of the divided country.

<Table 3-1> shows annual targets and achievements of the 5-year plan for greenhouse gas emissions reduction. Targets include the system establishment (inventory system) for GHG emissions management; making policies for GHG emissions reduction (improving building insulation, promoting public transportations, expanding the use of green cars, and facilitating the conversion of wastes into energy); drafting policies for carbon circulation and absorption (reducing food wastes, increasing carbon storage in forests, establishing a carbon circulation system, developing overseas foreign resources, and creating a large marine forest); making policies for a low-carbon based society on the Korean peninsula (expanding tree-planting areas in North Korea, building a test complex for renewable energy and enhancing training programs for renewable energy professionals, improving the progress of Flood Prevention Project of Imjingang River, and improving the implementation of a comprehensive plan for the peaceful use of DMZ). The Achievement Index is not released for all indeces above. Performance indicators for various objectives are not being published. However, as shown in <Table 3-1>, performance indicators associated with the GHG, among green growth indicators compiled by Statistics Korea, is the GHG per unit of GDP. It increased from 0.617Kg CO2/thousand KRW in 2007 to 0.641Kg CO2/ thousand KRW in 2010, so it represented that substantial results had not been achieved. GHG increased from 590 million tons CO2 to 668.8 million tons CO2. On the other hand, forestry greenhouse gas absorption increased, so the amount reached from 36.2 million tons CO2 in 2007 to 39.6 million tons CO2. These policies to increase the carbon sinks were evaluated to be effective.

Table 3-1 | Practical Tasks and Goal of Key Indicators for Reducing GHG by Year

Tasks and Key Indicator		2009	2010	2011	2012	2013
1. Visible Carbon Society						
	Establish the national comprehensive system for greenhouse gas	Develop a master plan	Establish national inventory system	Promote building corporate and municipal inventory system	Complete building corporate and municipal inventory system	Complete the construction of the National Greenhouse Gas Management System
	Corporate response to climate change index	53	55	57	59	61
2. Carbon-Reducing Society						
	Reinforced insulation standard of buildings' windows (%)	0	-	20	-	40
	Metropolitan Transit division ratio (%)	50	51	53	55	56
	Green Car supplied number (cumulative number, K)	30	50	80	130	
	Energy available waste ratio (%)	3.1	3.5	14.1	21.2	33
3. Society to Absorb Carbon						
	Expected food waste amount (2% annual increase) to emissions reduction ratio (%)	-	5	10	15	20
	Forest carbon stocks (million ton CO2)	1,452	1,494	1,535	1,575	1,613
	Construction of carbon cycle system (pellet production, ten thousands tons)	3	11	20	28	40
	Development of international forest resource (thousands ha)	200	220	245	270	296
	Building large sea forest (ha)	100	900	2,500	3,000	3,000

Tasks and Key Indicator		2009	2010	2011	2012	2013
4. Towards a Low-carbon Green Peninsula						
	Afforestation area in North Korea (ten thousands ha)	-	0.5	1.0	1.5	2.0
	Construction of renewable energy model complex and technology experts training education (%)	-	10	30	80	100
	Imjin River flood prevention project progress (%)	-	10	30	50	100
	Completion ratio of the demilitarized zone master plan for peaceful use (%)	-	20	30	40	50
Outcomes	**Key Indicator**	**2007**	**2008**	**2009**	**2010**	**Trends**
	Greenhouse gas emissions per unit of GDP (Kg CO2/thousands)	0.617	0.617	0.620	0.641	→
	Total greenhouse gas emissions (million ton CO2)	590.3	604.1	609.1	668.8	↗
	Forest greenhouse gas removals (million ton CO2)	36.2	38.7	39.5	39.6	↗

Source: PCGG (2009b), pp.39~59, Statistics Korea Green Growth Indicators (http://green.kostat.go.kr), Accessed: 2014.9.7).

1.2. Setting the National Medium-Term Greenhouse Gas Reduction Target

1.2.1. Progress of Setting the Reduction Target

Green growth policies initiated from the recognition that sustainable development with economic development paradigm of the past had become difficult to maintain, due to the limited amount of fossil fuels and the increase in greenhouse gas emissions based on the excessive use fossil fuels, which has led to climate change. The background of green growth is the idea of reducing GHG and sustain growth at the same time. As the increase of greenhouse gas emissions and climate change became a global issue, developed countries implemented the reductions mandated by the Kyoto Protocol, and developing countries announced voluntary greenhouse gas reductions. In November 2009, Korea set the national target to reduce its emissions by 30% from the 2020 business-as-usual (BAU) level. In order to support these goals by law, the "Framework Act on Low Carbon, Green Growth" and its enforcement decree were entered into force (April 2010).

The greenhouse gas emissions reduction target was set based on the emissions outlook, emissions reduction potentials and a macro-economic impact analysis. The future GHG emission forecast was based on an economic outlook including oil prices, growth rates, industry structure and industry investment plans. The reduction potential analysis was achieved by utilizing the MARKAL model (MARKet ALlocation) for a bottom-up model, which was developed by the International Energy Agency (IEA) to analyze the amount of GHG that can be reduced by the individual technique and policy. Lastly, the macroeconomic impact of GHG emissions is done by Computable General Equilibrium (CGE), a top-down model. Given the requirement of the international community and analysis result made through the above methods, three reduction target scenarios were made: 21% reduction, 27% reduction and 30% reduction compared to BAU (see <Table 3-2>).

Table 3-2 | National Medium-Term GHG Reduction Target Scenario

Scenario	Reduction Target	Reduction Policy Selection Criteria	Major Reduction Measures
1	21% (reduce 171 million ton compared to BAU)	Cost-effective technologies and policies	• Enlarge the supply of Green homes, Green buildings • Advertise high-efficiency products such as LED • Reform high efficiency and low-carbon transport system • Industry high-efficient process innovation (green process) • Expand renewable energy and nuclear power • Reflect some of smart grid
2	27% (reduce 223 million ton compared to BAU)	Reduction cost of international standards	• Remove fluorinated gas with high Global Warming Potential • Supply hybrid cars • Expand biofuel blending ratio • Introduce basic CCS
3	30% (reduce 244 million ton compared to BAU)	The maximum level of reduction required on developing countries	• Supply the next generation of green cars such as electric cars and fuel cell vehicle • Enlarge the most advanced high-efficiency products • Introduce enhanced CCS

Source: The Sourcebook about the National Debate for Setting the National Medium-Term Target for Greenhouse Gas Emissions Reduction (2009), p.10.

Then 30% reduction compared to BAU targets was chosen through the opinion from various fields of study in October 2009. Korea would be able to achieve 30% reduction through enhancing the next generation of green cars such as electric cars and fuel cell vehicles, expanding the most advanced high-efficiency products and introducing Carbon Capture and Storage (CCS). The final national medium-term GHG reduction targets were set after extensive deliberations during the social consensus process.

After the reduction scenarios were published, 44 debates were held (central and local public hearings, meetings with industry sector and civil society, etc.). The industry wanted to select scenario 1 (21% reduction) or a lower reduction target in fear of losing industrial

competitiveness, and the civil society wanted to select scenario 3 (30% reduction) or a higher reduction target that was worthy of the status of an OECD country. Scenario 3 was chosen taking into account the long-term perspective and international requirement (PCGG, 2009b, p.13).

1.2.2. Policies for Achieving Reduction Targets

As discussed in the previous chapter, various legal and institutional foundations have been established to achieve GHG reduction targets (see <Table 3-3>). As a legal basis, the 'Framework Act on Low Carbon, Green Growth,' 'New Energy and Renewable Energy Development and Use and Dissemination Promotion Law' and 'Act on the Allocation and Trading of Greenhouse Gas Emission Permits' were introduced. GHG reduction is the task that must be achieved for responding to climate change, and it was a big driving force in the Five-Year Plan for Green Growth.

The Chapter 5 of 'Framework Act on Low Carbon, Green Growth' (implementation of a low-carbon society), from Article 38 to Article 48, proposed a way to reduce GHG emissions. Article 38 set up long-term GHG reduction targets as the basic principle of addressing climate change and promoting efficient and systematic reduction. It states that Korea should develop and utilize advanced and convergence technology to reduce GHG significantly. Also, it allows for market trading of the rights and obligations under the GHG emission reduction measures, which should be prepared for the international carbon market by activating its domestic version first. Article 42 recommends long-term goals be set up, and that assurances are put into place to execute each step. In particular, it includes a provision that call for measures needed to set and achieve departmental goals for industry, transportation, commercial and home. In addition, building a GHG comprehensive information management system, introducing a cap-and-trade emission trading, and the provision of the GHG management in transportation sector were specified in the Articles 45, 46 and 47, respectively, thus establishing a basis for policies to achieve GHG reduction targets.

Based on the top-level legislation regarding green growth policy, the 'Framework Act on Low Carbon, Green Growth', the GHG and Energy Target Management System in 2010 and Renewable Portfolio Standard (RPS) in 2012 were implemented, and the GHG ETS (ETS) will be conducted from 2015. The main content of each system is summarized in Chapter 2 of this paper.

Table 3-3 | Policies and Legislations for Achieving GHG Reduction Target

- 'Framework Act on Low Carbon, Green Growth' (Law No. 11965, Enforcement 2013.10.31) and Decree
- 'Act on the Allocation and Trading of Greenhouse Gas Emission Permits' (Law No. 11690, Enforcement 2013.3.23) and Decree (Presidential Decree No. 25179, Enforcement 2014.2.14)
- 'Enforcement Decree of Act on the Allocation and Trading of Greenhouse Gas Emission Permits'
- 'GHG and energy management system' (Implementation in 2010)
- 'Renewable Portfolio Standard' (Implementation in 2012)
- 'GHG emissions trading scheme (ETS)' (expected implementation in 2015)

Source: Created by the author based on Ministry of Government Legislation (http://www.moleg.go.kr, Accessed: 2014.9.08.) and Korea Energy Management Corporation (http://www.energy.or.kr/knrec/12/KNREC120700_02.asp, Accessed: 2014.9.08.).

1.2.3. National GHG Inventory and Management

GHG Inventory & Research Center of Korea (GIR) was launched in June 2010 as a climate change research institute, based on comprehensive Framework Act on Low Carbon, Green Growth. It is a national GHG comprehensive information management authority and institute for analysis and evaluation of GHG emission reduction under the Ministry of Environment. This center takes its role as a "GHG emission reduction think tank to address climate change" and aims at "building global systems for international cooperation about climate change, the response to climate change and comprehensive efficient GHG information management". In addition, "operating national GHG comprehensive information management of world-class, supporting GHG reduction target set by country and sector, expanding international cooperation for global GHG reduction, supporting GHG and energy management system and researching domestic and foreign GHG reduction" are the five core functions (GHG Inventory & Research Center of Korea, 2014).[21] Information on GHG Inventory & Research Center of Korea is briefly summarized in <Table 3-4>.

21. GHG Inventory & Research Center of Korea (2014),
http://www.gir.go.kr/home/index.do?menuId=28#his04, Accessed: 2014.9.1.
http://www.gir.go.kr/home/index.do?menuId=30, Accessed: 2014.9.1.
http://www.gir.go.kr/home/index.do?menuId=29, Accessed: 2014.9.1.

Also, according to the paragraph 1 of Article 45 in the 'Framework Act on Low Carbon, Green Growth', the government should build GHG comprehensive information management system for developing, managing and verifying GHG emissions & absorption coefficient, information and statistics related to GHG. In this regard, Decree No.36 in the Division of Enforcement began to build and manage the content of a comprehensive GHG information management system. Article 36 places the GHG comprehensive information center under the Minister of Environment, support GHG reduction targets set by country and sector, operate a national GHG comprehensive information management system and research & study for domestic and foreign GHG reduction support. It also makes related authorities by sector submit GHG information and statistics of last year to GHG Inventory & Research Center of Korea by June 30.

Table 3-4 | The Overview of GHG Inventory and Research Center of Korea

Category	Content	
Related Law	Article 42 of 'Framework Act on Low Carbon, Green Growth'	
purpose	To establish the global cooperation system for comprehensive and effective greenhouse gas information management, response to climate change through greenhouse gas emissions reduction, and international partnership for climate change	
Features	• Operate the national GHG comprehensive information management system of world-class • Support GHG reduction target set by country and sector • Expand the international cooperation for global GHG emission reduction • Support GHG and energy management system • Research & study domestic and foreign GHG reduction	
Implementation System	General authority	Ministry of Environment (a center installed under the minister of the Ministry of Environment)
	Governing institutions	• Ministry of Agriculture, Food and Rural Affairs (Agriculture, Livestock and Forestry), Ministry of Trade, Industry and Energy (Energy and industrial processes), Ministry of Environment (waste), Ministry of Land, Infrastructure and Transport (building and transportation) • Submit GHG information and statistics of last year to the center (June 30)
	Operating	• Composed of senior officers of the council authorities and operating

Category	Content	
Center Configuration	Planning and management team	• Human resources and public relations, budget and service management
	Information management team	• National GHG statistics and information of related firms management
	Reduction target team	• Set and analyze reduction target by sector • GHG reduction roadmap

Source: Greenhouse Gas Inventory & Research Center of Korea website (http://www.gir.go.kr/home/index.do?menuId=30, Accessed: 2014.9.1); 'Framework Act on Low Carbon, Green Growth' (Law No.11965, Revised 30/07/2013, Enforcement 2013.10.31), 'Enforcement Decree for Framework Act on Low Carbon, Green Growth' (Presidential Decree No.25456, Revised 14/07/2014, Enforcement 2014.7.15).

Commonly, the GHG emission statistics has been used interchangeably with a term GHG inventory, and Korea also has created and managed GHG inventory based on the 1996 IPCC Guidelines. "Previously, under the Energy Basic Law before 2010, Ministry of Knowledge Economy wrote the national GHG inventory. Since 2010, under the Framework Act on Low Carbon, Green Growth, the Ministry of Environment has overall authority for creating the inventory (GHG Inventory & Research Center of Korea, 2014, p.11)."

GHG Inventory & Research Center of Korea provides guideline (MRV5 guidelines) for measurement, reporting and verification the national GHG statistics by sector, and the governing authority submits GHG inventory from the field (every June 30). Also, GHG Inventory & Research Center of Korea collects the comprehensive emission statistics, and the national GHG statistics working council reviews the National GHG Inventory Report with various authorities. Due to its complementary process, the working council goes through the discussions with civilian experts who participated in the results of calculated emissions by sector. As a last step, the National GHG Inventory Statistics Management Committee, the highest decision-making organization of GHG Inventory, determines the estimated emissions through deliberation and voting. The determined emissions are published by the GHG Inventory Report (NIR), which is the national GHG emissions report (GHG Inventory & Research Center of Korea, 2014, pp.13~14). This process is summarized in <Table 3-5>.

Table 3-5 | National GHG Emissions Confirmation Process and Substances Classified as GHG

<table>
<tr><th colspan="2">Category</th><th colspan="2">Content</th></tr>
<tr><td rowspan="3">Estimation Process</td><td>Step 1</td><td colspan="2">• Calculation and reporting emissions
- The national GHG emission estimation institutions such as Korea Energy Management Corporation, Korea Environment Corporation estimate GHG emissions
- Report to Ministry of Agriculture, Food and Rural Affairs, Ministry of Trade, Industry and Energy, Ministry of Environment, Ministry of Land, Infrastructure and Transport
- Report on GHG Inventory & Research Center of Korea</td></tr>
<tr><td>Step 2</td><td colspan="2">• Emissions verification
- GHG Inventory & Research Center of Korea performs verification of GHG emissions by the sector</td></tr>
<tr><td>Step 3</td><td colspan="2">• Emissions determined
- After the negotiation about verification and complementary results with governing institutions through the national GHG statistics working council, the national GHG statistics management committee confirms the emissions by deliberation</td></tr>
<tr><td colspan="2">Estimation Material</td><td colspan="2">• The six GHG on the Kyoto Protocol (CO2, CH4, N2O, HFCs, PFCs, SF6)</td></tr>
<tr><td colspan="2">Estimated Target Field</td><td colspan="2">• Energy, industrial processes, agriculture, land use, land use change and forestry and waste</td></tr>
<tr><td colspan="2" rowspan="5">Governing Institutions</td><td>Ministry</td><td>Sector</td></tr>
<tr><td>Ministry of Agriculture, Food and Rural Affairs</td><td>Agriculture, Livestock and Forestry</td></tr>
<tr><td>Ministry of Trade, Industry and Energy</td><td>Energy and industrial processes</td></tr>
<tr><td>Ministry of Environment</td><td>Waste</td></tr>
<tr><td>Ministry of Land, Infrastructure and Transport</td><td>Building and transportation</td></tr>
</table>

Source: Greenhouse Gas Inventory and Research Center of Korea (http://www.gir.go.kr/home/index.do?menuID=23, Accessed: 2014.9.1).

2. Reduction of the Use of Fossil Fuels and Enhancement of Energy Independence

2.1. Related Plans and Outcomes

Reduction of the use of fossil fuels and the enhancement of energy independence is the second policy direction of the 'Five-Year Plan for Green Growth'. The Five-Year Plan suggests building a high energy efficient and low-consumption community, expanding clean energy supply and nuclear power production capacity, enhancing the capacity of overseas resource development. Also, it prescribes annual goals to achieve key indicators selected by the task and practice.

<Table 3-6> summarizes the targets and major task outcomes by year. Regarding the annual targets, the major indicator for establishing low energy consumption and high efficiency is the improvement of energy source unit. In 2008, when green growth policies began, the energy source unit was 0.317, and the goal was to decrease it every year to 0.290 by 2013.[22] In addition, the plan aimed to increase the new and renewable energy supply target from 2.7% in 2008 to 3.78% in 2013 and to increase the market share in the global market for new and renewable energy from 2.8% in 2008 to 5.4% in 2013. Also, since Korea lacks natural resources, the annual targets were established for the indictor for capacity building in overseas resource development.

In this regard, Statistics Korea published 2013 statistics on the annual trend of green growth indicators. But the indicators are somewhat different from the indicators of the Five-Year Plan for Green Growth. The performance indicators of Statistics Korea and targets set by the Five-Year Plan for Green Growth are organized in <Table 3-6>. The main outcomes show that energy consumption per GDP had increased from 0.248 TOE/million KRW in 2009 to 0.251 TOE/million KRW in 2012. On the other hand, oil and gas self-development rate[23] had risen from 3.0% in 2009 to 13.8% in 2012. Also, the renewable energy supply rate had reached from 2.50% to 3.17% during the same period.

22. Energy Source Unit is an indicator that is "internationally used for evaluating the efficiency of energy consumed for economic activities." It is the ratio of the total energy consumption (TOE) against total creation of added-value (GDP) (National Energy Statistics, http://www.kesis.net/ei/ei07_2_2_2.html, Data Search Date: 10.25. 2014).

23. Independent Development Ratio in the Achievement Index represents the ratio of domestically developed and produced resources to the total import volume. Calculation formula is as follow: the total amount of resources domestically produced through the development of oil and gas (dollar amount) / total imports (dollar amount) x 100 (Category-wise Index, National Statistics Office, http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1167, Data Search Date: 10.25. 2014).

Table 3-6 | Action Plans for Reduction of the Use of Fossil Fuels and Enhancement of Energy Independence and Annual Goals of the Key Indicators

Action Plans and Key Indicators		2009	2010	2011	2012	2013
1. Building the High Energy Efficient and Low Consumption Community						
	Improve energy intensity (toe/thousand)	0.317	0.313	0.307	0.297	0.290
2. Expanding Clean Energy Supply						
	Renewable energy supply target (%)	2.7	3.0	3.2	3.54	3.78
3. Expanding Nuclear Power Production Capacity						
	Renewable energy share in world market (%)	2.8	3.6	4.3	5.0	5.4
4. Enhancing the Capacity of Overseas Resource Development						
	Early establishment of a fuel management plan and use (%)	speculation	100	-	-	-
	Securing of new nuclear power site (%)	25	50	75	100	-
	Timely construction of new nuclear power plants (base)	-	1	1	1	2
	Localization of dependent key technologies (%)	25	50	75	100	-
	Achieve the nuclear business abroad (%)	20	50	60	90	100
Performance	**Key Indicator**	**2009**	**2010**	**2011**	**2012**	**trend**
	Energy consumption per GDP (toe/million KRW)	0.248	0.253	0.255	0.251	↘
	Independent crude oil and gas development rate (%)	9.0	10.8	13.7	13.8	↗
	Renewable energy supply rate (%)	2.50	2.61	2.75	3.17	↗

Note: The methods to establish the major performance indicators are as follows.

- Energy consumption per unit of GDP: primary energy consumption / real GDP.
- Independent crude oil and gas development rate: the ratio of the amount of crude oil and gas developed and produced by Korean companies domestically and abroad to the total imports of crude oil and gas (independently developed amount / total imports of crude oil and gas).
- Renewable energy supply rate: renewable energy supply / primary energy supply.

Source: PCGG (2009b), pp.73~92, National Statistics Office Green Growth Indicators green growth indicators (http://green.kostat.go.kr, Accessed: 2014.9.7).

2.2. Major Policies

Projects promoted by the government in the area of the reduction of the use of fossil fuels and enhancement of energy independence were mainly implemented by the Ministry of Knowledge Economy at that time (currently managed by the Ministry of Trade, Industry and Energy) and the Ministry of Education, Science and Technology (currently called the Ministry of Science, ICT and Future Planning). Many projects were implemented. Representative ones include the LED diffusion policy, compulsory energy grade 1 for public organizations, tax credits for investments in energy saving facilities, government supported ESCO projects, the power generation cost difference support system, and the one million green home project. Main content and organizations in charge of these policies are set forth in <Table 3-7>.

Table 3-7 | Policies for the Reduction of the Use of Fossil Fuels and Enhancement of Energy Independence

Policies	Content	Organizations in Charge
LED Diffusion Policy	• Concept: The LED industry is a green industry with energy saving and environment-friendly characteristics that can drastically save energy compared to existing light sources • Content: The LED lighting diffusion policy is implemented for mainly large demanders such as public buildings. The production, import, and sales of incandescent bulbs will be completely prohibited through stepwise regulations that prohibit incandescent bulbs for candle power exceeding 70W but not exceeding 150W from January 2012 and those for candle power exceeding 25W but not exceeding 70W from 2014	• Ministry of Strategy and Finance • Ministry of Trade, Industry and Energy • Korea Energy Management Corporation
Compulsory Energy Grade 1 for Public Organizations	• A system that requires all public organizations to compulsorily use products with energy consumption efficiency grade 1 when the need new energy equipment or should replace energy equipment	• Ministry of Knowledge Economy • Korea Energy Management Corporation
Tax Credits for Investments in Energy saving Facilities	• Concept: A system to deduct a certain percentage from the amount of investments in energy saving facilities made by corporations or individuals from tax amounts • Year of introduction: newly established in 2000 and applied to investments made in 2001 and thereafter	• Ministry of Strategy and Finance • Korea Energy Management Corporation

Policies	Content	Organizations in Charge
Government Supported ESCO Projects	• Concept: The ESCO (Energy Service Company) is a system in which specialized energy saving companies first invest in energy saving facilities and collect the investment cost thereafter with the amount of saved energy costs • Year of introduction: Grounds for the system were prepared in 1991 by the amendment of the Energy Use Rationalization Act and the policy has been continuously implemented from 1992 • Content: Security light and street light replacement projects, waste heat recovery and heat exchanger installation projects, and deteriorated boiler replacement projects were implemented	• Ministry of Knowledge Economy • Korea Energy Management Corporation
Power Generation Cost Difference Support System	• Concept: This is a system in which the government pays differences between production costs and electric power transaction prices in cases where the standard prices notified by the government by energy source are lower than market prices. This system was introduced in 2002	• Ministry of Knowledge Economy • Korea Energy Management Corporation • Korea Electrical Safety Corporation • Korea Electric Power Corporation • Korea Power Exchange
One Mission Green Home Project	• Concept: Green homes are low energy environment-friendly houses in which the use of fossil fuels is maximally suppressed and air pollutant discharges are minimized by introducing new and renewable energy (solar light, solar heat, terrestrial heat) and using high efficiency lighting and boilers and environment-friendly insulating materials • Year of introduction: In August 2008, the government announced its policy to promote the "one million green home project" and adopted it as one of 100 major government projects • Content: With a view to the dissemination of one million green homes by 2020, the government pays part of installation costs when new and renewable energy facilities have been installed	• Ministry of Knowledge Economy • Korea Energy Management Corporation

Source: Korea Energy Management Corporation (http://www.kemco.or.kr, Accessed: 2014.10.13).

3. Greening of Manufacturing

3.1. Related Plans and Outcomes

The greening of manufacturing businesses is a policy related to the 'greening of existing industries and promotion of green industries' that was presented as the fifth policy direction in the 'Five-Year Plan for Green Growth.' In relation to this for the five year plan, practical tasks; resource cycling economy/industrial structure construction, greening of industries and diffusion of innovation, fostering green small/medium, venture businesses, and the fostering of knowledge led green clusters were set and major indicators to be achieved by practical task were prepared. <Table 3-8> shows the goals set forth in the Five-Year Plan for Green Growth and the outcomes with major indicators announced by Statistics Korea in 2013.

Regarding the annual targets, the establishment of the economic and industrial structure for resource circulation consists of the information system to promote circulation of natural resources, enact laws, increase the rate of recycling ascon (from 2% in 2008 to 20% in 2013), and increase the rate of substitution of natural aggregates by recyclable aggregates (from 2.3% in 2009 to 5.0% in 2013). The green initiatives and the increase in innovation for each industry is greening of manufacturing from a technological perspective. The greening of manufacturing consists of a reduction in greenhouse gas emissions in industrial sectors, the development of green technology and promotion of innovation. With respect to the reduction in greenhouse gas emissions, the annual targets were established for the reduction in greenhouse gas and CO2 emissions from the manufacturing process in iron and steel, electronics and the IT industries. Additionally, the performance targets were established for fostering small/medium enterprises and venture enterprises in the green industry and green technology sector. In particular, the target was established to increase the number of companies, which participate in the establishment of green partnership, from 685 in 2009 to 1,500 in 2013. This shows the government's will to expand the greening of manufacturing to all companies. Finally, with respect to fostering the knowledge-led green cluster, the performance indicators were established for establishing green clusters (from 5 in 2009 to 10 in 2013), establishing the low-carbon industrial complexes (from 2 in 2010 to 10 in 2013).

When we see domestic material consumption per unit of GDP, it had declined from 0.666 Kg/thousand KRW in 2008 to 0.625 Kg/thousand KRW in 2011. Also, the scale of environment industry sales increased by 0.85 to 0.93 percent during the same period. The emission costs of renewable energy industry rose almost three times in the same period, reaching 9.85 billion KRW in 2012.

Table 3-8 | Tasks and Major Outcomes of Greening of Industries and Promotion of Green Industries

Tasks and Major Indicators		2009	2010	2011	2012	2013
1. Construction of Resource Cycling Economy · Industrial Structures						
	Construction of resource cycling information systems (%)	-	20	40	80	100
	Establishment of framework acts on resource cycling (%)	-	40	60	100	-
	Rate of recycling of recycled ascon (%)	2	5	13	15	20
	Rate of replacement of natural aggregates by recycled aggregates (%)	2.3	2.5	3.0	4.0	5.0
2. Greening of Industries and Diffusion of Innovation						
	Basic units of steel & iron industry greenhouse gas emissions (GDP million KRW/1,000CO2 ton)	312	322	332	342	352
	Petrochemical industry low energy consumption type product production expansion (%)	18	20	25	30	35
	Increases in the ratio of export of green textiles (%)	5	8	11	14	17
	Commercialization of plug-in hybrid cars (%)	20	40	60	80	100
	Ratio of future type environment-friendly ship orders received (%)	-	15	18	20	23
	ECO-ENER plant industry world market share (%)	5	6	7	8	9
	CO2 emissions per wafer (basic unit) (kg)	142	141	140	139	139
	LCD panel energy efficiency enhancement (based on W/40" LCD panels)	210	200	190	180	175

Tasks and Major Indicators		2009	2010	2011	2012	2013
	Home appliance industry IT manufacturing process CO2 emissions reduction rate (%)	3	5	10	20	30
	Green management standard·index development and guideline diffusion (%)	-	100	Diffused	Diffused	Diffused
	Green IDC construction (%)	5	10	30	40	50
	Green IT technology test bed construction (%)	-	30	60	80	100
	Ratio of manufacturing businesses that promote service provision (%)	12	13	15	20	30
	Improvement of design/construction standards for green construction (%)	20	40	60	80	100
	Ratio of environment-friendly agricultural products (%)	5	6.3	7.6	8.9	10
	Conferences/exhibitions for overseas expansion of the area of green industries held (case)	3	3	5	10	13
	Amount of foreigner investments in the area of green industries (100 million US dollars)	6.8	7.0	7.2	7.5	8.0
3. Fostering of Green Small/Medium, Venture Businesses						
	Green degree diagnosing companies (ea)	-	200	200	300	300
	Green factory technical development support companies (ea)	30	100	100	100	100
	Environment-friendly process/equipment supply companies (ea)	-	200	200	300	300
	Companies that participated in green partnership construction (ea, accumulated values)	685	865	1,065	1,300	1,500
	Ratio of occupation by start-up businesses in the area of green industries to all businesses that occupied BI (%)	-	13	15	20	25
	Designation of green business start-up clusters (ea)	-	1	1	1	1

Tasks and Major Indicators		2009	2010	2011	2012	2013
4. Fostering of Knowledge Led Rreen Clusters						
	Green cluster formation (ea)	-	2	4	6	8
	Quantities recycled and reduced of by-products and water generated in ecological industrial complexes (1,000 ton)	-	95,200	113,400	131,600	149,800
	Construction of ecological industrial complexes (ea, based on Hub complexes)	5	7	10	10	10
	Low carbon industrial complex greenhouse gas reduction (1,000 ton)	-	270	620	1,110	1,310
	Construction of low carbon industrial complexes (ea)	-	2	5	8	10
	Construction of u-Biz Conferences (%)	-	40	60	80	90
	Comprehensive monitoring of industrial complex environments (%)	-	30	40	60	70
	Construction of green industrial complex control centers (%)	-	40	60	70	80
	Waste resource management utilizing u-IT technologies (%)	-	-	30	50	70
	Energy monitoring management (%)	-	-	40	70	80
Outcome	**Major Indicators**	**2008**	**2009**	**2010**	**2011**	**Trend**
	Domestic material consumption per GDP unit (Kg/1,000 KRW)	0.666	0.628	0.637	0.625	↘
	Ratio of the sales of environmental industries (%)	0.85	0.96	1.05	0.93	↗
	Sales of new and renewable energy industry (billion KRW)	3,369	4,748	8,078	9,854	↗

Note: The method to establish the major performance indicators are as follows.

- Domestic material consumption per GDP unit: domestic material consumption (fossil fuels, government property for industry, government property for construction, biomass)/real GDP.
- The ratio of the sales of environment industries: the sales in environmental protection activities / domestic sales in all industries.
- Sales of new and renewable energy industry: total annual sales of new and renewable energy industry in the manufacturing sector / total sales in manufacturing (more than 10 people).

Source: PCGG (2009b), pp.188~210, National Statistics Office Green Growth Indicator (http://green.kostat.go.kr, Accessed: 2014.09.07.).

3.2. Major Policies

3.2.1. Greening of Industries

The green growth policies in Korea were not only intended to create low carbon and high added value new industries, but also intended to pursue greening of existing industries. In the case of developing countries, the capability to give up existing industries and foster new industries pursuant to the foregoing intent should be limited, and greening existing industries through cooperation with advanced countries should be an acceptable direction. In the case of Korea, representative success cases of greening of manufacturing businesses include the development of low carbon technologies and smart grids in the areas of secondary batteries, steel & iron, and power generation.[24] These are cases where the government and the private sector have cooperated to develop low carbon technologies in the area of manufacturing businesses. The policies and innovation processes through which Korea showed these outcomes will be described. <Table 3-9> briefly describes the greening policies for secondary batteries, steel & iron, development, and smart grids that will be described in this section.

Table 3-9 | Greening Policies for Manufacturing Businesses

Area	Content
Secondary Batteries	• Relevance to greening - Secondary batteries are batteries that can be repeatedly used and are a green technology that can be utilized in machines and devices that require efficient energy storage and utilization • Related policy: secondary battery competitiveness strengthening plan (2010)
Steel & Iron, Power Generation	• Relevance to greening - Although these are representative energy intensive industries, energy efficiency is greatly enhanced through development of technologies for greenhouse gas reductions • Related enterprises - Steel & iron: POSCO - Power generation: Korea Electric Power Corporation (KEPCO)

24. Secondary batteries are batteries that can be repeatedly used through storage and generation of electricity. Secondary batteries are a core technology for commercialization of electric vehicles and smart grids that require efficient storage and utilization of energy and provide high capacity power to miniaturized IT devices (Cho, 2011, pp.5~6).

Area	Content
Smart grids	• Relevance to greening - Supply new and renewable energy, operate electric vehicles, and provide energy management systems and diverse services - Promote green technology development, commercialization, and conversion into an export industry - Construct electric power/communication infrastructures for stable linkage to power grids and enhancement of transmission efficiency • Enterprises that participate in the Jeju smart grids - Twelve consortiums consisting of smart grid related enterprises such as electric power · communicationÐautomobileÐhome electric appliance companies (168 companies)

Source: Cho (2011), p.5, 8; Jeju Smart Grids Test-Bed (http://smartgrid.jeju.go.kr/contents/index.php?mid=0202, Accessed: 2014.09.10).

First, in the case of secondary batteries, global level technological prowess was secured through investments in green technologies and technological innovation. This is a representative case of new industry creation in the area of manufacturing businesses. The secondary battery industry in Korea began in 1993 when LG Chem, Ltd. began to develop secondary batteries. Competition in earnest was formed between large enterprises in 2000 when Samsung SDI began to produce secondary batteries (Joo, 2010, p.11). The battery industry developing and producing secondary batteries concentrated on technical development to chase Japan, the leading country in the industry. The Korean government has made efforts to enhance the level of secondary batteries made in Korea since 2003 through 'Next Generation Technical Development Strategy Programs.' In 2010, the Ministry of Trade, Industry and Energy announced the 'Secondary Battery Competitiveness Strengthening Plan.' To achieve the world market share of 50% by 2020 with investments amounting to 15 trillion KRW, the Ministry of Trade, Industry and Energy put up medium/large size battery competitiveness strengthening, core material industry fostering, the formation of industrial ecosystems as virtuous circles, and the establishment of road maps through secondary batteries (Cho, 2011, p.1, the Ministry of Science, ICT and Future Planning, 2013, p.260). Thanks to the government's support and the industry's efforts for technical development, the secondary battery industry in Korea achieved great accomplishments. The world market share of Korea that was 21.3% in 2007 jumped to 43.5% in 2012. However, the percentage of source technologies for core component materials held in Korea is only 30~50% of the country with the highest percentage. Therefore, domestic enterprises are trying to secure new source technologies (Korea Evaluation Institute of Industrial Technology, 2014, p.62, 78).

Second, although the areas of steel & iron and electric power are representative energy intensive industries, greening of these industries is being achieved through a combination of the government's will for greening of existing industries and relevant enterprises' efforts for green innovation. POSCO and Korea Electric Power Corporation (KEPCO) greatly enhanced their energy efficiency through the development of technologies for greenhouse gas reductions. In 2010, the government held 'greening forums for each of 11 major industries' to discussed detailed measures for greenhouse gas reductions in each industry. Greening efforts were continued at the level of enterprises too. POSCO, which is a representative steel & iron enterprise in Korea, is conducting activities to reduce greenhouse gas emissions in steel & iron processes, such as the development of energy saving and CO2 reducing innovative technologies, implementing new and renewable energy projects, and supplying energy saving materials (PCGG/Korea Chamber of Commerce and Industry sustainable management center, 2009, p.30). In particular, POSCO is implementing a 'mid/long-term technical development project (POSCO CO2 Break Through Framework)' to develop innovative CO2 reducing technologies. In addition, POSCO is conducting energy saving material development and supply activities to reduce not only greenhouse gas emissions in the process of production but also social greenhouse gas emissions in the stage of use of products (POSCO homepage).[25]

Although the area of electric power is also a representative energy intensive industry, CO2 emission reducing technologies and green technologies are being developed, mainly by Korea Electric Power Corporation (KEPCO). To reduce CO2 emissions in the power generation industry, KEPCO is conducting studies in the area of CO2 reducing technologies. In particular, KEPCO is developing CO2 collection and storage (CCS) technologies, which are CO2 reducing technologies and Integrated Gasification Combined Cycle (IGCC) technologies that are environment-friendly thermal power generation technologies. In addition, KEPCO is developing smart grid technologies that intellectualize and upgrade electrical grids based on information communication technologies, concentrating on the development and application of technologies for enhancing the efficiency of electric power systems (KEPCO homepage).[26] <Table 3-10> shows the outcomes by POSCO and KEPCO mentioned above.

25. POSCO (http://www.posco.co.kr/homepage/docs/kor3/html/sustain/environ/environment_04.jsp, Accessed: 2014.09.10).

26. Korea Electric Power Corporation (http://cyber.kepco.co.kr/kepco/KE/I/htmlView/KEIAHP00121.do?menuCd=FN010204, Accessed: 2014.09.10).

Table 3-10 | Outcomes of Greening by POSCO and KEPCO

〈POSCO's High Energy Efficiency Steel & Iron Materials' Annual CO2 Reduction Effects〉				
	2009	2010	2011	2012
High Tensile Strength Automotive Steel Sheet (CO2 1,000 tons)	288	502	631	659
High Energy Efficiency Directional Electrical Steel Sheet (CO2 1,000 tons)	182	185	223	219
High Energy Efficiency Non-oriented Electrical Steel Sheet (CO2 1,000 tons)	1,364	1,861	2,377	2,291
〈KEPCO's Environmental Outcomes〉				
	2009	2010	2011	2012
Quantity of New & Recyclable Facility Diffusion (total) (kW)	1,145	1,145	1,145	1,205
SF6 Emissions (CO2 1,000 tons)	1,841	1,841	924.09	1,162
Power Transmission/Distribution loss Rate (%)	4.07	4.03	3.83	3.77

Source: POSCO (http://www.posco.co.kr/homepage/docs/kor3/html/sustain/environ/environment_04.jsp, Accessed: 2014.09.10);
KEPCO (http://cyber.kepco.co.kr/kepco/KE/D/htmlView/KEDBHP004.do?menuCd=FN0103030104, Accessed: 2014.09.10).

Third, smart grids are next generation electrical grids that optimize energy efficiency and greatly reduce greenhouse gas emissions. The Korean government judged that new and renewable energy and electric car diffusion could not be activated as part of low carbon green growth policies using existing electrical grids, and thus promoted the construction of smart grids. The Ministry of Knowledge Economy announced the 'National Smart Grid Roadmap' in 2010 and planned to form a base of low carbon green growth through the construction of smart grids. In this road map, stepwise goals were set to construct nationwide smart grids by 2030 by constructing smart grid model cities in 2012 and wide area smart grids by 2020 (Ministry of Knowledge Economy, 2010, p.15). In this process, a smart grid test-bed (the construction commenced in 2009 and the operation began in 2013) was formed in Jeju-do. In the smart bed formed for approximately 6,000 households in the region of Gujwa-eup, Jeju-do, new and renewable energy is supplied, electric vehicles are operated, and energy management systems and diverse services are provided so that the residents can experience cutting-edge green life. In addition, 168 enterprises were allowed to participate in this project to promote the development, commercialization, and conversion into export industries of related technologies. In addition to these outcomes, smart grids in Korea will

be a good example for developing countries in which electric power infrastructures have not yet been sufficiently constructed in that the construction of electric power·communication infrastructures was attempted for stable linkages between electrical grids and for enhanced transmission efficiency.

3.2.2. Construction of Resource Cycling Economic and Industrial Structures

The whole world felt a sense of crisis from energy problems, from resource depletion and climate change due to greenhouse gases, and felt the necessity to implement resource cycling policies. In addition, as waste emerged as a new growth engine, the development of the resource cycling industry became necessary. Following these current trends, low carbon green growth was presented as a national vision in Korea and under the policy direction 'greening of industries', directions of resource cycling plans were presented through the practical task, the construction of resource cycling economic/industrial structures. Thereafter, as a strategy and plan to support this vision, the 'First Basic Resource Cycling Plan (2011~2015)' was prepared based on article 7 of the 「Act on the Promotion of Saving and Recycling of Resources」 (Ministry of Environment et al., 2011, pp.3~4). <Table 3-11> shows the content of major resource cycling related policies and laws.

Table 3-11 | Major Resource Cycling Related Policies and Laws

Policies/Laws	Content
Five-Year Plan for Green Growth	5-1 Construction of resource cycling economic/industrial structures 5-1-1. Construction of a nationally-integrated resource cycling management system • Construction and operation of a national resource cycling information system • Construction and operation of a resource circularity evaluation system • Development and supply of the Allbaro system that provides wastes information and linking modules 5-1-2. Modification of resource cycling related laws/systems • Establishment and operation of a basic resource cycling act • Modification of related legal systems such as the Wastes Control Act 5-1-3. Construction of a base of activation of resource cycling • Secure the economy of the scale of waste collection • Improve the distribution structure of recycling resources • Expand the demand base of recycled products

Policies/Laws	Content	
Five-Year Plan for Green Growth	5-1-4. Activation of city mining (waste metal recycling industry) • Expand the scales of city mines (waste metal resources) • Promote the development of city deposit resource recycling technologies • Foster city mining 5-1-5. Promote the supply of recycled aggregates produced from construction wastes • Expand the supply of recycled aggregates and recycled aggregates recycled products • Reduce the generation of construction wastes and strengthen proper treatment • Construct high quality recycled aggregates production/ use infrastructures	
Law	「Act on the Promotion of Saving and Recycling of Resources」 (law no. 12319, partially amended on 2014.1.21., became effective on 2014.7.22.)	
Plan	Plan name	• The First Basic Resource Cycling Plan (2011~2015)
	Vision	• Settlement of low carbon resource cycling (Zero-Waste) society
	Goal	• Formation of a base of waste resource upcycling - Achieve a resource cycling rate of 20.3% by 2015 - Reduce the final landfill quantity by 26% (compared to 2009)
	Strategies and Tasks to be Implemented	- Switch the society structure to a resource cycling one - Strengthen resource circularity in development projects and entire product processes - Formation of resources saving purchase · consumption culture • Realize value enhancing resource cycling (4R) - Minimize the landfill of useful resources - Promote resources reuse and reutilization • Construct integrated waste treatment infrastructures - Set waste treatment optimization methods and regions - Strengthen the management of harmful wastes • Develop technologies and foster industries - Promote the development of high added value resource cycling technologies • Prepare a base of resource circularity evaluation and implementation - Construct cooperation systems by economic unit

Source: PCGG (2009b), pp.50, 153~154, 188~192.

The 'First Basic Resource Cycling Plan' was implemented to achieve the goals of the Five-Year Plan for Green Growth and the low carbon green growth plan. Its goals have been set as the achievement of a resource cycling rate of 20.3% and a reduction of the final landfill quantity by 26% compared to 2009. In linkage with the Five-Year Plan for Green Growth, this includes mid/long-term resource cycling plans such as major resource cycling policies by department (refer to <Table 3-12>), resources energy recovery plans, and recycling plans by sector (Ministry of Environment et al., 2011, p.5).

Table 3-12 | Major Resource Cycling Policies by Department Linked to the Five-Year Plan for Green Growth

Division	Major Resource Cycling Policies
Ministry of Environment	Generally manages 4R (reduction, reuse, recycling, recovery of energy) policies, fosters resource cycling industries under its jurisdiction, promotes the development of technologies to promote the use of waste resources as energy sources, promotes industrialization of such technologies
Ministry of Public Administration and Security	Formation of green energy independence villages, conversion of livestock excretions into resources and energy
Ministry of Agriculture and Forestry	Promotion of the conversion of biomass into energy (Formation of model low carbon green villages)
Ministry of Knowledge Economy	Foster the resource cycling industry, develop and supply new and renewable energy technologies and promote the industrialization of such technologies, activate city mines, construct ecological industrial complexes, activate the remanufacturing industry, enhance industrial world resource productivity (including goal management), promote switching to resource cycling industrial structures
Ministry of Land, Transport and Maritime Affairs	Reduce sea disposal of land wastes (wastes discharge waters monitoring)

Source: Ministry of Environment et al. (2011), p.5.

4. Green Land and Transportation

4.1. Related Plans and Outcomes

In the green land and transportation sector, the government makes key indicators for action plans of each policy, such as low-carbon green urban development, expansion of the ecological space, expanding green buildings, building green transportation system and vitalization of bicycles. <Table 3-13> summarizes outcomes with green growth indicators published by Statistics Korea in 2013 and the key figures in the Five-Year Plan for Green Growth to achieve specific goals.

The annual targets are as follows. First, to establish green land and cities, the target was established for creating one low carbon green city in 2010 and increasing the number every year to 8 in 2013. Also, for development of low carbon new green cities, the target was established for selecting the energy independent test cities (2010), institutionalizing the mandatory rate of new and renewable energy used in public buildings, expanding its application to private buildings (2012) and increasing the mandatory rate in 2013. In addition, it sets annual targets for expanding recycling in low carbon green city cores and constructing the energy climate map for national land and cities. Second, for expanding the ecological space, targets were established for increasing the establishment rate of environmental information in cities and protection areas (from 10% in 2009 to 70% in 2013), increasing the ratio of ecological streams (60% in 2009 to 70% in 2013), increasing the area of low carbon green forests (from 1,800 ha in 2009 to 2,500 ha in 2013), and increasing the rate of multi-purpose horizontal sidewalk areas (from 5% in 2009 to 30% in 2013). Third, for increasing the number of green buildings, targets were established for expanding the rating system for building energy efficiency and certification of green buildings (from 40% in 2009 to 100% in 2013), and increasing the rate of support for green reconstruction of existing buildings (from 10% in 2009 to 60% in 2013). Fourth, for establishing the green transportation system, targets were established for increasing the share of public means of transportation (from 50% in 2009 to 55% in 2013) and share of railroad transportation (from 19% in 2009 to 30% in 2013) and decreasing the share of short-distance car driving (from 43% in 2009 to 30% in 2013). Finally, the target indicators for invigorating the use of bicycles include increasing the share of bicycle transportation (from 1.5% in 2009 to 5% in 2013) and increasing the supply rate of bicycles (from 10% in 2009 to 30% in 2013).

Looking through the data released by Statistics Korea, achieved goal shows that the per-capita urban forest area in living zones has increased from 7.76 m per capita in 2009

to 7.95 m per capita in 2011. The rate of passenger transport and subway share rose from 24.3% in 2008 to 25.9% in 2011. In contrast, environmental protection expenditures for GDP decreased slightly from 2.94% in 2008 to 2.73% in 2011.

Table 3-13 | Practical Tasks for Green Land and Transportation and Goals

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
1. Formation of Green Land and Cities						
	Low carbon green city formation (ea)	0	1	3	5	8
	New low carbon green city development	-	Selection of energy independence model cities	Systematization of the ratio of new and renewable energy that must be compulsorily used in public buildings	Systematization of the ratio of new and renewable energy that must be compulsorily used in private buildings	Increases in the ratio of new and renewable energy that must be compulsorily used
	Low carbon green regeneration of downtowns (%)	5	10	20	30	40
	Production of land· city energy climate maps (%)	5	10	30	60	100
2. Expansion of Ecological Spaces						
	Rate of construction of city and protected region environment information (%)	10	20	30	50	70

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
	Ratio of ecological rivers (%)	60	61	62	65	70
	Area of low carbon green forests formed (ha)	1,800	1,900	2,000	2,300	2,500
	Ratio of multi-functional street spaces formed (%)	5	10	18	25	30
3. Expansion of Green Buildings						
	Expansion of the building energy efficiency grade system and the green building certification system (%)	40	50	60	90	100
	Performance based green building design standard strengthening (%)	20	40	60	80	70
	Green building element technology development and supply (%)	20	30	40	50	60
	Expansion of green home model development and supply (%)	10	30	40	50	60

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
	Support for modification of existing buildings into green buildings (%)	10	30	40	50	60
4. Construction of Green Transportation Systems						
	Public transportation means share (%)	50	51	52	53	55
	Railroad means shares (%)	19	21	23	25	30
	Short distance car traffic ratio (%)	43	40	37	34	30
5. Vitalization of Bicycle Use						
	Bicycles' share of transportation means (%)	1.5	3	4	5	5
	Bicycle city (at least 10%) (ea)	1	3	5	10	20
	National bicycle path (km)	100	300	500	1,000	1,400
	Urban bicycle path (km)	50	100	300	600	1,000
	Bicycle distribution rate (%)	10	15	20	25	30

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
	Major Indicator	2008	2009	2010	2011	Trend
Outcome	Per-capita urban forest area in living zones (m²/person)	-	7.76	-	7.95	↗
	Rate of passenger transport and subway (%)	24.3	25.0	25.7	25.9	↗
	Ratio of environment protection expenditures to GDP (%)	2.94	3.06	2.79	2.73	→

Note: - The method to establish the major indicators are as follows.
Per-capita urban forest area in living zones: urban forest area / registered population in cities.
Rate of subway and railroad transport: subway and railroad transport / total transport.
Ratio of environmental protection expenditures to GDP: expenditures for prevention of pollution / nominal GDP.

Source: PCGG (2009b), pp.281~318, National Statistics Office green growth indicator (http://green.kostat.go.kr, Accessed: 2014.09.07).

4.2. Major Policies

As set forth in <Table 3-14>, in relation to green land and cities in the Five-Year Plan for Green Growth, the formation of green land and cities, the expansion of ecological spaces, the expansion of green buildings, construction of green transportation systems, and the vitalization of bicycle use were presented as practical tasks.[27] In addition, the implementation strategy of 'the formation of nature-friendly and safe national land spaces' pursued by green growth policies was reflected on 'the Fourth Amended Comprehensive National Land Plan (2011~2020) (Presidential announcement no. 224, announced on 2011.1.27.),' which is a national land related comprehensive national plan (refer to <Table 3-14>). This plan was

27. To accomplish these tasks, the 「Framework Act on the National Land」, the 「Act on the Support for Construction of Green Buildings」, 「Development Act for Sustainable Transportation and Logistics」, the 「Act on the Activation of Bicycle Use」, the 「Special Act on the Preservation of Ecosystems in Island Areas including Dok-do」, the 「Water Quality and Ecosystem Conservation Act」, and 「Marine Ecosystem Conservation and Management Act」 were established or amended.

established because new national land development strategies were necessary to respond to climate change, pursue low carbon green growth, respond to intensified global competition systems, and respond to diverse socioeconomic and environmental changes (Government of Korea, 2011, p.1).

Table 3-14 | Green Land and Transportation Related Plans and Laws

Policies/Laws	Content
Five-Year Plan for Green Growth	1. Formation of green national lands and cities - Formation of resource cycling green national lands where the environment and economy are harmonized with each other - Establishment of plans to manage and preserve national lands' ecological axis which is the root of life of the Korean Peninsula - Development of Korean style low carbon green city models, low carbon city regeneration projects, low carbon energy saving new cities and selection and support of model cities 2. Expansion of ecological spaces - Designation and expansion of local protection areas and international protection areas and fostering of these areas into strongholds for ecological tourism - Recovery of river health through the restoration of covered and damaged rivers and expansion of ecological cultural spaces 3. Expansion of green buildings - Strengthen building energy saving design standards and switch the standards to be centered on performance - Activate green building certification systems for environment-friendly buildings and energy efficiency - Develop green home models as environment-friendly low energy houses and increase supply by region 4. Construction of green transportation systems - Expand green key traffic networks centering on railroads and construct public transportation networks faster than passenger cars - Activate green logistics, such as green logistics certification systems and green logistics partnership - Develop new green transportation systems and increase usage 5. Activate bicycle use - Construct national bicycle networks at the level of European green ways that connect border areas, coasts, and river roads - Form bicycle use conditions, so that bicycles can be used any time anywhere

Policies/Laws	Content	
Laws	「Framework Act on the National Land」 (law no. 11690, effective as of 2013.3.23.) 「Green Building Construction Support Act」 (law no. 11690, effective as of 2013.3.23.) 「Sustainable Transportation Logistics Development Act」 (law no. 11801, effective as of 2013.5.22.) 「Act on the Activation of Bicycle Use」 (law no. 12248, effective as of 2014.7.15.) 「Special Act on the Preservation of Ecosystems in Island Areas including Dok-do」 (law no. 12458, effective as of 2014.3.18.) 「Water Quality and Ecosystem Conservation Act」 (law no. 11979, effective as of 2014.7.31.) 「Marine Ecosystem Conservation and Management Act」 (law no. 12490, effective as of 2014.3.18.)	
Comprehensive National Land Plan	Plan name	• The Fourth Amended Comprehensive National Land Plan (2011~2020)
	Vision	• Global green land for Korea's new leap forward
	Goal	• Competitive integrated national land • Sustainable environment-friendly national land • Elegant attractive national land • National land open to the world
	Implementation strategies	• Strengthen regional specialization and wide area cooperation to enhance national land competitiveness • Form nature-friendly and safe national land spaces • Form comfortable and cultural urban · residential the environment • Construct integrated governmental green transportation·national land networks • Construct new marine/national land bases for growth open to the world • Construct trans-border national land management bases

Source: PCGG (2009b), pp. 288, 295, 302, 312, 318; Government of Korea (2011), p.23.

Representative policies related to the area of green national land·transportation include the 'Green Remodeling Project' and the 'Four Major Rivers Restoration Project,' currently being implemented by the Ministry of Land, Transport and Maritime Affairs. In addition, many other policies have been implemented such as the green architecture certification system and building energy efficiency grade system. The process of implementation for projects can provide many lessons for future projects to be implemented later by Korea

and other developing countries. In terms of outcomes of projects, in particular, the green remodeling project and the Four Major Rivers Restoration Project will be examined.

First, the green remodeling project is being implemented by the Ministry of Land, Transport and Maritime Affairs and the Korea Infrastructure Safety Corporation, as part of the 'pilot green building formation project' implemented pursuant to the 「Act on the Support for Construction of Green Buildings」 established in 2012 (refer to <Table 3-15>). This project is being implemented to improve buildings' energy performance following the finalization of a reduction goal in the area of buildings according to the setting of a national greenhouse gas reduction goal. A pilot green remodeling project was implemented for buildings in 2013 in which the review of the orientation of facility improvement, checking of the degree of deterioration, the presentation of expected quantities to be reduced through energy simulations, and the calculation of construction work costs for green remodeling were supported. Through the pilot project in 2013, energy consumption was reduced by at least 20~30% compared to previous performance. Therefore, the pilot project has continuously operated in 2014, to enhance national perception of green remodeling and induce diffusion of green remodeling to the private sector.

In addition, the Ministry of Land, Transport and Maritime Affairs has been implementing a green remodeling interest support project for the private sector, from early 2014. If interested building owners request the green remodeling creation center for support, the center will support performance evaluation, project plan preparation, consulting, and introduce appropriate business operators. In particular, this project enables building owners to borrow project costs at low interest rates and repay the loans over long periods of time to reduce their burdens.

The outcomes of the projects cannot be evaluated yet because the pilot project for public buildings undergoing green remodeling began in 2013 and the pilot project for the private sector began in 2014. However, these project are energy performance improving projects for existing buildings, not for new buildings. Therefore, if the projects are expanded for all deteriorated buildings in the whole national land based on the know-how obtained from the pilot projects, the policy will cost-efficiently contribute to reductions in buildings' greenhouse gas emissions and strengthen their safety.

Table 3-15 | Green Land and Transportation Related Representative Policies: Green Remodeling Project

Division	Content
Background	• Green remodeling of deteriorated buildings is being implemented as part of the 'pilot green building formation project' implemented pursuant to the 「Act on the Support for Construction of Green Buildings」 established in 2012
Implementing Organizations	• Ministry of Land, Transport and Maritime Affairs • Korea Infrastructure Safety Corporation's green remodeling creation center
Necessity	• Finalization of a reduction goal in the area of buildings according to the setting of a national greenhouse gas reduction goal • Structural safety of deteriorated buildings should be secured as earthquake resistant design standards have been strengthened • Public buildings' energy performance should be urgently improved because the building energy consumption certification system came into effect in 2013 • Limitations in previous remodeling methods (uncertainty of energy saving)
Overview of the Project	• A system that enables building owners to borrow energy performance improving construction work costs from banks at low interest rates and repay the project costs over long periods of time with the saved room cooling/heating costs after completion of construction works • Interest support budget: 2 billion KRW (support 2~4% depending on the degree of performance improvement for five years) • Loan limit: non-residential buildings 3 billion KRW, houses 50 million KRW (apartments; 20 million KRW per unit) • Construction works that may be supported: insulation and window improvement, energy saving devices, new and renewable energy, etc. • Preliminary selection of green remodeling business operators: 171 companies were selected in the areas of construction, design, equipment, materials, etc.
Effect	• Apartment (exclusive use area 37.8 m²) insulation performance improvement: Room cooling/heating costs were reduced by 240,000 KRW/year and district heating use quantity decreased by 45% after the construction work (2013 use quantity was compared to 2011 use quantity) • Business facility (public business, gross area 30,000 m², seven floors) insulation performance improvement: Room cooling/heating costs were reduced by 85 million KRW/year after the construction work, indoor temperature increased despite that room heating time was reduced (2~3℃)

Division	Content
Pilot Green Remodeling Project (2013, 2014)	• Subject: public buildings that were approved for use more than 15 years earlier after being completed before 1998 • Selection criteria: symbolism of buildings, energy saving effects, easiness of ex post facto monitoring, number of years passed after completion, remodeling plan • Contents of technical support in the stages of planning and design - Review of the orientation of facility improvement considering public buildings energy reduction goals - Investigate maintenance history to identify the degrees of deterioration in the areas of architecture, electricity, and equipment - Figure out the level of performance compared to similar buildings through energy simulations - Present expected amount of reduction through energy simulations of improvement plans • Figure out rough green remodeling work costs - 2013 outcome: Energy consumption was reduced by at least 20~30% compared to previous performance - 2014 plan: A total of 2 billion KRW will be provided from the government budget to four buildings in the construction support project sector including the second annex to the Gyeonggi-do office building and seven buildings in the project planning support project sector including Incheon Medical Center - Support item: window replacement, insulation reinforcement, exterior shading devices, etc.

Source: Korea Infrastructure Safety Corporation (2013), p.4; Ministry of Land, Transport and Maritime Affairs press release (2014.3.27.), pp. 1, 4~8.

The 'Four Major Rivers Restoration Project' is one of the most controversial projects, in terms of its policy intention and effects, among the projects related to establishment of green land and cities. This project was planned and implemented in July 2009 for national rivers including four major rivers called the Hangang (river), Nakdonggang (river), Geumgang (river), and Yeongsangang (river), plus the main stream and major tributaries

of Seomjingang (river) to secure water resources and control floods.[28] This project was implemented with a view to securing water resources, preventing flood damage, restoring the soundness of hydro-ecosystems, forming composite water front spaces, and promoting regional development (Kwon and Yun, 2009, pp.4~5). For this project, a total of 22.2 trillion KRW comprising main project costs 16.9 trillion KRW and directly linked project costs 5.3 trillion KRW was inputted (Jeon et al., 2013, p.10).

The content of the Four Major Rivers Restoration Project can be largely divided into four goals. The first one is river stage reductions for flood control. Flood stages were reduced by approximately 0.4~3.9 m by increasing cross sectional areas of rivers through deposit soil dredging. The second one is securing water resources to be prepared for future water shortages. To this end, 16 multi-functional barrages were constructed and 41 small water power plants were installed on the barrages to produce electricity (Four Major Rivers Restoration Project Headquarters, 2012, pp.14~15). The third is water quality improvement. Sewage treatment plants were newly established or extended so that water quality improvement projects could be implemented at 1,322 places. The fourth is the formation of waterfront spaces for regional residents. In the waterfront spaces, composite spaces including convenience facilities, sport facilities, trails, and bicycle paths (1,230 km) were formed to be utilized as residential resting and leisure spaces (Board of Audit and Inspection, 2013, p.7).

After the Four Major Rivers Restoration Project, the number of large-scale floods decreased. Flood stages dropped by up to 3.78 m in Nakdonggang (river) in the vicinity of Sangju, 2.54 m in Hangang (Yeoju), 3.36 m in Geumgang (Yeongi), and 2.13 m in Yeongsangang (Naju) and farmland remodeling effects could be obtained (Kim, 2011, pp.26~28). In addition, as a result of the water quality improvement project, the water quality of the four rivers measured at 66 places and 16 barrages in the first half of 2012 was shown to have been improved greatly compared to before the project (2007~2009). The average value of biochemical oxygen demand (BOD) was improved from 2.6 mg/L to 2.1

28. The Four Major Rivers Restoration Project was determined to be implemented after being selected as one of government projects by the Commission on Presidential Transition following the election of Former President Lee Myung-Bak (December 2007). The 'Four Major Rivers Restoration Planning Group' was organized in the Ministry of Land, Transport and Maritime Affairs in February 2009 and the organization was expanded into the 'Four Major Rivers Restoration Project Headquarters' in April to form a government-wide task force team with personnel from related government agencies, local governments, and public organizations. Thereafter, in May, public opinions were collected through discussions among related agencies, expert consulting, public hearings, and regional presentations (Four Major Rivers Restoration Project Headquarters, 2012, p.10). Through these processes, the master plan was finalized in June of the same year and the construction work began in earnest in July (Four Major Rivers Restoration Project Headquarters, 2012, p.10).

mg/L and the average value of total phosphorus (T-P) decreased by 44% from 0.149 mg/L to 0.083 mg/L (Ministry of Land, Transport and Maritime Affairs, 2012, p.1~3).

The significance of the Four Major Rivers Restoration Project can be found from the cultural and economic aspects. After opening 16 barrages throughout the country since October 2011, one million people visited the barrages as of January 17, 2012. The number of visitors reached two millions on March 29, 2012 ,which was three months after the opening of the barrages. Accordingly, tourists visiting the convenience and sport facilities installed in the waterfront spaces increased, which has helped the vitalization of regional economy (Four Major Rivers Restoration Project Headquarters, 2012, p.19).

As the Four Major Rivers Restoration Project was implemented as a Korean style green new deal project, the project attracted great attention in terms of its purpose and scale. However, according to the results of audits by the Board of Audit and Inspection announced in 2013 (2013.1.17), the quality of major facilities were identified as being problematic. Due to poor design, 11 of 16 barrages installed in the four rivers are not sufficiently durable, and water quality may be deteriorated because the quality of water in the barrages in the four rivers was managed based on inappropriate water quality management standards. In addition, it was announced that, due to the dredging plan implemented inefficiently and without accurate prior review, excessive maintenance costs are expected to be required hereafter (Board of Audit and Inspection, 2013, pp.2~5).

Unlike the aspects evaluated and announced by the government as a successful result of the Four Major Rivers Restoration Project, the inspection by the Board of Audit and Inspection showed a negative side of the project as well. Thus, the progress and results of the comprehensive evaluation are still up for debate. Although the Four Major Rivers Restoration Project was implemented under the goals of water resources securing, flood damage prevention, hydro-ecosystem soundness recovery, composite water front space formation, and regional development promotion, it brought about doubts about the project itself and controversies over the destruction of the environment from the beginning of the project, since it was implemented in a short time with large budgets. In particular, it has been criticized that the quality of construction was compromised, in order to achieve quickly in the short period. Even though the Four Major Rivers Restoration Project has been controversial in terms of its process and outcomes, the project itself could serve as a lesson to third parties in large civil engineering projects in the future.

5. Green Lifestyle

5.1. Related Plans and Outcomes

Green living is a policy directly related with 'green revolution of life,' which is the ninth policy direction in the Five-Year Plan for Green Growth. It could be seen as the 'practice of the green movement in life'. The Five-Year Plan for Green Growth suggests five practical challenges for the green living sector. First, construction of bases of green growth education and green citizen cultivation; second, diffusion of the practice of green life; third, activation of green consumption; fourth, green village formation and development of movements; and fifth, activation of ecological tourism. Annual targets and main outcomes for key performance indicators and practical challenges in the five-year plan are summarized in <Table 3-16>.

First, the annual target was set to establish the national implementation system and roadmap, and expand the beneficiaries for green growth education. Second, in order to encourage green life, indicators were set to be developed completely by 2011, increasing the number of green citizens (from 500,000 in 2009 to 1 million in 2013) and number of green households (from 160,000 households in 2009 to 300,000 households in 2013). Third, in order to encourage green consumption, indicators were established for increasing the amount of green purchases (from 2.5 billion KRW in 2009 to 4.0 billion KRW in 2013) and expanding the list of items certified for carbon labeling (from 50 in 2009 to 500 in 2013). Fourth, with respect to the construction of gree villages and the related movement, the targets to increase the number of green village centers (from 20 in 2010 to 100 in 2013) and number of green villages (from 12 in 2010 to 16 in 2013). Finally, in order to encourage eco tours, targets were established to promote public awareness about ecological tours (from 70% in 2009 to 100% in 2013), thereby expanding the list of items certified for ecological tours (from 10 in 2011 to 100 in 2013).

In a typical major achievements in the green revolution policy sector, household energy consumption per capita has been unchanged, which has been from 0.432 TOE per capita in 2008 to 0.434 TOE per capita in 2011. During the same period, domestic water consumption per capita decreased from 337 L per capita to 335 L per capita, and it is clear that domestic waste per capita shows a decline from 1.04 Kg per capita per day to 0.95 Kg per capita per day.

Table 3-16 | Practical Tasks of Green Revolution of Living and Yearly Goals of Major Indicators

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
1. Construction of Bases of Green Growth Education and Green Citizen Cultivation						
	Construction of national green growth education practice system	-	Completed			
	Establishment of green growth education road map	-	Completed	Implemented		
	Increase the number of beneficiaries of green growth lifelong education (accumulated ratio of beneficiaries of education to the total population, %)	-	10	15	20	230
2. Diffusion of the Practice of Green life						
	Develop green life indicators (%)	-	60	Completed		
	Cultivate green citizens (person)	500,000	700,000	800,000	900,000	1,000,000
	Cultivate green homes (household)	160,000	180,000	200,000	250,000	300,000
3. Activation of Green Consumption						
	Amount of green purchases (trillion KRW)	2.5	3.1	3.4	3.6	4.0
	Carbon labeling certification items (ea)	50	100	250	400	500
	Enterprises with green purchase agreements (ea)	102	120	130	150	170
	Green distribution shops (ea)	387	450	500	550	600

Practical Tasks and Major Indicators		2009	2010	2011	2012	2013
4. Green village Formation and Development of Movements						
	Increase green village centers by strong hold (ea)	-	20	50	80	100
	(government led) green village centers (ea)	-	12	4	58	16
	Develop/diffuse low carbon green village models	-	Developed	Diffused		
5. Activation of Ecological Tourism						
	Degrees of progression of 10 major ecological model projects (%)	-	20	50	80	100
	National recognition of ecological tourism (%)	70	80	95	100	100
	Ecological tourism certification products (including accommodations and tourism destinations, ea)	-	-	10 (model)	20	100
Outcome	**Major Indicators**	**2008**	**2009**	**2010**	**2011**	**Trend**
	Home energy consumption per person (TOE/person)	0.432	0.418	0.429	0.434	→
	Living water consumption per person (L/person/day)	337	332	333	335	↗
	Domestic waste generation per person (Kg/person/day)	1.04	1.02	0.96	0.95	↗

Source: PCGG (2009b), pp.322~354; National Statistics Office Green Growth Indicator (http://green.kostat.go.kr, Accessed: 2014.09.07.).

5.2. Major Policies

Policies were implemented in diverse sectors to promote green life. Among them, the resource cycling policies related to the disposal of food wastes and e home electric appliances have been highly evaluated in terms of outcomes. The food volume-based waste fee system was introduced as a means of reducing food waste and a free of charge collection system for large waste home electric appliance products was introduced. In relation to this, Iksan-si, Jeollabuk-do introduced food volume-based waste fee systems using RFID (Radio Frequency IDentification) and payment chips in July 2012. In 2012, the first year after introduction, food wastes per person decreased by 22.5% and disposal costs decreased by 21.8% compared to the previous year (Ministry of Environment, 2013a, p.14).

In addition, in the case of the 'free of charge collection system for large waste home electric appliance products' that was initiated by the Ministry of Environment in June 2012 in Seoul and was implemented in six cities. As of September 2013, the quantities collected increased to 1.5~6 times compared to 2012 before implementation by the local government. With only the quantity collected in 2013, economic effects amounting to 14.7billion KRW could be obtained and greenhouse gas emissions were reduced by 25,000tons. Among 8,601 users of the service in 2013, 99.6% answered that they were satisfied with the relevant service. This system is currently implemented throughout the country (Ministry of Environment, 2014a, pp.3~6).

In addition, as green life activation systems and programs, a green point system, suppression of use of disposable products, the food volume-based waste fee system, green leader cultivation projects, green campus activation, cool style movements, LED lighting support projects, building greening projects, city vegetable garden formation projects, bicycle use activation, and the car-free day system were implemented. For the major policies related with green life, <Table 3-17> contains resource recycling policies and <Table 3-18> summarizes green life policies.

Table 3-17 | Resource Recycling Policies

Policies	Content	Organizations in Charge
Food Volume Based Waste Fee System	• Concept: an economic incentive system that induces food waste volume reductions by imposing fees according to the volumes of food waste discharged • Volume-based waste fee system modes: volume based waste fee system bag mode, RFID portable reader recognition mode - Volume based waste fee system bag: Dischargers buy volume based waste fee system bags and discharge the bags in front of their houses or into base collection containers, the fees are paid in advance by buying the volume based waste fee system bags (implemented since June 2013) - RFID based volume based waste fee system: Wastes are collected using small collecting containers attached with RFID tags or individual measuring collecting booth in which the volumes are automatically measured using electronic scales and the discharge information is transmitted to the management system (will be switched to the RFID mode step by step by June 2015)	• Ministry of Environment • Korea Environment Corporation
Bio-gas Production Using Food Wastes	• Concept: The food waste rendering to resources separates solids and liquid phases and makes the solids into feed or compost while producing bio-gases from liquid phase food waste effluent. The hybrid method can product bio-gases using solid wastes • Present state: a total of 11 food waste bio-gasification facilities have been installed in Korea (2012), the quantity of bio-gases produced in 2012 (including other wastes than food) is 178,510,000 m^3, which is a heat quantity corresponding to approximately 670,000 barrels of crude oil. The bio-gases produced are mainly used as self-heat sources or used to produce electricity for sales through power generation • Market scale: A total of 2,050 billion KRW of market demand is expected by 2020 and a bio-gasification plant market amounting to 200 billion KRW per year is expected to be created	• Ministry of Environment • Korea Environment Corporation

Policies	Content	Organizations in Charge
Free of Charge Collection System for Large Waste Home Electric Appliance Products	• Concept: Large waste home electric appliance products larger than 1m such as refrigerators, washing machines, air conditioners, and TV are collected free of charge from consumers and recycled • Year of introduction: It was introduced in June 2012 in Seoul and has been implemented in a total of 12 cities and dos from June 2014 • Content: The collected waste home electric appliance products are reborn as materials that can be used for new products through automated processes in recycling centers such as pre-treatment, selection, and crushing	• Ministry of Environment • local government • Korea Association of Electronics Environment

Source: Reduction of Food Waste (http://www.zero-foodwaste.or.kr/info/info02.do, Accessed: 2014.9.17), Korea Environment Corporation (https://www.citywaste.or.kr/websquare/citywaste.do?w2xPath=/view/portal/sysinfo/sysinfo01.xml, Accessed: 2014.9.17); Ministry of Environment (2012), pp.4~17, Ministry of Environment Free Collection System for Large Unusable Appliances (http://www.me.go.kr/home/web/board/read.do;jsessionid=W6emOcF3TATa2akJ1eWwJxiQuyrf1DbAa1gUVc14fuYBGtyrSBPyayPl1BTYejaA.meweb2vhost_servlet_engine1?pagerOffset=0&maxPageItems=10&maxIndexPages=10&searchKey=&searchValue=&menuId=10181&orgCd=&boardId=357613&boardMasterId=54&boardCategoryId=&decorator=, Accessed: 2014.9.17).

Table 3-18 | Green Life Related Policies

Policies	Content	Organizations in Charge
City Vegetable Garden Formation Project	• Concept: Grow crops utilizing diverse living spaces in city regions such as lands and buildings for the purpose of hobbies, leisure, learning, or experience • Plan: the first five year plan for city agriculture fostering (2013~2017) • Goal: City vegetable garden area 1,500ha, and two million participants in city agriculture by 2017, improvement of satisfaction with participation in city agriculture, diversification of city agriculture demander classes • Implementation strategies: supplementation of city agriculture related laws, securing spaces for city agriculture, city agriculture R&D and supply of technologies, cultivation of experts, and expansion of education	• Ministry of Agriculture, Food and Rural Affairs • Local government

Policies	Content	Organizations in Charge
Green Campus Activation	• Concept: Form university campuses as environment-friendly and energy saving spaces for diverse education, research, and practice for low carbon green growth • Operation method: The Ministry of Environment provides government funds and the Korea Environment Corporation implements projects (introduced in 2011), subject universities of green campus projects are supported for the construction of greenhouse gas inventories in the universities, establishment of reduction strategies, development of green educational courses, and university's green life practice movements • Case (Myongji University): Opened liberal arts classes under the subject of environment, installed graywater facilities for service water saving, and utilizes recycled energy through the installation and operation of sunlight generation facilities	• Ministry of Environment • Korea Environment Corporation
Suppression of the Use of Disposable Products	• Concept: Reduce the use of disposable products and reinforce the collection of recyclable resources for resource saving and activation of recycling • Related policies and project: 'Public organizations' disposable product use reducing practice rules' were prepared (2009), 'voluntary agreements for disposable product reductions' were made with private organizations (2009)	• Ministry of Environment
Green Start Movement and Cultivation of Green Leaders	• Concept: nation-wide practice movement for greenhouse gas reductions, cultivate 21st century type green activists and increase citizens' participation • Green start movement: Green start national network was established in January 2008, nation-wide movements for greenhouse gas reductions were developed • Green leader: As of 2010, 4,693 green leaders were cultivated through the operation of climate schools (16) and public offering projects (8), green leaders acquire the knowledge and technologies necessary for green life diffusion and perform related works thereafter	• Ministry of Environment • Green Start National Network

Policies	Content	Organizations in Charge
Car-free Day System	Concept: Induce the use of public transportation to contribute to energy saving, traffic congestion relief, and environmental pollution improvement Case (Seoul): The car-free day system was introduced in July 2003, a weekday designated for participants as a car-free day to restrict car driving, electronic tags (RFID) are attached to participating cars to check whether or not the system is observed, and benefits are given to participants (automobile tax reduction, public parking place use charge reduction, toll discount, etc.)	• Local Government

Source: Ministry of Agriculture, Food and Rural Affairs press release (June 3, 2013), green campus (http://www.greencampus.or.kr/user/main/main.asp, Accessed: 2014.09.19), Ministry of Environment Reduction of Non-Reusable Products (http://www2.me.go.kr/web/222/me/c3/page3_13_1_1_1.jsp, Accessed: 2014.9.19); Ministry of Environment Manual for Operation and Management of Green Leaders (http://www.me.go.kr/home/web/policy_data/read.do;jsessionid=lT5LsdJbYhaHJ7OCoS5C7sd4Ci0XDL9k6lqCAYxQPRUH2dHF2koGw6PCpBHNsu5A.meweb2vhost_servlet_engine1?pagerOffset=60&maxPageItems=10&maxIndexPages=10&searchKey=&searchValue=&menuId=10262&orgCd=&condition.code=A3&seq=3534, Accessed: 2014.09.19), Seoul Weekly No Driving Day Campaign (http://no-driving.seoul.go.kr, Accessed:2014.09.19).

2014 Modularization of Korea's Development Experience
Experiences and Lessons of Green Growth

Chapter 4

Lessons from Green Growth Policies

1. Green Growth Policies as a Strategy for Sustainable Development
2. Development Projects that Take the Environment into Account
3. Economic Effects of Green Growth Policies
4. Establishment of Legal and Institutional Foundations
5. Appropriate Allocation of Roles between the Government and Private Sector
6. Knowledge Sharing Programs and Green Growth
7. Challenges for Green Growth Policies

Lessons from Green Growth Policies

1. Green Growth Policies as a Strategy for Sustainable Development

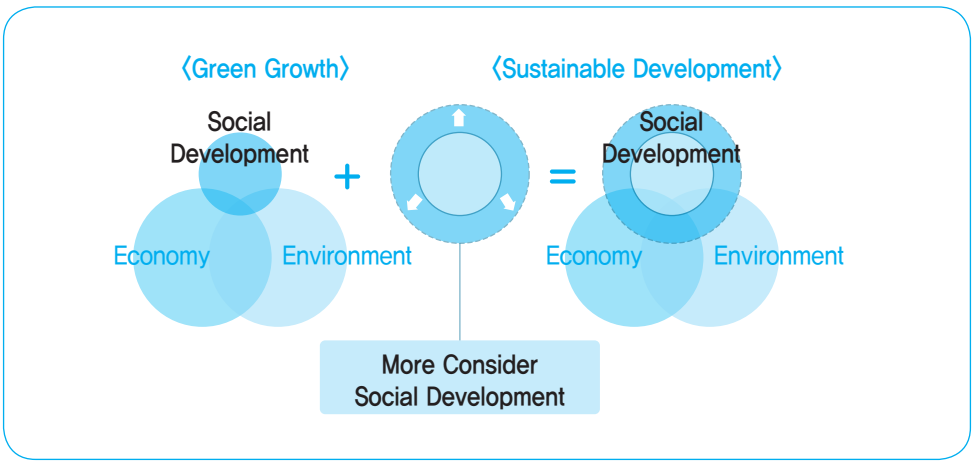
As discussed in Chapter 2, international organizations such as OECD and UNESCAP research and discuss green growth actively, and Korea is one of the countries that voluntarily implemented green growth policies. The purpose of green growth policies being implemented in Korea and the international community is to get citzens to think beyond themselves. They are also considered policy tools or processes to achieve sustainable development. The term green growth or green economy is the combination of two concepts, i.e. green and growth, and this refers to a growth strategy that takes green and thus the environment into account.

oth developed and developing nations are establishing various development and growth plans to continue their economic growth. Yet, if these plans are based on the traditional economic growth strategy, sustainable development cannot be guaranteed. Economic growth damages the environment, which in turn inhibits growth, and this vicious cycle cannot end. In order to decrease the threats that hinder sustainability of the economy, such as depletion of resources and environmental degradation, a growth strategy must be environment-friendly. To this end, green growth policies emerged as policy tools to achieve sustainable development.

Of course, the term green growth policy does not replace sustainable development, and green growth policies alone do not achieve sustainable development. However, in order to overcome the limitations of the traditional growth strategy, preparation for potential social conflicts (social integration) that may emerge during the growth process and, furthermore,

social development, need to be considered. [Figure 4-1] shows the relationship between green growth and sustainable development. In order to achieve sustainable development, the economy, environment and social development must be in balance. In order to achieve the ultimate goal of sustainable development, green growth policies need to include policies that lead to social development and minimize the negative effects that may arise during the growth process, such as the increase in the poor, exacerbation of social inequality and social exclusion.

Figure 4-1 | Green Growth and Sustainable Development



Source: the author revised a figure in Jung and Kang (2012) p.42.

Korea's green growth policies include the strategy to respond to climate change as a threat to sustainable development, a growth strategy that takes the environment into account (green technology development, greening of the industry, etc.) and the policies for improving quality of life and aiming to contribute to the ultimate goal of sustainable development. Yet, as instruments to achieve sustainable development, green growth policies have not provided sufficient measures for social integration or social development, which is another pillar of sustainable development, in contrast to their measures for the environment and economic growth. Promoting green growth policies does not automatically achieve social development, so green growth policies need to consider the aspects of social development such as relative poverty in addition to absolute poverty, income inequality, capacity building and social integration. Only then, green growth policies can be sufficient to contribute to sustainable development. Although the third strategy 'Improvement in Quality of Life and Enhanced International Standing' of the Five-Year Plan for Green Growth includes policies

for social development. However, the policy directions and tasks related to that strategy are about establishing green land and transportation, bringing green revolution into daily lives and becoming a role model as a green growth leader, so they do not take social development into account sufficiently.

2. Development Projects that Take the Environment into Account

When promoting development projects as a part of green growth policies, the environment needs to be taken into account, and social consensus needs to be formed. As discussed previously, Korea's high economic growth was accompanied by the costs of environmental degradation and pollution. Of course, the efforts for environmental protection such as the Saemaul Movement and afforestation were made during the process of economic growth, but other environmental problems were not sufficiently considered. When the Korean government achieved economic growth to some extent and acquired the economic capacity, it has made continuous efforts, such as the volume-rate garbage disposal system and restorations of Shihwa Lake, Taehwa River and Cheonggye Stream, in order to reduce waste materials and restore the environment.

Korea achieved economic growth with relatively less international pressure for environmental protection, when the international community paid relatively less attention to measures to respond to global warmin as well as climate change, which are discussed frequently in the present. Yet, developing nations, who are experiencing recent economic growth, do not face the same international environment as Korea did in the past. As the international community pays more attention to the environment, and the environment for international trade provides various benefits for environment-friendly products, export-dependent developing nations have to increase production through investment in environment-friendly products. Hence these countries should implement economic development policies that consider the environment from the stage of economic growth. This factor is the difference from Korea's economic growth process.

During the process of economic growth, economic development policies that consider the environment face conflicting interests within the government, as well as from companies and civic organizations. Therefore, these problems must be made a social, public issue and need to be resolved sensibly. In Korea's case, the Four Major Rivers Restoration Project is an example of projects that have these complex problems. In addition to restoring the environment that was polluted during the process of economic growth, it was a complex

development project that aimed to develop the regions near the four major rivers and promote regional development through increasing their incomes. This project was crucial as it took both the environment and economic development into account. However, it has not formed a social consensus with respect to the process of collecting opinions or its spillover effects.

Since 2009, the Korean government has implemented the Four Major Rivers Restoration Project for the main streams and tributaries of the Han, Nakdong, Geum and Yeongsan rivers, which are called the Four Major Rivers of the Korean peninsula, in order to secure water resources, prevent flood damage, restore the quality of aquatic ecology, establish complex waterfronts and promote regional development (Kwon and Yoon, 2009, pp. 4~5). When the project was initially implemented, it began as a Korean green new deal project that restores the environment, prevents natural disasters, improves the landscape and contributes to regional development. Yet, during its actual implementation, doubts on the project itself emerged, and a controversy arose that it would actually damage the environment. According to inspection by the Board of Audit and Inspection that was announced in 2013, 11 out of 16 barrages that were built during the project lacked durability, and the water quality could become compromised. Also, maintenance costs were expected to exceed the initially expected costs (Board of Audit and Inspection, 2013, pp. 2~5).

As a Korean green new deal project, the Four Major Rivers Restoration Project was promoted amid much public attention. However, from its beginning to the present when its implementation has been completed, the controversy about the validity and results of the project remains. This controversy is due to the fact that the project aimed to produce results in a short period of time from its planning stage to its implementation and to its completion, while failing to take its economic and social spillover effects and environmental effects into account sufficiently. When the Lee Myung-bak regime began in 2008, it was chosen as a major government project. Its master plan was announced, and its construction began the following year and ended in 2011. In a short period of time, its plans were established, and it was implemented.

Despite heavy criticism on the Four Major Rivers Restoration Project, the Cheonggye Stream Restoration Project has been well regarded. The Cheonggye Stream was a natural stream, yet since the Japanese colonial era in the 1930s, it began to be covered due to sanitation problems, road expansion plans and maintenance of facilities for urban infrastructure. Its covering was completed in late 1978. Yet, the Cheonggye Stream Restoration Project was promoted in order to resolve the problems of unstable covering structures and air and noise pollution, restore historic remains and invigorate the regional economy (Sung and Kim, 2005, p. 266, Ministry of Land, Infrastructure and Transport and Korea Development

Institute, 2013, pp. 58~59). In contrast to the Four Major Rivers Restoration Project, the Cheonggye Stream Restoration Project collected various opinions and established plans through seminars and debates, in which the related government departments, civil society and participating experts from its planning stage (prior to construction). In July 2002, the Cheonggye Stream Restoration Project Headquarters was established, and the construction was completed in 2005 after the planning stage, the process of collecting opinions, and implementation. The positive evaluation of the project was due to the fact that the government collected various opinion sufficiently during the planning stage, and restored tributaries to form a waterfront ecological environment and contributed to regional development by developing tourist attractions for Seoul.

During the process of economic growth, indiscriminate development and use of resources led to environmental degradation. The projects that restore the environment, secure sustainable water resources and contribute to regional development can be promoted in developing nations. Hence, when this type of projects is promoted in developing nations, the original goal of the development project that takes the environment into account needs to be achieved based on Korea's experience. In particular, from the planning stage, various opinions need to be collected sufficiently, and governance needs to be established to incorporate these opinions. Taking the environmental effects into account should be a top priority so that such development projects do not damage the environment.

3. Economic Effects of Green Growth Policies

The important goal of green growth policies is to address the environmental problems and achieve sustainable economic growth. Hence, when sharing the experience of establishing and implementing green growth policies with the international community, implementation of economic growth policies that respond to the global problem of the environment needs to be proven to contribute to economic growth of the implementing countries. Only then can the international community convince many developing nations to implement green growth policies.

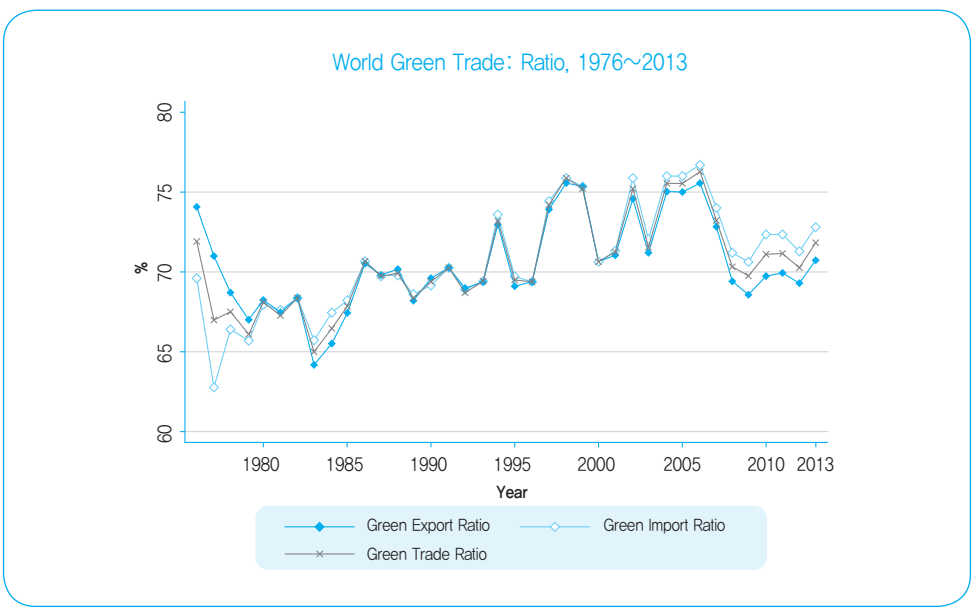
The green growth policies, which Korea announced in 2008, included a plan to invest two percent of the total GDP in the green industry. They clearly stated the economic outcome of this investment with the production-inducing effect of about 182~206 trillion KRW (about 3.5~4.0 percent of the estimated GDP in 2009) from 2009 to 2013, and during the same period, the employment-inducing effect of 1.18~1.47 million employees. Nevertheless, this plan and discussion on its economic effect have a problem. According to the five-year plan, the investment plan for the green industry aimed to shift the investment from the non-green

industry to the green industry, instead of increasing new investment. The job creation in the green industry would lead to the decrease in jobs in the non-green industry, and the ultimate effect should be the net effect that considers this decreasing effect.

However, from the perspective of developing nations that heavily depend on exports, it is true that the increase in investment in the green industry contributes to their economic growth. The global trade pattern and thus the demand in the global market show that the ratio of the green industry is increasing (Kang, 2014).[29] [Figure 4-2] shows that the ratio of trade of the green industry has been continuously increasing since 1976, except for a period between 2005 and 2008. The ratio of the trade of the green industry was 71.9% in 1976 and 71.8% in 2013, showing little change, and exhibiting a continuously increasing trend.[30]

This phenomenon is due to the fact that many developed nations have implemented various environment-friendly policies, and increased the imports of environment-friendly products. Hence, for developing nations, the investment in the green industry increases exports relatively more than the investment in the non-green industry, and will certainly be linked to economic growth.

Figure 4-2 | World Green Trade Ratio



Source: Kang (2014).

29. Refer to Kang (2011) for detailed discussion on the definition and classification of the green industry.
30. Refer to Kang (2014) for detailed discussion on the trend in the green industry and green trade.

More importantly, developing nations have established the plans for green growth policies, well as in Korea's case, yet they do not have sufficient plans to fund the details of their plans. For instance, Cambodia, Vietnam and Laos have established economic development plans at national level, yet they need to consider the means to fund their plans to achieve the goal of this economic growth. Since they do not have sufficient funds, developed nations will have to support them through foreign aids and green funds.

4. Establishment of Legal and Institutional Foundations

The core organization behind Korea's green growth policies was the Presidential Committee on Green Growth (PCGG), and it played a main role in establishing green growth policies and implementing related plans. PCGG led the establishment of the Five-Year Plan for Green Growth and held regular meetings to share the results of the green growth policies, check their progress and discuss tasks for the future. Yet, its limitation was that its role was restricted to review, mediation and consultation (Kang, 2012, pp. 167~168).

According to the National Government Organization Act, government committees consist of administrative committees and advisory committees. PCGG is not classified as an administrative committee and can be classified as an advisory committee (or a consultative committee). Administrative committees have the "administrative functions as well as the quasi-legislative functions to enact rules and quasi-judicial functions to make decisions such as objections (Article 2, Clause 4, The General Rule for the Organization and Capacity of an Administrative Institution)." Although PCGG was a presidential committee, its legal and institutional foundations were fragile, and as a presidential advisory committee, it could not serve as the control tower for green growth (Kang, 2012, pp. 167~168).

Despite these limitations, PCGG played a crucial role in green growth policies. Since the Five-Year Plan for Green Growth was established by PCGG, the related follow-up plans and measures were continuously enacted. This was because PCGG was a presidential committee instead of belonging to a certain department, and overcame the interests of departments to a certain extent. For example, under the leadership of PCGG, related departments cooperated to establish legal foundations for green growth policies by enacting the Framework Act Low Carbon, Green Growth and its enforcement decree, the Act on the Allocation and Trading of Greenhouse Gas Emission Permits and its enforcement decree, the Act on the Creation and Facilitation of Use of Smart Grids, the Act on the Support for Construction of Green Buildings, and the Act on the Development of Sustainable Transportation and Logistics.

For many countries, in which a certain department promotes green growth policies, the policy making process involved can create a conflict of interests with other departments, making the policy implementation difficult. Based on the cases, in which even developed nations experienced confusion among departments when promoting green growth policies, the process of resolving the conflicts between the environment and growth policies is crucial in the intra-governmental context as well as in the government-private sector context. In 2009, under the leadership of Ministry of Economy, Trade and Industry, Japan established the plans for the Low-Carbon Revolution in the 'J-Recovery Plan' and included low-carbon strategies to pursue sustainable growth. At the same time, the Ministry of the Environment announced the 'Green Economy and Social Change' in 2009, which included the policies to achieve low carbon in addition to those of Ministry of Economy, Trade and Industry. This interdepartmental confusion meant that the conflicts between companies in the private sector and NGOs could not be resolved, and ultimately, successful policy implementation became difficult (Korea Council of Humanities Social Research Institute, 2010, p.116).[31]

Korea's governance also has problems. During the legislative and policy implementation process, the related laws need to be enacted or amended first, in order for new policies to be implemented. Hence, regardless of how urgently the policies need to be introduced, they cannot have the basis or driving force if the related legislation process is delayed. In order to overcome this problem, core organizations such as PCGG need to be granted the quasi-legislative authority, in addition to the functions of review, mediation and consultation, reducing the delay between the establishment of a policy and its implementation. Of course, during the process of reinforcing the governance for green growth, if the top-level institution of the operation system has the authority of an administrative committee, its authority could be excessively reinforced, concentrating power on one institution (Kang, 2012, p. 168). Hence, when reinforcing the authority, this problem must be noted.

31. Britain, Germany and France are the examples of countries that successfully implemented the policies. In October 2008, Britain newly established the Department of Energy and Climate Change, addressing climate change and promoting energy policies efficiently. France established the Ministry for Ecology, Sustainable Development and Energy, whose minister was the deputy prime minister, in order to govern all aspects related to the environment, energy, land and transportation, actively responding to climate change and promoting sustainable growth (Korea Council of Humanities Social Research Institute, 2010, p.116).

5. Appropriate Allocation of Roles between the Government and Private Sector

Korea achieved high economic growth in a short period of time because the government with professional civil servants, who were superior to the private sector, led the establishment and implementation of policies, and governance played a crucial role with its strong leadership. In particular, in Korea's case, the ability of the Economic Planning Board and other government departments to establish and implement plans and the leadership of the president provided a driving force for the rapid economic development. At the time, the role of the government was bigger than that of the private market because the competitiveness of the private sector was not higher than that of the public sector, and simultaneously, the private competency or ability to mobilize finance was not high enough for the private sector to make private investment profitable.

Under strong government leadership, the failures of the government can cause more severe problems when the costs of government inefficiency increase as the competitiveness and capacity of the private sector are reinforced. This means that, as the economic development progresses, the economy needs to gradually shift from the government-led economy to the private-led economy. Hence, through vitalization of the market functions, policies need to be implemented to increase the participation from the private sector. While not interfering with the autonomy of the private sector, the government needs to encourage the participation from the private sector, lead policy discussions and make sure the plans are implemented according to the national strategy. Also, it has to facilitate smooth communications with private experts throughout the processes of suggesting, establishing and implementing policies. Also, the legal and institutional foundations need to be secured so that green growth policies can be promoted consistently even when a new regime is established.

In fact, Korea has followed this pattern. From the initial period of economic growth in the 1960s to the 1990s, Korea promoted government-led economic development based on the government-led Five-Year Plans for Economic Development. Yet, when the green growth policies were announced in 2008, it reached the development stage, in which its per-

capita income exceeded 20,000 USD. Thus it had to promote policies based on the private sector, led by the market rather than the government. This is because the private sector already had international competitiveness in terms of capacity in investment and personnel. Yet, during the process of implementing green growth policies, the role of the government was still important, and continuous support from the government was necessary because the risks of investment in the green industry were very high, returning profits over a long period of time. Due to these reasons, Korea's green growth policies were not government-led but were promoted with the government supporting the economy centered on the private sector.

In sum, during the initial phase of economic growth, the government-led economic development policies under the strong government leadership are necessary as in Korea's case. Yet, as the development progresses, the economy shifts to the market-led economy based on the private sector, and the government needs to support this transition. For developing nations at the beginning stage of economic development, the international competitiveness of the private sector is weak, and investment resources are not sufficient, thus requiring government-led economic policies. Particularly, since investment resources are not sufficient, developed nations need to actively support developing nations with foreign aid based on international cooperation or policies such as the support from International Climate Fund. This is because the greenhouse gas emissions that have accumulated since the Industrial Revolution caused the current climate change. Thus the current developed nations may be more historically responsible, and therefore, the global problem of climate change must be resolved together.

6. Knowledge Sharing Programs and Green Growth

Developing nations understand the necessity and importance of green growth policies, but do not have sufficient economic, social and environmental infrastructures to promote them. Consequently, it is difficult for developing nations to plan and implement the policies. Hence, in order for developing nations to promote green growth policies, international cooperation from the leaders of green growth and international organizations is necessary.

When establishing the Five-Year Plan for Green Growth, Korea not only promoted green growth policies domestically, but also included 'Becoming a Role Model for the International Community as a Green Growth Leader' in the ten policy directions in order to expand green growth policies. The knowledge sharing programs (KSP) and green ODA pursue the same course.[32]

So far in the international community, cooperation with developing nations was often in a form of ODA, which is bilateral cooperation. Through this, developing nations have built infrastructures for economic development, laid institutional foundations and improved their education and health sectors. Yet, green ODA that supports green growth of developing nations must be expanded, moving on from the traditional bilateral cooperation. For green growth policies to be promoted, the alleviation of and adaptation to climate change, expansion of and improvement in productivity of economic infrastructure, greening in each industry, and technological and human resource capacity building are necessary. Many of these can be achieved through green ODA. Korea has recognized the importance of green ODA and promoted it with the Committee for International Development Cooperation, Korea International Cooperation Agency (KOICA) and Export-Import Bank of Korea. Yet, in addition to support for financing and building infrastructures for projects, Korea needs to provide policy consulting on exactly how to develop and reinforce which sector as a national strategy or plan (Climate Change Policy Research Institute, 2012, p. 47, p.73; Kang, 2012, pp.177~179).

Since 2004, Korea has implemented the KSPs in order to share its economic growth experience with developing nations. From 2004 to 2012, projects were implemented with 441 topics for 39 partner countries (Korea Development Institute and Import-Export Bank of Korea, 2013, pp.12~13). Developing nations have a keen interest in Korea's economic growth experience, and the demand for the KSPs has been continuously increasing. Yet, the previous KSPs mainly discussed the traditional economic growth experience rather

32. In particular, KSP is a program that "provides policy research, consultation and training for partner countries and supports them with building the institution and capacity based on Korea's development experience" and a development cooperation project with a focus on policy consulting (Market Economy Research Institute, 2012, p.12). Green ODA is ODA supports green growth of developing nations, the targeted sectors are the environment, forest, energy, agriculture, water, public health, new and renewable energy, forestry and environmental policies. Jung and Kang (2012) suggest the need for green growth ODA, which is ODA for "supporting a country's economic growth and development and realization of the green society in addition to response to climate change." This is a new concept that includes drinking water, hygiene, policy, transportation, energy (policy, electricity transfer, gas supply, etc.), agriculture, fishery, industry, and urban and rural development (Jung and Kang, 2012, pp.58~60). The detailed information about Korea's ODA in general as well as green ODA can be found on the homepage for the Committee for International Development Cooperation (http://www.odakorea.go.kr).

than sharing the experience of economic growth that takes the environment into account (Kang, 2012, p.174). Developing nations also understand the need for economic growth that takes the environment into account and thus the need for green growth policies, so the discussion on such economic growth experience is necessary. Particularly, green growth policies include economic growth and environment-friendly factors at the same time, and hence, it is advantageous for developing nations to apply them. Consequently, in the future, projects need to incorporate the economic growth experience that takes the environment into account.

7. Challenges for Green Growth Policies

Korea achieved effective policy establishment and implementation with a government-led top-down approach in its process of economic growth in the past. Yet, the implementation of the policies to create the market and support the private sector was limited in the government's effort to achieve economic development. In addition to the lessons from Korea's green growth policies in the previous sections, this section will summarize the challenges for green growth policies that Korea will have to resolve. These challenges are the core agenda that Korea's green growth must take into account.

Korea's green growth policies showed a new pattern based on its experience from the process of implementing policies in the past. The government provided the green growth policy paradigm, yet the focus is to support the private sector instead of government-led policies. Technological innovation was at the core of the policies. Green growth policies emphasized the positive aspect of increasing the role of the private sector in policies compared to the past. Yet, the challenges for green growth policies still remain.

First, the improvement in the green financial and tax system to help the private sector actively participate in greenfication has been slow. The green technology and green industry sectors, which are the core of green growth, can result in large profits in the long run but carry high risks. Consequently, funding for this sector must be supplied with discretion, and the tax system for fostering the green industry needs to be improved.

Regarding green finance, rules for green finance (Article 28) were established in the Framework Act on Low Carbon Green Growth. The Plan to Encourage Capital Inflows to Promote Green Investment and the Plan to Reinforce the Fiscal and Financial Support to Increase Green Competitiveness were presented in 2009 and 2011, respectively, marking the beginning to green financial policies (Gu, 2011, p.4). According these plans, the Green Certification System was introduced in 2010 so that green business and companies with

green certification can take loans from banks at low interest rates. Since 2011, the Green Policy Fund has been established, enabling investment in green companies through public financial enterprises.[33] Yet, in contrast to the government's will about green growth and green finance, private financial institutions are relatively unwilling to promote them. The loans for green companies through private financial institutions are 24% of the total loans for green companies, and the share of public green fund for domestic investment in total green fund is 0.3% (as of late May in 2011) (Noh, 2011, p.42).

For the operation of taxes for green growth, Article 30 of the Framework Act on Low Carbon Green Growth included details about the operation of green taxes, and the amendment of the Tax Reduction and Exemption Control Act introduced tax reduction for investment in overseas resource development, tax exemption for value-added goods from recycled waste resources, and reduction in consumption taxes for hybrid vehicles.[34] Yet, criticism that Korea's tax system has a limited environment-friendly role remains. The related tax system is operated in a complex manner, and the economic incentives for reducing greenhouse gas emissions and conserving energy need to be reinforced. Also, for the operation of the environment-friendly tax system in the future, the linkage among the environmental taxes such as the greenhouse gas emissions trading scheme, renewable portfolio standard and carbon taxes is necessary (Kim and Kim, 2010, pp.185~188). The Framework Act on Low Carbon Green Growth and the Clean Air Conservation Act were revised in order to implement the Low Carbon Vehicle Incentive System (Vehicle Carbon Tax), which includes the concept of carbon taxes, from 2015.[35] Yet, the implementation of this system was postponed to 2020. It is appropriate to have enough discussions and consultations for the system prior to its implementation, yet there has not been clear achievement in terms of the introduction of the environment-friendly tax system in Korea as of now. In order to provide incentives for responding to climate change, conserving energy

33. Green Finance General Portal (http://www.green-finance.or.kr/sub02/sub02_05_01.php, Accessed: 2014.10.25.).

34. Daily Legal Information http://oneclick.law.go.kr/CSP//CSP/CnpClsMain.laf?popMenu=ov&csmSeq=543&ccfNo=5&cciNo=3&cnpClsNo=4, A: 2014.10.25.).

35. The Low Carbon Vehicle Incentive System is a system that charges taxes to consumers who purchase vehicles with high CO2 emissions and provides subsidies to consumers who purchase vehicles with low CO2 emissions, encouraging the reduction in greenhouse gas emissions (Ministry of Strategy and Finance press release, 2014.9.2., p.3). The Carbon Tax is the means to reduce carbon emissions by imposing taxes on the use of fossil fuels based on carbon content (Korea Energy Economics Institute, http://www.keei.re.kr/main.nsf/index_mobile.html?open&p=%2Fweb_keei%2Ffaq08.nsf%2F0%2F1d998bbd0b94f0a6492576b80036b84a&s=%3FOpenDocument%26is_popup%3D1%26Click%3D, 2014.10.25.).

and encouraging private sector participation in green growth, the current tax system needs to be revised to be environment-friendly.

Second, the improvement in green growth governance is necessary so that various stakeholders can have enough discussion prior to project implementation. With respect to Korea's governance in promoting green growth policies, the Four Major Rivers Restoration Project can be compared to the Cheonggye Stream Project. As discussed in Chapter 3, Korea's Four Major Rivers Restoration Project shows that criticisms for the effect of the project are inevitable when the discussion among stakeholders was not sufficient during the preparation stage. In contrast, the Cheonggye Stream Restoration Project gathered sufficient opinions beforehand, which became the reason behind its successful implementation. During Korea's economic growth, the government led the establishment and implementation of many policies and did not institutionalize the process of gathering opinions from stakeholders and incorporating them in the projects. As in the case of green growth policies, when the effect of a policy occurs over a long term and its spillover effects occur in various sectors such as the economy, society and environment, the establishment of strong green growth governance is necessary.

Finally, the sustainability of green growth policies needs to be guaranteed in the next administration. Green growth cannot remain as an agenda of a particular government, and environment-friendly economic growth strategies must be deemed important in the next administration. The Lee Myung-bak regime proclaimed and promoted green growth as the new economic growth paradigm, and the Park Geun-hye regime has suggested a creative economy. President Park Geun-hye stated that creative economy is "the convergence between scientific technology and industry and between culture and industry, promoting creativity across industries," "creation of new markets and jobs based on convergence, transitioning from the traditional approach of expanding the markets (President Park Geun-Hye's Inauguration Speech). Under this creative economy paradigm, 30 core technologies were selected as core targets of investment, and these technologies, such as solar energy, environment-friendly cars, smart grids, CCS, pollution control and management, overlap with the Lee-Myung-bak regime's 27 core green technologies to a certain extent. Considering that the creation of new growth paradigm through technological innovation was at the center of green growth policies, creative economy and green growth have a policy direction in common. In other words, green growth and creative economy are the policy vision with the common purpose of advancing scientific technology, fostering new industries through technological innovation, creating new jobs and promoting sustainable development (Kang, 2013)

Although the creative economy and green growth share a purpose, the Presidential Committee on Green Growth changed from a presidential committee to a committee under the Prime Minister. Some worry that the ability of green growth to promote policies might have become weakened. Economic growth that takes the environment into account is a value we cannot give up. Consequently, in order to achieve sustainable development, the creative economy needs to form linkages in policy directions with various sectors of green growth policies in addition to green technology.

2014 Modularization of Korea's Development Experience
Experiences and Lessons of Green Growth

Chapter 5

Lessons of Green Growth Policies

Lessons of Green Growth Policies

Korea is a leader of green growth that implemented the idea as a new paradigm for national economic growth. Korea recognized that the process of rapid economic growth since the 1960s had not taken the environment into account and led to its deterioration. The new growth paradigm pursues the virtuous cycle of the environment and economy. Particularly, during the process of implementing policies, the industry, which had to modify its traditional strategy, resisted to some extent. Yet, Korea reached the present after the social consultation through collecting and coordinating various opinions.

Korea's green growth is a policy to create a harmony between the environment and economy and has served a policy that contributes significantly to sustainable development. The successful implementation of the green growth policies was due to the fact that green growth has not suddenly or newly emerged, and the past policy efforts have combined with the new growth paradigm to materialize as a comprehensive economic growth policy. Of course, prior to 2008 when green growth was proclaimed as an economic growth paradigm, policies that share a common direction with green growth had been continuously promoted. Yet, it is in 2008 when they were established as a comprehensive economic development plan.

The afforestation projects and Saemaul Movement contributed significantly to the restoration of the forests that were degraded due to economic development in the 1960s~70s. Also, the restoration projects for Shihwa Lake, Ulsan Taehwa River and Cheonggye Stream are the examples of environmental projects that restored the environment damaged during the process of economic growth. These policies were implemented prior to the green growth policies and demonstrate that Korea did not disregard the environment during the process

of economic growth. In the previous period, policies that take the environment into account were promoted to some extent. Yet, the desire for economic growth was relatively strong, and the environmental deterioration during the process was not avoidable.

In 2009, the Five-Year Plan for Green Growth was established, and Korea's green growth policies began to be actively promoted. The Five-Year Plan established three sectors and ten policy directions in order to respond to climate change, foster a new growth engine, improve the quality of life and boost Korea's national status. This movement established its legal foundation when the Framework Act Low Carbon, Green Growth was enacted in 2010, and it became a national movement with the efforts of the PCGG, and regional committees on green growth in each local government and related institutions, to establish and implement follow-up policies. When the green growth policies were initially implemented, there were doubts, but the awareness of the need to respond to climate change, reduce the use of fossil fuels, strength energy independence, green the manufacturing industry, and green the land, transportation and lifestyle was set in motion. Also, in response to the green growth policies, Korea voluntarily announced its goal to reduce greenhouse gas emissions by 30% compared to the BAU level by 2020.

After about five years since the implementation of the green growth policies, the absolute reduction in GHG emissions has not been achieved yet. However, various policies for GHG emissions reduction have been continuously implemented, and the reduction compared to the BAU level is continuously making progress as predicted. As a policy to reduce GHG emissions, the Greenhouse Gas and Energy Target Management System began in 2010, and the GHG Inventory & Research Center was established in 2010. In 2011, the Greenhouse Gas Management System was established, and the Renewable Portfolio Standard was introduced in 2012. In 2015, the emission trading system will begin. Hence, the reduction of GHG emissions is expected to be accomplished in the near future. Of course, in addition to the policies for GHG emissions reduction, various policies are being implemented at the same time to achieve green growth continuously, reducing the use of fossil fuels, strengthening energy independence, greening the manufacturing industry, building green land and transportation and spreading green lifestyle.

Although Korea's green growth policies resulted in many achievements, many problems were revealed while pursuing them. First, green growth policies are a strategy to achieve sustainable development, and they need to take into account the economy, environment and social development, which are the three pillars of sustainable development, in a balanced manner. The green growth policies are not sufficient to achieve sustainable development. The current economic growth policies include a fair share of policies for economic and

environmental development, yet they lack consideration for the social sector relatively. In other words, the important factors for social development such as the increase in the poor, exacerbation of social inequality and problems of social exclusion are not sufficiently taken into account in the green growth policies. Therefore, the consideration for social development needs to be expanded in order for the green growth policies to be differentiated from the traditional economic growth paradigm and become a policy instrument that is environment-friendly and achieves sustainable development at the same time.

Second, green growth is an environment-friendly growth strategy that involves development projects during the process, yet the environmental effects should be sufficiently taken into account to minimize its degradation. The Four Major River Restoration Project, which is an example of Korea's Green New Deal projects, aimed to produce results in a short period of time, and could not collect opinions about its environmental effects sufficiently. It received criticisms about faulty construction and a decrease in water quality. Hence, in addition to the evaluation of current performance, the error of not collecting enough opinions during the process of establishing and implementing plans should not be repeated. In contrast, the Cheonggye Stream restoration project is considered to be an example of successful implementation. It included a process of collecting and coordinating opinions of various stakeholders during its preparation, and it successfully restored the stream and created an ecological environment, taking the environmental effects into account. When implementing development projects, the process of communicating with various stakeholders is necessary, and particularly when the environmental effects are sufficiently considered during the process, environment-friendly development projects can be successfully implemented.

Third, legal and institutional foundations must be established for promoting green growth policies. Korea enacted the Framework Act Low Carbon, Green Growth and established the legal foundation for promoting green growth policies such as the Five-Year Plan for Green Growth. Since then, the enactment and reenactment of various laws enables the related policies to be implemented legally. Yet, the Presidential Committee on Green Growth, which is the top-level institution for establishing green growth policies, is an advisory body that can only review, mediate and provide consultation. Thus it lacked the actual authority to coordinate the opinions of different government departments and fulfil the political will. The concentration of power may be a problem if the authority of a particular institution is strengthened. Yet, for the national implementation of a new national strategy or economic growth paradigm, the top-level institution of the operation system needs to have the functions of an administrative commission.

Fourth, in order to support developing nations to promote green growth policies, Korea needs to link the existing knowledge sharing programs with green growth. Developing nations understand the necessity and importance of promoting green growth policies, and lack the resources and capacity to promote green growth with policies. Korea's knowledge sharing programs are development cooperation projects that provide policy consultation for developing nations based on Korea's growth experience. Now the knowledge sharing programs need to take the environment into account and support developing nations to achieve economic growth while avoiding environmental degradation and effectively responding to climate change.

Green growth and sustainable development should not be the policy and strategy, in which only developed nations participate. Facing the international crises such as climate change and global warming, developing nations should also participate in the strategy for common prosperity of the international community. As a leading nation for green growth, Korea should help developing nations participate in green growth by sharing the results and lessons of its experience of green growth through various means of cooperation, and Korea should also improve the quality of its green growth policies.

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